Private Non-Profit Organization Established in 1976
Financial contributions mainly from Kuwaiti Shareholding Companies (KSC) are used to promote and enhance an effective Science, Technology and Innovation system in Kuwait
Chairman
His Highness the Amir of the State of Kuwait,
Sheikh Sabah Al-Ahmad Al-Jaber Al-Sabah

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• Mr. Mustafa Jasem Al-Shamali
• Dr. Salah Abdul Latif Al-Ateeqi
• Mr. Khalid Khider Al-Mashaan
• Prof. Faiza M. Al-Kharafi
• Mr. Hani Abdulaziz Hussain
• Mr. Osama M. Al Nisf

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Dr. Mohammad Al-Ramadhan
Director

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• Dr. Essam Al-Sayed Omar
• Khaled Al-Awadhi
• Manal Al-Ebraheem
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• Batoul Dhawi
• Shaima Al-Shukaili
• Mirvettee Samara
• Nadia Masri
• Sheikh Zahid Ali

• Shafiqa Al-Awadi
• Johaina Al-Hamdan
• Anwar Bin Amer
• Dina Al-Nakib
• Noura Al-Zaidan
• Sumaya Al-Kandari
• Mohammed Shaker
• Sawsan Sayed
• Sunita V. D'Souza
• Hadia M. Saker
The Director

General’s Message

The Kuwait Foundation for the Advancement of Sciences (KFAS), which is a unique national foundation with exceptional nature, was established as a corporate entity by an Amiri Decree bestowed with a special identity according to the instrument of its inception in 1976. KFAS enjoys continuous patronage and support from the Chairman of its Board of Directors, His Highness the Amir of Kuwait, Sheikh / Sabah Al-Ahmed Al-Jaber Al-Sabah. The Foundation’s objective is to promote science, technology and innovation (STI) system in every aspect of the Kuwaiti society in order to contribute to the sustained development of the State of Kuwait. This is achieved by incentivizing scientific and research institutions to explore their horizons of science and knowledge and the ways the State can benefit from their capabilities. In addition, KFAS contributes to the development of the private sector’s ability to innovate and benefit from modern technology in order to develop its services and institutions.

KFAS aspires to be the incubator of pioneering ideas and initiatives in cooperation with the future leaders of scientists, researchers, academicians, the Kuwaiti shareholding companies and relevant entities in the public and private sectors and civil society institutions so that Kuwait can become a strong foothold in the science and research community at the regional and global levels, whence the role of the Research Directorate which strives to achieve one of the most important objectives of the Foundation’s strategy that is based on promoting a culture of scientific research and supporting research and technological development.

The Research Directorate seeks to incentivize collaboration between national research institutions and similar institutions in the advanced countries with in order to raise the standard and activate the role of scientific research so that appropriate solutions to the key contemporary issues confronting the State of Kuwait can be found, and to create new opportunities for research and development in promising technological applications. By implementing this strategy, KFAS aims at ensuring that its participation in supporting research work in Kuwait complements the support provided by the State to the research activities allocated within the budget of each state institutions and corporations like the Kuwait Institute for Scientific Research, Kuwait University and the Ministry of Heath, provided that KFAS support, including research grants awarded to private universities, is directed to research that addresses the national priorities of development goals of the country and contributes to finding appropriate solutions.

Over recent years, the work undertaken by the Research Directorate gathered a tremendous momentum through partnerships forged with national scientific institutions and prominent global scientific institutions and organizations. In 2018, KFAS supported very carefully selected research projects, particularly those that address the challenges faced by the State of Kuwait in energy, water, health and environment.

The Foundation has been keen to contribute to the establishment of an industrial environment that supports the local economy, in addition to supporting projects related to the development of services, healthcare and other issues. To this end, the grants provided by KFAS helped in driving research and development in the public and private sectors in order to develop improved applications and products, activate technological innovations and benefit from its positive results in various economic and industrial areas and sectors. KFAS equally contributed to supporting research projects that focus on addressing the most serious difficult and chronic noninfectious diseases in the State of Kuwait such as cancer, cardiovascular and blood vessel diseases. This year, KFAS gave considerable attention to funding of stem cell research seeking to discover new diagnostic and forecasting protocols that might have positive results in the field of medical sciences. In addition, KFAS was attentive to the funding of research work related to the renewable energy resources and their applications in Kuwait with a view to expand its applications in line with the vision of His Highness the Amir to meet %15 of the demand for energy in Kuwait through renewable energy by the year 2030. This year, the Foundation gave considerable attention to the question of food security by funding research related to the hereditary characteristics of local plants, improved agricultural practices, dairy, poultry and means of improving their productivity.

This continuous support provided by KFAS, represented by the Research Directorate to the Kuwaiti research community enabled the publishing of 38 scientific papers, 16 of which were published in prestigious global scientific journals, in addition to filing three patents and authoring of one book. Since its inception, the Research Directorate participated in funding 1228 research projects with a total value of KD 53 million, of which 84 new projects were financed in 2018 with a total amount of KD 2.8 million.

In 2018, KFAS, represented by the Research Directorate continued contributing to supporting scientific workshops and conferences that aims to direct individuals and institutions toward strengthening the building of scientific and research capabilities, the exchange of knowledge, and identifying scientific developments in the relevant fields.

The achievements made this year reflect KFAS’ commitment to play its vital role and continue to make steady efforts focusing on providing positive support to the development of sciences, technology, innovation and scientific education in the State of Kuwait. These achievements could not be realized without the vital role played by the Kuwaiti shareholding companies which made every possible effort to continue to support and finance all the activities and programs of the Kuwait Foundation for the Advancement of Science.

Dr. Adnan A. Shihab-Eldin
Director General
Introduction

The Research Directorate has steadily continued its efforts to support research projects and build the capacity of scientific researchers by providing financial support for outstanding research projects and training opportunities for outstanding Kuwaiti graduates. The Directorate has also sought to enhance collaboration and partnerships amongst national research institutions as well as with the most prestigious international academic institutions and universities around the world for the purpose of facilitating collaboration with local researchers and scientists and enhancing the quality of scientific research in Kuwait, as well as activating its role in attaining appropriate solutions to the most important challenges confronting the country.

In this context, the Research Department has continued its efforts this year through its programs (Research Grants Program, Research Capacity Building Program, Flagship Program and the Collaborative Research Unit) to provide funding for carefully selected research proposals in various areas of research, submitted by academic and professional institutions in the State of Kuwait. This year, KFAS, represented by the Research Directorate, has provided 84 research grants with a total value of KD 2.8 million, while the number of research projects underway has reached 124 with a total value of KD 9 million.

The Capacity Building program provided financial support for 288 applicants for scientific missions to attend international conferences and seminars, which gave the opportunity for researchers and scientists from Kuwait to present their research findings in the international fora.

The Research Directorate has also provided support to 11 Kuwaiti researchers, PhD holders and postgraduate students either to complete their studies in prestigious universities or to obtain training certificates in specialized scientific fields in international scientific and research centers.

During the year, the Research Directorate, through Flagship Projects Program, has provided necessary support for several pilot projects in the areas of environment, energy and public health. The Program which is intended to be incubator for this type of projects that are expected to have remarkable results that in turn will stimulate their wide application in the State of Kuwait.

Last but not least, this year, the Collaborative Research Unit oversaw projects jointly implemented by local research institutions in collaboration with international research centers such as Massachusetts Institute of Technology (MIT) and others to serve national goals and to help Kuwaiti researchers gain scientific expertise that helps them compete with their peers in international institutions.
Statistical Profile

1. Annual Statistical Indicators (2018)

During the fiscal year, KFAS funded 84 new research projects under four major programs, namely, the Research Grant Program, Capacity Building Program, Flagship Projects Program and Collaborative Research Unit. The total funds approved by KFAS for the new projects in basic and applied research amounted to K.D. 2,817,704.

Table (1) and Figure (1) depict the distribution of funds allocated to newly approved research projects under the major programs.


<table>
<thead>
<tr>
<th>Program</th>
<th>Projects</th>
<th>Amount in (KD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Grant Program</td>
<td>68</td>
<td>2,029,383</td>
</tr>
<tr>
<td>Capacity Building Program</td>
<td>11</td>
<td>76,937</td>
</tr>
<tr>
<td>Flagship Projects Program</td>
<td>3</td>
<td>315,100</td>
</tr>
<tr>
<td>Collaborative Research Unit</td>
<td>2</td>
<td>396,284</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>84</strong></td>
<td><strong>2,817,704</strong></td>
</tr>
</tbody>
</table>

The Research Directorate supports research projects that address national priority, science and public health. Moreover, the directorate funded 35 exploratory projects (research grant awarded is less or equal 10,000 K.D.) which covers scientific issues and research capacity building among young researchers (Table 2).

Table (2): Research Grant Program Project Classification

<table>
<thead>
<tr>
<th>Program</th>
<th>Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Priorities Projects</td>
<td>23</td>
</tr>
<tr>
<td>General Grants</td>
<td>10</td>
</tr>
<tr>
<td>Exploratory Projects</td>
<td>35</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>68</strong></td>
</tr>
</tbody>
</table>

Figure (1). Distribution of Newly Funded Projects by Programs (2018)
KFAS continues to provide the support for the national and private institutions, specially research projects with local and international collaboration. The following Table enlists the beneficiaries of the newly approved grants during the fiscal year 2018:

**Table (3): Beneficiaries of the New Research Grants (2018)**

<table>
<thead>
<tr>
<th>Institutions</th>
<th>Projects</th>
<th>KFAS Contribution (KD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kuwait University</td>
<td>21</td>
<td>641,746</td>
</tr>
<tr>
<td>Kuwait Institute for Scientific Research</td>
<td>19</td>
<td>948,158</td>
</tr>
<tr>
<td>Australian College of Kuwait</td>
<td>11</td>
<td>86,091</td>
</tr>
<tr>
<td>Ministry of Health</td>
<td>4</td>
<td>99,552</td>
</tr>
<tr>
<td>Public Authority for Applied Education and Training</td>
<td>4</td>
<td>38,045</td>
</tr>
<tr>
<td>Kuwait College of Science and Technology</td>
<td>4</td>
<td>31,050</td>
</tr>
<tr>
<td>Gulf University for Science and Technology</td>
<td>3</td>
<td>22,050</td>
</tr>
<tr>
<td>Ministry of Defense</td>
<td>2</td>
<td>44,194</td>
</tr>
<tr>
<td>The University of Michigan, USA</td>
<td>2</td>
<td>13,085</td>
</tr>
<tr>
<td>Environment Public Authority</td>
<td>1</td>
<td>35,143</td>
</tr>
<tr>
<td>Kuwait International Law School (KILAW)</td>
<td>1</td>
<td>15,750</td>
</tr>
<tr>
<td>McGill University, Canada</td>
<td>1</td>
<td>12,998</td>
</tr>
<tr>
<td>University of California, Davis, USA</td>
<td>1</td>
<td>11,172</td>
</tr>
<tr>
<td>University of California Los Angeles, USA</td>
<td>1</td>
<td>10,051</td>
</tr>
<tr>
<td>Alnowair Al Kuwaitia – Bareec Program</td>
<td>1</td>
<td>10,000</td>
</tr>
<tr>
<td>University of Florida, USA</td>
<td>1</td>
<td>7,450</td>
</tr>
<tr>
<td>Columbia University, USA</td>
<td>1</td>
<td>7,411</td>
</tr>
<tr>
<td>Harvard University, USA</td>
<td>1</td>
<td>6,322</td>
</tr>
<tr>
<td>University of British Columbia, Canada</td>
<td>1</td>
<td>6,210</td>
</tr>
<tr>
<td>University of Texas, USA</td>
<td>1</td>
<td>5,323</td>
</tr>
<tr>
<td>Fawzec Educational Company</td>
<td>1</td>
<td>4,900</td>
</tr>
<tr>
<td>Applied Behavior Center Kuwait</td>
<td>1</td>
<td>4,450</td>
</tr>
<tr>
<td>Sabah Al Ahmed Center for Giftedness and Creativity</td>
<td>1</td>
<td>9,000</td>
</tr>
<tr>
<td>Centro de Investigacion Principe Felipe (CIPF), Spain</td>
<td>*</td>
<td>17,750</td>
</tr>
<tr>
<td>DNA Link Service Company, Korea</td>
<td>*</td>
<td>19,220</td>
</tr>
<tr>
<td>Massachusetts Institute of Technology, U.S.A.</td>
<td>*</td>
<td>154,818</td>
</tr>
<tr>
<td>GTIMD, U.S.A.</td>
<td>*</td>
<td>270,395</td>
</tr>
<tr>
<td>Northwestern University, U.S.A.</td>
<td>*</td>
<td>155,000</td>
</tr>
<tr>
<td>Others</td>
<td>*</td>
<td>130,370</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>84</strong></td>
<td><strong>2,817,704</strong></td>
</tr>
</tbody>
</table>

*These amounts are paid to collaborative institutions.*
2. Key Performance Indicators (2018)

The Research Directorate continued to devote its efforts to promote quantitative and qualitative outcomes in scientific research and technological development. Following are RD tasks/activities that were accomplished during the fiscal year table (4):

Table (4): RD tasks and activities that were accomplished during the fiscal year:

<table>
<thead>
<tr>
<th>Key Performance Indicators</th>
<th>No. of Payments</th>
</tr>
</thead>
<tbody>
<tr>
<td>New research grant applications received (cycle 1 &amp; cycle 2) 2019.</td>
<td>184</td>
</tr>
<tr>
<td>Research projects monitored (follow-up).</td>
<td>267</td>
</tr>
<tr>
<td>Payments released during the year.</td>
<td>240</td>
</tr>
<tr>
<td>Project progress reports received and evaluated.</td>
<td>73</td>
</tr>
<tr>
<td>Final project reports received and assessed.</td>
<td>58</td>
</tr>
<tr>
<td>Scientific papers (KFAS-sponsored research) published in international journals which includes three patents.</td>
<td>38</td>
</tr>
<tr>
<td>Scientific experts/consultants contacted for the peer-review of new research proposals and to review progress of ongoing and final projects.</td>
<td>2,222</td>
</tr>
<tr>
<td>Peer-reviewers/consultants who accepted and participated in scientific evaluation.</td>
<td>568</td>
</tr>
<tr>
<td>Research proposals declined after completion of evaluation process.</td>
<td>74</td>
</tr>
<tr>
<td>Research proposals cancelled upon project leaders’ request.</td>
<td>3</td>
</tr>
<tr>
<td>Joint research collaborations.</td>
<td>9</td>
</tr>
<tr>
<td>New research grant applications received and processed.</td>
<td>184</td>
</tr>
</tbody>
</table>

Table (5): Status of Approved Research Projects by Scientific Program & Status:

<table>
<thead>
<tr>
<th>Program</th>
<th>New</th>
<th>Ongoing</th>
<th>Completed</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Grant</td>
<td>68</td>
<td>107</td>
<td>51</td>
<td>226</td>
</tr>
<tr>
<td>Capacity Building</td>
<td>11</td>
<td>14</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>Flag Ship Projects</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Collaborative Research Unit</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>84</strong></td>
<td><strong>124</strong></td>
<td><strong>59</strong></td>
<td><strong>267</strong></td>
</tr>
</tbody>
</table>

Figure (2). KFAS Contributions (K.D.) vs. Number of Newly Funded Projects (2014-2018)

The above chart shows a continuous increase since 2016 in the number of research projects that the Foundation contributed to financing. The number increased in 2018 to 84 projects, an increase of 27% compared to the previous year. This increase in the number of funded projects is an indication of the keenness of the Research Directorate to provide all the required resources for researchers to carry out their assigned role. To serve science and society. It is to be noted that private universities in Kuwait have been more active in research with more requests submitted for KFAS funding.

The graph above also shows a continuous increase in the Foundation’s material contribution to funding research projects since 2016. This year the Foundation contributed KD 2,817,704, which indicates the success of the Foundation in pushing and encouraging researchers and to carry out studies and scientific researches, especially those focused on national priorities.

Figure (3) below shows the number of collaborative research projects, i.e. projects that have been implemented by more than one research institution, which have been funded in 2018 compared to previous years. The Foundation is very keen on encouraging these type of projects since they can contribute to building and enhancing research and scientific capacities in local research institutions through collaboration with renowned international scientific institutions, which is one of the strategic goals of KFAS.

Figure (3). Number of Collaborative Research Projects vs. Newly Funded Projects (2014-2018)
4. **Cumulative Indicators (1978-2018)**

Cumulative figures reiterate KFAS’ continued support for more than three decades towards the advancement of the sciences, particularly, national scientific research. Since the inception of KFAS, the total contributions have amounted to KD 52,972,468 for 1228 research projects (table. 6).

KFAS’ role is rooted in its mission to support overall national development and enhanced technical and scientific progress in the nation. Over the years, KFAS has upheld its noble vision with the implementation of relevant programs, projects and activities that sustain institutional development, whether academic or research or centers of excellence within the State of Kuwait.

**Table (6): KFAS Contribution to Institutional Research (1978-2018)**

<table>
<thead>
<tr>
<th>Institution</th>
<th>Number of projects</th>
<th>%</th>
<th>Amount in KD</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kuwait Institute for Scientific Research</td>
<td>411</td>
<td>33</td>
<td>20,897,432</td>
<td>39</td>
</tr>
<tr>
<td>Kuwait University</td>
<td>359</td>
<td>29</td>
<td>14,860,186</td>
<td>28</td>
</tr>
<tr>
<td>Public Authority for Applied Education and Training</td>
<td>85</td>
<td>7</td>
<td>1,319,813</td>
<td>2</td>
</tr>
<tr>
<td>Ministry of Health</td>
<td>48</td>
<td>4</td>
<td>1,325,555</td>
<td>3</td>
</tr>
<tr>
<td>Others</td>
<td>325</td>
<td>27</td>
<td>14,569,481</td>
<td>28</td>
</tr>
<tr>
<td>Total</td>
<td>1228</td>
<td>100</td>
<td>52,972,467</td>
<td>100</td>
</tr>
</tbody>
</table>

Under the Assigned Research Funding Program, 18 projects were supported since 1985, 14 projects in Social Sciences, 4 in Engineering Sciences, 1 project in Biological Sciences and 2 environmental projects. The project on Dictionary of the Holy Quran is ongoing, table (7).

**Table (7): Total Funds for Assigned Research Projects (1985-2018)**

<table>
<thead>
<tr>
<th>Area</th>
<th>Completed</th>
<th>Ongoing</th>
<th>New</th>
<th>Total</th>
<th>KFAS contribution in KWD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Sciences &amp; Humanities</td>
<td>13</td>
<td>1</td>
<td>0</td>
<td>14</td>
<td>3,127,100</td>
</tr>
<tr>
<td>Engineering Sciences &amp; Technology</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>4</td>
<td>135,676</td>
</tr>
<tr>
<td>Biological Sciences</td>
<td>1</td>
<td>-</td>
<td>0</td>
<td>1</td>
<td>270,676</td>
</tr>
<tr>
<td>Environment</td>
<td>2</td>
<td>-</td>
<td>0</td>
<td>2</td>
<td>80,000</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>1</td>
<td>2</td>
<td>21</td>
<td>3,613,452</td>
</tr>
</tbody>
</table>
2. Funding Scientific Research

Contributions from Kuwait Shareholding Companies (a percentage of their net profit) constitute KFAS’ research fund, which is utilized to sustain and promote national research. There are specific rules and regulations that govern the research grant award process. Research project proposals are solicited from local academic, public and private institutions within the State of Kuwait.

Research Project Submission (Proposal)

The Research Directorate receives applications for grant awards from local institutions in the form of research proposals. All research proposals should provide clear and descriptive account of the research that is proposed, including the research objectives, budget, methodology, output, citations, etc. along with duly filled KFAS forms and CVs of the main researchers involved in the project. Researchers may refer to ‘The Research Grant Manual’ for any clarifications on the procedures, evaluation standards or project execution. Applicants’ adherence to the guidelines will facilitate and expedite the evaluation and grant award process.

Research Project Evaluation and Funding Mechanisms

The mechanism of evaluating research proposals was subject to changes over the years since KFAS’ inception. The aim was to secure a better, comprehensive and scientific decision-making process to support the research project. The process of evaluation comprises of three inter-dependent stages: (a) preliminary evaluation by the Research Directorate (review of the general format, the administrative and financial aspects); (b) inviting referees and experts for scientific evaluation of the project; and (c) the decision-making stage wherein the proposed project is recommended for support, modifications or declination. In order to expedite the different processes and expand the information database, the Research Directorate set up a network of local, regional and international scientific peer-reviewers as well as in-house experts in specific scientific disciplines. The entire process of evaluation was based on standard international criteria approved by RD, especially with reference to technical, administrative and financial data, scientific merit and relevance to the country. The Principal Investigators as well as the affiliated institutions are, to a great extent, responsible for the smooth functioning of the evaluation and funding mechanisms. A carefully revised project proposal containing all the required details, prior to submission to the Research Directorate, will undoubtedly expedite the implementation of the procedures, thus advancing to the next level, namely, the project execution process. The review process adopted by RD is in accordance with international scientific standards and regulations (Fig. 4).

3. Documentation & Dissemination of Scientific Information

Scientific Documentation: The Research Directorate keeps sustainable interest in documenting and archiving information and databases of research projects to safeguard the integrity and relevance of such data and information for the benefit of researchers and the scientific community in and outside Kuwait.

This task is accomplished through utilizing available technologies and relevant software such as databases, electronic archiving software, and other means.

The Directorate also documents all its activities through compiling and publishing an annual report with full details of statistics on funded research projects, funding sums allotted and the beneficiaries.

The report also includes statistics on the number of phased and final reports received by the Directorate in a year, the number of referees who were used to evaluate research projects and their affiliation.

Furthermore, the annual report presents a list of all articles generated by the research funded by the Foundation and published in international scientific journals as well as statistics on the beneficiaries and the funding sums allotted to each of them.

This venture is but a part of the role that the Foundation plays in assisting the scientific community in general and the local community to do their best in serving scientific research and development.

The Directorate is keen to share a copy of this report with all research and scientific entities in Kuwait as well as government agencies and Kuwaiti embassies abroad to inform them of the efforts made by the Foundation to disseminate science and technology.
In 2018, (2,222) local, regional and international peer reviewers were contacted, to evaluate new, ongoing and completed projects. We received (568) evaluations distributed across the following institutions:

**United States of America**
- Brown University
- Rice University
- Northeastern University
- Boston University
- Case Western Reserve University
- Columbia University
- Cornell University
- Dartmouth College
- Duke University
- Florida International University
- Georgia Institute of Technology
- Harvard Medical School
- Illinois Institute of Technology
- Indiana University
- Iowa State University
- James Madison University
- Michigan State University
- Michigan Technological University
- National Renewable Energy Laboratory
- New York University
- North Carolina State University
- North Dakota State University
- Oak Ridge National Laboratory
- Ohio State University
- Oregon State University
- Rutgers University
- San Francisco State University
- Sea Education Association
- St. Cloud State University
- Stanford School of Medicine
- Stanford University
- Texas A&M University
- Texas Technical University
- The George Washington University
- The Ohio State University
- The Pennsylvania State University
- The State University of New Jersey
- The University of Hawaii
- The University of North Carolina at Chapel Hill
- The University of Tennessee
- The University of Texas at Arlington
- The University of Texas at Austin
- The University of Texas at Dallas
- The University of Texas Health Science Center at Houston
- Tufts University
- University at Buffalo
- University of Arizona
- University of California
- University of California, Berkeley
- University of California, San Diego
- University of California, Santa Barbara
- University of Central Florida
- University of Chicago
- University of Cincinnati
- University of Colorado Boulder
- University of Colorado
- University of Colorado Denver
- University of Connecticut
- University of Florida
- University of Georgia
- University of Houston
- University of Idaho
- University of Illinois at Urbana-Champaign
- University of Illinois
- University of Kentucky
- University of Maryland
- University of Massachusetts
- University of Michigan
- University of Missouri
- University of Nebraska-Lincoln
- University of Nevada
- University of North Carolina at Chapel Hill
- University of North Carolina at Greensboro
- University of Oregon
- University of Pennsylvania
- University of Pittsburgh
- University of South Florida
- University of Southern California
- University of Washington
- University of Wisconsin-Milwaukee
- US Forest Service Research Branch
- USDA Hydrology and Remote Sensing Lab
- Virginia Tech
- Virginia Commonwealth University
- Wake Forest University
- Washington University in St. Louis
- Wayne State University
- West Virginia University
- Western Michigan University
- Western Washington University
- Woods Hole Oceanographic Institution
- Yale School of Medicine

**United Kingdom**
- Anglia Ruskin University
- Aston University
- Cardiff University
- Cranfield University
- Glasgow Caledonian University
- Heriot-Watt University Edinburgh
- Imperial College London
- King’s College London
- London South Bank University
- Nottingham Trent University
- Oxford University
- Plymouth Marine Laboratory
- Plymouth University
- Scotland’s Rural College
- Swansea University
- University of Edinburgh
- University of Manchester
- University of Nottingham
- University of Sheffield
- University of Exeter
- University College London
- University of Bath
- University of Bedfordshire
- University of Birmingham
- University of Bolton
- University of Brighton
- University of Bristol
- University of Buckingham
- University of Cambridge
- University of Durham
- University of Exeter
- University of Greenwich
- University of Heriot Watt
- University of Leeds
- University of Liverpool
- University of Northumbria
- University of Nottingham
- University of Oxford
- University of Oxford Brookes
- University of Sheffield
- University of South Wales
- University of Southampton
- University of Stirling
- University of Surrey
- University of Warwick

**Canada**
- Carleton University
- Concordia University
- Dalhousie University
- Hydro Quebec Research Institute
- Memorial University of Newfoundland
- Polytechnique Montreal
- Ryerson University
- Simon Fraser University
- The University of British Columbia
- The University of Calgary
- University of Alberta
- University of British Columbia
- University of Manitoba
- University of North British Columbia
- University of Ontario Institute of Technology
- University of Ottawa
- University of Toronto
- University of Waterloo
- York University

**Czech Republic**
- Charles University
- University of Ostrava

**Germany**
- Fraunhofer Institute for Microstructure of Materials and Systems
- Fraunhofer Institute for Solar Energy Systems ISE
- Friedrich-Alexander-Universität Erlangen-Nürnberg
- German Aerospace Center
- Heidelberg University Hospital
- Karlsruhe Institute of Technology
- Munich University
- Ruhr-University Bochum
- Universität Erlangen-Nürnberg
- University Hospital Cologne
- University of Heidelberg
- University of Kassel
- University of Tubingen

**Denmark**
- Aalborg University

**Norway**
- Norwegian University for Air Research
- Norwegian University of Science and Technology
- University of Stavanger

**Ireland**
- Trinity College Dublin
- University College Dublin

**Portugal**
- Instituto Tecnológico e Nuclear
- New University of Lisbon
- Universidade de Aveiro
- Universidade de Lisboa
- Universidade de Porto

**Brazil**
- Federal University of Prana
- Federal University of Rio de Janeiro

**Spain**
- Hospital Universitario Nuestra Señora de Candelaria
- Universidad Complutense de Madrid
- Universidad de Cantabria
- Universidad de Córdoba
- Universitat de Barcelona
- Universitat Politecnica de Valencia
- Universidad de Murcia
- Universidad de Salamanca
- Universidad de Santiago de Compostela
- Universidad de las Visceras del Campo

**France**
- École Polytechnique Fédérale de Lausanne (EPFL)
- ETH Zürich
- Swiss Federal Institute of Technology
- University of Fribourg
- Swiss Federal Institute of Technology
- University of Perpignan Via Domitia

**Belgium**
- Ghent University
- KU Leuven

**Switzerland**
- École Polytechnique Fédérale de Lausanne (EPFL)
- ETH Zürich
- Swiss Federal Institute of Technology

**Italy**
- CNR Institute of Science and Technology Molecular
- Italian National Council of Research (CNR)
- Politecnico di Milano
- Sapienza University of Rome
- University of Bologna
- University of Genoa
- University of Padua

**Austria**
- Institute of Genetic and Animal Breeding
- Technische Universität Graz
- University of Natural Resources and Life Sciences
KFAS’ reiterated its pivotal role in partnering for nationwide sustainability with the mega funding of national priority projects that addressed major domestic challenges pertaining to public health, healthcare, environment, energy and water. Relentless support was offered to promote collaborative research by local private and public sector organizations with renowned international research centers and educational institutions (e.g. NASA, MIT, Texas A&M University, International Atomic Energy Agency, IMEC, The London School of Economics and Political Science, etc.) for delivering world-class scientific outcomes.

Environmental research targeted the evaluation of critical parameters to determine the impact of neighbouring marshlands on indigenous coastal waters and islands, ecological balance, sediment transport, water quality, hydrodynamic regime and the marine environment. Other related priority research progressed in formulating integrated models to simulate strategies for reducing cost and emissions associated with power generation and consumption, while also probing the feasibility of offshore wind as an alternative source of clean energy for the State. Conversely, in a significant move to address the challenges of desertification, water harvesting and conservation, as well as water quality and quantity in the State, scientists resorted to innovative, effective and economic methods, which were expected to have direct impacts on the future of the national resources.

KFAS research grants for applied research in agriculture (mixed cropping, genetic characterization of native plants, enhanced agro practices), dairy (sustainable livestock production, management), poultry (performance of broiler chickens) and fishery (effective management plans, techniques) provided ample impetus for innovation and exploratory ventures to address and redress emerging challenges. In a major move to propagate native plants in the State, scientists set the vital baseline data for long-term vegetation programs and soil biodiversity research after intensive surveys and advanced next-generation sequencing and bioinformatics.

Research on public health delved into solutions that tackle prevailing morbidities and mortality issues in the State of Kuwait with new and effective treatments. Studies pursuing preventive and therapeutic measures for a prevalent chronic disease in the State, namely, the Sickle Cell Disease, reported on positive findings. Research reports highlighted a noteworthy discovery of the anti-inflammatory, wound-healing and anti-cancer activities of some of the lipids from the skin of the catfish, subsequent to joint initiatives by KU, The Hospital for Sick Children Research Institute and MD Anderson Cancer Center, which further elevated the research to a new level of clinical trials on diabetic and pancreatic cancer patients. During the year, stem cell research notably gained momentum in probing the diagnostic and prognostic protocols that may have positive inferences on medical sciences. Genetic studies significantly featured in diverse multi-disciplinary scientific undertakings, prompting optimistic and beneficial outcomes.

Economic, social, educational and cultural reforms constituted some of the predominant goals of research for promoting sustained development in the State. Societal concerns, role of media and international investment policies also comprised some of the key targets of KFAS-funded projects.
Completed Projects

European and US Policies towards Inward Investment from the Gulf in Strategic Industries (2010-1103-03)

M. Thatcher
London School of Economics and Political Science

Abstract:

The past thirty years have seen the growth of state-owned economic actors which operate across national borders. A very prominent example is that of sovereign wealth funds (SWFs), which are key investors from Gulf states in the US and Europe, and hence the focus of the study. SWFs are defined here as state-owned investment vehicles that invest at least part of their funds overseas. The first SWF was established in 1953: the Kuwait Investment Authority (KIA). However, numbers and size of SWFs have greatly increased over recent years. Thus, whereas there were around 13 in the 1980s, by 2017 there were around 80 SWFs in the world. Their assets have grown dramatically, from an estimated $1 trillion in 1990 to $3.1 trillion in 2009 to $8 trillion in 2018. Many of the most prominent are in the Gulf, notably the KIA, Abu Dhabi Investment Authority (ADIA), Saudi Arabian Monetary Authority (SAMA) Foreign Holdings and Qatar Investment Authority (QIA). There are many possible reasons for the expansion of SWFs, from growing imbalances in the international economy, notably trade and capital flows, to domestic politics or cross-national diffusion.

The novelty and political importance of SWFs are that states cross frontiers to invest in a foreign country. Thus, recipient countries face a foreign state as owners in their own domestic economy. These issues are particularly prominent for SWFs, as most of these funds are from non-Western countries but invest in Western companies. Purchases of shares are particularly significant as they are linked to corporate control. Indeed, SWFs have attracted increasing attention and been the subject of many controversies in policy debates and the media.

Two opposite visions of SWFs can be identified in political and even academic debates. One is that SWFs may invest in companies to pursue ‘political’ aims, that they are insufficiently transparent, that this ‘state capitalism’ undermines ‘market capitalism’ and that they may take over firms in ‘strategic’ industries. The dominant alternative view is that these fears are exaggerated and these funds have played a stabilising role, especially in the recent crisis, by investing long-
term, with no evidence that they are used politically. The academic literature itself has seen significant debates about
the determinants and effects of SWF investments, and especially whether such investment is financially beneficial.

Policy makers in governments and international organisations have examined how best to respond to SWF foreign investments. The report examines these political debates and the policies adopted towards SWF investments, at the international and supranational levels and by major Western countries, especially the US, UK, France and Germany. It takes a public policy approach, analysing which policies were adopted, how and why, in contrast to studies which have looked at the determinants of SWF investment or their financial and economic outcomes. It focuses on purchases of company equities, since these are linked to control and are the most politically controversial and uses a broad definition of policy to include the rhetoric of action, the definition of legal frameworks that regulate SWF investments, and the use of those legal powers or informal instruments to influence SWF investments. It studies share purchases by non-Western SWFs, particularly from the Gulf, together with those from China, as these are often prominent and reveal the differences between the two views of SWFs.

**KFAS contribution:** £139,616

**Total budget:** £139,616

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### Use of Estimated Average Glucose and Adipokines as Screening Tests for Categories of Glucose Intolerance. The Kuwait Adipokines and Derived Average Glucose Study (KADAGS)

(2011-1302-01)

N. Abdella

Kuwait University

**Abstract:**

Mainly as a result of rising prevalence of obesity, Type 2 diabetes mellitus has emerged as a leading cause of morbidity and mortality among the adult Kuwaiti population. In a previous study on a relatively young adult Kuwaiti population below 50 years of age, the frequency of type 2 diabetes, impaired glucose tolerance and impaired fasting glucose was found to be 14.8% using the 1997 American Diabetes Association diagnostic criteria. Based on the World Health Organization and similar reports the projected estimates for prevalence of Type 2 diabetes by the year 2010 is expected to show a striking tendency to higher prevalence of the disease in Kuwait and other Gulf Co-operation Countries. Recently, the American Diabetes Association (ADA) included HbA1c testing as part of the diagnostic criteria for diagnosis of diabetes in non-pregnant individuals without haemoglobin variants. The ADA, European Association for the Study of Diabetes (EASD), International Diabetes Federation (IDF), and the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC) have also recommended that A1c-derived Average Glucose (ADAG) or estimated average glucose (eAG) should be reported as measures of long term glycemic control so that HbA1c could be expressed in the same units as day-to-day glucose monitoring units used by patients. Therefore, it is of particular interest to evaluate the practical utility of using these new diagnostic modalities on the main categories of glucose intolerance, study the associations with the risk factors for glucose intolerance in a Kuwaiti population that has a relatively high prevalence of haemoglobin variants.

We present final data from 2262 subjects that were recruited for the study. Results included in the current report show the significance of using appropriate HbA1c methods in the Kuwaiti population that has a relatively high prevalence of haemoglobin variants. The study further explores some of the determinants of glucose intolerance in Kuwait such as SHBG (sex hormone binding globulin), adipokines and VDBP (Vitamin D binding protein), which were related to categories of glucose intolerance. We also explored the potential utility of fructosamine as a marker of categories of glucose tolerance in subjects with and without haemoglobin variants. We also present data on the potential influence of inflammatory markers, hsCRP (high sensitivity C-Reactive Protein) and TNF-A (tumour necrosis factor alpha) as related to categories of glucose tolerance. We conclude that the project has met all the stated objectives and is on course to exceed the productivity estimated for the project.

**Publications:**

Abdella NA, Mojiminiyi OA; Cross-sectional study of the determinants and associations of sex hormone-binding globulin concentrations in first degree relatives (FDR) of patients with Type 2 Diabetes Mellitus; Diabetes Res Clin Pract. 2017 Nov 133:159-167.

Nabila A. Abdella and Olusegun A. Mojiminiyi; Vitamin D-Binding Protein Clearance Ratio Is Significantly Associated with Glycemic Status and Diabetes Complications in a Predominantly Vitamin D-Deficient Population; J Diabetes Res. 2018 May 20;2018

**KFAS contribution:** KWD 116,959

**Total budget:** KWD 116,959
The Collapse of Kuwait’s Fishery Stocks: Analysis and Identification of the Causes, Data Needs and Remedial Management Actions (2011-1401-06)


Kuwait Institute for Scientific Research

Abstract:
Kuwait’s fishery landings decreased by 50% from 1996 to 2014. To address the fall in landings, a three-year project was established to identify the reasons for this decline, devise a roadmap for recovery, and identify data needs to monitor fish landings and recommend effective management plans. Ten key commercial species, twenty-two bycatch species, and eight threatened, endangered, or protected species (TEPS) were selected for analysis. Ecological risk assessment (ERA) and productivity-susceptibility analysis (PSA) for each species showed that 7 (hamoor, hamra, zobaidy, suboor, newaiby, nagroor, and shaem) of the 10 key species were at high risk from the effects of fishing and 3 (maid, and shrimp species; Penaeus semisulcatus, and Metapenaeus affinis) were at medium risk. Also, at high risk from fishing were 13 of the 22 bycatch species, and all 8 of the TEPS. Only suboor, T. ilisha, was found to be at high risk for changes in salinity. Seven of the 10 species were at high risk from changes in chlorophyll, i.e., productivity, with the remaining three (hamoor, E. coioides; hamra, L. malabaricus; and newaiby, O. ruber) at medium risk. Suboor and shrimp were at high risk from habitat destruction, and only maid was at high risk from pollution. None of the key species was at high risk from climate change. Principle component analysis identified six factors with statistically important effects. Only two of these factors were identified to be significant: the effects of fishing and discharge of the Shatt Al-Arab. For the impact of fishing gears on six identified marine habitats, the trawl highly impacted the benthic mud, coral reef, and estuarine habitats. Gargoor had a high impact only on the coral reef, and gill nets had a high fisher impacted only rivers and marshes, again because of the lack of information. Management plans for each fishery were formulated and gaps of data identified, and accordingly a mentoring program was proposed for Kuwait fishery.

KFAS contribution: KWD 310,000
Total budget: KWD 310,000

Establishment of National Unrelated Hematopoietic Stem Cell and Cord Blood Donor Registry (2012-1302-04)

S. Al-Shemmari

Kuwait University

Abstract:
Stem cell transplantation (SCT) is now a well-established procedure in the treatment of many hematological and other diseases and matching for human leukocyte antigens (HLA) is essential in ensuring the success of the transplant outcome. HLA types are known to occur at differing frequencies in different racial groups in various geographical areas. The chances at best, there is only 30% chance of finding a matched related donor among patients’ siblings. The internationally accepted solution is the alternative stem cells source transplantation (matched unrelated, haplo-identical or cord blood transplantation). To start alternative SCT program, establishments of accredited state of the art Immunogenetics laboratory for high resolution Human leukocyte Antigen (HLA) typing was established. The lab is accredited by European Federation for Immunogenetics (EFI). This would permit allelic typing of the HLA system, allowing for the best match possible. Allelic matching reduces transplant related mortality by reducing the incidence of acute and chronic graft vs host disease (GVHD) and better immune-reconstitution. So far, we were able to do over 70 matched related and several haplo-identical SCT based on high –resolution HLA typing. Further, the program also established specific techniques to improve transplantation outcome, like testing for anti-HLA antibodies and killer-immunoglobulin receptor typing. The program also included many volunteers healthy donors.

KFAS contribution: KWD 529,398
Total budget: KWD 529,398
National Sickle Cell Disease Registry (2012-1302-07)
A. Adekile
Ministry of Health

Abstract:
Kuwait National Sickle Cell Disease Registry (KNSCDR) was funded by KFAS since November 2013 as a 3-year project, but was extended by 1 year, thus ending in 2017. The registry is for patients (adult and pediatric) seen in all the five government hospitals: Mubarak Al-Kabeer, Amiri, Adan, Sabah, Jahra and Farwaniya. The main objectives are to document the number, distribution, presentation and complications of the disease in the country. Long-term goals are to unify the management in all the hospitals and to assist the Ministry of Health in planning for the patients. Data are obtained via questionnaires and also by the review of patients’ records to document the age, Hb genotype, clinical presentation, complications and treatment given. In the first-year report, we had registered a total 334 patients, and in the second year, the number rose to 365 and to 380 at the end of the third year. Now we have a total of 396 patients in the registry. Most patients (88.6%) were Kuwaiti nationals with 52.0% males and 48.0% females. Most (62.1%) were SS, 34.8% SP and 2.8% SD. Their ages ranged from <1 to 73, with a mean of 19.2± 15.6 years while the HbF ranged from 1 to 55, with a mean of 21.2 ± 9.8%. Most patients (63.6%) had mild phenotype (0 -1 pain crises/year) and the most common complication was gallstones (33.1%) followed by splenic sequestration (26.8%) and avascular necrosis (AVN) of the femoral head (21.2%). These complications were more common in the older age group (>16 years) and also among Sβthal patients. We have completed molecular studies on some of our SPthal patients and this was published in the Journal of Pediatric Hematology and Oncology. Another paper on pulmonary function was published in Medical Principles and Practice. Other papers are in preparation, while poster and oral presentations on work from the registry were made in various local and international conferences.

Publications:

KFAS contribution: KWD 56,669
Total budget: KWD 86,717

The Effects of Developments in Mesopotamian Marshland on Boubyan and Warba Islands (2012-1401-01)
Y. Alosairi, N. Al Sulaiman, S. Neelamani, I. Polikarpov, A. Kwarteng, C. Small, A. Al Handal
Kuwait Institute for Scientific Research

Abstract:
The discharge regime of Shatt Al-Arab has been significantly modified during the past 50 y owing to the anthropogenic activities in the Mesopotamian Marshlands and upstream of the rivers. Having said that, Boubyan and Warba Islands, northwest of the Arabian Gulf, are directly influenced by the varying discharges including the geomorphology, sediment transport, water quality, and hydrodynamic regime. Advance assessments had been conducted on Boubyan and Warba Islands, utilizing remote sensing techniques. In connection with the reduction of freshwater flow, the results showed that the coastline of Boubyan and Warba is mostly stable, apart from the southwest regions of Boubyan. The assessments of the physical and water quality parameters indicated that the general historical characteristics of the regions have been altered significantly due to the reduction of the flow of Shatt Al-Arab. The tidal harmonic assessments had been conducted for the measured water levels around Boubyan Island, indicating that the tides can be mainly described by five principal tidal constituents, namely S2, O1, K1, N2, and M2. The measurements and analyses of Shatt Al Arab discharge showed to have reached extremely low levels of 35 to 50 m3/s in 2016-2017. The numerical model studies revealed that the reduction of Shatt Al Arab discharge has altered the transport and the flushing regime of the surrounding area. The impact in these perspectives extended from Warba to the southern coast of Kuwait including the Bay. This has resulted in the disruption of the ecological balance at various levels.

KFAS contribution: KWD 80,065
Total budget: KWD 169,335
F. Hadi, S. Mourad
Kuwait Society for the Advancement of Arab Children

Abstract:
The Wechsler Intelligence Scale for Children- Fifth Edition (WISC-V) is an individually administered, comprehensive clinical instrument for assessing the intelligence of children aged (6:00-16:11yrs). This revision provides subtest and composite scores that represent intellectual functioning in specific cognitive domains (e.g., verbal comprehension, working memory), as well as a composite score that represents general intellectual ability (e.g., Full Scale IQ). A number of other subtest, process, and index scores intended for additional clinical uses are included.

The Wechsler Intelligence Scale for Children- Third Edition was standardized in Kuwait by the Department of Psychological Services at The Ministry of Education in 2009. This version is still used in Kuwait despite of its’ scores and norms problems. The WISC-V consists of 21 subscales (12 verbal subscales, and 9 performance subscales). Ten of these subscales are from old version, and 11 are new ones. The WISC-V provides psychologists with diagnosis and clinical features.

Researchers reviewed the English version of WISC-V to determine the suitability of each item of subscales to Kuwaiti Cultural. The first pilot testing for the 10 subscales -of 396 children aged from (6:00-16:11yrs) from the six Educational regions- took place in September 2015, in order to determine psychometric properties, and order of items for each subscales. Twelve psychologists administered subscales in the first pilot testing. The second pilot testing for the rest of other six subscales- on the same sample- took place during March - April 2016. Items of subscales were reordered based on the data analyses, baselines were determined for each age group and scoring procedures were set for all subscales.

Standardization procedures is taking place now on a sample of 1452 children from six Educational Regions in order to estimate norms and usage procedures of the scales for the purpose of diagnosis and clinical uses, together with a sample of 72 children to determine test retest reliability of WISC-V. A sample of 30 children with learning disability from Center for Child Evaluation & Teaching were chosen to determine validity of test.

KFAS contribution: KWD 94,586
Total budget: KWD 117,386

Spaces of Living: Urban Reflections of Kuwaiti Society (2013-1401-01)
S. Alshalfan
AGi Architects

Abstract:
This research project explored the ways of living of Kuwaiti society through analysing the physical aspects of the home and the activities that take place within, in order to outline opportunities for an alternative approach to housing in Kuwait that is socially relevant, culturally grounded and contextually driven. This was achieved first through understanding the recent historical local context, both socially and urbanistically, with a special focus on housing. Secondly, it documented the formal aspect of the different existing examples of Kuwaiti homes, focusing on housing types, sizes and locations and their changes over time. Thirdly, it dissected the current social activities and cultural traits within the various spatial settings of the home; and finally, it came up with alternative recommendations for the future of the Kuwaiti home.

The main findings of this research are as follows:
1. Three historical eras were identified that relate to the recent history of the Kuwaiti home (within the last eighty years):
The Pre-Oil Era. This relates to a time prior to the 1950s when the community was closer and much more dependent on one another for survival. Collective living at the scale of the extended family was the norm and social networks happened at both the extended family and neighbourhood scales.

KFAS contribution: KWD 37,125
Total budget: KWD 96,150
The Effect of Dietary Probiotics and Prebiotics on the Performance of Broiler Chickens in Kuwait (P114-12SL-06)


Kuwait Institute for Scientific Research

Abstract:

There is a need to minimize the use of antibiotics in poultry feeds for health and safety reasons. Probiotics and prebiotics claimed to serve as effective alternatives to antibiotics in the poultry feed. The objective of this project was to investigate the effect of different commercially produced probiotics and prebiotics on the performance, meat quality, and immune response of broilers raised in Kuwait. The project involved four broiler cycles, two during winter and two during summer. In the first two cycles (summer and winter), different types of probiotics and prebiotics were used. The probiotics were Bacillus coagulans (1g/kg dried culture) and Lactobacillus (1g/kg dried culture of 12 commercial strains), and prebiotics included Fructo-oligosaccharides (FOS) (5g/kg) and mannan-oligosaccharide (MOS) derived from Saccharomyces cerevisiae (5g/kg). Based on the results obtained, the best treatment was chosen to be FOS, from which different ratios were used in the last two cycles during winter and summer. The levels of FOS chosen were 0.3, 0.5, and 0.7% of diet.

Both the control and the treatment diets were equally consumed by the chickens indicating that probiotic and prebiotic inclusions did not adversely affect the palatability of the diet consumed by chickens. In cycles 1 and 2, results showed that there was no effect of the different commercially produced probiotics and prebiotics on body weight, feed consumption, feed efficiency, weekly body weight gain, total body weight gain, total feed consumption, and overall feed efficiency of broilers. In broiler cycle 3, a significant effect of different levels of probiotic FOS on body weight was observed for broilers at 1, 3, and 4 weeks of age. Similarly, significant effect on the feed consumption of broilers was observed at 1, 2, and 3 weeks of age. No significance was obtained for weekly body weight gain, total feed consumption, and overall feed efficiency. In broiler cycle 4, results showed that birds fed 0.7% FOS had significantly higher body weights than those fed 0.5% and 0.3% FOS. No significance was observed for feed consumption, feed efficiency, weekly body weight gain, total feed consumption, and overall feed efficiency.

The results of the effect of feeding broilers different probiotic and prebiotics on tissue weight showed significance. This increase in the thymus weight of the control group may indicate an increase in the T-immune cells in the thymus which are responsible for the specific cellular response.

The lipid profile analysis using the gas chromatography (GC) analysis, biochemical analysis of leg and breast samples using proximate analysis, and taste panel studies showed no significant effect. In the organoleptic study of cycle 1, the effect of dietary treatments on breast color showed significance in terms of varying intensities of yellow color for meat samples. Majority of the panelists indicated that the smell, color, taste, and texture of the cooked meat were acceptable, and that there were no significant differences between the broilers fed the different diets with or without prebiotics and probiotics.

In general, all broilers appeared healthy and no significant mortality occurred throughout the experimental period. Interestingly, there was no significant effect of the different probiotics and prebiotics on all of the biochemical parameters of the blood among the experimental groups of broilers at 3- and 5-weeks of age.

Cellular immune response, represented by the haemaglutinin test, showed that dietary FOS and MOS induced higher cellular response than the other treatments (P=0.04) in the first cycle. In the second cycle, the results revealed that dietary FOS induced higher cellular response than the other treatments (P=0.019).

Interestingly, the used dietary treatments have a positive effect on microbial count in 5-week-old broilers, there was no salmonella sp. recorded using the four diet treatments in the first cycle, and the growth of E. coli was reduced significantly. Intestinal lactobacillus number was not affected by treatments. In the second cycle, all dietary treatments in 3-wk-old broilers did not affect the count of both lactic acid bacteria (LAB) and E. coli. At 5-weeks-old of the same cycle, the bacterial count of E. coli increased even with control, whereas salmonella growth was inhibited. The pH value was driven towards acidity in all of the treatments, but it failed to reach significant levels, as it is only a numerical difference. The acidic pH results from the production of undissociated volatile fatty acids in the caeca (acetic, butyric, propionic, and lactic acids) and antimicrobial substances that effectively exclude or kill many different pathogens. It is noteworthy that the addition of probiotics and prebiotics did not cause anaemia for the chickens as there was no significant adverse effect on the red blood cell (RBC) counts and haemoglobin concentration. Probiotics and prebiotics can be used in chicken feed safely and without any adverse effects on the productive parameters and immune status of the flock.
From an economic point of view, it was generally concluded that in all dietary treatments, food was consumed less in cycle 1 than in cycle 2, the total body weight gain was more in cycle 1 than cycle 2, and the average feed efficiency was less in cycle 1 than cycle 2. This indicates that the weather condition affected better in cycle 1. Also, there were very small differences between the dietary treatments in each cycle. In cycle 1, the best total feed consumption was for the FOS treatment, the highest total body weight gain and average feed efficiency were for B. coagulans. In cycle 2, all performance was better in FOS treatment. FOS significantly reduced the Salmonella sp. counts in the intestine, where the environment was driven towards acidity. FOS was the best on the average taste panel study of the produced meat. Accordingly, FOS prebiotic was chosen to be the best treatment to be used in cycles 3 and 4.

The economic impact analysis generally revealed that there were no big differences between the treatments in all of the studied indicators, but there was difference between the cycles. That means that the weather condition in cycle 1 gave a better performance in all indicators. The minor differences of the indicators can guide the decision maker to choose the best treatment in each cycle.

KFAS contribution: KWD 54,200

Designing and Constructing a Social Accounting Matrix (SAM) for the State of Kuwait
(P114-17IA-01)


Kuwait Institute for Scientific Research

Abstract:

The Kuwaiti economy has a number of structural imbalances. The authorities are committed to undertake far reaching reforms aiming at removing these bottlenecks in the national economy. Success in achieving these goals will critically depend on evidence based policy-making. This study was started with an overall objective of strengthening the evidence base for decision-making. The project started with a comprehensive review of development policies and challenges in the Kuwaiti economy. These informed the design of the Social Accounting Matrix (SAM). The sequence of accounts in the System of National Accounts (SNA) were converted from tabular to matrix format to construct an aggregate SAM with eleven accounts. The individual SAM blocks were separately analyzed, balanced, and reconciled for various institutions’ accounts. Resident households in Kuwait were classified into two broad groups in the first instance (nationals and expatriates) and then each into five income groups. Similarly, the labor force was disaggregated into nationals and expatriates, and then each into four skill levels. The financial account was firmly linked to the economic accounts, filling the existing gaps in the Kuwaiti SNA. A framework for economy-environment interaction was created and a preliminary analysis of accounting for natural capital depletion was conducted. The aggregate SAM with 11 accounts was extended into 234 accounts and then balanced. Input-output multipliers based forward, and backward linkage analyses were undertaken. A user-friendly software for calculating multipliers was introduced and its use was explained. The study ended by presenting a series of recommendations to various stakeholders on ways to improve data production and distribution as public good.

KFAS contribution: KWD 21,370

Total budget: KWD 144,373
Cloud Computing for Healthcare Institutions in Kuwait (P114-18NH-01)

I. Omran
Gulf University for Science & Technology

Abstract:

Kuwait is a developing country that has ambitions to reach the highest standards in healthcare services. A key element to reach these standards is: availability of the information in the right time for the right (authorized) people. The importance of electronic healthcare has caused numerous changes in both substantive and procedural aspects of healthcare processes. These changes have produced new challenges to patient privacy and information secrecy. Traditional privacy policies cannot respond to rapidly increased privacy needs of patients in electronic healthcare. Technically enforceable privacy policies are needed in order to protect patient privacy in modern healthcare with its cross-organizational information sharing and decision making. At the same time, a repository of patients’ information should be available for authorized users such as physicians and consultants in order to keep high services standards and protect health and lives.

An information infrastructure requires an efficient and effective information relational system to provide access to the items stored in the infrastructure. However, natural language terms used in classification, indexing and querying contain semantic relations between them may make the creation of effective search services difficult. Semantic technologies have a great potential to help in these situations and provide a more precise and more context sensitive response. On the other hand, a cloud is essential to provide availability to the required health and personal information.

This project proposes a cloud for hospitals and healthcare institutions in Kuwait which provides availability and security for the sensitive patient personal information. A personal information flow model will be developed to help the cloud manage the data access management to provide availability and security on the same time. The ontology will help users of the cloud to find the information on the right time. In addition, it will help in data mining for researcher purposes. On the other hand, the project will use Chain method instead of the traditional Role based access control (RBAC) which helps in retrieving the information in faster timing as Chain method requires less constraints and tables to be applied in data access management.

KFAS contribution: KWD 5,750
Total budget: KWD 5,750

Media Effect on Citizenship in the Gulf States: Case of Kuwait and Oman (P115-11AM-02)

A. Dashti
Gulf University for Science and Technology

Abstract:

Citizenship has become a major concern for many Gulf States. The wars in Syria, Iraq and Yemen, the crisis in Bahrain and confrontation with Iran have created an environment of sectarianism in the region. This hostile environment challenged the media to deal with citizenship (Al-Muwatana) responsibly. In the Gulf States, print media play an important role in framing citizenship either positively or negatively. The study uses social responsibility theory to shed the light on the role of print media play regarding citizenship in partly free and not free states focusing on two Gulf States: Kuwait and Oman. The results show that Omani newspapers deal with citizenship positively when reporting news from Syria, Bahrain, Iraq, Yemen and Iran, despite press censorship, while Kuwaiti print media, who enjoy more press freedom, are more negative about citizenship.

KFAS contribution: KWD 6,000
Total budget: KWD 6,000
Statistical Predictive Modeling of Cytokine Profiles in Normal and Complicated Human Pregnancy (P115-12SL-06)

K. Dingle
Gulf University for Science and Technology

Abstract:

Pregnancy involves a state of immunoregulation designed to actively tolerate the semiallogeneic fetus while retaining the ability to mount immune reactions. This immunoregulation includes changes in local and peripheral immune responses and in cytokine profiles. The production of anti-inflammatory Th2 cytokines such as IL-4 and IL-10 are upregulated, while Th1 pro-inflammatory cytokines such as TNF-α and IFN-γ are downregulated. We have studied the cytokine profiles in several pregnancy complications. These included recurrent spontaneous miscarriage, preterm labor, premature rupture of fetal membranes, pregnancy-induced hypertension and intra-uterine fetal growth retardation. In all these complications the cytokine balance was significantly different, compared to gestationally age-matched normal pregnancy.

We aim to use statistical learning techniques to infer and quantify the connection between cytokine profiles and different categories of pregnancy conditions. Using the cytokine data we have previously gathered, we aim to make a statistical predictive model, which will allow classification (or association) of a given set of cytokine levels to one of the pregnancy conditions. This investigation will shed light on to what extent cytokine profiles are related (or can predict) the different pregnancy conditions: if the cytokine levels can predict with high accuracy the pregnancy conditions, then this would imply that the cytokines are an important element of the disease process. If, instead, the cytokine levels only poorly predict the pregnancy conditions, then this would suggest that other factors beyond the cytokines are more significant than just the cytokine levels we have measured. Further, if we can infer a predictive model which works with high accuracy, then this model could be used in clinical settings: If a patient has cytokines level associated to an unhealthy pregnancy, the model could be used to predict which cytokines a clinician should attempt to up/down regulate (and by how much), in order to encourage a normal pregnancy.

KFAS contribution: KWD 5,900
Total budget: KWD 5,900

Performance of Some Forage Crops Under Different Cropping Systems (P115-12SL-07)

H. Al-Menaie, A. Al-Shatti, O. Al-Ragam, A. Merlene, A. Naseeb, A. Rabaa, I. McCann, M. Hadidi
Kuwait Institute for Scientific Research

Abstract:

The present study investigated the potential of mixed cropping of barley and alfalfa under different seed weight ratios (1:1, 1:3, 3:1) in enhancing the forage yield and quality under Kuwait's environmental conditions. The results identified superior performance of mixed cropping treatment 4 (75% Barley and 25% Alfalfa) over other treatments. It presented 34% and 11% more dry matter yield than sole cropping of barley and alfalfa respectively. Besides, the dry matter yield did not differ significantly between the 100%, 75% and 50% irrigation, which opens a great scope for forage production using less amount of irrigation water under this treatment. In addition, it expressed the highest protein content of 22% on a dry matter basis in the first as well as second cuts ensuring consistent forage quality throughout the season. Forage production under improved water use efficiency is vital in an arid country like Kuwait with limited irrigation water resources. For optimal water use efficiency, a suitable irrigation strategy would be to irrigate the first cut at 50% and the 2"d cut at 75%, with perhaps a general strategy being to impose a higher level of deficit irrigation when water requirements are relatively low, but to reduce the degree of deficit irrigation as water requirements increase to ensure that stress is not high enough to drastically reduce yield to little or zero. With the view to expand the spectrum of plant species employed in forage production, the yield performance of some annual forage crops were evaluated through pilot-scale studies carried out in summer and winter seasons to provide year-round forage supply. The present study revealed pearl millet (Indian and Moroccan) during summer and alfalfa during winter as a better choice over other selected forage crops in terms of yield and nutrition under Kuwait's environmental conditions. Profitability is one of the major factors that influence the feasibility of successful forage production and the economic analysis conducted has shown the large effect barley has on the profitability of the production lines. Therefore, it was concluded that barley should be included in the production mixture to produce a profitable line in Kuwait.

KFAS contribution: KWD 50,000
Total budget: KWD 207,490
Knowledge and Attitude of Primary Care Physicians towards Palliative Care in Kuwait (P115-13MC-03)

A. Al-Ansari
Ministry of Health

Abstract:

Background: Although the primary care physicians' role in delivering the majority of care with high quality service for patients under palliative care is unquestionable, it is not clear what their current level of knowledge and attitude toward palliative care is as there is limited research.

Aim: To recognize primary care physicians' knowledge and attitude toward palliative care in Kuwait.

Design: National survey using stratified random sampling was performed and a novel self-administrated 39-items questionnaire was constructed and distributed.

Setting: A total of 25 primary care clinics in Kuwait were selected and 284 primary care physicians were recruited.

Results: The response rate was 79.2% (n=225). 55.1% (n=124) of primary care physicians had uncertain attitude towards palliative care while only 15 (6.7%) had good knowledge. 148 (65.8%) of them emphasized on the lack of on time communication between palliative care providers and themselves. Moreover, 141 (62.7%) were not familiar with palliative care services in their community 132 (58.7%) were uncertain of the types of services covered under the palliative care benefit. More than 85% of the respondents knew the difference between traditional care and palliative care and multidisciplinary team role in palliative care. Less than 50% responded correctly to the questions regarding opioid initiation, types, toxicity and its role in refractory dyspnea.

Conclusion: The majority of primary care physicians in Kuwait had uncertain attitude and poor knowledge towards palliative care. Attention should be given to palliative care by the national health policy. There is urgent need to be incorporated into primary care physicians' education and training courses. Civilizing palliative care will require considerable investment in the research and to furnish proper education them and other health care providers.

KFAS contribution: KWD 9,992
Total budget: KWD 22,152

A Novel Biologically Inspired Algorithm for Optimization Based on Worm's Behavior (P115-18EO-02)

J. Arnout
Gulf University for Science and Technology

Abstract:

In recent years, and as optimization problems are becoming more complex and exact solution approaches computationally infeasible, the arena of biologically inspired computing is becoming quite popular. Subsequently, this research introduces a novel optimization algorithm called Worm Optimization (WO) inspired by the foraging behaviors of Caenorhabditis elegans (Worms).

In particular, and even though worms have a limited number of neurons, they were able to achieve several intricate behaviors including finding better quality food, avoiding toxins, interchanging between solitary and social foraging styles, alternating between "dwelling - food exploiting" and "roaming - food seeking", and entering a type of stasis stage. Consequently, the worms' behaviors will be mimicked to develop an optimization metaheuristic that will be able to find optimal solutions in a faster computational time. WO effectiveness will be illustrated on known NP-hard problems and compared to well-known naturally inspired algorithms.

Publication:


KFAS contribution: KWD 9,800
Total budget: KWD 13,200
The Role of Lipoxygenases in Testicular Ischemia Reperfusion Injury, An Experimental Model for Testicular Torsion (P116-13MB-01)

M. Al-Maghrebi
Kuwait University

Abstract:

**Background:** Testicular ischemia reperfusion injury (tIRI) is widely accepted as the underlying mechanism for the pathophysiology of testicular torsion and detorsion. The most common consequences of tIRI include reactive oxygen species (ROS) generation, germ cell apoptosis (GCA), inflammation, and oxidative DNA damage. One of major intracellular sources of ROS is the pro-oxidative lipoxygenases (LOXs) as by-products of arachidonic acid oxidation. LOXs are also known to play a key role in inflammation through the generation of the pro-inflammatory mediators, leukotrienes (LTs) and the anti-inflammatory mediators, lipoxins (LXs). Thus, LOXs, LTs, and LXs could be involved in the pathophysiology of tIRI. Thus, the aim of the study is to examine the role of LOX-induced ROS generation in the etiology of tIRI-induced apoptosis and oxidative DNA damage using its potent selective inhibitor nordihydroguaiaretic acid (NDGA).

**Methods:** A total of 36 adult male Sprague-Dawley rats were divided into three groups: sham, unilateral tIRI, and tIRI + NDGA (25 mg/kg). The tIRI was performed as 1-hour ischemia followed by 3 hours reperfusion. Harvested testes were evaluated after 3 hours of reperfusion for spermatogenic damage, oxidative DNA damage, GCA, and tissue expression of the 3 LOXs and their inflammatory mediators. The involvement of the apoptosis pathways JNK and GSK was also investigated.

**Results:** Our data showed that tIRI caused disorganization of the seminiferous tubules layers and spermatogenic damage. High LOX immunopexpression and upregulation of LOXs gene expression were demonstrated as a result of tIRI. Augmented levels of LOX-induced protein, lipid, and DNA oxidative damage were significantly increased during tIRI. The protein expression of LXs and LTs did not show any significant changes. Activation of the JNK and GSK signaling pathway associated with surviving down regulation was also observed during tIRI. Selective inhibition of LOXs by NDGA diminished the above changes induced by tIRI.

**Conclusion:** The study outcomes indicate that LOX inhibition prevented GCA and oxidative DNA damage. This implicates the role of LOX in ROS generation, which partly contributed to the tIRI-induced damaging effects that also led to spermatogenic damage and release of pro-inflammatory mediators and induction of the apoptosis pathways JNK and GSK. This new finding would provide good understanding to the tIRI/TTD mechanism in the field of translational medicine worldwide.

**KFAS contribution:** KWD 10,000

**Total budget:** KWD 18,200
Speech Restructuring and Speech-Anxiety Treatment: Comparing Order and Outcomes of Stuttering Therapies in Kuwait (P116-13MC-09)

M. Alameer
FAWSEC Educational Company

Abstract:

Background: Stuttering has been associated with physical and psychological symptoms. Two commonly used but theoretically opposed treatment approaches for stuttering are speech restructuring (SR) and speech anxiety treatment (SAT). In SR, clients use a new speech pattern to reduce stuttering, but the effect of this approach on reducing speech-anxiety remains unclear. The goal of SAT is to reduce negative thoughts and fear associated with stuttering, but its findings thus far indicate that it is ineffective for reducing stuttering.

Aims: The aims for this study were to understand whether SR and SAT have significant impacts on stuttering severity and speech anxiety in adult Kuwaiti PWS by 1) exploring the effects of both treatments on stuttering severity and speech anxiety, and 2) understanding whether treatment order has a significant impact on stuttering and speech anxiety.

Methods: A crossover design was used for 30 participants. The SR group (n=15) received SR followed by SAT, while the SAT group (n=15) received SAT followed by SR.

Results: Both SR and SAT significantly reduced stuttering and speech-anxiety for across all time points, and effects were maintained at 6-months follow-up. There was no significant effect of treatment order, however the SR group showed greater reductions in stuttering, while the SAT group showed greater reductions in speech anxiety. The greatest treatment effects were found at crossover for both groups.

Clinical implications in Kuwait and directions for future research are also discussed.

KFAS contribution: KWD 2,220
Total budget: KWD 4,690

Development of iPad Interactive Story and Sequences Application for the Treatment of Speech Disorders and Enhancement of Speech (P116-13MC-12)

G. Al-Naqi, N. Al-Ghurair and I. Salamah
Kuwait Institute for Scientific Research

Abstract:

The Systems and Software Development Department (SSDD) at the Kuwait Institute for Scientific Research (KISR) has been conducting pioneer projects for supporting people with special needs. Moreover, for the last decade, SSDD conducted several projects in the field of speech disorders. When a person is unable to produce speech sounds correctly or fluently, or has problems with his voice, then he has a speech disorder. Difficulties pronouncing sounds, or articulation disorders, and stuttering are examples of speech disorders.

This project started in March 2017 and it took 12 months. The main objective of this project was to develop the first Arabic iPad application to treat language difficulties and disorders in children. Based on the request from Physical Medicine and Rehabilitation Hospital (PMRH), the project team developed two iPad applications that targeted children with speech disorders. A detailed description of project tasks is explained including all steps of application design, development and testing. PMRH is using the developed iPad applications in clinics as well as it is available for the parents to use at home. The developed iPad applications are the first of its kind in Arabic and are available on App Store for all interested individuals in Kuwait and all other countries.

KFAS contribution: KWD 5,950
Total budget: KWD 32,950
On Root-Involutions and Root-Sub-Groups of the Chevalley Group $E_6(K)$, Over a Field $K$ of Characteristic 2 (P116-14SM-01)

S. Aldhafeeri
Public Authority for Applied Education and Training

Abstract:
The purpose of this paper is to investigate the root-involutions and root-subgroups of the Chevalley group $E_6(K)$ for fields $K$ of characteristic two. The approach we follow is the elementary and self-contained depends on the notation of M-sets which we have introduced in [Aldhafeeri and Bani-atta, On the construction of Lie-algebras of type $E_6(K)$ for fields of characteristic two, Beit. Algebra. Geom. 58 (2017) 529-534]. The approach is elementary on the account that it consists of little more than naive linear algebra. It is much been researched. This work may contribute in this regard.

KFAS contribution: KWD 16,650
Total budget: KWD 27,200

On the Stabilizer of a 2-Dimensional Vector Space of 27-Dimensional Module of Type $E_6$ Over a Field of Characteristic Two (P116-16SM-01)

Y. Alkhezi
Public Authority for Applied Education and Training

Abstract:
The aim of this project is to give an elementary and explicit construction of the maximal parabolic subgroup $P_2$, of $G$ the Chevalley group $E_6(K)$ over a field $K$ of characteristic two which are important and fundamental in mathematics. Most of the available of the literature on Chevalley group does not deals with fields of characteristic two. Hence this project aims to fill an important gap in the subject. The approach we follow here is new and could have the bonus of possibly leading to a new construction of a known algebraic object, namely the sporadic Fischer group $Fi22$.

KFAS contribution: KWD 10,300
Total budget: KWD 26,100

Self-Efficacy and Affect Infusion Theory for Understanding Web Usage and Learning: A Comparative Study of Kuwait vs. United States (P116-17OS-01)

D. AlSaleh
Gulf University for Science and Technology

Abstract:
This study focuses on the factors that influence managers’ attitude toward Web usage. Using self-efficacy and affect infusion theory as a foundation, a framework is developed to depict managers’ Web knowledge, Web expertise, and affect to be the antecedents of their attitude toward the Web which in-turn lead to their intention to use the Web.

Most e-commerce researchers would not disagree that managers’ Web knowledge, Web expertise, and affect toward the Web lead to their attitude formation toward the Web; however, none have incorporated all three predictors into a single model. In order to achieve the objectives of this research, data was collected from managers both in Kuwait and United States. Structural equation modeling (SEM) is used to empirically test the framework.

Based on the results, this study gives insights to the following stakeholders in Kuwait and United States: (1) corporations/managers; (2) scholars; (3) schools and universities for online learning; and (4) policy makers that will enable them to enhance the employee’s productivity at the workplace.

KFAS contribution: KWD 10,762
Total budget: KWD 14,643
Genetic Characterization of Haloxylon Salicornicum and Rhanterium Epapposum Native Plant Species of Kuwait by DNA Markers (P214-42SL-02)

F. Al-Salameen, N. Habibi, V. Kumar, S. Al-Amad, L. Talebi, B. Doaij and J. Dashti

Kuwait Institute for Scientific Research

Abstract:

The native plants of Kuwait are highly valuable due to their adaptation to the harsh desert ecosystem, and there is significant loss of plant biodiversity in Kuwait over the recent years mainly due to various reasons such as overgrazing, increase in off-road driving activity, desert camping, expansion in urban areas, and damage caused during the Iraqi invasion. The understanding of genetic variation in the community is essential to the establishment of effective and efficient conservation practice for desert native plants. In the two-year project, molecular methods were adopted to study and understand the genetic diversity of selected native plants. Inter simple sequence repeat (ISSR) and genotyping by sequencing (GBS) were employed to assess the genetic variation of two important native plants namely Haloxylon salicornicum and Rhanterium epapposum. The results of ISSR demonstrated overall genetic differentiation and allelic diversity within the populations to be high. However, among the population, diversity and pairwise genetic distances were low. Gene flow observed in both the plants was high. Whole genome sequences were assembled into rough genomes to use as reference for GBS analysis. Diversity analysis by GBS pointed out 31 and 40 genomic regions in H. salicornicum and R. eappaposum of high variability. Further analysis on minor allele frequency indicated the occurrence of rare alleles among the genotypes of both the species. Clustering analysis revealed the overall population structure to be weak by ISSR and GBS.

KFAS contribution: KWD 41,100
Total budget: KWD 69,020

Investigation of Soil Microbial Communities and Vegetation for Baseline Database Development at Selected Sites in Kuwait Desert (P214-42SL-03)


Kuwait Institute for Scientific Research

Abstract:

Native plants population in Kuwait has been declining in the recent years due to inadequate and erratic rainfall, soil degradation, climate fluctuations, and various anthropogenic activities. These factors have a significant effect on vegetation and microbial diversity, species composition, and other environmental parameters in Kuwait’s desert. This final report provides the research findings of a three-year investigation on the soil and plant microbial community structure and diversity, and native vegetation attributes from four key regions in Kuwait’s desert representing major vegetation communities. Datasets were acquired through the combination of tools consisting of vegetation surveys, classical microbiology, phospholipid fatty acid (PFLA) analysis, and advanced next-generation sequencing and bioinformatics. Vegetation cover and species richness in Kuwait varied considerably, and the site, year, and soil types significantly affected the vegetation cover. In general, the PFLA analysis revealed considerably low soil microbial biomass in the region including extremely low level of arbuscular mycorrhizal (AM) fungi. Metagenomics analysis revealed highly variable diversity indices for microbial population among the study sites, in which the bulk soils demonstrated consistently lower diversity indices than rhizospheric soils. AM fungal inoculation in both greenhouse bioassay and field experiment showed significantly increased plant growth and nutrient uptake with Acacia gerrardii and Pennisetum divisum. Heating pad-induced increase of soil temperature in bioassay had significant effect on the bioassay and field experiment showed significantly increased plant growth and nutrient uptake with Acacia gerrardii demonstrating consistently lower diversity indices than rhizospheric soils. AM fungal inoculation in both greenhouse revealed highly variable diversity indices for microbial population among the study sites, in which the bulk soils demonstrated consistently lower diversity indices than rhizospheric soils. AM fungal inoculation in both greenhouse bioassay and field experiment showed significantly increased plant growth and nutrient uptake with Acacia gerrardii and Pennisetum divisum. Heating pad-induced increase of soil temperature in bioassay had significant effect on the overall population structure to be weak by ISSR and GBS.

KFAS contribution: KWD 73,536
Total budget: KWD 144,406
Quantitative Survey of Sargassum Macroalgae along Kuwait Coastline: First Step towards Its Bed Restoration (P214-42SL-04)

Kuwait Institute for Scientific Research

Abstract:
The aims of this research project, which is partly funded by Kuwait Foundation for the Advancement of Science (KFAS), are to provide a baseline study on the distribution of Sargassum in Kuwait’s marine environment and to improve the understanding of the role of Sargassum as a valuable natural resource in Kuwait. The activity of this project started in January 2015. The project started with a mobilization task and an extensive survey in Kuwait’s waters to uncover many aspects related to Sargassum. The use of echo sounder technology, underwater cameras, and direct sampling by divers helped in providing valuable information on Sargassum, regarding the species and distribution. Sampling areas were selected for the monthly sampling of Sargassum. This report includes several chapters that cover Sargassum distribution in Kuwaiti waters, Sargassum population analysis, documenting the first attempt toward Sargassum production and culture in Kuwait, analyses of juvenile fish and shrimps inhabiting Sargassum, microepiphytes that grow on Sargassum, chemical and physical characteristics that are associated with Sargassum areas, and chemical, nutritional and safety aspects of edible Sargassum.

KFAS contribution: KWD 46,375
Total budget: KWD 162,516

Approaches to Enhance the Sustainability of Energy Systems in Kuwait: Environmental Impact and Cost Estimation of Changing Fuels in Kuwait’s Electricity Grid (P214-42WE-02)
N. Alhajeri

Kuwait University

Abstract:
The main objective of this project was to develop an integrated model through which different policies/scenarios can be studied to investigate their system-wide economic and environmental impacts prior to implementation. By establishing an integrated model of the entire energy production system of the State of Kuwait, parameters of interest can be tweaked to provide insightful perspectives into how can the energy grid be improved. The first chapter provided the basis for the base case state of fuel consumption and cost, electricity generation, and water production in Kuwait. More importantly was that there was no clear strategy for fuel allocation between power plants in Kuwait, making an optimized fuel allocation strategy particularly attractive for fuel cost reduction. Fuel consumption data was then used to establish unit-based emission inventories for power plants across Kuwait. Energy demand and emissions inventories were predicted up to 2030, using a multivariate regression model that accounts for seasonality. Energy demand is projected to grow at an annualized rate of 2.8% by 2030 compared to 2015 levels. Accordingly, a more ambitious target of renewables penetration is to be adopted if Kuwait was to reduce its emission levels going forward.

The spatial distribution of the resultant emissions of SO₃ and NOₓ were simulated using a simulated one-year episode using AERMOD for 2014. In addition, two mitigation scenarios aimed at curbing SO₂ emissions are studied, namely, load levelling and fuel switching for hours of exceedances from the base case scenario. Then, a unit commitment dispatch model was developed and used to simulate two different strategies for reducing cost and emissions associated with power generation and water desalination in Kuwait. In the dispatch model was developed to incorporate solar PV capacity into the grid and increase the capacity of RO (Reverse Osmosis) desalination plants as well as the implementation of a carbon tax. Finally, an optimized fuel allocation strategy with the objective of lowering fuel cost was developed. The implementation of such preferences is probably hindered by the environmental cost in terms of harmful emissions for crude oil consumption and of how Kuwait’s reliance on exported LNG for energy production over locally produced heavy fuel oil could be perceived as a national security concern.

Publication:

KFAS contribution: KWD 59,050
Total budget: KWD 121,510
Evaluation of Tsunami Hazards along the Kuwaiti Coastline Due to Possible Earthquake and Landslides  
(P214-44SE-01)  
K. Al-Salem, A. Al-Enezi, F. Al-Shatti and A. Al-Ragum  
Kuwait Institute for Scientific Research  

Abstract:  
This project presents the results of a scientific study to evaluate tsunami hazard to the Arabian coast with a particular interest to Kuwait. It has been identified from historical and literature reviews that tsunami for the Arabian Gulf regions, except from the extraterrestrial source, can be generated by submarine earthquake and landslide sources. The submarine earthquake can possibly occur at the Makran Subduction Zone, offshore of Oman, and the landslides, from tall cliff along the Iranian coast. A series of numerical simulations were performed applying a well-known original tsunami modelling computer code developed at Tohoku University and low resolution and accurate elevation data. The code was further improved in this study by including the effects of natural tide. This report presents some preliminary simulation results showing that there are insignificant adverse effects of the tsunami to Kuwait in terms of wave height. Kuwait has roughly 12 h and 3 h preparation time for tsunami triggered by the submarine earthquake source and from the landslide, respectively. Future works include remodeling the tsunami simulation using accurate high-resolution elevation data, finalization of the modelling scenario, evaluation of the tsunami hazard to Kuwait in terms of strong currents and rapid bed sediment transport associated with the tsunami, generation of hazard maps, and result presentation and documentation.  

KFAS contribution:  KWD 54,450  
Total budget:  KWD 159,710  

Restoration Potential of Selected Native Plant Species in Kuwait  
(P215-42SL-01)  
Kuwait Institute for Scientific Research  

Abstract:  
Kuwait is executing large-scale revegetation programs to restore the degraded ecosystems, which necessitates standardizing planting techniques of native plants, their salinity tolerance and nitrogen fixing ability of associated rhizobacteria. Hence, the Kuwait Institute for Scientific Research initiated this project in September 2015. Four dominant native plants, namely Acacia pachyceras, Haloxylon salicornicum, Rhanterium epapposum, and Farsetia aegyptia, were used in this study. Results from this study revealed that transplanted seedlings had a higher survival percentage and total plant biomass accumulation compared to sown seeds. Considering the effectiveness of sowing vs. transplanting, primed seeds of these four species can be sown directly if subsequent irrigation and weed control measures are undertaken. Results from the field experiment and two greenhouse studies suggested highest salinity tolerance by Acacia pachyceras followed by Haloxylon salicornicum. Although Acacia pachyceras is a well-adapted species in arid environments, its survival and growth were affected at very high level of salinity. Both Rhanterium epapposum and Farsetia aegyptia could grow modestly when soil salinity was increased to EC 5 but suffered severe growth reduction and mortality beyond EC 5.  

The aims of the soil microbial communities study were to isolate and identify free-living and rhizobial nitrogen-fixing bacteria from rhizospheric soils and root nodules collected from the Kuwait's desert; and to determine the nitrogen-fixing ability of isolated strains using acetylene reduction assay. This study successfully identified the 50 nitrogen fixers isolated using 16s rRNA gene sequencing, among them 78% were confirmed as nitrogen fixers using ARA. The dominant species were from Rhizobium, Pseudomonas, and Agrobacterium genera followed by Cellulomonas and Bacillus. The greenhouse study demonstrated a successful bacterial inoculation and exhibited a significant increase in plant dry biomass and nutrient uptake.  

Finally, the team recommends to perform additional salinity tolerance studies and expand inoculum results for use in environmental restoration projects.  

KFAS contribution:  KWD 44,450  
Total budget:  KWD 95,340
**Studies on the Biocatalytic Desulfurization of Diesel: Phase I (P215-42SL-02)**

H. Mahmoud, W. ElMoslimany, A. Dorsselaer, D. Heintz, M. Awad, A. AbdulRahim and L Jose

Kuwait University in collaboration with University of Strasbourg, France

**Abstract:**

In this project, we investigated biodesulfurization of fossil fuels. Biodesulfurization is a biotechnology-based approach that has gained increasing interest for removal of sulfur from diesel and other distillates. As compared to the conventional hydodesulfurization, microbial biodesulfurization is environmentally friendly, economic, and more efficient. We set two main objectives for our studies.

1. We applied proteomics and metabolomics on the biodesulfurizing model strain R. erythropolis IGTS8 using either inorganic sulfate or the diesel-born organosulfur compound, dibenzothiophene (DBT) as a sole sulfur source. Through these studies, we aimed to gain better understanding on a holistic scale of the metabolic and physiological adaptations of the biodesulfurization microbes when challenged with diesel-born organosulfur compounds, instead of the conventional sulfur source, inorganic sulfate. This is a pre-requisite for the development of efficient biocatalysts for biodesulfurization.

2. We also adopted metagenomics to prepare a library from DNA recovered from refinery wastewater treatment plant. Here we aimed to explore the wealth of unculturable structural and functional microbial repertoire in the environment for novel biodesulfurizing microbes or pathways. This is particularly important because the majority of the biodesulfurizing microbes known so far were enriched and isolated via the conventional culturing methods, which recover only a minor fraction of the microbial population in a given ecosystem.

One of the major findings of this project is the reclassification of the biodesulfurization model bacterium Rhodococcus erythropolis IGTS8 as Rhodococcus qingshengii IGTS8. This was based on the whole genome sequencing results. Another major finding deals with the influence of the sulfur source on the physiology and metabolism of the IGTS8 strain. The type of the sulfur source provoked large scale physiological and metabolic adaptations in the IGTS8 strain as revealed by the proteomics and metabolomics investigations. The metabolomes of the IGTS8 cultures grown with either DBT or MgSO4 as a sole sulfur source appeared very different particularly during the mid-log phase of growth. Many of the detected metabolites might be novel as revealed by absence of matches in the databases. Similarly, the proteome of both cultures were largely different and revealed temporal changes according to the growth phase. Many unique proteins were detected in the DBT cultures but were lacking in MgSO4 cultures. The unique proteins were more diverse in terms of the assigned protein families and (putative) functions. These proteins were associated with sulfur metabolism, redox reactions, nucleic acids processing and nucleotide metabolism, solute transport (uptake and efflux), regulation of gene expression (including two-component systems), sugar metabolism, lipid metabolism, aminoacid metabolism, chaperones for protein degradation, biosynthesis of vitamins and enzyme cofactors, sulfate starvation, sulfur acquisition, stress response, iron uptake, biosynthesis of osmoprotectants, oxidative phosphorylation, cell envelope biosynthesis, cell division, metal homeostasis, and mycothiol biosynthesis. A striking finding of the proteome analysis is the identification of a probable transporter for DBT. The metagenomics work revealed many biodesulfurization-competent clones. Sequencing revealed large structural and functional diversity with many unknown proteins, which may comprise novel biodesulfurization genes/pathways. In addition, many of the known organosulfur metabolism genes were detected in the metagenome. The outcome of the project greatly advances our understanding of the biodesulfurization process. The data can be further investigated towards the development of commercially viable biodesulfiriztion technology in Kuwait, which shall be beneficial to the oil refineries in Kuwait.

**KFAS contribution:** KWD 45,900

**Total budget:** KWD 87,150
Ecological Assessment and Restoration Plan of Terrestrial Biodiversity in Umm Al Namil Island, Kuwait (P215-42SL-03)


Kuwait Institute for Scientific Research

Abstract:

This project provides complete information on the inventory of the biodiversity in Um Al-Namil island and the proposed restoration and management plan, based on the findings of two years of research and consultations with national and international experts. This report includes data interpretation and discussion of soil, vegetation, wildlife, intertidal zones, hydrodynamics, and Geographic Information System (GIS) database of the island. The island holds a high biodiversity component regardless of its small size (647,264 sq. meters). In addition, several archaeological sites, ancient stromatolites, and breeding birds’ habitats are in the vicinity of the island.

KFAS contribution: KWD 45,250
Total budget: KWD 98,250

Establishment of Mangrove Plantations - Phase II (P215-42WE-01)


Kuwait Institute for Scientific Research in collaboration with Marine Environment Research Centre, UAE

Abstract:

Mangrove communities inhabit the intertidal zones and play a pivotal role in enriching the marine ecosystems in tropical and subtropical areas of the world. They once existed along Kuwait's coastline, but disappeared due to anthropogenic causes. Kuwait's coastal and marine conditions (anti-clock wise tidal movements, excessive tidal energy, high water temperature, intense radiation, sediment structure/composition, etc.) do not allow natural seedling recruitment. Another main reason for poor establishment of large-scale mangrove plantations in Kuwait is the very high rate (over 50%) of seedling mortality. Therefore, the overall objectives of this 30 months duration project were to reduce the seedling mortality and establish mangrove plantations and study their impact on coastal environment and marine biodiversity.

These objectives were accomplished by implementing seven tasks, namely, mobilization (Task 1), hydrology and habitat assessment (Task 2), standardization of production of hardened mangrove seedlings (Task 3) and establishment of mangrove plantation (Task 4), growth monitoring and sediment characterization (Task 5), preliminary impact assessment (Task 6) and reporting (Task 7). The average rate of sedimentation in Sulaibikhat Bay and KISR sites was estimated to be 1.15 ± 0.26 and 2.15 cm yr⁻¹, respectively. Based on a number of studies conducted, raising of seedlings in freshwater and subsequently, acclimatizing them to seawater salinity using a flow-through system was found to be effective in reducing seedling mortality in the field at KISR1 site to 20%. Besides the conventional planting technique, the coir-pillow and comp-mat planting techniques proved equally effective in reducing seedling mortality and promoting seedling establishment at this site. High seedling mortality observed in Kuwaisat and KISR 2 sites was primarily related to sediment structure/composition, and prevailing hydrodynamic conditions. The report includes a detailed discussion of factors that may have contributed to high seedling mortality and recommendations for reducing the seedling mortality further under Kuwait's environmental conditions.

KFAS contribution: KWD 31,340
Total budget: KWD 74,960
Mechanical and Physical Evaluation of High Content Waste/Virgin Polyolefin Blends Exposed to Natural and Accelerated Weathering (P215-44EC-01)

S. Al-Salem,

Kuwait Institute for Scientific Research in collaboration with Equate Petrochemical Company

Abstract:

The project was successful and all tasks detailed in its proposal were executed in time and have yielded the technical deliverables of the work. The final report was divided into three volumes where the work in this project has been detailed and illustrated in segments. Each volume will focus on a different aspect of the work. This volume will focus on the development of a standalone compounded plastic product from mechanical recycling efforts executed in this work, resulting from the experimentation on virgin and waste plastic materials.

The team required to execute this project was trained, organized, and mobilized, along with the procurement of equipment and chemicals needed to conduct the intended work. In accordance with Task 1, plastic film waste acquired from a local distributor was randomly tested using differential scanning calorimetry (DSC) to investigate Kuwait's plastic film waste constituents. Compounding of test samples was achieved for the different virgin to waste ratios as per the proposed blends to cover the wide range of materials reaching to a 100 by weight% of plastic film waste. The materials and experimental procedures and methods are also detailed in this volume.

Weight gain was noted in some of the formulations after exposure to weathering (accelerated and natural tests) which was attributed to the photo-degradation mechanism triggered by UV exposure resulting in longer chain compounds. By examining the formulated blends and conducting experimental analysis on eight (8) market products of plastic film, it can be deduced that the most superior blend was the 10/90 formulation which can valorize waste from plastic and replace plastic film bags in the market.

Publication:


KFAS contribution: KWD 19,665

Total budget: KWD 127,435
Calibration and Validation of NASA (SMAP) Satellite for the Retrieval of Soil Moisture and the Application to Environmental Modeling in Kuwait (Phase II) (P215-44SP-01)

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Abstract:

The Project “Calibration and Validation of NASA (SMAP) Satellite for the Retrieval of Soil Moisture and the Application to Environmental Modelling in Kuwait” was divided into two phases [Phase I – Project # 2012141301 (from 01st January 2013 till 01st August 2015 – including 8 months extension) and Phase II – Project # P21544SP01 (from 09th July 2015 till 08th January 2016 – including 6 months extension)] and has been funded by Kuwait Foundation for the Advancement of Science (KFAS). This Project was in collaboration with national and international establishment.

Kuwait SMAP Science team conducted around 78 field trips and samples were collected over SMAP test site (36km by 36 km) in the open desert located on the west side of Kuwait City (Salmi area) during three years from 2014 December till 2017 December. The volumetric soil moisture variations during summer winter season and the nominal root mean square values from all soil field measurements shows a homogeneity of SMAP test site in terms of soil moisture variations. This gives Kuwait SMAP grid site (which represents the only site in the Middle East) as an excellent site for Calibration and validation of SMAP satellite soil moisture data.

Around 6 Weather Stations are installed over the SMAP grid test site and a near real-time data was transferred to NASA FTP and hence included these data for the publication of “Validation of SMAP Surface Soil Moisture Products with Core Validation Sites”.

The high resolution (3 km) upsampling field trips conducted and collected 322 soil samples over the test grid. The average of soil moisture is 0.044 m3 m-3 for the three major soil classes in SMAP test site with standard deviation of 0.0155 m3 m-3. These results show exceptional homogeneity over the SMAP grid test. From the upsampling results it was shown that the number of stations representative for SMAP (36 by 36Km resolution can start with a minimum of 4 automated weather stations. Spatial and Temporal variation study over the test grid also conducted and found the spatial and temporal stability of soil moisture over the test site. The sampling density analysis for these intensive field trip data was also similar and hence proves the homogeneity of test site. The spatial variation of soil moisture and its effect on elevation also conducted and found that there is no obvious correlation between soil moisture and topography over the test site. The model simulation of brightness temperature are mostly impacted by soil moisture after accounting for surface roughness and soil temperature contributions. The SMAP 1.4 GHz brightness temperatures agree with simulated brightness temperatures from the forward model for both vertical and horizontal polarizations. The SMAP radiometer has RFI detection and mitigation capabilities and therefore it is less affected. The lower frequency microwaves show greater dynamic range and match with simulated brightness temperatures with in situ field measurements as input. The SMOS 1.4 GHz measurements are apparently affected by RFI and have considerably higher brightness temperatures. At mid-range microwave AMSR2 frequencies, the vertical channel measurements are uncorrelated with the forward model simulations with in situ inputs but the horizontal polarization satellite measurements are well correlated. At the highest AMSR2 and SSMS1 frequencies (18.7 and 19 GHz respectively), even for bare soils, the satellite measurements at both polarizations cannot track changes in surface soil moisture due to both model sensitivity and atmospheric effect. These data and statistical results were used in the manuscript “Forward Simulation of Multi-Frequency Microwave Brightness Temperature Over Desert Soils in Kuwait and Comparison with Satellite Observations”.

A study on the effects of Sea Breeze Circulation on Soil Temperature over Kuwait by using the sensor data and included in the manuscript “Effects of the Sea Breeze Circulation on Soil Temperature over Kuwait Using in Situ Observations and the ECMWF Model”.

A comparison study of the 6 Weather Stations sensor data with in-situ volumetric soil moisture during the validation time from May 2015 till December 2017 was conducted by the NASA SMAP Kuwait Science team. Another comparison study of soil moisture retrieval over Kuwait desert site from satellites such as SMAP, SMOS also conducted. The result of the comparison between SMAP and station sensors showed an RMSD Value of 0.047 m3 m-3. This is comparable with the 0.045 m3 m-3 RMSD value when SMOS soil moisture data compared with the station measurements. These data has been used in the manuscript for the “Validation of NASA SMAP Satellite over the desert test site of Kuwait”.

Another parallel case study on the effect of mesoscale circulation in soil moisture over Kuwait during the summer shows that soil moisture increase during summertime is a likely caused by mesoscale circulation was also conducted during this project. The mesoscale circulation over Kuwait is an important influence on changes in regional skin and soil temperature. This project presents two common summertime atmospheric features over Kuwait linking wind circulation to soil temperatures. We use (CERA-SAT) multi ensemble models and the European Centre for Medium-range Weather Forecasts (ECMWF) reanalysis (ERA-interim) model. The results show that a strong pressure gradient will lead to strong northerly wind over Kuwait, while a weak synoptic-scale pressure gradient force over Kuwait in summer will lead to easterly light humid winds from the Gulf, consistent with a mesoscale circulation in which it might affect soil moisture.
The Extent and Determinants of Student’s Perception of Sustainability in GCC Universities
(P215-49TM-01)
A. Almutairi
Gulf University for Science and Technology

Abstract:
This study is set out to investigate students’ attitude towards environment sustainability in a sample of commerce students in the GCC countries. The study is based on a questionnaire survey. The results of the analyses are expected to reveal that environment sustainability values, attitudes and behaviours differ widely among tertiary students, based on their gender and age, whether studying on or off the campus as well as the region in which they have spent most of their time. In general, female students are more likely to be more environmentally aware than male students. Students in the sample where sustainability is an essential component of their academic program are also expected to be more aware of the impacts of humans on environment in a broader sense than students in sample where their academic program had no sustainability element. The paper might help to explore GCC commerce students’ attitudes and behaviours toward the environment. It also helps in developing course material and activities, as well as provide suggestions to protect the environment and explore solutions to environmental problems.

Assessment of The Microplastic Pollution of Kuwait’s Marine Environment
(P216-42SE-01)
T. Saeed, N. Al-Jandal, A. Al-Mutairi, H. Taqi and J. Zafar
Kuwait Institute for Scientific Research

Abstract:
All over the world plastic debris in the marine environment has become an important environmental issue in the last 15 years. About half of the plastic produced each year is discarded, and about 10% of produced plastic ends up in the oceans. Large plastic fragments eventually degrade into smaller pieces called microplastics (5 mm or less), considered to be harmful to the marine ecosystem due to their bioavailable size, magnification of harmful pollutants, and release of degradation products and additives. The objective of this study was to assess the microplastic pollution of Kuwait marine areas by examining the beach sediments, trawling the coastal areas and examining the stomach contents of local marine biota (4 types of fish and two types of clams). A total of 44 intertidal locations (from Kuwait – Saudi border to Khor Subiya) were sampled. Seawater trawls (40) were conducted to assess the microplastics (MPs) in seawater. Additionally, 87 biota stomach contents were also examined. The isolated plastics were characterized by Raman spectroscopy. The number of microplastics found in all of these samples was quite low. In the sediment, MPs were detected at 12 locations in the Kuwait Bay and at only 3 locations in the south. Neuston trawls indicated that MPs were low in number in seawater. MPs were found in only two samples from Kuwait Bay and also in two samples from the southern areas. In biota, only three pieces of plastics were recovered from Hamour. Polypropylene, polyethylene, and polystyrene were the commonly found MPs. It appears from these results that although Kuwait beaches are littered with discarded plastic, the microplastic levels are quite low in the sediment and in biota.
Trofich Transfer of $^{210}$Po in Marine Environment in Northern Arabian Gulf (P216-44SP-01)

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Kuwait Institute for Scientific Research

Abstract:

This study presents $^{210}$Po data for the marine food web in the northern Gulf waters. Since $^{210}$Po is concentrated in marine biota, a large number of samples of various marine organisms covering several trophic levels, from microalgae to sharks, were analyzed. $^{210}$Po was found to be highly concentrated in several marine species, and the highest $^{210}$Po concentrations found in yellowfin tuna, that is 37.3–44.9, 451–548, and 1511–1693 Bq kg$^{-1}$ wwt in muscle, digestive system, and liver, respectively. In most dissected fish samples, $^{210}$Po showed increasing concentrations in the following order: edible tissue, gills, digestive system, liver, and fecal matter. Fish feces had $^{210}$Po concentrations several orders of magnitude higher than that in seawater, fish muscle, and the fishes’ ingested food. The high $^{210}$Po concentration in fish fecal matter suggests that the bulk of $^{210}$Po content in fish is eventually excreted back into the environment as fecal pellets. In most, fish high concentrations were noted in liver, with the highest $^{210}$Po concentration recorded in yellowfin tuna liver. Moreover, $^{210}$Po concentration in the soft tissue of tunicate and bryozoan samples were 872-1012 and 402-527 Bq kg$^{-1}$ wwt, respectively, far higher than that in fish muscle (0.04 – 44.9 Bq kg$^{-1}$ wwt). It was observed that the maximum $^{210}$Po concentration in edible fish tissue among the fish in trophic level 2 was an order of magnitude lower than that in fish in trophic level 3 and two orders of magnitude lower compared to that in fish in trophic level 4. The highest concentrations in the muscle tissue were observed in the following order: tunicate > bryozoans > zooplanktons > mollusc > phytoplankton > crustacean > fish. Among all the biota analyzed, the highest overall concentration of $^{210}$Po was noted in yellowfin tuna (Thunnus albacores) indicating potential biomagnification of $^{210}$Po in this particular top predator species. In general, $^{210}$Po concentrations found in the commercially important fish from Kuwaiti waters were comparable to levels that have been reported for similar fish species from several other marine areas worldwide.

The $^{210}$Po concentration among the primary producers, diatoms, and diinoflagellates were 6.99 –11.35 and 8.51 – 15.41 Bq kg$^{-1}$ wwt, which were significantly lower than the concentration among copepods that range between 33.46 and 158.79 Bq kg$^{-1}$ wwt. The $^{210}$Pb concentration in marine biota was significantly lower compared to $^{210}$Po. Typically, the fish muscle concentration was <0.1 Bq kg$^{-1}$ wwt with exception to mullet. The $^{210}$Pb concentration in muscles < gills < eggs < digestive system < fecal matter, suggested excretion of $^{210}$Pb via alimentary canal in most fish. The $^{210}$Po and $^{210}$Pb concentration in seawater shows a seasonal variation, with higher concentration range of 0.58–0.70 and 0.85–0.90 mBq L$^{-1}$ during autumn and summers, while a lower concentration of 0.30–0.38 and 0.66–0.74 mBq L$^{-1}$ during spring and winters. The concentration in sediment for $^{210}$Pb and $^{210}$Po are 30.3–45.8 and 12.1–25.1 Bq kg$^{-1}$ dwt.

KFAS contribution: KWD 32,600
Total budget: KWD 123,600
**Education for Sustainability: Training Educators and Civil Society Leaders in Participatory Environmental Research and Action (P216-44WE-02)**

Elisa Franceschinis
The en.v Initiative

**Abstract:**

The “Educating for Sustainability” program was developed with the aim to build the capacity of local educators and civil society leaders to engage Kuwait’s youth in participatory research and conservation projects promoting environmental protection and sustainability. Kuwait is currently facing a number of important threats to the environment including in areas of waste management, biodiversity monitoring and assessment, air quality, and climate change. Although a number of public agencies, scientists and civil society organizations / volunteer groups are increasingly trying to tackle these issues, their impact to date has been limited due to a lack of collaboration and knowledge-sharing among key stakeholders and limited engagement of Kuwait’s large youth population. Data collected by researchers and public institutions is not easily accessible to non-scientists such as civil society leaders and educators who wish to generate greater awareness about the country’s environmental challenges. The research question we addressed was, how can we involve the public, and particularly the country’s youth, in the promotion of environmental awareness and education, and bridge the gap between them and the scientific community for greater long-term impact?

Implemented as a pilot from June 2017 to February 2018, “Educating for Sustainability” provided local educators and civil society groups with training, mentoring and funding to develop participatory, impactful and realistic projects promoting data collection, analysis and action in the field of environmental science and education. The project officially kicked off with a three-day workshop on Participatory Action Research (PAR), designed in partnership with an international consultancy and incorporating the input of an advisory committee of local environmental experts. Following the workshop, five projects submitted by participants were selected for funding. The en.v team provided mentoring and support to the subgrantees throughout the four-month implementation period, and paired each project team with one of the members of the advisory committee for further guidance.

A final evaluation of the pilot to gather lessons learned and inform future program activities was conducted in February, during which subgrantees discussed challenges and shared their success stories. One of the most notable achievements of this program was the fact that all of the community projects developed have already resulted in sustainable initiatives which will continue beyond its finalization. One project led to the development of a student-led and sustained hydroponic garden to promote sustainable living, water conservation and healthy eating at the American School of Kuwait (ASK).

Another project, entitled MW6INY, was officially adopted by the Environmental Voluntary Foundation and now operates as an NGO promoting the participation of the community in beach clean-ups and data collection. A third project, entitled “Clean Deserts”, has resulted in the establishment of a student club visiting other private and public schools to present their findings and raising awareness about clean- camping habits amongst the general public. We believe that these results demonstrate that more participatory and innovative approaches to environmental education can lead to greater curiosity and enthusiasm amongst local youth to promote sustainability, as well as to the development of more creative and action-oriented initiatives.

**KFAS contribution:** KWD 21,790

**Total budget:** KWD 25,791
Design of Iptycene Polymers: A New Generation of Gas Separation Nanomaterials for Energy Applications (P314-34SC-01)

B. Alameddine
Gulf University for Science and Technology

Abstract:

We would like to summarize our results on the synthesis of new polymers of intrinsic microporosity for gas separation materials. These interesting findings resulted in the publication of five articles in first quartile (Q1) peer-reviewed journals in addition to seven conference proceedings.

It should be noted that we have faced major logistical hurdles during the first and second years of the project, and in which we were unable to purchase several key intermediates required to synthesize the hitherto target triptycene-based polymers due to customs regulations and restrictions that ban these chemical reagents from entry in Kuwait. Nevertheless, we could be able to make new target polymers based on iron (II) clathrochelate that we believed it has a potential internal free volume due to its three-dimensional structure. Therefore, we have synthesized—in collaboration with Professor Kay Severin from the Federal Polytechnic Institute in Lausanne, some supramolecular nanocages whose unique structures was published in a first quartile journal.

In a further step, we report for the first time the synthesis of four iron (II) clathrochelate polymers (P1-4) which were made in one step only and under mild reaction conditions. The investigation of intrinsic microporosity properties of P1-4 was carried out by nitrogen adsorption where one of these polymers (P4) reveals a Brunauer-Emmett-Teller (BET) surface area of 412 m²/g and average pore volume of 0.36 cm³/g. In addition, we have been able to make a series of two-dimensional highly soluble organometallic polymers, whose despite their scarce microporous properties reveal an interesting oragnogel formation in concentrations as low as 10 wt% in organic solvents of low and medium polarity.

We have been finally able to purchase in 2017 some of the chemical reagents required to make triptycene derivatives. Therefore, novel building blocks of these latter substituted at their 1,4- positions with branched aromatic moieties were prepared by microwave-assisted [4+2] Diels-Alder cycloaddition reaction in very good yields. Two of these new triptycene derivatives underwent palladium-catalyzed Suzuki-Miyaura cross-coupling reactions affording the desired products in very good yields. This successful tetra- and octa- fold substitution paves the way for the employment of these new synths to prepare polymer networks for various applications.

Furthermore, we have been able to devise new ethynylene triptycene-based copolymers with various aromatic spacers using the palladium-catalyzed Sonogashira cross-coupling reaction. The alkyne groups of 3a-d were oxidized into their respective α-diketone copolymers 4a-d. In spite of the low microporosity of these polymers, it was found that the nature of the aromatic spacer influences the emission properties of the target α-diketone triptycene copolymers, causing either a red or blue-shift with respect to that of their ethynylene triptycene copolymer synthons where some of these reveal emission in the range of 440-475 nm, thus, qualifying them to act as blue emitters.

Publications:

Noorullah Baig, Suchetha Shetty, Saleh Al-Mousawi, Fakhreia Al-Sagheer, Bassam Alameddine; Influence of size and nature of the aryl diborate spacer on the intrinsic microporosity of Iron (II) clathrochelate polymers. Polymer 151 (2018) 164e170

Alameddine, B.; Baig, N.; Shetty, S.; Al-Mousawi, S.; Al-Sagheer, F., Tuning the optical properties of ethynylene triptycene-based copolymers via oxidation of their alkyne groups into α-diketones. Journal of Polymer Science Part A: Polymer Chemistry 2018, Accepted. Published Online, DOI: 10.1002/pola.28971


KFAS contribution: KWD 96,600
Total budget: KWD 153,900
Investigation of Cleaning Methods for Photovoltaic Systems under Kuwait Environment (P314-35EM-04)
A. Alasfour, A. Alkandary and F. Alzubi
Kuwait Institute for Scientific Research

Abstract:
While recently there has been a growing interest in generating energy from photovoltaic systems in the GCC region, dust deposition on the surface of PV modules reduces power output of up to 60%, causing serious performance and reliability issues. In this study, the project team evaluates the technical and economic effectiveness of five photovoltaic cleaning methods proposed in literature under Kuwait's environment. Technical data were collected by applying each method nine times over a course of one year when the PV samples’ power reduces by 15% because of dust. Furthermore, a residential and a commercial lifetime cost estimation models were developed to assess each cleaning method economically. All of the cleaning methods fully restored power output after cleaning, except when cleaning with dry air, which was unable to restore any lost power. The use of hydrophobic and hydrophilic coatings to modify the photovoltaic glass surface improved water consumption and cleaning time, however it was unable to prevent or slow down dust deposition. The ineffectiveness of dry air and partial underperformance of coatings is reasoned to be a result of the strong soil cementation build-up influenced by high humidity at the test site near the coastline. Ultimately, the most cost-effective cleaning solution was pressurized water. For residential systems, it offers the owner a low competitive lifetime cost and ease of operation. As for larger commercial systems, it is three to eight times less expensive than the other investigated cleaning solutions primarily because it presents the fastest cleaning time and thus significantly reduces labor costs. Further developments in this field will require the reduction of labor expenses by minimizing the cleaning time required. This can be done by either introducing feasible automation solutions or combining two high-potential existing methods such as hydrophobic coatings and pressurized water.

KFAS contribution: KWD 98,400
Total budget: KWD 124,500

Efficient Separation of Dilute Oil Contaminations from Wastewater by Functionalized Magnetic Nanoparticles (P315-25EC-01)
A. Al-Haddad
Kuwait University

Abstract:
There are several industries producing large quantities of dilute oily-wastewater for which the oil separation is challenging. Current technologies to separate the oil contaminants are compositional dependent, energy and material demanding, and expensive. They require large buffering tanks because of low selectivity, and frequent process maintenance in the case of membrane-based separation technologies. These challenges are intensified for large wastewater throughput, and for conditions where the oil is in the form of stable emulsions with a high viscosity, and of comparable density to the water phase (e.g., heavy oil-water mixture). Moreover, the presence of surfactants and solid contaminations add complexity to the challenge. We had proposed a methodology to use magnetic nanoparticles (MNPs), dispersing them in the aqueous phase to encapsulate the oil droplets, and to separate them using a magnet. In the experiments, we used 1% oil in the aqueous solution (deoxygenized water and surfactant). The emulsion was prepared by high shear mixing followed by sonication. After the emulsion was stabilized, the size distribution of oil droplets was measured by dynamic light scattering technique over a period of up to one week. We used 30 nm Fe3O4 MNPs that were functionalized by PEG and dispersed in water (1 mg Fe3O4/L H2O) to emulsion and successfully separated the oil droplets from emulsion medium. The effects of magnet pull force, SDS concentrations and MNP loading on separation efficiency were investigated. It was observed that the surfactant may interfere with the MNPs, especially if it is present in concentrations above the CMC level. So, a lower concentration of SDS is desired. It was also observed that for the range of our emulsion droplets, a magnet pull force greater than 25kg is required to obtain practical separation. The settling time of emulsion droplets plus MNPs followed a power law correlation with the magnet pull force. It was observed that using a magnet with 60kg pull force, the separation was possible within 5 minutes. The methodology has been proven successful; however, more research is required to investigate optimal coating of MNPs, type of MNPs (and the dispersion media), MNP loading, dispersion methodology, magnet pull force and process scale up.

KFAS contribution: KWD 9,950
Total budget: KWD 9,950
Assessing the Feasibility of Offshore Wind as an Alternative Source of Energy for the State of Kuwait (P315-34SE-02)

W. Al-Nassar
Kuwait Institute for Scientific Research

Abstract:
An assessment of offshore wind power potential for Kuwait is carried out. The technical and financial risk, environmental impact along with the geographic information system and the financial and economic impact to fortify the sustainability and growth of this renewable energy were all investigated in this study. Measured data from eleven different offshore weather stations are used. In general, in the territorial waters of Kuwait, Wind Power Density (WPD) in the range of 200 to 400 Watt/m² is available at 30m elevation from mean sea level. The offshore of Boubyan Island was found to be the most suitable with WPD of more than 500 Watt/m² in summer, which is good, since in summer, the demand for energy is high. The marine stations closer to the main land area are good in summer. The wind power density is also high at Sea Island Buoy, Umm AlMaradim and Beacon M28 in winter, which is well away from mainland. Kuwaiti territorial water is ideal for wind power stations since the water depth is low; waves are less and there is no cyclone or Tsunami. Wind energy technology is identified for sustainable development of significant renewable energy share in Kuwait by 2020 onwards. The cost of producing 1 kWh from wind, LEC, is estimated to be about 27.6 fils/ kWh, which is highly competitive in comparison to conventional power plants, mainly due to the high annual operating cost when the cost of fuel is added.

KFAS contribution: KWD 42,406
Total budget: KWD 183,442

A Modular Multi-Terminals PV Interfacing System (PN17-15EE-01)

B. Alajmi
Public Authority for Applied Education and Training

Abstract:
This project presents a PV interface system based on an isolated high-gain high-frequency dc/dc converter. The PV array is connected to a square pulse high-frequency H-bridge. The Pulse Width (PW) of the output square voltage from the H-bridge inverter is controlled to extract the maximum power from the PV array using any of the Maximum Power Point Tracking (MPPT) schemes. The output of the H-bridge inverter is connected to the primary winding of a multi-secondary high-frequency transformer where each secondary winding is connected to a bridge rectifier. The bridge rectifiers are connected in series to boost the output de-link voltage which is interfaced with the grid using a Voltage Source Inverter (VSI). During normal operating conditions, the VSI is controlled to regulate the de-link voltage to transfer the harvested maximum power from the PV array to the grid at unity power factor. Moreover, the paper presents a Low Voltage Ride Through (LVRT) controller to meet the grid-code requirements and simultaneously protecting the proposed interface system from overvoltage. Simulation results based on PSCAD/EMTDC software are provided to assess the proposed PV interface system during different modes of operations.

KFAS contribution: KWD 4,404
Total budget: KWD 4,454
Aligned PVDF Nanofibers Embedded with Carbon Nanotubes for Energy Harvesting (PN17-35EE-02)

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Kuwait College of Science and Technology

Abstract:
This project studied the fabrication and characterization of an energy harvester based on Polyvinylidene Fluoride (PVDF) aligned nanofibers generated by the electrospinning technique. The electrospinning technique allowed the applications of high DC-Voltage to enhance the formation of enough polarization inside βPVDF, to support parallel β-sheets. Moreover, the nanofibers were aligned by applying g static field-focusing design at the collector side of the electrospinning facility; instead of the traditional high-speed drum collector. Also, Carbon nanotubes (CNTs) were added in-situ to enhance the performance of β-sheets and consequently enhanced the efficiency of piezo-electricity of the formed nanofibers. Our results show that both alignment and added CNTs increased the formation of beta sheets inside the nanofibers, which correlates to a better polarizability inside the material. Consequently, the piezoelectric sensitivity of alignment PVDF doped with 0.3 wt % of CNTs was improved up to the range of 73.8 mV/g when applying weights up to 100g, where the generated nanofibers mat can be used as a piezoelectric sensor.

Publication:

KFAS contribution: KWD 9,000
Total budget: KWD 9,000

Benchmarking the Energy Use Intensity of Kuwait’s Residential and Commercial Building Sectors (PN17-35EV-01)

E. Aazar and B. Al-Alfan
Kuwait Municipality

Abstract:
Benchmarking the energy performance of Kuwait’s building sectors is an essential step to understand the current drivers or energy consumption and guide future energy conservation strategies, policies, and research efforts. While various energy saving initiatives are taking place in Kuwait, such an effort has not been conducted prior to this study. The goal of this research is to conduct the first empirical analysis of the drivers of energy consumption in Kuwait buildings in an effort to benchmark their performance and guide actions that aim to reduce the energy demand of this sector. Specific goals include:

1. Mapping and understanding the characteristics of Kuwaiti commercial, residential, and mixed-use buildings,
2. Quantifying the impact of their characteristics on the observed energy use levels,
3. Developing a predictive model of energy performance to test the impact of potential changes in building characteristics
4. Recommend actions and strategies that can help reduce the energy demand of this sector and transition towards a less energy-intensive footprint.

To achieve the above objectives, data was first collected from 463 commercial, residential and mixed-use buildings. Then, a variety of data analysis and modeling techniques were applied including descriptive modeling (e.g., correlation matrices), explanatory modeling (e.g., machine learning and gradient boosting), and predictive modeling (e.g., linear regression). The findings were significant, indicating that building size is the most influential factor on building energy performance, while other building characteristics - such building age, location, or air conditioning types - are not. In addition, the authors successfully developed and validated a model that predicts a building’s electricity consumption given its type and size. The model was used to develop recommendations on effective actions that can be taken to reduce the energy intensity of the building sector. The recommendations cover design practices, urban planning strategies and policies, in addition to the needed information and data infrastructure for effective research and development in the field.

KFAS contribution: KWD 7,154
Total budget: KWD 10,000
Quantifying the Impact of Human Actions on The Energy Performance of Kuwaiti Residential Buildings (PN17-35EV-02)

E. Aazar and B. Al-Aifan

Kuwait Municipality

Abstract:

Buildings consistently consume more energy than the estimations made during the design phase, including low-energy and green-certified buildings. The traditional approach to address this problem has been to further develop and adopt energy-efficient building designs and components such as low-energy air conditioning or lighting systems. In recent years, there has been a growing interest to evaluate how occupants and facility managers operate buildings and the resulting impact on building energy performance. Studies in the field confirm that actions taken, or not taken, by people highly impact energy consumption and should be properly understood to avoid rises in energy use levels. These findings have motivated researchers to quantify the impact of human actions on building performance and propose strategies to reduce energy consumption without necessarily investing in building design changes and retrofits. However, human-focused building energy research remains scarce in literature, is mostly focused on western countries with results not applicable to extreme weather conditions such as in Kuwait, and is limited to simplistic analysis approaches, overlooking combined effects or uncertainty in multiple parameters.

The goals of this research are to:

1. Quantify the impact of actions taken by occupants or facility managers on the energy consumption of Kuwaiti residential buildings.
2. Study potential synergetic or combined effects between parameters.
3. Evaluate the response of buildings to potential uncertainty in human actions (e.g., testing extreme energy use patterns).
4. Use results to recommend human-focused energy saving solutions.

A three-phase methodology was developed and applied to achieve the above objectives. The first phase consists of gathering information about the building of interest, in this case an archetype Kuwaiti residential building. The gathered data is used in the second phase to develop and calibrate a Building Performance Simulation (BPS) model that simulates the energy performance of this building. The third and last step is parametric variation, where parameters of the BPS model are varied individually, and in batches, while monitoring the resulting impact of these variations on the energy consumption predictions of the BPS model.

Three main conclusions can be made from the observed results. First, changing the set point temperature setting of the Air Conditioning (AC) system is the most influential parameter studied, which was expected given the extreme hot climate of Kuwait. A 2°C change in this parameter can lead to changes in energy consumption exceeding 10% from the base case levels. Second, the combined parameter variation did not show synergetic effects between the parameters, which means that the impact of two or more parameters on building energy consumption is very close in value to the sum of their individual impacts. This result helps answer questions raised in the literature regarding the importance of parameter interactions and whether it should be the focus of upcoming research efforts on the topic. Finally, the last and most important finding, is that building energy consumption can change between +30% and -20% from current levels if occupants adopt high-energy or low-energy use patterns, respectively. The findings are significant as they quantify, on the hand, the risk from inefficient occupant behavior, and on the other, the opportunity to achieve important energy savings from responsible energy conservation practices.

Finally, this study concludes with 5 main recommendations to the Kuwaiti government including:

1. Educating building occupants on the importance of efficient AC set point control.
2. Promoting smart thermostats with the ability to learn from and adapt to the patterns of occupants.
3. Deploying smart metering technology.
4. Developing a mandatory performance-based green building certification system.
5. Further supporting building research initiatives that promote collaboration between the public sector, the private sector and the educational institutions.

KFAS contribution: KWD 6,801
Total budget: KWD 10,000
Man and Human Society in Literature of Ismail Fahad Ismail, A Critical Study (PR17-11AA-01)

S. Arkadan
Gulf University for Science and Technology

Abstract:

Critics believe that the novelist Ismail Fahad Ismail is the pioneer the art of writing novels in Kuwait, and with him, Kuwaiti novel became complete artistically and achieved high level of fame. The writer had published over the last half century more than twenty novel, as well as literary studies, plays and short stories, until he became one of the names that referred to in the contemporary landscape of the Arab narrative, and probably he achieved that level at the time he wrote his first novel (It was Blue Sky) in 1970. The writer and critic poet Salah Abdul Saboor, said at the time: "The novel was a big surprise to me, this novel as fresh as I would imagine, at the standard of twentieth century, coming from the far Gulf, where there are no traditions of art of novel writing, and where the poem still has priority".

Ismail Fahad Ismail, is not a Kuwaiti writer confined by his environment, culture and society and far away from the Man in the wider world that extends to the open world with its 8 dimensions. He wasn't confined in his stories to local personalities, but his writings are beyond that, which can be understood if are translated and read in any environment because of their humanitarian dimensions affecting the individual and society and address general human issues although he started off with localities that are consistent with global community. Ismail Fahd Ismail is a novelist and writer who grew up between two societies and met many diversified communities and cultures in his own country as outside. And if we add to his experience his imagination, we'll see in the writings of Ismail this creative marrying between the specific and the general, would see the multi interests, diversified, multiple treatments, that gives attention to marginalized classes without losing sight of the higher ones, to a level where you think he is a social worker taking every opportunity to help in liberating the human beings from their social bondage and their complexes by using language that doesn’t intimidate those who do not agree with him.

This study is an attempt to highlight the approach used by Ismail Fahad Ismail in his literature and his writings exposing aspects of the human being and the society the way he saw it and the way he proposed to resolve some issues. It is an objective study that will look into some of his most famous novels and short stories objectively that can see beyond the lines as should any objective study.

KFAS contribution: KWD 5,300
Total budget: KWD 5,300
Studies on the Biogeochemical Role of Dolomite Forming Microbes Isolated from a Kuwaiti Sabkha (PR17-125L-10)

H. Mahmoud

Kuwait University in collaboration with University of Toronto

Abstract:

Dolomite is an important carbonate rock for oil and gas exploration. Despite centuries of research, the origin of dolomite remains one of the most debated subjects in sedimentary geology. In the east coast of the Arabian Peninsula dolomite is forming in the upper sediment layers in salt flats or hypersaline lakes known by sabkha. This study is aiming to evaluate the microbial role in dolomite formation in sabkha samples collected from Al-Khiran south of Kuwait and stored in the laboratory. The geochemical profile and the identification of dolomite in the sabkha samples was assessed using microsensors, powder x-ray diffraction (XRD), and scanning electron microscopy/ energy dispersive x-ray spectroscopy (SEM-EDS). The microbial diversity in the sabkha was assessed using enrichment microcosm experiment and metagenomic approaches. Dolomite was detected in the first layer of the sabkha sediment. The microbial consortium enriched from the first layer of the sediment precipitated clusters of spheroidal and dumbbell-shaped crystals. Various spots of the crystals were scanned using SEM-EDS demonstrating the characteristic elemental peaks of dolomite (Mg, Ca, C, and O). The pH of sabkha samples decrease as the depth of the sediment increase and the isolated microbial consortium participate in increasing the pH in the microcosms from 7 to 8.58. The dolomite forming microbial consortium was dominated by Halomonas sp. (98.4%), Clostridium sporogenes (1.4%), Methanolobus sp. (0.07%), and Bacillus subtilis (0.006%). Functional profiling from microbial data showed that membrane transport > amino acid metabolism > carbohydrate metabolism > replication and repair > energy metabolism metabolic pathways accounted for ≈ 45% of reads in the consortium metagenome. The results showed the ability of the cultured microbial consortia from preserved sabkha sediment in dolomite formation.

KFAS contribution: KWD 10,000

Total budget: KWD 17,000
Multi-Parametric Testing of Immunological and Biochemical Markers of Osteoporosis in Postmenopausal Women (PR17-18SL-01)

F. Azizieh
Gulf University for Science and Technology

Abstract:

Osteoporosis is a significant health issue which is set to rise alarmingly worldwide. In addition to some well-characterized factors such as hormones and nutrients, a diverse group of other markers and factors have been suggested to interfere with bone formation and resorption, during pathologic bone remodeling.

This project aimed to compare several factors that may contribute to, or indicate, bone loss in postmenopausal women. We compared the circulatory levels of parameters related to oxidative stress, cytokines, adipokines, bone turnover markers, estradiol, vitamin D, vitamin D binding protein (VDBP) and single nucleotide polymorphisms (SNPs) in the VDBP gene in postmenopausal women with normal or low bone mineral density.

Methods:

Circulatory levels of (a) oxidative stress markers (Catalase, Peroxiredoxin 2 (PRX2), Superoxide dismutase 1 (SOD1), Superoxide dismutase 2 (SOD2) and Thioredoxin (TRx1)), (b) selected pro-resorptive (TNF-α, IL-1β, IL-6, IL-8, IL-12, IL-17), and anti-resorptive (IFN-γ, IL-4, IL-10, IL-13, GMCSF, TGF-β) cytokines, (c) adipokines (adiponectin, adipin, lipocalin-2/NGAL (neutrophil gelatinase-associated lipocalin), PAI-1 (plasminogen activator inhibitor-1) and resistin), (d) bone turnover markers (PINP, CTX), and (e) estradiol in postmenopausal women with normal or low BMD were measured using the Multiplex ELISA system and ELISA assays. Furthermore, we explored the association of vitamin D, vitamin D-binding protein (VDBP) levels and two single nucleotide polymorphisms (SNPs) in the VDBP gene for their association with VDBP levels and risk of osteoporosis and osteopenia.

Results:

While circulatory levels of cytokines were comparable between groups, serum levels of adiponectin, adipin, PAI-1 and resistin were found to be significantly higher in postmenopausal women with low BMD group as compared to women with normal BMD (p= 0.0001, 0.034, 0.032 and 0.041 respectively). Among the five adipokine markers measured, levels of only adiponectin showed significant correlation with BMD of the hip and spine (r= -0.28, -0.27; p= 0.038, 0.05 respectively). Further, while levels of CTX were not different between the two groups, levels of PINP, the ratio of PINP/CTX and levels of estradiol were significantly lower in women with low BMD (p= 0.005, 0.0001 and 0.026, respectively). In terms of correlations, circulatory levels of PINP correlated significantly with BMD of the hip and spine (r= 0.35, 0.35; p= 0.009, 0.010 respectively). While CTX levels did not show any correlation, the PINP/CTX ratio correlated with BMD of the hip and spine (r= 0.44, 0.36; p= 0.002, 0.013 respectively). Similarly, estradiol levels significantly correlated with BMD of the hip and spine (r= 0.42, 0.32; p= 0.001, 0.017 respectively).

As compared to subjects with normal BMD, subjects with low BMD had comparable serum levels of vitamin D and VDBP. We further reported equal prevalence of VDBP variants in the two groups. None of the genetic variants were associated with risk of osteopenia or osteoporosis and neither were they associated with categorical vitamin D groups or VDBP levels.

Conclusions:

The results shed light on possible links between these parameters and bone health. Data from this research will contribute to a better understanding of the etiopathology underlying osteoporosis and may contribute to the development of strategies for monitoring, preventing or reversing the systemic balance associated with the bone loss and related processes.

KFAS contribution: KWD 10,450
Total budget: KWD 10,450
Relationship Share an Outcome of Customer Relationship Management: A Comparative Study of Kuwait & U.S. Firms (PR17-18SM-01)

D. AlSaleh
Gulf University for Science and Technology

Abstract:
In today's highly competitive business world, customer relationship management (CRM) is emerging as a core marketing activity in both developed (e.g., U.S.) and developing countries (e.g., Kuwait). Studies have indicated that it costs six times more to acquire new customers than to retain an existing one (Reichheld 1996). Hence, many firms are devoting more attention to maintain and develop relationships with customers, which is likely to increase the customers' willingness to engage in a relationship (CWER) with the firm and increase the customer relationship share (RS) of that firm.

This study offers an in-depth investigation of the factors that influence RS and it empirically tests whether customer satisfaction (SAT) and CWER affect RS in a cross-cultural context (Kuwait vs. U.S.). A conceptual model is derived by drawing on theories taken from multi-disciplinary literature, including marketing, management, and social psychology.

The two-fold objectives of this study are: (1) to identify the important determinants of CWER and (2) to empirically test the influence of satisfaction and CWER on RS in both developed (e.g., U.S.) and fast developing economy such as Kuwait. The other main contribution of this study would be that there are no studies in the literature that has discussed the concept of company's relationship share with their customers in terms of these three dimensions: time, money, and thoughts in both developed and developing economy.

The present study will add value to existing research by providing empirical evidence using data from U.S. and Kuwait managers and customers' perceptions of the critical factors that enhance companies' relationship share in both developed (U.S.) and developing (e.g., Kuwait) economies.

Finally, this study is expected to make important contributions theoretically and managerially. These contributions will provide valuable information and new insights for scholars, practitioners in Kuwait and U.S., government, and public policy makers.

KFAS contribution: KWD 10,750
Total budget: KWD 15,350

Telecommunication Services for Emergency Crisis: Kuwait vs U.S.A. (PR17-18SM-03)

D. AlSaleh
Gulf University for Science and Technology

Abstract:
Innovation in telecommunication service industry in developed (e.g., U.S.) and developing countries (e.g., Kuwait) using end-user involvement has remained under-researched. The involvement of end-user in the product development, and the outcome of that innovative product development have not been given merit in the literature. Academics, managers, and public policy makers in developed (e.g., U.S.) and developing countries (e.g., Kuwait) have not meticulously examined (1) the effect of interaction between different end-users in generating innovative products/ideas in the telecom sector and (2) how these wireless telecommunications devices are used to tackle exigencies.

This study contributes to the compendium of knowledge in different ways: (1) it provide a theoretical background in understanding the importance of different groups of end-users in the innovative product development (2) how the communication method of information sharing between different groups of end-users enhances the effective uses of the wireless devices in crisis management, and (3) this study also empirically validates the importance of different end-user groups in the development of the innovative devices in the telecommunication sector and its usage during crisis management using student, consumer, and manager samples from Kuwait and United States. Based on the findings related implications for the wireless service and manufacturing firms, consumer public policy makers in both Kuwait and U.S. is provided.

KFAS contribution: KWD 11,130
Total budget: KWD 15,503
Natural Radioactivity Exposure to the Kuwaiti Populace from the Ingestion of Fish (PR17-44SE-02)

T. Alrefae
Kuwait University

Abstract:
Radioactivity in the environment is caused by natural sources and man-made sources. Examples of natural radionuclides are the potassium isotope $^{40}$K, uranium $^{238}$U and its decay series, and thorium $^{232}$Th and its decay series. In addition to being extremely long-lived with half-lives in the order of $10^9$ years, these natural occurring radioactive materials (NORM) are typically present in air, soil, and water in different amounts and varying levels of activity. Therefore, the presence of NORM in environmental samples is inevitable. Man-made radionuclides on the other hand, are the products of military, industrial, and medical applications. An example of a man-made radionuclide is $^{137}$Cs, which has a relatively long half-life of 30 years. The detection of a man-made radionuclide in an environmental sample is an indicator of a previous contaminating event.

Whether natural or man-made, radionuclides find its way to humans through a number of channels, one of which is ingestion. In other words, radioactive exposure to the general public is directly related to the quality and quantity of the consumed food. Fish are considered a popular food in Kuwait. As such, this study aimed to investigate the natural and man-made radioactivity content in edible fish.

Fish samples were collected from the local market before undergoing proper preparation and measurement. All natural radionuclides were detected in some or all samples with varying concentrations. As for the man-made radionuclide, namely $^{137}$Cs, it was detected samples of Sea Bass that originated from Turkey. Nonetheless, all readings were well below guideline limits. Therefore, all samples were considered to be safe for the investigated radionuclides.

KFAS contribution: KWD 7,900
Total budget: KWD 14,690
Ongoing Projects

The Biology of Marine Bivalves and their Environment in Kuwait, Phase I: Population Structure, Reproduction and Mitochondrial DNA
(2012-1207-02)

S. Al-Mohanna
Kuwait University

Project Progress - Abstract:

The four-edible clam species showed distinct distribution along the intertidal zone of the northern and western coasts of Kuwait Bay in association with sediment type. The main clam beds of Amiantis ambonella were located in Sabiya intertidal zone where the sediment is predominantly of mixed sand and mud, while beds of Protape cor were located along the intertidal coast of Kazma and the northern shore of Sulaibikhat Bay where the sediment is a mixture of mud and silt. Marcia opima beds were restricted to the intertidal zone of Kazma, while Marcia flammae beds were located along the intertidal zone of Doha where the sediment of a mixture rocks and sand.

The reproductive cycle of the four-clam species occurs biannually during spring and autumn. The female and male gonadal activity in spring initiates during late February and continue until late May, while in autumn it is restricted to October and November. Gonad activity was quiescent from late June to mid-September. During clam gonadal seasons of 2018, a spawn induction experiment was performed which involved using the neurotransmitter serotonin. The bivalves were injected with a specific amount of serotonin solution either into the gonad or adductor muscles. Both male and female bivalves responded successfully to the serotonin, with males releasing a cloud of sperms and females releasing oocytes that sunk to the bottom of the Petri dish. Pilot attempts of in-vitro fertilization showed to be successful with occurrence of both monospermy and polyspermy.
Genomic analysis was applied to authenticate and molecularly identify the bivalves via what is called ‘DNA barcoding’: the first attempt to investigate and determine the genetic structure and composition of the four species of clams (Amiantis umbonella, Protape cor, Marcia flammae & Marcia opima) present along the northern coast of Kuwait. Determining the DNA barcodes will be used to assess biodiversity and endemism through phylogenetic analyses. Various issues of troubleshooting were encountered during the DNA sequencing reaction with some of the bivalve species. Background noise and odd peaks were present underneath the main sequence peaks on the Electrophoregram, which might be due to primer input or an inefficient sequencing reaction. In order to improve the quality of the template preparation, we will attempt to repeat the analysis taking into account proper quantification of the template and primer; and assuring there is no ethanol carry over from the purification process.

KFAS contribution: KWD 63,750
Total budget: KWD 74,750

Identification and Characterization of Post-Translational Modifications in the Raf Kinase Inhibitory Protein: Implication for a Molecular-Based Therapy of Breast Cancer (2012-1302-01)

M. Bitar and F. Al-Mulla
Kuwait University

Project Progress - Abstract:

The metastatic process is a complex cascade that consists of distinct steps. A specific class of metastasis suppressor gene (MSG) may regulate the metastatic process, and the loss of MSG function is an important event in progression toward a malignant phenotype. Given their overriding importance in cancer pathophysiology a thorough understanding of how MSGs function and how they are regulated remains urgently needed. Moreover, the high potential of MSGs to serve as therapeutic targets argues for vigorous and extensive investigation of their molecular mechanisms. We have identified Raf Kinase Inhibitor Protein, RKIP, as a new member of the MSG family in prostate and breast cancer; it was also documented that RKIP expression was reduced in tissues obtained from patients with breast and prostate cancer. Interestingly, we garnered data demonstrating that enhanced expression of RKIP inhibited breast/prostate cancer metastasis in murine models. In contrast, germline deletion of RKIP promotes metastasis in prostate cancer prone transgenic mic. To date, only a handful of MSGs have been identified. Furthermore, little is known about the mechanisms by which these genes and their protein products suppress metastasis in vivo, nor do we have a detailed understanding of how MSG expression and function is regulated. However, our studies to date indicate that RKIP action is intimately tied to key cellular machinery regulating metastasis. Since wound healing and tumor growth share many common features and thus we will take advantage of the emerging information of RKIP in breast cancer studies for the benefit of understanding and treating non-healing diabetic wounds.

KFAS contribution: KWD 157,561
Total budget: KWD 157,561
Concomitant Anti-EGFR Antibody (Cetuximab) plus Hyper-Fractionated Radiotherapy Versus Chemotherapy plus Hyper-Fractionated Radiotherapy in Advanced Non-Metastatic Head & Neck Cancer (Random Controlled Study) (2012-1302-06)

K. Al-Saleh

Ministry of Health

Project Progress - Abstract:

This study was launched and patients’ enrollment was started on 1st of November 2014, 30th November 2017, 40 patients (17 patients in the 1st year, 15 patients in the 2nd year, and 8 patients in 3rd year) were enrolled after fulfilling eligibility criteria and confirming their diagnosis and stage.

The patient characteristics are shown in table 1. The median age of these 40 patients is 51 years (range 27-72 years). Thirty five patients are male and almost 43% of them are of Asian origin (mostly Indian or Bengali). Seven patients are Kuwaiti while 15 are Arabian nationality and one is European. Most of these patients gave a history of cigarette smoking (68%).

Regarding the primary site of their disease; 14 patients have their primaries in larynx, 11 in oropharynx, 8 in oral cavity, and 5 has tumor in hypopharynx. Two patients had disease in nasal sinus or overlapping subsides. Regarding stage of disease at diagnosis; 50% has T4 lesions while 35% has T3 lesions. Nodal status was (N0-1) in 20 patients and (N2-3) in 20 patients. Overall staging showed a majority to have stage IV disease (63%).

Regarding study arms, 21 patients were randomly allocated in Arm A (platinum-based) while 19 were in Arm B (cetuximab).

The overall tolerance and toxicities of the treatment were recorded in these patients regardless of the arm assigned (Table 2). It is still early to statistically compare both arms in this aspect considering the high possibility of late endocrine, renal and neurotoxicity. The toxicity profile is so far acceptable. However oral mucositis was moderate-severe, and that is managed conservatively with no treatment interruptions. To be noted, 2 patients in Arm (A) suffered from severe neutropenia that required prolonged hospital admission and platinum-based chemotherapy was discontinued. Also two patient was shifted from cisplatin to carboplatin due to drop of renal parameters. These former two patients were shifted to cetuximab arm (a cross-over that is not allowed in our study design). These two cases will be excluded from the treatment outcome analysis at the end of study, however they may be included in the toxicity profile comparison (intend-to-treat patients).

We got some early data regarding failure and disease recurrence. Out of these 40 patients, 17 patients failed. Actually, 9 of them could not achieve complete remission rather than having recurrent disease. Failures were almost equally distributed between the two arms i.e. 8 patients platinum arm and 9 patients in cetuximab arm. Two patients has not completed the planned chemotherapy course due to toxicity (One developed grade IV pancytopenia with radiation interruption). Thirteen patients had a locoregional failure while 4 developed distant metastasis. Two patients has both locoregional and distant metastasis. Eight received palliative chemotherapy, 4 underwent salvage surgery (one in addition to chemotherapy) and 5 labeled for best supportive care. Four patients who underwent surgery achieved complete remission. Three out of these 17 failures still alive and further data about them will follow in the 3 years follow up publication. Fourteen patients of the study cohort died so far (6 in arm A and 8 in Arm B).

KFAS contribution: KWD 35,750

Total budget: KWD 49,750
**Development of an Optimal Implementation Model for Seawater Multiple Effect Distillation Technology in Kuwait**

**Abstract:**

This project is aimed at developing an optimal implementation model to be used as a reference for future deployment of seawater multiple effect distillation (MED) plants in Kuwait. The MED technology is of a spray falling film horizontal tube heat exchanger type, with parallel and forward feed configurations, most commonly used in the industry today.

The approach is based on establishing the basis for interaction between design parameters and efficiency of the MED systems for Kuwait's operating conditions. The model is meant to represent the interaction that yields a system with the best efficiency and with minimum requirements of the materials for construction and manufacture of working space and surfaces. Other design parameters include number of effects, heating steam thermodynamic state, temperature difference between the effects, feed water temperature and concentration, and process configuration in terms of feed water scheme, i.e., parallel or forward feed. The development involves mathematical modeling, combined with comprehensive pilot testing over a wide range of fouling/operating conditions. For this purpose, an MED pilot unit was designed and constructed, and will be in operation to provide means of obtaining the needed measurements and operational data for the optimization. The third progress report provides details of progress in Subtasks 3B, 3C, 3D, 3E and 3F, which are connected to fabrication, site preparations, testing prior to shipping, shipment procurement, and on-site installation for the MED pilot unit.

**KFAS contribution:** KWD 134,630

**Total budget:** KWD 685,160

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**Composition of Steroids and other Lipid Fractions and Proteins. The Anti-Inflammatory, Anti-Cancer Activities in Preparations from the Skin of the Arabian Gulf Catfish (Arius Bilineatus, Valenciennes)**

**Abstract:**

The project has achieved tremendous progress on all its aspects using preparations from skin of the catfish as follows:

1. Work on diabetes at the Biological Sciences Dept., Faculty of Science, KU, resulted in curing diabetes in experimental animals and regeneration of organs and tissues affected by diabetes, such as the pancreas, the kidneys, the liver, the heart, the testes.

2. Work on the crushed sciatic nerves at the Dept. of Anatomy, Fac. Of Medicine, KU resulted in regeneration of the crushed sciatic nerve and the spinal cord and recovery of sensory and motor activities.

3. Work on the deadly pancreatic cancer has been finalized with successful treatment of the cancer in test animals at MD Anderson Cancer Center (MDACC) in Houston, TX. We started on liver cancer research.

4. At Toronto Sick Children Hospital Research Institute and at MDACC, we discovered and proved the anti-inflammatory and anti-cancer activities of some of the lipids from the skin of the catfish. Acceleration of wound healing was proved in experiments on rodents and zebrafish.

5. Human clinical trials are planned to utilize our results on diabetes and pancreatic cancer.

**KFAS contribution:** KWD 96,407

**Total budget:** KWD 544,654
Composition of Steroids and other Lipid Fractions and Proteins: The Anti-Inflammatory, Anti-Cancer Activities in Preparations from the Skin of the Arabian Gulf Catfish (Arius Bilineatus, Valenciennes) (2013-1207-1B)

J. Al-Hassan & C. Pace-Asciak

Kuwait University, in collaboration with Hospital for Sick Children, Toronto

Project Progress - Abstract:

The project has achieved tremendous progress on all its aspects using preparations from skin of the catfish as follows:

6. Work on diabetes at the Biological Sciences Dept., Faculty of Science, KU, resulted in curing diabetes in experimental animals and regeneration of organs and tissues affected by diabetes, such as the pancreas, the kidneys, the liver, the heart, the testes.

7. Work on the crushed sciatic nerves at the Dept. of Anatomy, Fac. Of Medicine, KU resulted in regeneration of the crushed sciatic nerve and the spinal cord and recovery of sensory and motor activities.

8. Work on the deadly pancreatic cancer has been finalized with successful treatment of the cancer in test animals at MD Anderson Cancer Center (MDACC) in Houston, TX. We started on liver cancer research.

9. At Toronto Sick Children Hospital Research Institute and at MDACC, we discovered and proved the anti-inflammatory and anti-cancer activities of some of the lipids from the skin of the catfish. Acceleration of wound healing was proved in experiments on rodents and zebrafish.

10. Human clinical trials are planned to utilize our results on diabetes and pancreatic cancer.

KFAS contribution: KWD 226,761

Total budget: KWD 226,761

Composition of Steroids and other Lipid Fractions and Proteins. The Anti-Inflammatory, Anti-Cancer Activities in Preparations from the Skin of the Arabian Gulf Catfish (Arius Bilineatus, Valenciennes) (2013-1207-1C)

J. Al-Hassan, W. Renno

Kuwait University, in collaboration with MD Anderson Cancer Center, U.S.A.

Project Progress - Abstract:

The project has achieved tremendous progress on all its aspects using preparations from skin of the catfish as follows:

11. Work on diabetes at the Biological Sciences Dept., Faculty of Science, KU, resulted in curing diabetes in experimental animals and regeneration of organs and tissues affected by diabetes, such as the pancreas, the kidneys, the liver, the heart, the testes.

12. Work on the crushed sciatic nerves at the Dept. of Anatomy, Fac. Of Medicine, KU resulted in regeneration of the crushed sciatic nerve and the spinal cord and recovery of sensory and motor activities.

13. Work on the deadly pancreatic cancer has been finalized with successful treatment of the cancer in test animals at MD Anderson Cancer Center (MDACC) in Houston, TX. We started on liver cancer research.

14. At Toronto Sick Children Hospital Research Institute and at MDACC, we discovered and proved the anti-inflammatory and anti-cancer activities of some of the lipids from the skin of the catfish. Acceleration of wound healing was proved in experiments on rodents and zebrafish.

15. Human clinical trials are planned to utilize our results on diabetes and pancreatic cancer.

KFAS contribution: KWD 306,147

Total budget: KWD 544,654
Using Value Methodology for Deployment of Scrap Tires to Fight Desertification in Kuwait and Ration Water (2013-1501-01)

F. Al-Anzi
Kuwait University

Project Progress- Abstract:

Kuwait is facing many environmental challenges. Some of which are natural while others are manmade. Responding to these challenges in localized, innovative, effective and economic ways are the encounters that researchers rising to. One of the vital and significant examples of the natural challenges is desertification. Desertification is a type of land degradation in which a relatively dry land region becomes increasingly arid, typically losing its bodies of water as well as vegetation and wildlife. It is caused by a variety of factors, such as climate change and human activities. Desertification is a significant global ecological and environmental problem. Fighting desertification requires huge investment and technological solutions that most of the times are becoming hard to maintain and hence they become not economical and manageable in the long run. This project focuses on the following directions:

- Getting rid of ever growing huge tire dumpsters in Kuwait in a safe and environmental friendly manner.
- Finding out an economical alternative to well-known technology of Waterboxx kits.
- Harvesting rain water and managing the most valuable water resources.
- Capacity building in planting shrubs and trees in Kuwait deserts using state of the art techniques.

The project was complete in its three years’ duration. The project successfully achieved its goals in delivering an innovated design that is based on recycled tires and other plastic and paper based components. The comparison of the achieved results of the proposed design has shown to realize the functions and the quality with a fraction of cost of that commercial Waterboxx kits and hence achieving a much height value of the new design. The filed lab and field testing demonstrated the impact of the such approach on creating micro environment where plants can nurture with 70-80% saving of irrigation water. The project yielded in a registered US patent and number of journal and conference publication. The project also got a number of local and regional awards.

KFAS contribution: KWD 104,400
Total budget: KWD 104,400

Studying the Genetics of Congenital Thoracic Anomalies in Consanguineous Kuwaiti Families Caused by Cilia Dysfunction (P114-13MG-01)

D. Al-Mutairi
Kuwait University in collaboration with Westfaelische Wilhelms University Muenster

Project Progress - Abstract:

The aim of this study is to identify the genes of congenital thoracic anomalies that inherited in consanguineous Kuwaiti families and directly affecting the structure and the function of the cilia. The second year report that described the data from 41 families with PCD and CHD. During the third year of the project I managed to map the disease causing mutations in 13 families and performed the segregation analysis which confirmed that these mutations are segregated along with the disease phenotype. The most common mutation that was screened in the cohort was a homozygous loss-of-function mutation (c.800_803delGAA) in exon 6 of RSPH9 gene which predicts p.K268del. The second most common mutation that mapped in our cohort was a homozygous missense mutation (c.740 G>A; p. R247Q) with rs755060592 in exon 7 of DNAI2 gene. Interestingly, we mapped two novel splice site mutations in DNAI1 and ARMC4 genes in families 12 and 13 respectively. Both families are multiplex families with two affected individuals. Family 12 has a homozygous splice site mutation (c.1311+2T>A) of exon 13. The patients in family 13 also carry a homozygous splice site mutation (c.2799+5G<A) of exon 18 in ARMC4 gene. We reported an interesting finding for family 20 which is a multiplex family with three affected individuals one of whom passed away before we started the study. We mapped a homozygous loss-of-function (A) insertion mutation (c.2272_2273 ins A) of exon 13 in CR2 gene which predicts a premature stop of translation six amino acids after the base insertion point (p.L7601fs*6); this variant is not in any genomic database. Besides that, we mapped a combined heterozygous mutation in family 9 that is shared between the two affected individuals in exon 10 and 77 of DNAH5 gene.

KFAS contribution: KWD 195,950
Total budget: KWD 282,240
Assessment of Body Composition of Kuwaiti Infants by Using Air Displacement Plethysmography (PEA POD) (P114-13MK-01)


Kuwait Institute for Scientific Research

Project Progress - Abstract:

The high prevalence of obesity is the most important public health problem facing Kuwait, as it is a challenge to health care resources, and is emerging as an alarming burden on the country's economic resources. Given the strong scientific evidence of the strong association between fetal growth in the first 1000 days of life (from the onset of pregnancy) and diseases in adulthood and beyond (especially obesity and chronic diseases), understanding the growth patterns of Kuwaiti infants is needed to develop required interventions in order to reduce the increasing rates of obesity in its early stages. The study relies on Air Displacement Plethysmography technique to examine the effect of breastfeeding practices on the patterns of body composition changes (especially in fat mass) during the first six months of the infant's life, using PEAPOD®. The study is the first of its kind in the Gulf region.

This is a collaborative research between the Kuwait Institute for Scientific Research (KISR) and the Neonatal Department of Al-Sabah Hospital (Ministry of Health). The study was based on a sample of 100 mothers who received breastfeeding counseling program (intervention group); and 100 mothers who did not (control group). Body composition measurements of participating infants were successful. However, retaining the mothers who are participating in the study continues to be a major challenge. A total of 612 mothers were interviewed, 316 of them agreed to participate and sign the consent forms. However, only 86 mothers completed the required number of PEAPOD measurements. The medical and supporting staff in the Neonatal Department was very supportive in this study. PEAPOD measurements continue for the last group of mothers who have enrolled in November 2018.

KFAS contribution: KWD 43,775
Total budget: KWD 79,733

Challenges and Opportunities in Establishing Technology Commercialization Programs at GCC Universities (P114-17IM-08)

M. Al-Fahad

Kuwait University – Center of Excellence in Management

Project Progress- Abstract:

Gulf Cooperation Countries (GCC) is political union of six countries in Arabian Peninsula. The countries in GCC are factor-based economies whose GOP is predominantly relying on energy resources such as oil and gas. The governments of GCC have long since recognise the importance of education and establish several universities. These universities have played important role in knowledge dissemination through education and research. However, with growing importance of knowledge-based industry and governments initiatives to diversify its factor-based economy to knowledge based economy, policy makers in private and public sectors have realised the importance of universities in regional economic development. As a result, some of the GCC Universities are in process of transforming from education driven to knowledge driven and technology transfer. These Universities have critical role as source of intellectual property and talent in high technology industries. These have laid to establishing centres of innovation which manages programs such as technology commercialisation. Owing to early nature of such program there are many challenges before the program could be judged successful and several such programs are still struggling to achieve initial success. The objective of this proposal is to determine what are the current and future opportunities which have driven the creation of such programs and what are the current challenges faced on local and regional platform. These findings will assist the universities in present and future establishment of technology commercialisation programs.

KFAS contribution: KWD 7,975
Total budget: KWD 53,950
Synthesis, Characterization and Theoretical Investigation of Water Soluble Cationic Phthalocyanines and their in vitro Studies for Photodynamic Therapy (P114-14SC-01)

S. Makhseed
Kuwait University

Project Progress - Abstract:

Novel asymmetrical zinc phthalocyanine (pc) derivatives bearing quaternized triazolyl moieties for water solubility and iodine as a heavy metal atom were successfully prepared and reported by our group as exceptionally effective generation of singlet oxygen in aqueous media (J. Med. Chem., 2017; IF:6.25 and Dyes and Pigments. 2019; IF: 3.77) and had been published as starting blocks for a serious of potent and selective complexes. The lodo-triazole Pc was used as the starting material to prepare biotinylated zinc (II) phthalocyanine through Pd(0)-catalyzed Sonogashira cross coupling reaction and its quaternized biotinylated analogue (Journal of Porphyrins and Phthalocyanines. 2019; IF: 1.13). The novel complexes showed a synergy between the potency and selectivity along with optimizing pharmaceutical efficiencies and targeting toward cancer cells. We also succeed to design a new promising dyad from phthalocyanine and sub-phthalocyanine chromophores for many applications such as, light harvesting and sensors (under publication). Density functional theory (DFT) and time-dependent Theoretical investigations were used to estimate the electronic structures of the new dyad. The photophysical studies were used to investigate how efficient the compound will be active toward different applications. Accordingly, a new serious of carbazolyl phthalocyanines had been prepared and published in good journals such as, Inorganic Chemistry. 2017; IF: 4.70 and other paper submitted to Dyes and Pigments Journal, IF:3.77.

Moreover, the carbazolyl complexes were conjugated to graphene quantum dots (GQDs) through \( \pi-\pi \) stacking and a great enhancement in the photophysical properties of the complexes upon conjugation with nanomaterials were observed (J of Luminescence; IF; 2.73).

KFAS contribution: KWD 207,000
Total budget: KWD 300,760
**Viral Nerve Cacrosis in Hamoor: Detection in Brood Stock and Prevention in Larvae through Egg Disinfection (P115-12SL-01)**

A. Saheb, H. Al Gharabally and S. El Dakour
Kuwait Institute for Scientific Research

**Project Progress - Abstract:**

Due to the loss of broodstock and suspected nerve necrosis virus (NNV)-related mortalities of hamoor in the aquaculture facilities of KISR, this project was planned and taken up. The envisaged project helps in building a new broodstock, free of NNV and provides a standardized method of egg disinfection for preventing or reducing incidence of viral nerve necrosis (VNN) disease. Resource mobilization contact and communication with the consulting experts and laboratories, egg disinfection using glutaraldehyde, formalin, and iodophor were carried out. However, there was a delay in procuring the wild broodstock due to the difficulty in identifying reliable sources for the supply of quality brood fish from the wild. During the first year of the project, procuring new broodstock from the wild, developing primers and screening for the presence of VNN in the wild broodstock and existing stock of hamoor were conducted. A total of 17 brood fish (new) and over 50 existing fish of different size ranges were screened for the presence of VNN. Detailed confirmatory experiments on the egg disinfection could not be completed, during the first year, due to limited spawning success and insufficient supply of live food. However, the experiments will be carried out in the coming spawning seasons.

**KFAS contribution:** KWD 39,800  
**Total budget:** KWD 85,350

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**Biofuel and Side Products from Kuwait’s Microalgae (P115-12SL-04)**

B. Al-Hamar
Kuwait University

**Project Progress - Abstract:**

Marine microalgae have emerged as important feedstock for liquid biofuel production. The identification of lipid-rich native microagal species with high growth rate and optimal fatty acid profile and biodiesel properties is the most challenging step in microalgae-based biodiesel production. In this study, we investigated the microalgae inhabiting different environmental ecosystems including marine, intertidal zone, lagoon etc. A total of 75 monoalgal strains consist of 24 diatoms (Bacillariophyceae) 21 cyanobacteria (Cyanophyceae) 30 green algae (Chlorophyceae) were isolated from 109 pre-enrichment cultures using 180 environmental samples from different sample stations of Kuwait coastline. Preliminary screening of FAMEs profile and their principal components were analyzed for a total of 48 strains. Among them, six microalgal strains viz. Nannochloropsis gaditana (34G), Chlorella sp. (7G), Nannochloris sp. (52G), Scenedesmus sp. (17SR) and Tetraselmis sp. (16G, 38G) were selected for further downstream processes. These strains were subjected to intensive purification and subculturing, and characterized at the morphological and molecular levels. Eighteen identified microalgal strains through 16S and 18S rDNA sequencing were registered and deposited in GenBank with accession numbers. Selected strains (6N) were characterized for growth rate, total lipid content and FAMEs profile in order to identify important strains with high potential for large-scale outdoor culture, specifically for biofuel production. MALDI TOF MS protein profiling was done to study the whole cell protein for the selected microalgal strains. These investigated strains will be involved for optimal culturing conditions; which may inform us about the potentiality for large-scale, cost-effective microalga-based biofuel production. Moreover, the possibility of production of valuable sub-products (bioactive compounds, food, feed, etc.) from downstream processing of microalgae biomass will be investigated.

**KFAS contribution:** KWD 97,300  
**Total budget:** KWD 193,879
Genetics of Eczema in Kuwait (P115-13MC-05)
A. Ziyab
Kuwait University in collaboration with University of Southampton

Project Progress - Abstract:
The elevated life-time prevalence of eczema (atopic dermatitis) among children (up to 30%) and adults (up to 10%) makes eczema a global public health concern. Immunologic dysregulation and defective epidermal barrier are the main hallmarks of eczema. The high heritability (up to 86%) and clustering of eczema within families highlight the importance of genetic elements, in addition to environmental factors, in the pathogenesis of eczema. This research project aims to discover genetic risk factors, specifically which regulate the epidermal barrier development and function, of eczema among the Kuwaiti population (representing an Arab population). First, we aim to screen the epidermal differentiation complex (EDC), a genomic region harboring a dense cluster of genes that are critical for the development and maintenance of a functional epidermal barrier, using targeted sequencing approach. Subsequently, associations between genetic variants within the EDC and eczema risk will be assessed. To approach the study aims, we have proposed to conduct a population-based case-control study (250 eczema cases and 500 controls) nested within a large cross-sectional study (n=3,864; males: n=1,695; females: n=2,169). At this point in time, we have finished subject recruitment into the cross-sectional study and in the process of completing recruitment into the case-control study. We have successfully enrolled 187 cases and 411 controls and anticipate that recruitment of study participants into the case-control study to be completed by February 2019. During the third year of the project, we will complete the enrollment of study subjects into the case-control study and perform the genetic analysis as originally proposed.

KFAS contribution: KWD 48,868
Total budget: KWD 63,908

Retinitis Pigmentosa and Leber's Congenital Amaurosis in an Extended Kuwaiti Family (P115-13MM-01)
J. Al-Merjan
Ministry of Health

Project Progress - Abstract:
Inherited retinal diseases are one of the main causes of visual impairment in Kuwait in the working age group. In recent years there has been many advances in understanding their natural history and pathogenesis. Furthermore, new therapies are being developed to treat those conditions including: gene therapy, gene editing, optogenetics and retinal chip implants. This ongoing study has been designed to shed light on retinitis pigmentosa (RP) and leber congenital amaurosis (LCA) in an extended family in Kuwait. In this report we discuss the phenotype and genotype of 19 subjects from 12 different subfamilies, of which, all subject parents belonged to the same tribe, but only 4 of the were closely consanguineous. Subjects have been recruited through the Visual Disability Committee, the ophthalmic genetics clinic at Al Bahar Eye Center and Kuwait Medical Genetic Center. Participants underwent a thorough clinical evaluation including: detailed ophthalmic and genetics history taking, slit-lamp examination, refraction, spectralis OCT, MAIA microperimetry, full-field and multifocal electroretinogram and DNA testing Mutations in five genes causing retinal dystrophy were identified as follow: FDE6B (n=6), RP1 (n=4), ABCA (n=2), USH1C (n=3), USH2A (n=4). Interestingly all mutations were detected as homozygous allelic variants. In our series, regardless mutation type, we detected a positive correlation between vision reduction and the age of all patients. Furthermore, there was a linear relationship between better best corrected visual acuity and better retinal sensitivity. Finally, in this study we are aiming to identify the genetic mutations and retinal function of RP and LCA patients in this extended family as a gateway to study all the Kuwaiti population, which will be a cornerstone toward a future treatment option and premarital counselling.

KFAS contribution: KWD 158,707
Total budget: KWD 250,257
Implementation of Distress Assessment and Response Tool (DART) Screening Tool in Kuwait Cancer Control Center (KCCC) (P115-13MQ-01)

M. Al-Awadhi
Kuwait University

Project Progress - Abstract:

The Distress Assessment and Response Tool (DART) is a new inter-professional program to enhance psychosocial healthcare delivery to cancer patients. It contains a survey embedded in a graded distress response program, which integrates patient self-directed strategies, specially trained nurses, technicians and psychiatrists. It is anticipated that DART will optimize referral to specialized psychosocial services, improve patient satisfaction with care and health-related quality of life, and lead in establishing optimal methods for effective distress screening programs. With the collaboration between KCCC and University health network and Princess Margret Hospital-Toronto Canada, the implementation of DART screening tool in KCCC outpatient department will be introduced in order to screen for distress levels in cancer patients in outpatient department, measure prevalence of depression and anxiety in those patients, and develop a referral system to the Psychosocial-oncology unit.

KFAS contribution: KWD 59,150
Total budget: KWD 129,470

Polymeric Nanoparticles as New Smart Contrast Agent for Breast Cancer Early Detection via MRI (P115-14SC-02)

M. Fouzi
Kuwait University

Project Progress - Abstract:

Contrast agents, or contrast media are considered as one of the key elements in the major modern medical imaging, where they play important role in improving the sensitivity of these imaging modalities by increasing the contrast enhancement of specific parts of the body and makes it easier to distinguish. Contrast agents can be customized and used in many types of imaging methods, including X-ray, computed tomography scans (CT scan), nuclear imaging and magnetic resonance imaging (MR1). In this project we are proposing the development of a new class of polymeric nanoparticles as smart TI contrast agents for MR imaging to help detect breast cancer in its early stages. These smart polymeric nanoparticles based contrast agents have the ability to remain switched off during circulation and then switch on their imaging capability upon arrival at tissue of interest (breast cancer cells). The new smart contrast agents are prepared from self-assembled pH sensitive amphiphilic polymer and Gadolinium Gd3+ complex based TI agent that has been encapsulated during the self-assembly of the nanoparticle.

The loaded nanoparticles with (tetraaquodichloro (4,4’-ditBu-2,2’-bipyridine) gadolinium(III) chloride) are fitted with targeting moieties that allows a selective accumulation within the tumour sites via an active approach achieved by conjugating the nanoparticle to an antibody that recognizes specific tumour surface markers such as MUC1 protein. This type of marker (MUC1) is frequently overexpressed at the cell surface of many epithelial cancers, including 90% of breast cancers. This new contrast agent has also the ability to increase the sensitivity through signal amplification of the targeted tissue. The signal is amplified via the massive amount of the contrast agent that will be released from these nanoparticles. This last feature allows us to detect breast cancer at an early stage.

Publications:


KFAS contribution: KWD 79,500
Total budget: KWD 171,060
Towards a Portable and Miniaturized System for the Detection of Drugs of Abuse Through Ru(Bpy)$_3^{2+}$ Chemiluminescence Reaction (P115-14SC-04)

E. Al Hetlani
Kuwait University

Project Progress - Abstract:

The synthesis, characterization and optimization of organic-based monoliths: poly(methacrylic acid-co-ethylene dimethacrylate) (poly(MAA-co-EDMA)) and poly(glycidyl methacrylate-co-ethylene dimethacrylate) (poly(GMA-co-EDMA)) monolithic columns as solid supports for chemiluminescence (CL) reactions. The influence of porogenic solvent composition on the porous structure and surface area of both polymeric monoliths was thoroughly studied. A series of poly(MAA-co-EDMA) monoliths of different porogenic compositions containing toluene and 1-dodecanol were synthesized by free radical polymerization. Similarly, a series of poly(GMA-co-EDMA) monoliths of different porogenic compositions of porogenic mixtures were synthesized. All the formulations made from various concentrations of porogen were directly polymerized inside silanized glass capillary by free radical polymerization. The synthesized monoliths were characterized using fourier-transform infrared (FT-IR) spectroscopy, thermogravimetric analysis (TGA), scanning electron microscopy (SEM), $N_2$ sorpometry and Zeta potential ($\zeta$) determination techniques. The formulation which gave maximum permeability in the capillary was considered as the optimum poly(MAA-co-EDMA). The optimized poly(MAA-co-EDMA) monolithic column was used to develop a procedure for the immobilization of Ru(bpy)$_3^{2+}$ complex on its surface. The concentration of the Ru(bpy)$_3^{2+}$ complex on the surface of the monolithic column was investigated using UV-vis spectroscopy and 90 min of exposure showed the maximum immobilization of Ru(bpy)$_3^{2+}$ on the monolith. The immobilized Ru(bpy)$_3^{2+}$ complex on the surface of the polymeric monolith was oxidized with Ce (IV) to form Ru(bpy)$_3^{3+}$. On the other hand, poly(GMA-co-EDMA) monolith was successfully modified with titania nanoparticles (TiO$_2$ NPs) and activated charcoal (AC) in attempt to enlarge the surface area. The modified monoliths were further characterized by Raman, $N_2$ sorpometry, $\zeta$-measurements and TGA analysis.

Publications:


KFAS contribution: KWD 46,300
Total budget: KWD 67,330
Towards a Series of Truly Water Soluble Sugar Conjugate Phthalocyanines for Optimum Cancer Treatment Using Photodynamic Therapy (PDT) (P115-14SC-05)

S. Makhseed
Kuwait University

Project Progress - Abstract:
A family of new peripherally/non-peripherally phthalocyanines (Pcs) and their hetero-atom analogs, azaphthalocyanines (AzaPcs), bearing dual spatial directional (up/down) propargyl moieties were rewardingly achieved. It is well-known that Pc/Pc-analogy systems have wide range of extraordinary applications associated to their unique characteristic/structural features. However, many drawbacks, including; synthesis difficulties, low yields and their tendency to self-aggregate in solution are considerably observed by these macrocycles. In sharp contrast, our designing strategy was based on introducing multiple propargyl moieties on the macrocyclic planar cores. The presence and/or the orientation of the alkyne ends are with a great interest since the resulted macrocyclic structures exist in their non-aggregated form which was confirmed by 1H-NMR, UV-Vis and single crystal X-ray diffraction analyses. Additionally, their photophysical and photochemical properties were investigated in order to evaluate their photocatalytic activities toward cancer treatment. It is noteworthy to mention that such achievement obtained by our group was documented as US patent (DOCKET NO. 23588.98). As the synthesis of novel alkynyl-substituted macrocycles fulfilled the challenging target, such activated systems, thus, are substantially practicable as the first finding key-intermediates “molecular platforms” to produce endless applicable non-aggregated macrocyclic materials that can be easily achieved via numerous organic transformation methodologies, specifically, the powerful click reaction, the Cu(I)-catalyzed azide-alkyne cycloaddition (CuAAC). Subsequently, utilizing these building blocks for further modifications were efficiently performed in currently hot topic applications, such as; photodynamic therapy (PDT), fluorescence probe, solar-cell and super-capacitors and others.

Examples:
A. Biocompatible carbohydrate–phthalocyanine conjugates demonstrating high uptake and low toxicity for enhancing photodynamic therapy.
B. Poly (ethylene glycol) conjugated zinc and magnesium phthalocyanines as a targeting agent for imaging and fluorescent diagnostics.
C. Perovskites structure utilizing Pyrene-metallophthalocyanines for efficient Solar Cells and super-capacitors.

KFAS contribution: KWD 50,000
Total budget: KWD 144,500
Advanced Crystalline Silicon Photovoltaics Research Program (Phase II)  
(P115-15EE-01)

Y. Abdulraheem

Kuwait University in collaboration with IMEC, Belgium

Project Progress - Abstract:

The Advanced Crystalline Silicon Photovoltaics Program is a KFAS funded program between Kuwait University and IMEC, Belgium. The program, which aims at producing high efficiency solar cell technologies which are market viable has been in effect since 2012 and has successfully completed phase I and entered phase II in December 2015. The second phase builds upon the developed silicon platform of phase I and aims to exceed current solar cell performance by introducing novel solar cell structures (perovskite-based hybrid solar cells) and by optimizing field performance by development of cell-to-module integration, cell and module adaptation and energy yield prediction.

Throughout phase II, KU researchers have worked at IMEC to learn the process of fabricating pervoskite solar cells with efficiencies of 17%. IMEC has also helped KU researchers in detailing requirements for setting up fabrication capabilities of pervoskite solar cells in Kuwait. This new emerging material has shown good potential for low-cost PV technologies and can be established and developed at KU, with great potential in placing KU at the forefront of this technology. One objective of the project is to reach efficiencies > 30% by combining a Si high-efficiency bottom-cell based on IMEC’s Si-platform with a high-bandgap thin-film cell based on pervoskite solar cells.

Main outcomes of phase II include: (1) Three visits by IMEC researchers to Kuwait where technical presentations and discussions on various aspects of the project were held; (2) Publication of two journal papers in highly ranked journals; (3) Presentation of six conference papers in the most reputable photovoltaics conference in both Europe and Asia

KFAS contribution: KWD 639,795
Total budget: KWD 639,795

Energy Subsidy and Price Reform in Kuwait: An Assessment Using a Computable General Equilibrium Model  
(P115-171A-02)

A. Gelan

Kuwait Institute for Scientific Research

Project Progress - Abstract:

The main objective of the study was to build capacity in Kuwait for energy policy analysis. This was implemented by developing a computable general equilibrium model (CGE) and undertaking extensive simulation experiments with the impacts of energy subsidy reductions. Due to unforeseen circumstances related to timing of baseline data availability, the model development and simulation experiments were divided into two phases. Twelve months into the project implementation timescale, the project was suspended for a period of twelve months, that is, until the baseline database was made ready for a more recent year, 2013. During the pre-suspension period of twelve months, the model development and simulation experiments were undertaken by using a social accounting matrix (SAM) prepared with 2010 as a base year. This proved to be a fruitful period in that results from the experiments were subjected to peer review mechanisms and publications of two articles with high impact international journals. During the post-suspension period, the model will be extended and more extensive simulation experiments will be undertaken, this time using another SAM, which is now made available for a more recent year, 2013.

During the second phase, the model will also be based on additional parameters estimated on the Kuwaiti economy. This would mean results generated will be empirically rooted and their policy relevance substantially improved.

KFAS contribution: KWD 23,650
Total budget: KWD 191,400
Enhancing Scientific Literacy and English Language Proficiency of Public High School Students in Kuwait through Science-Based Writing Projects (P115-19TO-02)

M. Tryzna
Gulf University for Science and Technology

Project Progress - Abstract:

The current project has reached its completion. At the preparatory stage, the project was introduced to principals and science teachers from several bilingual schools in Kuwait, with the Future Bilingual School of Fahaheel expressing interest in participating. The participants were male and female students (N=184) from grades six through twelve at a bilingual school in Kuwait. The project had a pre-posttest design with an intervention method involving a writing projects on a science topic aligned with the current grade curricula and of personal interest to the students under the supervision of both science an English teachers from the school. The researchers collected and analyzed the results of two tests: English language proficiency test and a science literacy questionnaire before and after the intervention method. The tests were administered with the help of research assistants and the data from the tests were analyzed with the help of a statistician. The results reveal differences between genders with respect to the effect of the intervention procedure on the English language proficiency as well as with respect to several aspect of science education.

KFAS contribution: KWD 9,900
Total budget: KWD 11,800

Evaluation of Techniques to Enhance Seed Germination and Evaluation of Seedling Establishment in Selected Native Plants (P116-12SL-03)

Kuwait Institute for Scientific Research

Project Progress - Abstract:

Native plants are widely used in revegetation, restoration, and reclamation programs in Kuwait. These require the availability of large quantities of superior quality seeds of native plants and efficient methods of growing them. For the mass propagation of plants, uniformity in germination, high viability, and easy handling of the seeds are crucial. Hence, the Kuwait Institute for Scientific Research initiated this study in October 2017 to explore the possibilities of developing effective seed techniques, namely, priming and optimization of the storage conditions of treated seeds and further performance evaluation of primed seeds in field conditions to ensure uniform germ inability and superior seed performance. Five native plant species, namely, Acacia pachyceras, Rhanterium epapposum, Nitraria retusa, Lycium shawii, and Convolvulus oxyphyllus, were selected for the study.

During the current reporting period (October 2017 to September 2018), Mobilization (Task 1) and Standardization of Seed Priming Techniques (Task 2) were initiated. Seeds of the selected species were collected from field or various local and international sources. Seed viability of the seed lots was tested through Triphenyl Tetrazolium Chloride (TTC) tests or germination test. Seed moisture content and imbibition rate of scarified and non-scarified seeds were determined. Based on the imbibition curve, the duration of hydro-priming was determined for each species. Seeds with physical dormancy, i.e., Acacia pachyceras and Convolvulus oxyphyllus, were scarified prior to priming treatments. Germination rate, percentage, seedling vigor index, and time to 50% germination were recorded. Manually scarified Acacia pachyceras seeds, which were hydro-primed for 8 h, and mechanically scarified seeds of Convolvulus oxyphyllus, which were hydro primed for 1.30 h, recorded significantly higher performance than control. There was no significant difference in the germination and vigor of hydro-primed and control seeds of Lycium shawii, Nitraria retusa and Rhanterium.

KFAS contribution: KWD 41,780
Total budget: KWD 136,890
Evaluation of Fig Trees for Developing Potential Fruit Production and Cultural Practices in Kuwait (P116-12SL-04)

H. Al-Zalzaleh, G. Dcntz, E. Al-Aii and D. Awad
Kuwait Institute for Scientific Research

Project Progress - Abstract:

The State of Kuwait is initiating efforts to strengthen agricultural production and achieve partial food security in selected commodities. In the recent past, fruit crops gained importance in Kuwait. Fig (Ficus carica L.) was selected for the study based on its potentiality of surviving the arid environment in addition to its desirable fruit production qualities. The overall objectives of the proposal were to evaluate the growth performance of new and improved cultivars of figs under Kuwait's climatic conditions and to evaluate the influence of intercropping on the growth and performance of figs in a multilayer system of planting. The current reporting period contains the results of completed Task 1, i.e., mobilization, and the progress made in Task 2 and Task 3. Results regarding the reporting period for the cultivar evaluation study showed that the cultivars significantly varied in stem thickness (p<0.05); while they did not vary significantly in other growth parameters in both sites (p<0.05). When the fig cultivars were subjected to varying irrigation regimes and supplemental nitrogen, results revealed that the irrigation treatments at 50% ETc and 75% ETc along with supplemental nitrogen significantly increased vegetative growth in all the cultivars. Based on these results, it can be concluded that a reduction of water supply in relation to estimated ETc had significant effect on the vegetative parameters measured. Therefore, in Wafra area it is possible to irrigate one year old fig trees with 21.6 mm in T3 (50% ETc) or 32.4 mm in T2 (75% ETc) for the months from August to November.

KFAS contribution: KWD 26,900
Total budget: KWD 66,945

Ecofriendly Green Synthesis of Silver Nanoparticles and its Application in Wastewater Treatment under Solar Energy Photocatalytic Effect from Contaminated Dyes (Methyl Orange) and Water-Borne Disease Bacteria Using Red Algae (Laurencia Papillosa) (P116-12SL-05)

M. Montasser
Kuwait University

Project Progress - Abstract:

Ecofriendly environmental synthesis of silver nanoparticles using Red algae (Laurencia papillosa) aqueous extract is nontoxic and rapid process. In this study will be investigated green synthesis of silver nanoparticles (AgNPs) from silver nitrate using Red algae (Laurencia papillosa) as bioresource of cost-effective nonhazardous reducing and stabilizing compounds. The resulting AgNPs will be characterized by UV-Vis Spectroscopy, X-ray Diffraction (XRD), X-ray Photoelectron Spectroscopy (XPS), Transmission Electron Microscopy (TEM), and atomic Force Microscopy (AFM). The possible functional groups of phytochemical or proteins in Laurencia papillosa that help in the reduction of Silver nitrate to AgNPs and its stabilizations will be determined using Fourier Transform Infrared Spectroscopy (FTIR). The optical properties of the obtained silver nanoparticles will be characterized by applying UV-visible absorption and room temperature photoluminescence. The antibacterial activity of synthesized AgNPs will be investigated against water borne diseases bacteria.

KFAS contribution: KWD 30,500
Total budget: KWD 71,300
Investigation of Lamb Morality in Kuwait: Improving Immunity and Vaccination (P116-12SL-07)


Kuwait Institute for Scientific Research in collaboration with Public Authority of Agriculture Affairs and Fish Resources

Project Progress - Abstract:

The objective of the study is to improve the existing vaccination protocol of ewes in Kuwait, to boost their immune status to produce high quality colostrum at post-lambing. The approach was to examine two scenarios: a) vaccinating ewes before pregnancy period, and b) no vaccination of ewes during pregnancy period, and then evaluating the quality of produced colostrum from both scenarios. Baseline data were obtained on the mortality rate of young-lambs, during the first 21 days of their lives. A study was carried out in nine-farms, using 27-flocks of Naeemi sheep breed. The results showed that the morality rate of young lambs was 15-50% in selected farms, while in KISR and PAAFR it reaches 2 and 8%, respectively.

During the field experiment, the concentration of Igs in serum and colostrum collected from ewes was measured using ELISA method. Results showed that the concentrations of Igs in blood and colostrum from KISR’s farm, were significantly higher (P<0.001) than the other farms, and reached 45.79±0.561mg/ml and 65.96±0.805mg/ml, respectively. In addition, the mortality rate of lambs ranged from 22.22 to 45.83%, in selected farms, while there was no incidence of mortality reported in KISR’s farm. In addition, tissues were collected from different organs, and were sent to PAAFR laboratories for diagnosis using Polymerase Chain Reaction. The results showed that the main cause of lambs’ mortality was the infection with some diseases for example; Clostridia, Pasteurella, Foot-and-Mouth Disease, Pestedes- Petitis-Ruminants, Salmonella, Coronavirus and Rotavirus sp. In addition, 50% of ewes’ abortion was according to infection of pregnant ewes with B. melitensis, while Toxoplasma gondii was responsible for 30% of ewes’ abortion. It was concluded from the present study that vaccinating ewes during pregnancy period, resulted in significantly higher (P<0.001) Igs in ewes’ blood and colostrum, which have a positive effect on decreasing the mortality rate of young lambs, and could be beneficial to livestock industry in Kuwait.

KFAS contribution: KWD 40,880
Total budget: KWD 251,940

Genetic Characterization of Naeemi Breed and Investigations of their Life-time Performance (P116-12SL-11)

S. Abbas, M.A. Razzaque, F. Al-Salameen, N. Habibi, F. Khalil, B. Al Doaij, J. Dashti

Kuwait Institute for Scientific Research in collaboration with Public Authority of Agriculture Affairs and Fish Resources

Project Progress - Abstract:

Local fat-tailed Naeemi sheep breed has been adapted to the environment of Kuwait and the adjoining Gulf region and has produced highly desirable lambs. Although this breed is preferred and has a high demand in this region, it could not be evaluated for life-time performance as what was done for thin -tailed breeds of Europe, Australia, and North America. The Naeemi breed has never been genetically characterized before. Genetic characterization of a breed is very important for the evaluation of genetic variability, which is an important element in the conservation of genetic resources and for undertaking breeding strategies. The focus of the phase I of the studies was characterizing Naeemi sheep (males and females) using single nucleotide polymorphism (SNP) chips and studying lifetime performance variables of local strain N sheep of Awassi breed.

The DNA have been isolated from sheep blood for characterization buy using QIAmp Blood Kit. The concentration of DNA samples ranged from 34.5 to 103.0 ng/ μl with a total yield ranging from 1.7 to 5.1 μg per 200 μl of blood samples. The preliminary results from autumn mating indicated that the fertilities % of Naeemi were 61%, 77%, and 79% at parities 1, 2, and 3 respectively. Parity of N ewes had an effect on the birth and weaning weights of its lamb (P<0.05). The perinatal mortality % of the lambs were significantly lower (P<0.05) on second and third parity. The mean daily milk yield for the first week was 1.2 kg per day and the amount was reduced to 0.9 kg at the second month of lactation just before weaning the lambs and drying the ewes for next reproduction cycle. There were high variations in milk yield between ewes, which is expected since the flock is from unselected or unimproved breed.

KFAS contribution: KWD 48,062
Total budget: KWD 124,037
Effect of Ocean Acidification on Growth and Abundance of Penaeus semisulcatus in the Northern Arabian Gulf (P116-12SL-13)

L. Al-Musallam and S. Uddin
Kuwait Institute for Scientific Research

Project Progress - Abstract:

The oceanic chemistry is rapidly changing due to enhanced uptake of carbon dioxide. Understanding the ecological effect of Ocean acidification (OA) and ocean warming (OW) is a priority for marine research. This study is designed to look at the interactive effect of temperature and pH changes on the abundance and food conversion ratio in the commercially important Crustacea Penaeus semisulcatus. The progress made so far under this project include culture of the algal species (Tetraselmis sp.), diatoms (Chaetoceros mulleri.) and Artemia, while mass producing them for feeding the shrimps larvae. The field sampling was successfully done where in February, April and November 2017. Graved females with well-developed ovaries were collected by trawl using Bahith-II research vessel from the Southern Coast of Kuwait. The graved females were kept in 1 ton tanks with strong aeration to induce spawning. Once the eggs are released the larvae were kept in the tanks with soft aeration. The water temperature in the tanks was maintained at 28°C by using heaters. The larvae were provided with diatoms and green algae in the 3rd day from hatching. Every day, 10 larvae were taken from the tanks and preserved in 5% formaldehyde in seawater to measure the length. The larvae length measurement was done under a light microscope. Participating staff was trained in these techniques. The post-larvae 21 were fed with pellet feed. The mean individual weight of shrimp reached to 22g (culture period 9 mo). There was a delay in the procurement process, and the supplier delayed the supply of pH electrodes for nine months that has adversely impacted execution of experiments.

KFAS contribution: KWD 23,500
Total budget: KWD 126,330

Enhancement of Native Forage Species Production as Local Feed Resources for Livestock in Kuwait - Phase II (P116-12SL-15)

T. Madouh
Kuwait Institute for Scientific Research

Project Progress - Abstract:

The production of food and feed in the desert environment can be a major challenge, considering the limited natural resources of the desert ecosystem and national needs. The demands of supplementary feed for the domestic livestock are high, and hence the market price will increase. Introduced species such as alfalfa (Medicago sativa) and Rhodes grass (Chloris gayan) consume large amounts of irrigation water. However, native forage species are biomass crops adaptable to the extreme climatic conditions of the desert’s ecosystem. Various native desert perennial grass species were evaluated and investigated for their potential to be cultivated as forage crops in a previously conducted project (FA078C). They were more efficient in using water and grew well in soils with low fertility and limited moisture retention. In addition, they produced considerable dry matter yield and stable amounts of nutritive value under moderate drought stress. These unique characteristics provide excellent potential for complementary uses of these species to be cultivated and grown commercially and can be a vital key for sustainable livestock production in Kuwait. Therefore, the scope of the present project will enhance the yield and quality of three species of native plants, i.e., Cenclmts ciliaris, Lasiurus scindicus and Pennisetum divisum through nutrient and water management under drought and arid conditions of Kuwait. The study will also involve seed collection and improvement in agropractices with different fertilizer application and irrigation levels. Forage quality [or livestock will be investigated along with cost and benefit of native forage production.

KFAS contribution: KWD 47,650
Total budget: KWD 151,395
Effects of Commercial Microdiets and Weaning Strategies on the Rearing of Sobainty (Sparidentax hasta) Larvae (P116-12SL-16)

S. El-Dakour and S. Kawahara
Kuwait Institute for Scientific Research

Project Progress - Abstract:
Replacement of live food with alternate food sources is of major importance in the commercial fish hatcheries due to the high cost and unreliability of live foods. In the first progress report, results of partial replacement study of live food (rotifers) with artificial microdiets in the larval rearing of sobainty (Sparidentex hasta) is described. Four different commercial feeds were used (Otohime, Love Larva, Inve and Skretting) in the experiment, sobainty larvae were reared from 2 days post hatch (dph) to 22 dph and their survival and growth were examined. Results obtained from this trial indicated that live food (control) achieved significantly the highest larvae survival and final wet weight (20.6% and 3.34 mg respectively) compared to all tested artificial feeds. The next high larvae survival rates (15.1% and 14.3%), and final wet weight (2.8 and 2.9 mg) were achieved with love larva and Otohime feeds respectively. The only exception was the final length in which at the end of the trial no significant difference was observed in larvae length between all treatments including the control. This study proves that although the best growth and survival rates are still achieved when sobainty larvae fed live food (rotifers), but commercial feeds (love larva and Otohime) can serve as partial replacements of rotifers and produce comparable growth and survival rates that potentially would reduce the reliance on live foods.

KFAS contribution: KWD 19,000
Total budget: KWD 141,420

Using Marine Algae as Poultry Feed (P116-12SL-17)

H. Al-Khalaifa
Kuwait Institute for Scientific Research in collaboration with Kuwait United Poultry Company

Project Progress - Abstract:
It is important to improve poultry industry under the adverse climate conditions of Kuwait in order for the local industry to compete with the imported poultry meat in terms of prices and quality. One of the ways to achieve this goal is by nutritional manipulation and addition of effective ingredients such as marine algae which are known to be beneficial for both animal and human health. Marine algae contain high amounts of omega-3 fatty acids which are beneficial to the general health. The major objective of this research project is to investigate the effect of the marine algae (Sargassum sp., Enteromorpha sp. and Spirulina sp.) on production performance of broilers raised in Kuwait. This objective will be met through several tasks including preparation of the algae treatment unit, harvesting the marine algae, investigating the cytotoxicity of algae, investigation of the effect of Sargassum sp., Enteromorpha sp. and Spirulina sp. on performance of broiler chickens, investigation of the effect of Sargassum sp., Enteromorpha sp. and Spirulina sp. on meat quality of broiler chickens raised in Kuwait, and studying the feasibility Study on the use of marine algae in broiler feed. The duration of this research activity will be 27 months.

KFAS contribution: KWD 70,000
Total budget: KWD 317,140

RESEARCH DIRECTORATE | Research Grant | Ongoing Projects
Investigating the use of Native Plants in Poultry Feed in Kuwait (P116-12SL-18)


Kuwait Institute for Scientific Research

Project Progress - Abstract:

This project was started on schedule on December 1, 2017 with the mobilization (Task 1) of manpower, research supplies and equipment required for implementation of various project tasks and/or activities. The mobilization tasks have already been completed on time. Ten species of native seeds and leaves were collected from the northern parts of Kuwait and KISR’s Station for Research and Innovation (KSRI), Kabd. Additionally, 11 native species were propagated in the greenhouse. In Task 2, native seed and leaf samples were analyzed for various chemical parameters using proximate analyses procedures. However, analyses for other chemical and biological parameters are currently under validation and evaluation. Results of proximate analyses showed the presence of high crude protein and crude fiber contents, especially in some leaf and seed samples. Due to the dry season during 2018 it was not possible to collect the sufficient quantities of fresh leaf samples for performing all analyses. Therefore, the digestibility test had to be moved to the next season (2019–2020). These test species will also be propagated in sufficient quantities in the coming growing season.

KFAS contribution: KWD 41,500

Cancer Pain Control Before and After Palliative Care Center Referral (P116-13MC-01)

A. Al-Ansari

Ministry of Health

Project Progress - Abstract:

Pain as a common symptom among cancer patients receiving palliative care services is progressively increasing at the end of life reaching almost 70%. Opioids are considered by World Health Organization (WHO) analgesic ladder as the golden standard for the treatment of moderate to severe pain. Despite that, still cancer patients continue to suffer from pain, especially those who are terminally ill. Palliative care team plays a crucial role in the delivery of the proper service for those patients to improve their quality of life. So our aim was to assess pain control in cancer patients and the pattern of opioid prescription before and after referral to Palliative Care Center (PCC) in Kuwait.

Prospective cohort study was performed to all cancer patients referred to our center for pain control from January 2016 till December 2017. Pain intensity and other associated symptoms were measured by numerical rate scale (NRS) and revised Edmonton symptom assessment scale (ESAS-r) respectively before starting palliative medicine plan at first presentation (Day 0) of the patient then at day 3, day 6 and lastly at day 14. Detailed pain medications including adjuvants were recorded in details at each time and any changes in the prescription were documented. All data manipulation and analysis were performed using the SPSS.

KFAS contribution: KWD 10,000

Total budget: KWD 10,000
**Determination of the Nutritive Values of Highly Consumed Dishes in Kuwait (P116-13MC-05)**

B. Dashti, M. Al-Aswad, B. Al-Fili, T. Al-Wallah, J. Al-Otabi, R. Khashawai

Kuwait Institute for Scientific Research

**Project Progress - Abstract:**

The aim of this project is to update the Kuwaiti Food Composition Data according to the new food pattern and consumption in the Kuwaiti society. Task one and two were executed at this stage. Thirty three highly consumed dishes were selected based on the results of the National Food Survey of the State of Kuwait. Recipes were standardized through a survey among Kuwaiti household. The standardized recipes were cooked in duplicate under the supervision of experienced cook in the central kitchen of a private food catering company in Kuwait. Cooked dishes were prepared according to their major ingredients and homogenized for nutritional evaluation in the laboratories of Kuwait Institute for Scientific Research (KISR). The dishes will be evaluated for their nutrient contents of proximate analysis (fat, protein, carbohydrate by analysis, ash, moisture, fibre and total energy), fatty acids profile, cholesterol, amino acids profile, minerals, phytic acid, and water-and fat-soluble vitamins. Fourteen dishes underwent sensory evaluation to assess the acceptability of using standard recipes using Hedonic scale.

**KFAS contribution:** KWD 24,719

**Total budget:** KWD 98,669

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**Estimation of Salt Intake Assessed by 24 Hour Urinary Sodium Excretion in the Adult Kuwaiti Population (P116-13MC-06)**

N. Al-Hamad

Public Authority for Food and Nutrition

**Project Progress - Abstract:**

Background, Rationale, and Specific Aims: Hypertension is the leading preventable cause of death worldwide and is a major risk factor for stroke and coronary heart disease – conditions of public health importance in Kuwait. Salt reduction is one of the most cost-effective and most cost-saving means of reducing blood pressure levels in the population. Although the WHO has stressed the importance of measuring salt intake in populations as a basis for salt-reduction policies and interventions, no accurate data are available on salt intake the Kuwaiti population. Thus, the specific aims of the present study are 1) to determine the baseline salt intake in the Kuwaiti adult population by assessing 24 hour urinary sodium, 2) to assess factors associated with salt intake, including sociodemographic factors, diet, blood pressure, urinary potassium, and body mass index, and 3) to validate and spot urine sodium concentration using 24-hour urine sodium concentration as the gold standard.

**Methods:** An age- and sex-stratified random sample of 918 participants will be taken from the Eastern Mediterranean Approach to Non-Communicable Diseases (EMAN) Study, based on the WHO STEPS Studies, done in the Kuwaiti population in 2014 (sampling frame, n=3918). Participants will be invited to their local Primary Healthcare Clinic, where enrollment procedures, including Informed Consent, will be conducted. Data collection procedures will include:

1. Questionnaire (sociodemographics, food frequency, and medical history)
2. Blood pressure measurement
3. Height and weight measurements
4. 24-hour urine and spot urine collection for urinary sodium and potassium concentrations.

Urine sodium levels will be measured using standard clinical laboratory assays at the Dasman Diabetes Institute. Urine samples will be stored for future ancillary studies, subject to future approval by the Kuwait MOH Standing Committee for Coordination of Health and Medical Research. Sampling weights will be applied to individual data, and analyses taking the weights into account will be conducted in order to provide population estimates generalizable to the Kuwaiti population.

**Public Health Significance:** Salt reduction interventions have already been implemented in Kuwait. However, the current level of salt intake in the Kuwaiti population is unknown. Furthermore, without a scientific research evidence base, the value or impact of such public health interventions cannot be assessed. The proposed study is needed to provide the needed evidence upon which to base salt-reduction policies, interventions, and future surveillance efforts to assess impacts of those efforts.

**KFAS contribution:** KWD 73,555

**Total budget:** KWD 166,535
The Use of Killer-Cell Immunoglobulin-Like Receptor (KIR) Genotyping in Related Stem Cell Transplantation (P116-13MC-08)

R. Ameen
Kuwait University

Project Progress - Abstract:
Hematopoietic stem cell transplantation (HSCT) represents curative treatment for many patients with hematological malignancies. However, despite advances in HLA typing, it is still impossible to prevent graft-versus-host disease (GVHD), which reduces the chances of curing malignancies using HSCT. Recent efforts have investigated the use of alternative donors such as haploidentical donors. Natural killer (NK) cells are important immunological factors that influence the success of HSCT. In healthy individuals, the cytolytic activity of these cells is important for the host defense against virus-infected cells and tumor cells. NK cells are closely regulated by Killer-cell Immunoglobulin-like Receptors (KIRs) that are ligands for specific HLA class I molecules. Donor NK cells can kill recipient cells due to a lack of self-recognition, provided that the donor expresses a KIR ligand that is missing in the recipient I-ILA genotype. The donor must also express a specific KIR that leads to a KIR/HLA ligand mismatch between the donor cells and the recipient's body. This study will use KIR genotyping as an additional criterion for selecting donors for related or haploidentical stem cell transplantation. In addition, stem cell donors in the national registry will be characterized to determine the KIR haplotype frequency in the Kuwaiti Arab population. Findings from this study could lead to more appropriate selection of HLA-matched potential related or haploidentical donors to improve the stem cell transplantation outcomes of AML patients. In addition, the findings will provide new data regarding KIR genotypes in Kuwait.

KFAS contribution: KWD 51,600
Total budget: KWD 126,000

Anticoagulation in Advanced Cancer Patient Receiving Palliative Care (P116-13MC-11)

A. Al-Ansari
Ministry of Health

Project Progress - Abstract:
The risk of venous thromboembolism seems to be increased among cancer patients especially those with advanced disease either due to cancer itself and its treatment or due to other patient factors such age, mobilization, and other co-morbidities. This can influence the incidence of thrombotic complications as well as the risk of bleeding. The beneficial effect of anticoagulation in those fragile patients with advanced incurable cancer in view of their survival is doubtful and no agreed consensus regarding giving or holding prophylactic anticoagulation. Low molecular weight heparin is considered to be more effective and safer over traditional oral anticoagulant therapy for long-term anticoagulation in cancer patients with venous thromboembolism, although clinical decision-making of starting anticoagulation may not be easy as there is an increased risk of both bleeding, and further episodes of VTE despite anticoagulation.

So, we aimed from this study to study the pattern of anticoagulant use and the incidence of newly developed symptoms suggestive of VTE and their effect on survival. A retrospective cohort study will be performed on the patients admitted in Kuwait Palliative Care Center with incurable advanced cancer stage who are not candidate for further active cancer treatment.

Demographic data, detailed medical and cancer history will be collected. Detailed history of anticoagulant medication, thrombotic and bleeding risk with follow up of any newly developed symptoms suggestive of VTE or any complications related to the anticoagulant therapy and their effect on survival. All data manipulation and analysis will be performed using the SPSS. Now we are in data collection phase. KFAS plays a great role in increased awareness about the importance of Palliative Care (PC) in Kuwait. In Kuwait, PC services are still in an early stage of development. KFAS is continuously supporting us financially, technically and scientifically in every phase of our study.

KFAS contribution: KWD 16,816
Total budget: KWD 47,430
Identification and Characterization of RKIP Network in Breast Cancer Metastasis: A Focus on Metalloproteinases
(P116-13MG-02)

F. Al-Mulla
Kuwait Institute for Scientific Research

Project Progress - Abstract:

Breast cancer represents the most common cancer in woman worldwide. Kuwait has similar incidence of breast cancer albeit presenting more aggressively than usual. This grant will address a key concept in breast cancer, namely its metastatic potential. The ability of breast and other cancers to spread to distant organs is termed metastasis and represents the major cause of death. We have identified RKIP as a major metastasis suppressor. Its expression is lost in aggressive breast cancer and other metastatic cancers.

This grant aims at identifying the RKIP network involved in the metastatic process and further focuses on preliminary data connecting RKIP expression with the expressions of protein metalloproteinases. As leaders in the RKIP and metastasis field, this grant will further strengthen our input in the cancer field in general and may allow us to extend our understanding of the role of RKIP in the metastatic process.

KFAS contribution: KWD 142,000
Total budget: KWD 221,000

National Registry for Children with Cancer in Kuwait from 2004-2018
(P116-13MK-01)

M. Bourusly
Ministry of Health

Project Progress - Abstract:

Introduction: NBK children's hospital, Sabah health district, is newly recognized as an independent hospital, established back in the seventies as a unit, and the only center for children with cancer in Kuwait. The hospital receives children with cancer from first week of life to 16 years. Since establishment, patients' data base remained basic and crude, which was challenging for any researcher to conduct studies related to cancer.

Objective and method: The objective of this registry is to create a national registry for children with cancer. In order to improve the services provided, using a prospective cross sectional and retrospective method, to give insight into the patients' background, type of cancer, response to management, complications, and relapse. The basic data was retrieved from patients' files, as well as the records of the emergency room, inpatients wards, and hospital out patients' clinics. Data collected by filling a designed form, was later entered into software.

Results and discussion:

It is estimated that 120 new cases are received every year. The total number of patients calculated was 1381. We managed to retrieve and register 932 patients' files back to 2005. Of those 793 forms were entered into the software, there were 468 Kuwaitis and 325 non Kuwaitis, 337 females and 456 males. Patients' files admitted before 2008 proved difficult to retrieve as patients' with oncology illness were following at a nearby cancer center. Similarly patients with leukemia files were kept at a pediatric department and many files were irretrievable.

Conclusion:

Statistics are corner stone for cancer care and management. Shortly we will be able to estimate the prevalence and incidence of cancer, and evaluate the background, nature, risks and complications attributed to cancer and treatment, and outcome. This registry would provide a foundation any future medical researches on pediatric cancer.

KFAS contribution: KWD 9,150
Total budget: KWD 9,150
Clinical Classification of the Sickle Cell Disease (SCD) According to Bone Involvements and Other Systemic Complications (P116-13MM-01)

H. Al-Jafar
Ministry of Health

Project Progress - Abstract:

Sickle cell disease (SCD) is a genetic disorder, around 100,000 SCD children born every year worldwide, including Kuwait.

Aim:

To create clinical classification for SCD.

Background:

Until present time SCD defined only through laboratory tests. This project divided the severity of the disease to a mild, medium and severe depending on the number and seriousness of its complications in order to treat the patient according to severity of the disease. Under certain conditions, such as cold, heat, or fatigue, the soluble hemoglobin in the red blood cells turns into a solid substance, and then the red blood cells become sickle shaped. The sickle cells accumulate in the capillaries, causing vaso-occlusive crises. This causes episodes of sudden and very severe pain attacks and may lead to multiple complications as bone avascular necrosis, liver damage, spleen atrophy, gallstones, pulmonary hypertension, brain and eye infarcts plus many other complications. The chronic hemolytic anemia resulting in a drop in blood level to about 60% where blood transfusions may be needed. Recurrent Infection is common in SCD due to Low immunity because of spleen atrophy.

Sever SCD Complications may cause complete organ failure, while other SCD patients may have less sever disease. Therefore, the classification of these patients is important for proper health care. SCD patients also need psychosocial support as well as medical support from various disciplines Based on the clinical results of SCD patients they referred to different medical specialties to prevent complications and for early treatment before it reach to stage of total. Our project is preventive and therapeutic to achieve sustainable health in a chronic disease. we started to get results of spectrum of sever mild and moderate cases of sickle cell disease as the first clinical classification for this disease worldwide.

Publications:


KFAS contribution:  KWD 37,050
Total budget:  KWD 440,690
Kuwait Obstructive Lung Disease Initiative: KOLD Study
(P116-13MM-04)
F. Al-Hurish
Ministry of Health in collaboration with Fawzia Sultan Rehabilitation Institute

Project Progress - Abstract:
COPD is the fourth leading cause of death worldwide; however, it lags behind other major causes of mortality in terms of awareness, diagnosis and treatment. Because of this COPD is placing a significant burden on medical resources worldwide. Global efforts are being made to assess trends in presentation of COPD, as well as assessment and treatment paradigms. Prevalence of COPD is found to be variable worldwide and no all-encompassing diagnostic tool exists as yet; thus, COPD must be considered at a regional level. Currently, no epidemiological study has been carried out on COPD within the Middle East.

The KOLD research protocol will follow that of the BOLD and COLD studies. Our aim is to analyze the nature of COPD in Kuwait, and the dynamic manner of COPD management within Kuwait’s healthcare system. We will investigate the prevalence and risk factors of COPD in Kuwait. Potential differences among Kuwaitis and Expatriates will be analyzed, as well as the effects of living adjacent to oil refineries or working in high-risk environments such as outdoors in the desert. We will identify who is diagnosing COPD, by what methods they arrive at their diagnosis, and which medications are prescribed after diagnosis. We will assess whether the attributes of Kuwait’s healthcare system play a role in delayed or missed diagnoses of COPD, and whether those diagnosed are referred to a pulmonologist. Other pertinent factors such as prevalence of smoking and effects of respiratory symptoms on quality of life will also be assessed.

5000 adults aged forty or over will be randomly identified in a manner reflective of the national Kuwaiti/non-Kuwaiti population distribution, and the age and gender spread within each region. Subjects will be interviewed via CATI (computerized automated telephone interview), and those suspected of having COPD will undergo bronchodilator reversibility testing.

KFAS contribution: KWD 15,150
Total budget: KWD 32,964

The Effect of High Density Lipoprotein on Ischemia-Reperfusion Injury in Spontaneously Hypertensive Rats
(P116-13MM-05)
A. Al-Jarallah
Kuwait University

Project Progress - Abstract:
Hypertension is a key risk factor in the development of cardiovascular disease and represents major healthcare problems in Kuwait and the Gulf region. Elevation in blood pressure was reported to be accompanied by alterations in high density lipoprotein (HDL) function and composition. The exact role of HDL in cardiac and vascular complications observed in hypertension is however not clearly understood. HDL and HDL components protected against ischemia/reperfusion (I/R) injury in vivo and ex vivo in experimental models of myocardial injury. HDL protection against I/R injury was demonstrated in hearts isolated from normotensive rats. Hearts from hypertensive rats were shown to be resistant to pharmacological or postconditioning induced protection. It's not clear however if HDL can protect against I/R injury in hearts isolated from spontaneously hypertensive rats (SHR). Furthermore, the role of HDL receptor, scavenger receptor class B type I (SR-BI), has not been previously addressed. In this project aim to test the effect of HDL and specific HDL lipid and protein components in I/R injury is SHR. In addition, we aim to test the involvement of HDL receptor, SR-BI, and downstream signaling machinery in HDL effects.

KFAS contribution: KWD 62,554
Total budget: KWD 115,104
The Effect of Metabolic Surgery on the Uncoupling Proteins (P116-13MM-06)

M. Jamal
Kuwait University

Project Progress- Abstract:

Metabolic surgery does not exert its effect through weight loss only, but mainly through its metabolic effects that lead to the resolution of most of the comorbidities including Non-Insulin Dependent Diabetes Mellitus (NIDDM). The purpose of this study is to study the effect of Metabolic surgery on the uncoupling proteins and whether Metabolic surgery exerts some of its metabolic and antidiabetic effect through the browning of fat. We would particularly focus on the expression of the novel hormone Meteorin-like and its pathways leading to the increased metabolism through the browning of fat.

Male Wistar rats will be divided into 3 groups, each of (20) animals, the first group will serve as control groups: A) normal control group will receive standard laboratory diet, and will be sacrificed at 18 weeks from the start of experiment B) Obesity control group this group will receive a high-fat, high-sucrose obesity-inducing diet consisting of a patty containing 40% fat, 15% protein and 44% carbohydrates and a jelly cube supplemented with 15% (w/v) sucrose and fructose for three months since the age of 21 days, and will be sacrificed at 18 weeks from the start of the experiment C) Metabolic surgery group, this group will receive a high-fat, high-sucrose obesity-inducing diet consisting of a patty containing 40% fat, 15% protein and 44% carbohydrates and a jelly cube supplemented with 15% (w/v) sucrose and fructose for three months since the age of 21 days. This group will undergo sleeve gastrectomy surgery at 12 weeks and will be sacrificed at 6 weeks post bariatric surgery. The blood and tissue from the animals in each group will be examined by real time PCR, Western blot, Elisa and Proteomics analysis for the uncoupling proteins and the Meteorin-like hormone expression. Also, blood will be taken from human subjects who is going to undergo metabolic surgery prior to the surgery and at 3,12 and 18 months post-surgery and will be examined in a similar manner.

The uncoupling proteins and the Meteorin-like hormone expression increases in response to bariatric surgery.

KFAS contribution: KWD 93,700
Total budget: KWD 111,700
The Identification of the Toxic Pathways Induced by the Mutant SOD1 Protein Associated with Canine Degenerative Myelopathy: A Potential Novel Model for Amyotrophic Lateral Sclerosis (P116-13MM-07)

T. Alfahad

Kuwait University in collaboration with University of Glasgow

Project Progress- Abstract:

Canine degenerative myelopathy (DM), is an adult-onset, progressive neurodegenerative condition strongly associated with a mutation in the Sod1 gene (118G>A) →(E40K) and results in elective euthanasia. SOD1 mutations have also been identified in approximately 10% of patients suffering from familial Amyotrophic Lateral Sclerosis (fALS). There are no naturally occurring models of ALS, accordingly DM may provide new insights into how SOD1 mutations can lead to the disease.

This project is testing the hypothesis: mutant SOD1 forms aggregates and affects the survival and function of glial cells which disrupts the axon glia unit leading to the axonopathy in canine DM.

The objects are

1. Optimise the transfection procedure for oligodendrocytes derived 158N cells
2. Compare the aggregate formation of wild type (normal) and mutant SOD1
3. Assess the impact of the mutation on the dynamics and activity of SOD1
4. Determine if mutant SOD1 activates cell stress pathways.

The key observations to date are

1. The density of cells displaying aggregates of SOD1 is significantly higher with DM compared to Wild type SOD1.
2. The decay rate of the wild type and mutant SOD1 are comparable with T1/2 approximately 24hours.
3. Both wild type and mutant SOD1 fusion proteins retain enzymatic activity.
4. Mutant GFP-SOD1 displays a different pattern on native gels compared to wild type GFP-SOD1 suggesting a difference in protein complex formation.

We are now investigating the impact of mutant SOD1 on the status of cells stress pathways in 158N cells. This will involve assessing the density of apoptotic cells transflect with wild type or mutant SOD1, the activation of the misfolded pathway using markers such as Bip protein and the impact of proteasome inhibitors on SOD1 complex formation. This will provide important insight into the impact of a SOD1 mutation on cells from an oligodendrocytes linage.

KFAS contribution: KWD 21,682

Total budget: KWD 35,182
Molecular Aberrations Among Patients with Myeloproliferative Neoplasms: Focus on Myelofibrosis
(P116-13MM-08)
S. Alshemmari
Kuwait University

Project Progress - Abstract:

Primary myelofibrosis (PMF) is a Philadelphia-negative myeloproliferative neoplasm that is heterogeneous in presentation and evolution, complicating therapeutic decision-making. Because PMF treatment is essentially palliative, allogeneic stem cell transplantation is increasingly being used and newer drugs tested in these patients; therefore, prognostic stratification of PMF patients is important for making treatment decisions. Molecular analysis of genetic material is of diagnostic and prognostic value in these patients. In this work, we used different molecular techniques for sequential analysis of major driver mutations in Janus kinase 2 (JAK2)/myeloproliferative leukemia (MPL)/calreticulin (CALR) in our PMF patient population.

We found frequencies of 47% for the JAK2V617F mutation, 25% for CALR mutation, 4% for MPL mutations, and 24% for the triple-negative patient subgroup. Compared to the JAK2/MPL mutation subgroups, the clinical characteristics of CALR mutation cases were associated with younger age, higher platelet count, lower hemoglobin and lower leukocyte count. The mutant allele burden was lower in CALR-mutated than in JAK2-mutated myelofibrosis. The driver mutations were responsible for clinical phenotype and independent predictors of clinical course. These findings clearly indicate that molecular and genomic information should be considered for patient diagnosis, prognosis estimation, and selection of targeted, safe and effective treatment.

KFAS contribution: KWD 94,700
Total budget: KWD 194,746

Advanced Strategies for Attenuation Correction and Synergistic Reconstruction in Dynamic Time-Of-Flight PET/MRI (P116-13MN-01)
T. Alrefae
Kuwait University in collaboration with Geneva University Hospital, Geneva

Project Progress - Abstract:

This project aims to develop and evaluate novel techniques for attenuation correction in PET-MRI. This goal is progressively achieved through a number of objectives. The first objective is to develop and evaluate a new technique to delineate bone structure. Such isolation is performed by contouring the skull region, before introducing appropriate correction factors in accordance to background signal. The second objective is to develop and evaluate a novel technique to maximize the utilization of MR data in PET. Specifically, this is performed by penalized maximum likelihood reconstruction of activity and attenuation (P-MLAA). The third objective is mainly comparing the techniques mentioned above with their counterparts in the literature.

KFAS contribution: KWD 25,500
Total budget: KWD 59,350
Knowledge and Attitude of Emergency Physicians towards Palliative Care in Kuwait (P116-13NO-01)
A. Al-Ansari
Ministry of Health

Project Progress - Abstract:

KFAS plays a great role in increased awareness about the importance of Palliative Care (PC) in Kuwait. In Kuwait, PC services are still in an early stage of development. Despite in most countries, end-of-life care policies are aiming at home death, the acute hospital setting remains a common place of final care and death in most countries.

Emergency physicians (EPs) as a part of health care professionals face those patients who have complex symptoms in most situations and need a different approach in assessment and management. Due to complexity of those patients, many of ERs try to avoid dealing with them although they are used to manage all emergencies in a professional way including invasive procedures and investigations and even ICU admissions which totally differ from palliative care view that focus in this stage on patients’ comfort and relief. So the aim of the study was to assess the knowledge and attitude of EPs toward palliative care as a whole and toward the patients assigned for PC. This could help in the future planning of EPs needs in the management of patients’ assigned for PC.

A cross-sectional survey was performed in the emergency rooms of all six general hospitals under the Ministry of Health of Kuwait. The approval of the ethical committee of the Ministry of Health was taken prior to the study. Attitude and Knowledge of the physicians toward Palliative Care Questionnaire (PCAK) is a newly developed questionnaire to assess attitudes and knowledge towards PC in patients with advanced cancer. All data manipulation and analysis will be performed using the SPSS. Total 154 questionnaires were distributed and the response rate was 67.53% (n=104). We finished data collection, data entry and revision. We are now in the statistical analysis.

KFAS contribution: KWD 9,492
Total budget: KWD 24,152

Investigations into the Anti-Inflammatory Mechanisms and Therapeutic Effects of Onion Bulb Extract and its Active Constituents in Animal Models of Inflammation (P116-13PT-01)
A. El-Hashim
Kuwait University

Project Progress - Abstract:

There has been a significant shift in the global disease burden from communicable to non-communicable diseases, particularly inflammatory diseases, despite the increase in the numbers of new chemical and biological therapeutic agents. In parallel, the use of nutraceutical based products has increased in recent years due to their demonstrated efficacy and their good safety profile.

Onion is one of the most commonly used herbal products in the management of various conditions including inflammatory diseases. However, neither its pharmacological anti-inflammatory effects, in diseases such as asthma and inflammatory bowel disease (IBD), nor its molecular mechanisms have been well characterized. In this study we investigated 1), whether treatment with onion bulb extract (OBE) has prophylactic, therapeutic and/or preventive effects in an asthma and colitis models and 2), the cellular and molecular mechanisms by which this may be achieved.

In a house dust mite (HDM) model of asthma, treatment with OBE using, prophylactic, therapeutic and preventative approaches, all inhibited the HDM challenge-induced airways inflammation such as cellular influx, histopathological changes and downstream signaling pathways such as pEGFR, ERK/1/2, and pAkt. In addition, OBE in combination with steroids demonstrated a synergism in the reduction of the airway inflammation. This anti-inflammatory effect was also observed in a DSS-colitis model with the three different approaches of OBE administration, which was in part through reducing the colonic expression/activity of various pro-inflammatory signaling molecules, cytokines and chemokines.

These data suggest that OBE may be used in the therapeutic treatment and also prevention of inflammatory diseases such as asthma and IBD.

KFAS contribution: KWD 121,000
Total budget: KWD 151,500
Modelling and Design of Nano-Structures: Multilayer Nanoplasmonics Configurations (P116-15EC-01)

H. Kurkcu
Gulf University for Science and Technology

Project Progress - Abstract:

Nanoplasmonics forms a major part of the field of nanophotonics, which explores how electromagnetic fields can be confined over dimensions on the order of or smaller than the wavelength. Initiated in 1902 by R.W. Wood with the discovery of grating anomalies, this phenomenon has attracted significant attention over the last century. Current applications relate, for instance, to bio-sensing wherein the binding of analyte molecules to a properly treated metallic arrangement can provide a very sensitive means to detect their presence through a shift in the resonant (plasmonic) frequency. The potential for further impact is even greater as the confinement of light in sub-wavelength regions can clearly provide significant gains in a wide variety of areas (e.g. telecommunications, microscopy). We believe that state-of-the-art computational thinking can be used to dramatically improve the design process for nanostructured optical materials. The Principal Investigator (PI) has already designed an efficient integral equation solver for single layer configurations and succeeded to outperform many challenges associated with the old-fashioned and inaccurate techniques (such as the ever-popular “FDTD”). In this proposal, the PI offer to extend this achievement to a more challenging case; multilayer configurations.

The new configuration, the PI proposes to study, will composed of a thin layer of noble metal (gold, silver, etc.) with depth larger than skin depth of the material, buried into different epoxies on top (glass/polymer substrate) and the bottom (liquid/water/blood). Unfortunately, the developments of the single layer case do not fully carry over to the multi-layer case. The PI proposes, initially, to derive a new modified integral-equation formulation, and high-order treatment of the challenges stemmed from the adapted new mathematical model. We feel that computations will result in new fast/accurate simulator that can be used for real time design.

KFAS contribution:  KWD 6,675
Total budget:  KWD 9,200

Reliability-Based Assessment of Existing Structures (P116-15EV-01)

Z. Sakka
Kuwait Institute for Scientific Research

Project Progress - Abstract:

Due to social and economic reasons, the assessment of existing structures has become more important to structural engineers and analysts. Most structural codes deal explicitly only with the design concepts of new structures. The aim of this study is to promote reliability-based (probabilistic) assessment of existing structures. The assessment of an existing structure differs very much from the design of a new one. The state of information, in terms of various uncertainties related to loads and resistance parameters, in the assessment of existing structures is completely different from that during design. In addition, special attention is given to specific zones of the existing structure and to a probably limited part of components with a real risk of damage according to the observed behavior of the structure. On the other hand, the interpretation and the analysis of the information may not be a simple matter. Therefore, specific guidelines, procedures, and tools are required in order to make a sound judgment of the reliability of existing structures.

In this study, current practices in the reliability-based assessment and the evaluation of existing structures will be reviewed. Also, improved guidelines, procedures, and tools will be developed to standardize the reliability methods of assessment in the region. The tools will consist of probabilistic computer applications that can be used in the assessment of reinforced concrete structures with different modes of failure. Different programming platforms for the computer applications will be considered. The outcomes of the proposed project will help in making the decision-making process in the assessment of existing structures less dependent on personal experience by providing clear guidelines, measurable risks, and easy-to-use computational tools. It will also contribute towards the development of an assessment code for the Gulf Cooperation Council countries.

KFAS contribution:  KWD 29,740
Total budget:  KWD 126,340
Wool Production Potential of Naeemi Sheep: Assessing Quantitative and Qualitative Status of Wool in Kuwait  
(P116-15SE-01)

S. Abbas  
Al SADU Co-op Handicrafts Society

Project Progress - Abstract:

Worldwide sheep are considered important animals for the provision of animal protein and wool. Fat tailed sheep populations of 800,000 ±5,000 comprise Naeemi, 80%; Arabi, 10%; and Najdi, 10%. They are mainly used for meat and milk production, and secondly for wool and manure.

The R&D studies of Kuwait institute for Scientific research in the past were concentrated on sheep, goats, and dairy cattle production, dealing with specialized areas of feeding, nutrition, breeding, and housing to increase the efficiency of meat and milk production. The studies on wool yield and its quality of Kuwait's fat-tailed sheep breeds were scarce. Past KISR works were limited to wool yield of local sheep at 2.0 to 3.5 kg/shearing/sheep and imported sheep produced up to 5.5 kg/sheep/shearing. The quality of wool of Naeemi and imported sheep has not been investigated. This study is investigated the yields and quality of wool of local and imported feedlot sheep. The variables of study as needed by Al SADU Co-op, Handicrafts Society are wool fiber length, diameter, tensile strength, crimp, kemp, scouring uses, etc. The preliminary results from grease fleece weight (GFW) from Naeemi sheep showed the amount ranging between 1251.62 and 1684.4 g for ewes; 1373 g for yearling lamb; and 1819 g for rams under intensive system of production. The GFW of Naeemi sheep has been shown to be affected by sex and nutrition of the animals. The indicated preliminary results of nutritional experiment the positive effect of addition of sulfur to ration in improving the in growth and feed conversion.

KFAS contribution:  KWD 85,200  
Total budget:  KWD 132,100

The National Study of the Future Forecast for the Need of the Jobs that Based on Knowledge, Innovation and R&D in the Public and Private Labor Markets during the Next Five Years  
(P116-17IC-04)

K. Al-Hashash  
Supreme Council of Planning and Development

Project Progress - Abstract:

In the midst of the fourth industrial revolution, a transformation revolving around artificial intelligence, Internet of Things, and knowledge governments heavily depends on all sectors especially (public, private and oil) to adopt a systematic approach to develop their capabilities and accelerate the evolution of knowledge into a key organizational resource. To do so, they have to be fully recognized that the knowledge workers are a crucial and essential asset and source of competitive advantage and value creation. As such, they are high on the agendas of policy makers as they seek to create environments that support the activities needed to better building their capacity.

This study seeks to contribute to exploring of knowledge management applications (if any), specifically, the awareness and, then, the current and future demand level of knowledge workers in the Kuwait market (public, private, and oil sectors) through a survey study-based investigation. Structured interviews will be conducted with more than 20 organizations operating in Kuwait market, questions focused on [1] the vision, strategies and policies (if any) to recruit knowledge workers either currently or at future [2] knowledge management awareness, practices and strategies for encouraging staff to share and exchange knowledge, and any challenges in these areas.

The study furthered providing a deeper understanding of the local market trends based on the demand of knowledge workers and how to secure the gap from exterior labour markets. The study helps decision-makers to design a clear vision about how to expand the knowledge workers scale to align with the Kuwait vision 2035 which is totally based on knowledge and knowledge economy.

The main contribution of the study is building a fully awareness of the future of knowledge workers demand in Kuwait labour market, as well it has significant implications for future research from knowledge management perspective, by Improving the matching in between educational curricula and labour market, enhancing training provision, focusing on innovative learning environments, and encouraging knowledge sharing programs.

KFAS contribution:  KWD 31,000  
Total budget:  KWD 39,400
Utilizing Applied Behavioral Research to Execute Subsidy Reform in Kuwait (P116-17IC-05)

H. Al-Ojayan

Kuwait University in collaboration with The London School of Economics and Political Science

Project Progress - Abstract:

The Kuwait government is highly dependent on oil revenues; its fiscal position is exposed to fluctuations in crude oil prices. Reducing expenditures will make Kuwait’s government more fiscally robust in the context of volatile oil markets. Reforming subsides is one way through which the government can reduce expenditures.

Electricity and water subsidies in Kuwait are costly; they represent about 11%-19% of fiscal expenditures (depending on the price of oil in the market). The household sector consumes 50% of total electricity produced and was exempt from the change in tariffs introduced in 2016.

The goal of this paper is to identify behavioural interventions, ‘nudges’, that could help save electricity in the household sector. Understanding citizens’ behaviour with respect to reforms and communicating effectively around such sensitive topics can help reduce conflict and gain support and trust of citizens. This should accelerate economic reform and foster sustainable development for Kuwait.

We developed the nudges through first; reviewing relevant behavioural literature and international examples of nudges. Second, conducting focus group interviews. Third, comparing Kuwait to other Gulf Cooperation Council (GCC) countries; and last through testing the cultural appropriateness of the nudges (instrument evaluation). Understanding citizen’s perspective is an essential input to designing communications and nudges.

The first nudge we propose is making the government subsidy more salient to citizens. The second is activating social norm, e.g. motivating individuals to save energy to enhance the quality of living in their local community. Third, framing, adding a message that makes subscribers care for future generations. Lastly, the recognition of saving efforts through reward system.

Going forward we intend to test the effectiveness of these four nudges through randomised control trails (RCTs). The results will provide policymakers with evidence to which nudge is more effective in reducing electricity consumption.

KFAS contribution: KWD 41,814
Total budget: KWD 67,967

Bubbles in the Hotel/Lodging Real Estate Sector (P116-17IM-02)

F. Almudhaf

Kuwait University

Project Progress - Abstract:

The purpose of this paper is to test for the presence of bubbles in the US lodging/hotel real estate investment trust (REIT) subsector from 1994 to 2016. It also compares the profitability of a buy-and-hold strategy with several technical trading rules when applied to lodging REITs. To investigate speculative bubbles, the sequential right-sided unit root tests of Phillips, Shi and Yu (2015a, b) are used. The results confirm the possibility of the existence of multiple bubbles and explosive behavior in prices and the price-dividend ratio. One of the detected bubbles coincides with the financial economic crisis of 2008 using both measures. In addition, several technical rules are found to be superior to a naïve buy-and-hold strategy even after adjusting for risk. These findings will be of interest to policy makers, who can use such models as an early alert to take anticipative action to avoid bursting of bubbles and consequent negative effects on the economy. The findings also provide important information to investors attempting to devise trading rules that utilize the signals from bubble detection, as well as to hotel executives devising policies aimed at reducing risk and creating more firm value to maximize shareholder wealth. Moreover, valuation and bubbles are important to lenders and creditors who use assets as collaterals for financing hotel REITs. Hotels are a unique hybrid of retail and housing that combine operating business with real estate. This paper is the first to investigate speculative bubbles in lodging REITs.

KFAS contribution: KWD 5,000
Total budget: KWD 11,775
Identifying Systems Models Characteristics Affecting the Propagation of a Change (P116-18QS-01)

N. Almasri
Gulf University for Science and Technology

Project Progress - Abstract:

System development is becoming more challenging with the increased complexity of software and frequent applied changes to accommodate the rapidly changing technologies and user requirements. Software design is a critical phase of Systems Development Life Cycle. Design decisions made at this phase will not only affect the functionality of the resulting software product, but it will also affect its performance as well as the speed to apply a change later on during the maintenance phase. Our research focuses on investigating the correlation between certain model characteristics and the impact of a change applied to the software later on during the maintenance phase. Our goal is to identify better design patterns which allow for minimum propagation of a change. Our work is mainly concerned with designing state-based system models with enhanced design decisions in an effort to simplify and speed up the maintenance process in order to rapidly react to changes in technology and in user requirements. In this stage of the project we present our progress and findings with respect to our pre-set research objectives:

(1) Exploring the relationship between system models characteristics and the impact of a change applied to the system during the maintenance phase, (2) identifying model characteristics which can increase or decrease the propagation of the change, and (3) providing system designers with guidelines for better decision making during the design phase of the system development life-cycle. At this stage of the project, and out of twelve EFSM models, 7 models were validated, encoded, and considered for the initial experiment. The main characteristics of the models were extracted, and a tool to measure the average impact of a potential change applied to the model was developed. Then the correlation between the models’ characteristics and the models’ average impact of a potential change was investigated. Based on the correlation results, model characteristics that seem to increase or decrease the model’s average impact of a change are identified.

KFAS contribution: KWD 9,700
Total budget: KWD 17,700

Levels of Pesticide Residue in Raw Milk and Selected Dairy Products in the Kuwait Market with Emphasis on Public Health (P214-42NM-01)

M. Al-Fayez
Public Authority for Applied Education and Training

Project Progress - Abstract:

The worldwide use of pesticides has increased steadily to the extent that the annual production of synthetic pesticide chemicals exceeds one billion tons. Organic Chlorine pesticide group mixtures are of particular concern as it tops the list of pesticides that remains in the environment after application. The organic chlorine group are lipophilic in nature and are absorbed by animals and increase in concentration as they pass up the food chain. Therefore, they are possibly found in milk and dairy products. Little is known about the milk and dairy products contaminated with organic chlorine pesticide. The study will examine the levels of pesticide residue in raw milk produced in farms in Kuwait and the residues in locally produced dairy products, such as. white soft cheese and yogurt.

The objectives of the study are:

1. Increase the public awareness of the adverse health effects resulting from the misuse of pesticides;
2. Establish a data base for pesticide monitoring in raw milk and dairy products in Kuwait,
3. Identify the preventive measures required to safeguard consumers’ health.

The first phase of the project focuses on the collection of samples and preparation for analysis (200 milk samples in winter and 200 in summer from 35 local farms in Kuwait), mobilizing and preparing the work plan and collection of samples, preparing samples for analysis by extracting fat and cleaning up the samples to get it ready for Gas Chromatography analysis.

KFAS contribution: KWD 73,400
Total budget: KWD 278,020
Biochemical Potential of Conocarpus Lancifolius in Uptake of Carcinogenic Polyaromatic Hydrocarbons and Heavy Metals (P214-42SL-05)

R. Al-Hasan, M. Afzal and A. Redha
Kuwait University

Project Progress - Abstract:

The proposed project is aimed to understand the adaptation mechanisms in C. lancifolius including its possible role in resolving environmental problems in Kuwait such as degradation of polyaromatic hydrocarbons (PAH) and removal of heavy metals from contaminated soil. The plants were exposed to individual and different combination of heavy metals, Cadmium (Cd2+), Nickel (Ni2+) and Lead (Pb2+) at 25 and 50 μM concentration for 30 days, under controlled growth conditions. Parameters, such as electron transport rate (ETR), chlorophyll fluorescence, photosynthetic rates and photosynthetic pigments including chlorophylls and carotenoid contents were measured. At 25 μM elemental exposure of the plant, all photosynthetic parameters largely remained unaffected while at 50 μM concentration, all parameters significantly decreased until 20 days of exposure followed by an increase until 30 days of exposure indicating slow adaptation of the plant to higher heavy metal concentration as well as mixed heavy metals. All studied parameters influenced photosynthesis, including a decline in the leaf fluorescence intensity, indicated that photosynthetic apparatus suffered a significant damage due to heavy metal exposure, especially at higher concentrations or mixture of heavy metals. The mixed metals proved to be more toxic than individual heavy metals at the same concentration. A comparative study of the sensitivity of C. lancifolius with heavy metal sensitive plants like tomato plants and heavy metal tolerant plants like bean plants was carried out. A preliminary study on root development was carried out using a newly designed apparatus (Rhizotron) which worked successfully provided promising results. DNA extraction of C. lancifolius was carried out and prepared for GISH analyses and sequencing.

Studies on the uptake of PAH were postponed to the next stage due to a delay in the delivery of the chemicals.

KFAS contribution: KWD 55,300
Total budget: KWD 130,400

A Revision on the Marine Algal Flora of Kuwait with Special Emphasis on the Epiphytes (P214-42SL-06)

R. Al-Hasan, D. Al-Bader and F. Al-Khraniej
Kuwait University

Project Progress - Abstract:

Over 500 samples of algal material were collected from different sampling sites during 2014 -2016 and processed for laboratory studies. Optimization of sampling and preservation procedures was carried out at the starting of the project. Each sample was given a code before divided into wet preserved, dry herbarium sheets, permanent slides for small and epiphytes, and for Molecular analysis. The sample code system has made it easy to trace and study the samples. In this study, an updated nomenclature and taxonomy has been recorded, based on published records using currently accepted names. 115 taxa of macroalgae have been identified to date, including 24 Chlorophyta, 26 Ochrophyta (Phaeophyceae) and 41 Rhodophyta, 10 Cyanophyta, one Xanthophyta, 10 Bacillariophyta, 4 Trachaeophyta.

Morphological and anatomical criteria were used for identification of the algae at this stage. Optimization of DNA extraction and the amplification of the partial 188 rRNA methods were fulfilled in the first year. Gene sequencing and analysis will be carried out next phase to confirm the identification of the algae samples. A total of 34 new algal records of partial 18S rRNA genes are deposited in GenBank under accession numbers from F579952 to MF579986.

Preliminary information about the algal communities and distribution will be established. Further work will focus on epiphytic communities and molecular characterization of collected algae. Ultimate goal is to update the algal list made in 1986, to establish a well-defined collection and to develop a catalogue of the marine algae of Kuwait.

KFAS contribution: KWD 48,800
Total budget: KWD 95,460
Development of an Emission Inventory for the State of Kuwait
(P214-44SC-03)
A. Ramadan
Kuwait Institute for Scientific Research

Project Progress - Abstract:

The project duration was originally planned to be 36 months. However, due to delays in obtaining the essential support from Kuwait Environment Public Authority (KEPA), the actual start of the project was delayed by 12 months, resulting in an extension which was approved by KFAS. The project team is working hard to keep the project on schedule. This report gives a brief update on the progress of the project since its beginning

KFAS contribution: KWD 89,840
Total budget: KWD 193,521

Feed Production Utilizing Greenery and Agricultural Residues: Evaluation of Feeds for Livestock in a Pilot-Scale Operation
(P215-42SC-01)
M. Razzque, S.A. Mohammad, F. Khalil, M. Al-Khamis, R. Al-Terkait, S. Albert, W. Al-Gallaf, A. Shaffi, H. Miah
Kuwait Institute for Scientific Research

Project Progress - Abstract:

This project is being supported jointly by Kuwait Foundation for Advancement Sciences (KFAS), Al Alunad United Co and KISR for 30 mo from June 1, 2016 to November 30, 2018. The objectives were to continue assessing plantations and plant residues (PRs) generation, selecting, collecting, formulating TMRs, evaluating quality of PRs through animal response trials and economic analysis. The tasks for the reporting period were the following: (2) Quantitative assessment of PRs, (3) Quality of PRs, (4) Growth performance of lambs, (5) Supplement formulation and testing, (6) Data analysis, and (7) Feed market and economic studies. This report presents additional methods of experimental work in task 4 as prerequisites of animal performance trials.

The updated data of PRs and date palm trees of Kuwait, growth performance studies of lambs fed TMRs containing PRs feeds, feed availability/costs were the main areas of work from March to May, 2018. Trees, shrubs and ornamental plants reached 11 million, concentrated in two Governorates Ahmadi and Jahra, thus PRs could be collected easily. PRs composition and quality were influenced by locations, seasons, and parts/sections of plants/PH..s. ADF, NDF, DMD% and TDN % of Conocarpus PRs were significantly higher in of location 1 than 2 of KISR sites. Nutritional quality of DPL was not influenced by the location differences. Quality of lawn grasses was generally higher than those of Conocarpus and DPL. Parts/section 1 top leafy section of Conocarpus plants had the highest content of DMD 66.91% and TDN 61.16%. Then DMD% and TDN% were reduced to 57.31% and 51.90 %, 42.39% and 37.51% in plant sections 2, 3 and 4 respectively. The quality of DPL was poorer in all sections than Conocarpus DMD% ranging from 52.84% to 41.46% and TDN 47.59% to 36.31%. The effects of Date Palm Leaves (DPL) parts and location of sampling was minor on quality of PRs. Lawn grasses quality was high with DMD 64.81% to 66.57% and TDN 59.14 to 60.84%. Feed intake, daily live weight gains of lambs fed six treatments TMRs T1: 0, T2: 10, T3: 15, T4: 20, T5: 25, and T6: 30% PRs differed. Lambs of T 3 (PRs 20%, alfalfa 5% and straw 5% + 70% concentrate (C) had highest feed intake, followed by T 4 (30% PRs 0% alfalfa and 0% straw). Highest daily live gain was 371.40 g/d of lambs receiving T4 (30% PRs, alfalfa 0% and straws 0%). The interim findings indicated potentials for PRs use. Experiments on feed supplements formulation testing, data compilation, analysis were on progress. Feed market studies and economic assessment were on progress. The study showed total of 35,000t/y feed (forages) was produced in Kuwait out of total estimated 800,000 t/y required for Kuwait’s livestock population. Feed price increases were 20 % to 81% during past 10-20 y. The highest price increase was for roughages. Therefore, there is a need to use PRs as roughage.

KFAS contribution: KWD 53,800
Total budget: KWD 197,180
Dead Animals Disposal - Sheep
(P215-42SC-02)
T. Al-Sabbagh
Kuwait Livestock Trading in collaboration with Kuwait Institute for Scientific Research

Project Progress - Abstract:

This study is divided into 3 sections: 1) cement slab com posting of sheep with microbiology assessment; 2) Ecodrum com posting of sheep with microbiological assessment; and 3) Growth of vegetables with compost from 1 and 2 compared to market compost and a non-compost control. This study gives continuing information for composting organic waste (dead sheep) using the Ecodrum method versus the traditional cement slab method. The Ecodrum accelerated the composting process by at least five fold. The four months processing by the traditional cement slab method was reduced to only 20 to 25 days using the Ecodrum. The traditional method using the cement slab was modified by eliminating the turning of the piles to facilitate aeration. Instead, air was introduced directly in the piles of compost. This modification did not shorten the time needed for composting but reduced the manual labor needed for the turning of piles. The texture and the phenotype of the products were almost the same. The laboratory tests of the resultant products compared favorably with market compost. The color and texture of the Ecodrum and the cement slab products were superior to that of market compost. The project details the bacterial and fungal tests for the different compost products and their effect on vegetable growth.

KFAS contribution: KWD 49,370
Total budget: KWD 189,500

Developing Sustainable and Environmentally Safe Strategies to Mitigate Overuse of Toxic Pesticides on an Invasive Pest
(P215-42WE-03)
M. Jallow, M. Albaho, A.Dahab, B.M. Thomas
Kuwait Institute for Scientific Research

Project Progress - Abstract:

The tomato leafminer, Tuta absoluta, is one of the most destructive pests of tomato worldwide, and the management of the pest is mainly based on chemical insecticides. Consequently, developing environmentally friendly control strategies is needed. The susceptibility of 8 field populations of T. absoluta to diamide insecticides (flubendiamide and chlorantraniliprole), the risk of resistance evolving as well as inheritance of resistance to the insecticides was investigated. The susceptibility variation among the populations tested was low. The LC50 values for flubendiamide ranged from 0.04 to 0.11 mg L-1, and for chlorantraniliprole 0.29 to 1.13 mg L-1. After 34 generations of selection in the laboratory, 750- and 860-folds increase in resistance were recorded for flubendiamide and chlorantraniliprole, respectively. The realized heritability (h2) of resistance was estimated at 0.21 for flubendiamide and 0.29 for chlorantraniliprole. In a separate trial, the efficacy of four biopesticides, Azadirachtin, Bacillus thuringiensis var. kurstaki, Steinernema feltiae, and Beauveria bassiana were evaluated in winter and summer for controlling T. absoluta on tomato under greenhouse conditions. In both seasons, the biopesticides, except S. feltiae, provided some degree of control of the pest. In particular, the combination of Azadirachtin and B. thuringiensis or Azadirachtin and B. bassiana was most effective, resulting in 90% and 81% reduction in fruits damaged in the summer experiments, respectively, and 96% and 91% in winter. Similarly, the mating of T. absoluta was disrupted with high pheromone doses (1000 dispensers/ha; 60 g ha-1), with over 90% reduction in males captured in monitoring traps. Mating disruption was as effective as conventional insecticides in reducing foliage and fruit damage by T. absoluta. Since some studies are still in progress, the recommendations to integrate some of the control strategies as a key component of an Integrated Pest management (IPM) program to manage T. absoluta will be drawn after completing all the project tasks.

KFAS contribution: KWD 50,000
Total budget: KWD 121,170
Development of a Decision Support System for Radioecologically Sensitive Areas in Kuwait (DESSAK)-Phase I: Experimental Studies, Modeling and Development of Database for Radioecology (P215-44SP-02)

A. Aba, A. Ismaeel, A. Alboloushi, M. Ahmed, S. Al-Awadi, H. At-Baker, H. Al-Shammari, S. Al-Tamimi, A. Al-Enezi, A. Al-Dousari

Kuwait Institute for Scientific Research

Project Progress - Abstract:

Kuwait recognizes the potential benefits of the nuclear energy and its application. It recognizes as well the risk associated with embracing these technologies and the regional developments in utilizing nuclear power. As such, a radioecological environmental decision support system (EDSS) for Kuwait was established. The ultimate goal is for the system to be used as a decision support tool for policy makers in case of a nuclear and radiological emergency.

The main activity was the preparation to conduct the leaching and transfer factor experiments. This included Lysemetry and containers preparation to host both experiments. In addition to that, measurements of background radiation levels in relevant food chain elements have been carried out and will be continued. Alongside, radiological database creation which was started in the first year is continuing. It should be noted that most of the reviewers’ comments and recommendations have been considered during the second year project’s execution.

KFAS contribution: KWD 35,800
Total budget: KWD 311,030

Estimating Internal Radiation Dose Due to Airborne Radioactive Dust in Kuwait (P215-44WE-02)

A. Isameel, A. Aba, M. Al-Rashicli, O. Al-Boloushi, S. Al-Tamimi, Gh. Al-Ghadeeri, M. Malak, and A. AlBoloshi

Kuwait Institute for Scientific Research

Project Progress - Abstract:

Radioactive airborne particles travel atmospherically for long distances and spread in different directions. Therefore, estimating the activity of radioactive airborne particles is essential in calculating the inhalation internal effective dose. This project focused on aerosols measurement in different residential areas in Kuwait for one year, and determining the concentrations of selected radionuclides. The internal public dose was modelled based on the recent international commission on radiological protection (ICRP) dose parameters. The obtained results can be used as a baseline in case of any regional nuclear incidents.

Five residential areas were selected for sampling covering all governorates. This selection was based on the criteria suits the requirements of ASTM D1357 (1995) “standard practice for planning the sampling of the ambient atmosphere. Sampling started in January 2018 on a weekly basis for a year using High Volume Air Sampler equipped with a Cascade Impactor. Samples were collected weekly for three consecutive days at a flow rate of 420 litre/ min and size of each sample was approximately 1700 m3.

The air filters were prepared for gamma and alpha measurements in the Radiation Measurements Laboratory in Kuwait Institute for Scientific Research. Filters were divided according to AMAD sizes into three groups per week (AMAD less than 0.7 μm, 0.7 to 2 μm and greater than 2.1 μm). The activity concentrations were measured for 7Be, 40K, 210Pb, 137Cs, and the relatively short-lived radionuclides daughters of both 222Rn and 220Rn by low background HPGe detectors. The activity concentrations of 210Po, 238U, and 234U were analysed by radiochemistry and measured by alpha spectroscopy. Conclusively, differences in the activity concentrations of radionuclides with different AMAD diameters were detected. Additionally, the average of the annual total internal effective dose was 21.67 μSv, which is very low compared to the public dose exposure.

KFAS contribution: KWD 22,100
Total budget: KWD 171,260
Designing Mixed Air Distribution Systems to Reduce Micro-particle Indoor Concentrations (P216-42WE-04)

W. Chakroun
Kuwait University

Project Progress - Abstract:

As people spend 90% of their time in indoor spaces, it is essential to be aware of all the threats that surround the occupants. A significant relationship was shown to exist between particle pollution and people’s health problems, such as asthma and a variety of respiration diseases. Therefore, it is important to understand the mechanisms by which these particles detach from surfaces and are inhaled by the occupants. Moreover, identifying the particles that pose a threat to people during breathing activities, close to surfaces, helps in taking preventive measures when dusting and vacuuming.

On the other hand, considering that vacuuming is incapable of fully recovering dust particles from surfaces and floors, thus causing them to re-suspend and become airborne, removing the re-suspended particles using the appropriate ventilation system at is a vital concern to prevent them from re-depositing on surfaces and floors. This is why it is a priority to design a suitable energy efficient ventilation system to reduce indoor contamination and remove airborne particles thus protecting occupants from hazardous diseases.


KFAS contribution: KWD 41,000
Total budget: KWD 87,290

Internal Wave Climate and Turbulence Mixing on the Continental Shelf of the Northwestern Arabian Gulf, Off the Kuwaiti Coast (P216-44SE-01)

F. Al-Senafi
Kuwait University in collaboration with Texas A&M University, U.S.A.

Project Progress - Abstract:

The fluxes and turbulent mixing supported by internal waves (IWs) play a major role in transporting nutrients in coastal waters, affecting biological productivity, and water-borne constituents such as contaminants and sediments. A better understanding of the effects of these IWs in numerical models is required to reproduce the crucial links between large scales, into which most energy is injected, and small scales in which dissipation occurs.

To address some of these issues, we examined the characteristics of IWs, and the associated energy cascade from IWs to turbulence, on the continental shelf of the northwestern Arabian Gulf, off the coast of Kuwait. The study conducted during midsummer (15 to 27 July, 2017), collected spatial transects and time series measurements at five moorings and five days of continuous turbulence profiles at four locations in the vicinity of the moorings. Measurements of temperature, salinity, currents, turbidity, dissolved oxygen, chlorophyll a and turbulence reveal that IW activity was consistent with a diurnal and semidiurnal. Based on cross[shore tracking of the IWs, we estimated that these waves propagated towards the coast at an average speed of 0.31 m/s, with amplitudes ranging from 7 to 9 m. The results presented here shed new light on IW characteristics in the Arabian Gulf and offer the first detailed study of these waves in this region.

KFAS contribution: KWD 63,217
Total budget: KWD 108,593
Hydrodynamic Studies on Slotted Vertical Wave Barriers (P216-44SE-03)

S. Neelamani, Alanoud Al-Ragum
Kuwait Institute for Scientific Research

Project Progress - Abstract:

Kuwait imports good quality stone and is expensive for coastal and marine construction activities. Novel structures are needed. The present work is to study, understand, and propose slotted vertical structure as wave barrier. Experimental investigations were carried out with regular and random waves on a single slotted vertical barrier with 10%, 20%, 30% and 40% porosities. A wide range of wave heights and periods are used. Analysis was carried out and wave transmission coefficient, reflection coefficient, dissipation coefficients were obtained. It was found that the wave transmission and reflection are strong functions of porosity of the slotted barrier, incident wave period, and wave height. Increase in porosity of the slotted barrier increases the wave transmission coefficient and reduces the wave reflection coefficient. In general, increase in wave period increases the wave transmission coefficient and reduces the wave reflection coefficient. With single slotted wall and porosity from 10% to 40%, minimum transmission coefficient possible was about 0.35, and the maximum reflection coefficient possible was about 0.60. Average dissipation coefficient of 0.7 was achieved for the random wave study. Further investigation is in progress with two to six barriers.

KFAS contribution: KWD 25,077
Total budget: KWD 105,667

Preliminary Assessment of the Spatial Variations in the Atmospheric Concentrations of Persistent Organic Pollutants in the West Asian Sub-Region (P216-44WE-01)

B. Gevao
Kuwait Institute for Scientific Research

Project Progress - Abstract:

The primary goal of this study is to measure generate spatial and temporal atmospheric concentration data on Persistent organic Pollutants (POPs) in the West Asian sub-region. The mean annual average concentrations of organochlorine pesticides were highest in Lebanon (1067 pg m-3) followed in decreasing order in Turkey and Oman (32 pg m-3), Kuwait (16 pg m-3) and Jeddah in Saudi Arabia (10 pg m-3). DDT and their metabolites were most abundant at most sites in the region with moderate concentrations of Hexachlorobenzene, Pentachlorobenzene, and isomers of Hexachlorocyclohexanes. The DDT/DDE ratios suggests current use of DDT in Lebanon and Oman but not in Saudi, Kuwait and Turkey. PBDEs were generally low in the subregion with the highest concentrations measured in Kuwait (16 pg m-3). The concentrations measured at all the other sites in other countries were below 10 pg m-3, suggesting an absence of hot spots of these compounds in the subregion. The concentrations of [jPCBs were highest in Lebanon (294 pg m-3) and lowest in Jeddah, Saudi Arabia (135 pg m-3). In Kuwait, there was a clear seasonality in the concentrations of [jPCBs with higher concentrations in summer and lower concentrations in winter and a clear urban-rural gradient was apparent.

The concentrations of [jPCDD/Fs were generally higher in Oman reflecting its proximity to a steel melting company at Al-Rassil Industrial; Area (1274 fg-ITEQ m-3) hospital incinerator at Al-Mutalga (1117 fg-ITEQ m-3) in winter; whereas the concentrations reduced to 401 and 209 fg-ITEQ m-3 in the summer respectively. The annual average concentrations at the Abdali site in Kuwait was 450 fg-ITEQ m-3 reflecting its location close to oil operations. The Levels of PCDD/Fs at all other stations within the region were generally lower than 70 fg-ITEQ m-3.

This study has provided the first reliable measurements of the atmospheric concentrations of several POPs in the subregion, which are regulated under the Stockholm Convention on POPs. The concentrations of “legacy” POPs are regulated by temperature controlled air-surface exchange, whereas primary emissions regulate the concentrations of PCDD/Fs, which are unintentionally released into the environment from combustion sources.

KFAS contribution: KWD 57,760
Total budget: KWD 240,890
**Modelling and Analysis of the Coupled Gulf-Atmosphere System (P216-45EV-01)**

D. Al-Rukaibi  
Kuwait University

**Project Progress - Abstract:**

Climate change has an enormous impact on the environment of Kuwait. Eltahir group at MIT have developed, for the first time, a high-resolution two-way coupled regional Gulf-atmosphere model for the study of the climate of the Gulf with the capability of consistently predicting surface heat fluxes including evaporation, lateral heat exchange with the Arabian Sea, and Sea Surface Temperature (SST). Although these three variables are interrelated, only SST has been directly and sufficiently observed. Without any artificial flux adjustment, the model succeeds in simulating the climate of the Gulf, as demonstrated in the close agreement of simulated SST with satellite and in-situ observations of the same variable. The model simulates the details of the circulation in the Gulf at high resolutions (3km horizontal, 1m vertical), including estimates of the exchange of water and heat with the Arabian sea, (Xue and Eltahir, 2015).

The proposed collaborative project between Kuwait University and MIT will build on this past research, using the model described above. It will focus on the sub-region around Kuwait with the objectives of: (1) Numerical simulation of the impact of the current and planned desalination plants around Kuwait on the temperature and salinity of the water around Kuwait; (2) coordinated analysis of field data archived by ROPME (Regional Organization for the Protection of the Marine Environment) and satellite data describing the state of the Gulf (temperature, and salinity) acquired and archived by Kuwait University in order to test and refine the coupled model of the Gulf-atmosphere system; (3) Simulation of the impact of climate change on the coupled Gulf-atmosphere system, for the 21st century. The study will use boundary conditions from select set of global climate models.

**KFAS contribution:** KWD 111,000  
**Total budget:** KWD 121,500
Energy-Efficient and Sustainable Communications Network (P314-35EO-01)

M. Awad
Kuwait University

Project Progress - Abstract:

The objective of the project is to design and develop an energy efficient, eco-friendly and sustainable networks. In particular, the research team focus on optimizing the network in three domains: network planning, resource allocation and sleep scheduling. The multidisciplinary team with diverse expertise was able to make substantial progress and contribute to the three domains, as proposed.

For the network planning domain, we proposed two self-organizing schemes for Large Scale Wireless Sensor Networks (LS-WSNs) that generate clustering-based and scale-free-inspired, which are energy-efficient and robust. One of the schemes shows higher energy efficiency and stronger robustness to node failures, because it avoids establishing links to hub-nodes with high potential connectivity. Analytical and simulation results demonstrate that our proposed schemes outperform the existing scale-free evolution models in terms of energy efficiency and robustness.

Resource allocation is another possible domain for improving energy efficiency of communication networks. The incorporation of Cognitive Radio (CR) and Energy Harvesting (EH) capabilities in wireless sensor networks enables a spectrum and energy efficient CRSNs. In these networks, energy harvesting supplies the network with continual source of energy to facilitate self-sustainability of the power-limited sensors. Furthermore, cognitive radio enables access to the underutilized licensed spectrum to mitigate the spectrum-scarcity problem in the unlicensed band. For this type of networks, we develop an aggregate network utility optimization framework for the design of an on-line energy management, spectrum management and resource allocation algorithm.

Furthermore, we consider sleep scheduling and energy efficient routing for traditional Ethernet networks and emerging software-defined networks (SDNs). In SDNs, the central controller has a global view of the network topology, traffic matrices and QoS requirements, which allowed us to optimize the energy consumption of the network through energy-aware routing. In addition, we considered the issue of securely reporting data from smart meters to the data aggregator in a smart grid.

Publications:


KFAS contribution: KWD 71,590
Total budget: KWD 71,590
Irrigation Studies in Date Palm (Phoenix Dactylifera L.) Phase II: Development of Precision Irrigation Scheduling Under Kuwait’s Environmental Conditions (P315-22SL-01)

N. Bhat, I. McCann, T. Thomas, M. Albaho, S. Chellan, L. Al-Mulla, S. Mathew, S. Isathali, and P. George

Kuwait Institute for Scientific Research

Project Progress - Abstract:

Presently, more than >200 m³ of water/tree/year (31,250 m³ of water/ha year) is applied to date palms in Kuwait. In the first phase of long-term irrigation studies, Kuwait Institute for Scientific Research (KISR) showed that the water requirement of young date palms based on actual evapotranspiration (ETc) in Kuwait varies from 23,392 - 27,251 m³/ha/ y. These studies also suggested that irrigating date palm at 50% of ETc did not significantly affect their growth performance compared to full ETigation. While these studies needed to be continued until the commercial bearing age was attained, additional studies on the evaluation of new potential irrigation strategies were essential to effectively address the twin national challenges, namely, conserving water resources and improving growth, yield, quality, and water productivity in the date palm. Hence, the second phase is aimed at developing precision irrigation scheduling using modern concepts such as variable ETigation rate, regulated deficit irrigation, and subsurface ETigation systems. During the first year of this project (December 2015-November 2016), the mobilization task was completed, and Task 2, dealing with determination of water requirements, was initiated and is ongoing. The required research equipment, drainage lysimeters, and soil moisture probes and sensors required for determining the water requirements of date palms were procured and commissioned. During the second year (December 2016- November 2017), in addition to Task 2, the remaining tasks, namely evaluation of variable irrigation and regulated deficit irrigation were initiated. For this purpose, an additional 600 date palms have been established in the field for conducting the remaining studies.

KFAS contribution: KWD 50,800
Total budget: KWD 183,840

Measurement and Characterization of Solar Irradiance and Climatological Factors for Assessing Solar Conversion Technologies in Kuwait (P315-34SE-01)

M. Al-Rasheedi, A.H.J. Ismail

Kuwait Institute for Scientific Research

Project Progress - Abstract:

The Kuwait Institute for Scientific Research (KISR) has proposed this project to its Solar Resource Assessment Program for Kuwait, based on both ground-based observations and extensive modeling. During the first year, ground observations of solar radiation from five desert sites were analyzed and quality checked. Other four stations in urban sites are in the process of deployment in rooftops of schools representing different urban areas. The Quality assurance tests showed that the weather stations were well maintained. There were limited number of data gaps and outliers, which were mainly due to power shutdown. The project team conducted a study to understand the deviations between photodiode-based radiometers and thermopile-photometers and pyranometers radiometers. The long-term variability of aerosol optical depth (AOD), dust episodes, and Direct Normal Irradiance (DNI) over Kuwait have been studied for Concentrated Solar Power (CSP) applications. A typical meteorological year (TMY) datasets was developed for Shagaya and Kabed based on 14 years of satellite data, corrected with 1-year ground data measurements. The correction aims to improve the quality of the modeled data by removing systematic or seasonal biases. Since the methodological details of site adaptation techniques are usually proprietary, there is currently no direct performance comparison between different techniques in the literature. Hence, the project team has initiated such a comparison as a preliminary exercise to learn more about the strengths and shortcomings of these techniques. A new tailored version of SMARTS2 for Kuwait has been developed in its first version. This version can synchronize ground irradiance measurements with their modeled counterparts. The SMARTS2 use sunphotometer observations as inputs data. The modeled data show good agreement with ground measurements data.

Publications:


KFAS contribution: KWD 63,727
Synthesizing of MgH₂-Nb₂O₅-based Nanocomposite Powder Particles for the Manufacturing of Hydrogen Storage System for Light Duty Vehicles, Phase II (P315-35EC-01)

M. El-Eskandarany, H. Al-Matrouk and F. Aldakheel

Kuwait Institute for Scientific Research

Project Progress - Abstract:

The main goal of the project is to improve the hydrogen storage parameters for magnesium (Mg) metal through the development of MgH₂-based nanocomposite powders proposed for using as feedstock materials to manufacture a hydrogen storage system integrated with fuel cell. In order to achieve this goal, the tasks of the project were classified into nine tasks. In reference to the master plan of the project, Task 2, Synthesizing of Nanocrystalline MgH₂ Powders, and Task 4, Preparation of Nanocomposite MgH₂ Powders, which were started on March and July 2016 respectively, have been successfully completed. The tasks related to the materials characterizations; Task 5, Hydrogenation Properties and Structural and Thermal Stability, and Task 6, Morphology and Powder Characterizations, which were started on March and May 2016, respectively, are ongoing Tasks. Task 7, Pilot Tank Development was started on April 2016 to be completely finished by October 2018. Task 8, Data Analysis, was started on April 2016 and will be completed by October 2018. Task 9, Report Publications, which is addressed to prepare the reports related to the project and paper publications in the journals and conferences, will be finished by January 2019. Within the period extended from January to December 2017, project team published six papers that appeared in top quartile category (Q 1/Q2) scientific journal, and submitted one paper. In addition, eight papers were presented in highly cited international conferences during the same period. In addition, the project team was awarded two patents issued from the US Patent office.

Publication:


KFAS contribution: KWD 91,750
Characterization and Assessment of Industrial Wastewater in Kuwait (P316-25EC-01)

A. Al-Haddad, M. Ahmad, H. Abdullah, A. Almatouq, M. Khajah, A. Abusam, R. Al-Yaseen, A. Al-Dhafeeri, B. Al-Salman and S. Al-Salem

Kuwait Institute for Scientific Research

Project Progress - Abstract:

This study is a continuation of the previous project (WTO 13C), which aims to collect data on the quality and quantity of petroleum and non-petroleum industrial wastewater from various sources in Kuwait and develop database on industrial wastewater quality and quantity. The progress of the work from the start date to 31 October 2018 is reported herein. Total of 75 field visits were conducted by the project team and questionnaires were submitted to owners of industries in the Sabhan, Kuwait City, and Shuaiba industrial areas. The completed field survey results indicated that the activities of the industries were distributed among 20 categories and classified to 11 and 37 petroleum and non-petroleum industries. Also, the field data indicated that limited number of owners of factories used on-site treatment systems for industrial wastewater. In the next step, the quantity and quality of wastewater will be monitored through flow meters and through collection of industrial wastewater samples from each factory over the period of a year. The wastewater samples will be analysed for inorganic and organic parameters by the chemists of Water Research Center (WRC) and Environment and Life Sciences Research Center (ELSRC) laboratories. The laboratory results will be compared with local and international wastewater standards. Moreover, the outcome of this study will include assessment of results, and recommendations for future national programs related to industrial wastewater quantity and quality control and possible treatment for integrated water resource management in the country.

KFAS contribution: KWD 66,590
Total budget: KWD 182,145

Assessment of Viability and Efficiency of Two Forward Osmosis Membrane Technologies for Seawater Desalination: Pilot Plant Scale (P316-25EC-02)

M. Ahmed, Y. Al-Wazzan, B. Garudachari, R. Kumar, M. Al-Tabtabaei, and J.P. Thomas

Kuwait Institute for Scientific Research in collaboration with Ministry of Electricity and Water

Project Progress - Abstract:

The Ministry of Electricity and Water (MEW) requested Kuwait Institute for Scientific Research (KISR) to conduct an applied research to develop and demonstrate the viability of forward osmosis (FO) technologies on a pilot-scale level, tailored especially for seawater desalination. Thus, KISR has taken the lead in developing and investigating the FO technology for commercial applications. This annual progress report covers the outcome of all activities of the completed and ongoing tasks. The main aim of this project is to assess the feasibility and effectiveness of using two different FO technologies, i.e., forward osmosis-reverse osmosis (FO-RO), and forward osmosis-thermal separation (FO-TS), for seawater desalination. The research plan includes six main tasks that will be covered over a period of 24 mo, and the total estimated budget is KD277,995. The Kuwait Foundation for the Advancement of Sciences (KFAS) and MEW were approached for funding the operating and capital expenses, respectively. The delay in approvals from MEW delayed the start of the project. Due to commitment with KFAS and to avoid further delay in starting the project, the capital expenses of the project was reduced by lowering the capacity of the pilot plants. KISR has approved funds for procuring the pilot plants and also to cover the remaining items under the operating expenses. Accordingly, the revised contract was signed by KISR’s director general (DG) and KFAS’s DG on 8th and 15th April 2018, respectively. KISR’s version was approved by KISR’s DG on 20 May 2018 and the budget accounted for the project was available from 20 May 2018. As a result, the first, second and third Tasks were delayed and work is under way. However, the FO-TS pilot plant was received, installed, and commissioned according to the schedule. The experimentation and data collection of FO-TS pilot plant is ongoing as per the schedule. Upon receiving the FO-RO pilot plant, the delayed as well as remaining tasks will be performed with all possible efforts to complete the project on time and as scheduled.

KFAS contribution: KWD 49,995
Total budget: KWD 277,995
Pilot Hybrid Biofilm Reactor for Treatment of Industrial Wastewater (P316-25EC-03)

M. Ahmed, R. Al-Yaseen, A. AJHaddad

Kuwait Institute for Scientific Research

Project Progress - Abstract:

This progress report presents a novel and innovative pilot hybrid biological reactor for the treatment of industrial wastewater. Based on agreement from the Public Authority for Industry (PAI), initial samples of industrial wastewater were collected from Al-Wafra industrial wastewater treatment plant at different points in the treatment scheme to use in designing the pilot hybrid reactors for experimental evaluation. As planned in Task 1, the hybrid pilot reactor was designed using an innovative mathematical model and its dimensions and operating parameters were estimated. The hybrid pilot was manufactured and assembled at Sulaibiyah Research Plant. The pilot reactors were tested using potable water, and after all minor issues were resolved, testing using petrochemical wastewater was started. The pilot reactors were ultimately dimensioned at 80 x 80 x 60-cm and packed with random packing (RP) plastic biological growth carrier and are being primed using industrial wastewater. The mobilization phase (Task 1) is at a completion with only part of the experimental analysis reagents awaiting delivery. In addition, initial priming of the reactors is being carried out as part of Task 2, and the data analysis task (Task 3) is due to start in May 2018.

KFAS contribution: KWD 40,225
Total budget: KWD 154,355

Extraction of Magnesium Oxide from Concentrated Brine: Pilot Plant (P316-25EC-04)

M. Ahmed

Kuwait Institute for Scientific Research

Project Progress - Abstract:

Seawater desalination plants in the State of Kuwait produce large amount of brines, which is high saline water discharged into the sea, resulting in a negative impact on the marine environment, because the brine discharged by the desalination process contains higher salt concentration and a relatively higher temperature than that of seawater. Because the brine is rich in minerals and salts, the extraction process, recycling, and exploiting of these minerals and salts as raw materials in industrial processes are successful ways to eliminate the environmental damage caused by seawater desalination plants and will enhance the economic resources of the country. Therefore, the main objective of this study is to assess the technical viability of the integration of membrane, thermal, and chemical separation processes on pilot-scale for the extraction of minerals and precious salts from brine of desalination plants. To achieve the objective of this study, the work plan includes five main tasks to be carried out over a period of thirty (30) months. Over one year, the scope of work involved the literature survey to compile and evaluate all of the previous related citations on rejected brine from Seawater reverse osmosis (SWRO) desalination plants and review the different design aspects, cost-effective methods, and parameters affecting solubility and precipitation of magnesium (Mg). In addition, the mobilization task included several subtasks, normally, design development, construction, and mobilization of supplementary equipment needed for this project, conducting necessary site preparations, calibration of the measuring instruments, procurement of chemicals and supplementary equipment needed for this project. A laboratory test unit was designed, constructed, equipped, and operated to execute laboratory experiments on the rejected brine of desalination plants up on request of the Ministry of Electricity and Water.

Samples were collected from the rejected brine of the main SWRO desalination units of Desalination Research Plant (DRP) twice a week for conducting physical and chemical analysis at DRP’s laboratories. Results showed that the concentration of magnesium in brine from SWRO desalination units of DRP was 1,670 mg/L. The laboratory results showed that Mg extraction process using commercial grade sodium hydroxide as a base with pH and temperature of 10 and 90°C, respectively, was able to extract 1,651 mg of Mg per one liter (equivalent to approximately 90% of Mg in the reject brine of SWRO desalination units of DRP). The pilot-scale results will be started upon final commissioning.

KFAS contribution: KWD 36,270
Total budget: KWD 136,450
Conducting a Periodic Statistical Study in Educational Facilities for Measuring the Water Consumption (P316-25EM-02)

S. Al-Muzaini

Ministry of Education in collaboration with Kuwait Water Association

Project Progress - Abstract:

The available information indicates that the amount of water used in the schools of the Ministry of Education in recent years is dramatically increasing as a result of the increase in the number of schools and students (boys and girls), as well as expansions and renovation of the current schools' buildings.

Additionally, the results of studies indicate that the current practice of unsustainable water use in the schools will lead to continuously raising of the water bill. This will certainly cause a negative impact on the Ministry of Education's budget if it did not set up plans and immediate action to manage them. Current awareness programs should be more enforced, and this requires a periodic monitoring and controlling that can explain the water situation and its impact on the water source. It is worth mentioning that there is no periodic accurate information regarding the amount and usage of water. But the available information is limited to some decisions carried out by the Ministry of Electricity and Water periodically.

Therefore, this study will be based in conducting a periodic statistical study in educational facilities for measuring the water consumption and raising awareness among students, teaching staff and services, as well as to estimate the real consumption by connecting water data loggers to the water meters. The loggers will measure and show the Minimum Night Flow (MNF) for each school. MNF will give us accurate information about the water usage behavior inside the schools as well as the required measures and solutions needed to be carried out in the future.

KFAS contribution: KWD 31,300  
Total budget: KWD 50,800

Evaluation of Surface Runoff along the Wadis of Northern Kuwait (P316-25SE-02)

A. Mukhopadhyay

Kuwait Institute for Scientific Research

Project Progress - Abstract:

The main objective of the current study is to assess the volume and quality of rainfall runoff generated along dry river channels (‘wadis’) in North Kuwait during rare high intensity rainstorms that occur occasionally. It has been proposed that runoff volume generated along two or three “wadis” and its electrical conductivity (EC) will be measured over two rainy seasons for this purpose. A tender was floated in June 2018 inviting bids from competent companies for installing suitable automatic sensors and rain gauges at selected sites on “wadis” in north Kuwait that would measure the flow rate of runoff and rainfall amount. Installing a suitable telemetry system that would transfer the measurements from the field to the office was also a part of the responsibility of the company. Only one bid was received against this tender, and the price quoted was much higher than the budget provided. To attract more bids, the tender was refloated in July 2018; but this time also only one bid was received with very high price, and it was also technically rejected for the non-submission of a fresh bank guarantee. To encourage more bidders to submit their bids, it has now been decided to revise the tender with somewhat reduced scope and more general specifications without substantially affecting the objectives of the study, and to refloat it.

KFAS contribution: KWD 89,600  
Total budget: KWD 200,360

RESEARCH DIRECTORATE | Research Grant | Ongoing Projects
Continuous Synthesis and Isolation of Magnetic Nanoparticles Using Droplet Microfluidics For Wastewater Treatment (PN17-24SC-01)

E. AlHetlani
Kuwait University

Project Progress - Abstract:
The design of visible-light active nanophotocatalysts is of great importance in wastewater treatment. Therefore, in this work, two types of nanophotocatalysts, namely (1) semiconductor-based (CeO$_2$, Ag$_2$S/CeO$_2$, Cu$_2$S/CeO$_2$ NPs) and (2) magnetic-based (Fe$_3$O$_4$ and metal ferrites CoFe$_2$O$_4$ and NiFe$_2$O$_4$ NPs) were synthesized and thoroughly characterized using XRD, XPS, FTIR, TGA, UV-Vis, DLS, BET, TEM, HRTEM and electrochemical techniques. For nanophotocatalysts semiconductor-based, two nanoheterstructures were developed by mixing 90% CeO$_2$ NPs with 10% of Cu$_2$S or Ag$_2$S NPs, respectively. The TEM results revealed average particle sizes of ~ 3.9, 6.8 and 7.1 nm for CeO$_2$, Ag$_2$S and Cu$_2$S NPs, respectively. The particle size of NPs increased to 12.3 and 11.1 nm upon the growth of Cu$_2$S and Ag$_2$S on the surface of CeO$_2$ NPs, respectively. The $S_{\text{BET}}$ surface area of CeO$_2$ NPs was 72.4 m$^2$g$^{-1}$ and increased to 81.5 and 101.16 m$^2$g$^{-1}$ for Cu$_2$S/CeO$_2$ and Ag$_2$S/CeO$_2$, respectively. The photocatalytic activities for CeO$_2$, Ag$_2$S/CeO$_2$ and Cu$_2$S/CeO$_2$ NPs were tested toward the photodegradation of Rhodamine 6G dye (R6G) under natural solar radiation. The obtained results showed an enhancement of the photodegradation efficiency in case of Cu$_2$S/CeO$_2$ and Ag$_2$S/CeO$_2$ by 44% and 30% compared to 23% only for bare CeO$_2$ NPs. This enhancement in photo efficiency is mainly related to the change in band structure and narrowing the band gap of CeO$_2$.

Publications:

KFAS contribution: KWD 49,900
Total budget: KWD 104,390

Hybridization Appraisal of Forward Osmosis and Membrane Distillation Processes for Seawater Desalination (PN17-25EM-01)

M. Ahmed, M. Al- Tabtabaei, S. Al-Muqahwi, and J. Thomas
Kuwait Institute for Scientific Research in collaboration with Ministry of Electricity and Water

Project Progress - Abstract:
The hybrid membrane system using forward osmosis (FO) and membrane distillation (MD) is a sustainable solution for seawater desalination application in the future. This innovative hybrid system has its advantages and can avoid the limitations of conventional seawater desalination technologies. KISR has taken the lead in developing and investigating this research area through this project. This annual progress report covers completed activities and ongoing tasks.

The objective of this project is to assess the viability and efficiency of a hybrid system of the FO-MD technology for the Arabian Gulf seawater desalination under the prevailing conditions of Kuwait. The research plan included five main tasks that will be carried out over a period of twenty four (24) months with a total budget of KD 174,197. The Kuwait Foundation for the Advancement of Sciences (KFAS) and MEW were approached for funding the operating and capital expenses, respectively. The delay in approvals from MEW delayed the start of the project. Due to commitment with KFAS and to avoid further delay in starting the project, the capital expenses of the project was reduced by lowering the capacity of the pilot plant. KISR has approved funds for procuring the pilot plants and also to cover the remaining items under the operating expenses. Accordingly, the revised contract was signed by KISR’s director general (DG) and KFAS’s DG on 21st and 25th March 2018, respectively. KISR’s version was approved by KISR’s DG on 21st April 2018 and the budget accounted for the project on the same date. Task 1 (Mobilization) is ongoing. Design and specifications for the pilot plant were developed; purchase request was processed; laboratory site was identified and prepared at the Desalination Research Plant (DRP) for the hybrid system. Execution of the other tasks will follow after constructing, commissioning, and operation of the pilot plant.

KFAS contribution: KWD 49,117
Total budget: KWD 174,197
**Versatile Polymers for Organic Field Effect Transistors: Sustainable Materials for Photovoltaic Cells and Sensing Applications (PN17-34SC-01)**

B. Alameddine

Gulf University for Science & Technology

**Project Progress - Abstract:**

Six conjugated polymers bearing phenanthrene-9,10-dione and dibenzo[f,h]quinoxaline as the acceptor units were synthesized via an optimized Suzuki cross-coupling reaction. The resulting co-polymers display excellent solubility in common organic solvents with high chemical stability, allowing for the determination of their structural, thermal, and optical properties by various analytical techniques. We would like to thank the Kuwait Foundation for the Advancement of Sciences, whose generous funding allows for the realization of this research project, and, improvement of our research capacities by expanding our group in organic materials chemistry at Gulf University for Science and Technology.

![Chemical structure and graph](image)

**KFAS contribution:** KWD 84,025  
**Total budget:** KWD 198,425

**Development of Advanced Perovskite Solar Cells (PN17-34SC-02)**

Y. Abdulraheem

Kuwait University

**Project Progress - Abstract:**

Interest in perovskite solar cells has increased rapidly over the last few years due to perovskite’s great potential as a light harvester. Perovskite solar cells are composed of a perovskite based light absorbing material in between an electron transport layer (ETL) and a hole transport layer (HTL) as well as front and back electrodes. The main limitations preventing perovskite solar cells from commercialization is its limited small size, instability rapid degradation in ambient conditions. This project aims first at developing perovskite solar cells greater than 1cm² and with power conversion efficiencies larger than 15%. The perovskite solar cell will then be further improved through the optimization of the ETL and the HTL in terms of researching different materials and thicknesses for the ETL and focusing on different thicknesses for the HTL. The front electrode will also be optimized in terms of its electrical conductivity, absorption and work function through use of different fabrication techniques. Research into the stability of the solar cell will include addition of metal ions to the perovskite and its possible effect on improving stability. Finally, research will include modelling of both perovskite solar cells and tandem solar cells that include both a perovskite based top cell and silicon based bottom cell.

**KFAS contribution:** KWD 171,600  
**Total budget:** KWD 297,300
**Solar Cells Efficiency Improvement Using Optical Nanostructures Coating Layers (PN17-35EE-01)**

A. Hajjiah  
Kuwait University

**Project Progress - Abstract:**

In this study, the main target is to improve optically solar cells power conversion efficiency. One of the efficiency reduction reasons solar cells are able to absorb only visible wavelengths and convert it into the required electrical output power, while the rest solar irradiance energies are considered as losses. Furthermore, about 49 percent only of the incident solar irradiance are visible wavelength while the rest of the irradiance energies are infra-red (IR) or ultraviolet (UV) photons. Optical conversion materials are considered as the best ways to exploit this un-absorbed bands within the radiant solar energy and convert it into visible absorbed ones using up or down conversion materials. Rare earth trivalent erbium (Er3+) material is one of the best efficient up conversion materials specially after doping it in a host crystal. Sodium yttrium fluoride (β-NaYF4) and cerium oxide nanoparticles are considered as the best studied Er3+ host crystal materials. NaYF4 host materials have low vibrational energy that leads to achieve high up conversion efficiency after doping erbium ions inside it. Meanwhile, ceria nanoparticles doped with erbium have the advantages of being both up/down optical conversion of solar cells. The existence of Ce3+ ions in side ceria nanoparticles help in the down-conversion from UV excitation to visible emission, while erbium dopant forms energy levels inside the low-phonon ceria host to up-convert IR excitations into green and red emissions. When coating erbium-doped ceria nanoparticlesorNaYF4 on the back side of a solar cell, a promising improvement in the solar cell efficiency might be happen because of the visible photon energies resulted from the optical conversion processes.

**Publications:**


**KFAS contribution:** KWD 8,000

**Total budget:** KWD 18,400

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**Experimental Study to Investigate the Effect of Nano-Particle on Improving Heavy Kuwaiti Oil Recovery (PN17-35EP-01)**

O. Alomair  
Kuwait University

**Project Progress - Abstract:**

Worldwide demand for oil has led to the need to exploit even unconventional oil resources, such as heavy/extra-heavy crude oils. Most likely, progression and recovery of heavy oil (HO) requires great energy and water intensive, which consequently results in environmental impacts. Therefore, it is necessary to quest for new ideas and alternatives, such as nanoparticles (NPs), in the field of in/ex-situ upgrading and recovery to improve current technologies and make them both environmentally friendly and cost-effective. The main objectives of applying nanoscale materials in oil reservoirs are the remediation of formation damage, enhancing volumetric sweep, improvement of energy efficiency, mobility control, reduction of environmental impacts, and ultimately, improving incremental recovery of oil reservoirs.

This project is aimed at understanding the behavior and flow characteristics of heavy crude oil resulting from NPs injection in EOR process. Although the use of NPs is not new, but the ability to monitor the NPs distribution in the fluid and core is not yet investigated. Therefore, the main objective of this study is to develop a new approach of real time imaging, under reservoir conditions, the injected NPs in core sample and NPs solution in crude oil.

This can be accomplished by investigating the effects of different Nano-fluids on the recovery of heavy oil using different types of rock samples (synthetic and real). The investigation will include; heavy crude oil viscosity reduction, wettability alteration, and interfacial tension reduction during Nano-fluids flooding process. The objective will also be extended to study the formation damage resulting from the use of NPs by applying state-of-the-art real time 2-D/3-D imaging technology before, during, and after NPs injection.

Finally, a comprehensive explanation of the effect of various Nano-fluids in Kuwaiti heavy oil recovery from reservoir rocks will be conducted. Ultimately, this study will yield the most optimum Nano-fluids need to be considered for successful application of NPs injection to enhance oil recovery of Kuwaiti heavy oil reservoirs. It will also answer most discrepancies in the clarification of the behavior of NPs when injected inside rock.

**KFAS contribution:** KWD 140,850

**Total budget:** KWD 225,135
Pollutant Dispersion within Built-up Environment under Changes of Atmospheric Stability and Building Configurations (PN17-44SE-01)

M. F. Yassin, M. Al-Rashidi, A. Al-Hemoud, A. Ramadan, A. Al-Dabous, M. Malak and M. Shlas

Kuwait Institute for Scientific Research

Project Progress - Abstract:

The most common sources of harmful pollutants (e.g., toxic and odorous chemicals) in the built-up environment are industrial, restaurants, institutional and hospital laboratories. Depending on thermal stability and airflow re-circulation, effluents can be transported toward fresh air intakes and contaminate indoor air causing health problem to the buildings' occupants. The prediction of air intake contamination in a built environment is important for avoiding adverse air quality impacts. The current study presents a numerical simulation of the flow and dispersal of hazardous gaseous release from different stack locations in a building with varying atmospheric thermal stability. The three-dimensional flow and dispersal of gaseous pollutants were modeled using a computational fluid dynamics model (CFD) incorporating different three-dimensional k-ε turbulence models and were solved using Reynolds-averaged Navier–Stokes equations. Numerical simulations with varying thermal stratifications were conducted using an isolated cubical building model. The diffusion flow field in the building wake was studied for different stack locations (left, center and right sides) and atmospheric stabilities (stable, neutral and unstable conditions). Experimental data from a wind tunnel were used to evaluate and validate the numerical results using the data qualitatively and quantitatively. The numerical results were consistent with the wind-tunnel results. The numerical results showed that the concentration of the plume spread is high near the stack and decreases with distance. When stable conditions occurred, flow motion and separation increased in the wake and concentration of the lateral spread at a human level decreased. When unstable conditions occurred, the flow of the vortex circulation was fast and strong, and concentration of the vertical spread increased.

KFAS contribution: KWD 26,700
Total budget: KWD 109,700

Sustaining the Competitive Identity of Kuwait: The Role of Elites and Social Media Users (PR17-11AM-01)

Y. Abdelrahim

Gulf University for Science and Technology

Project Progress - Abstract:

The project aims to examine the role of elites and social media users in promoting the image of Kuwait globally and sustaining Kuwait's 'competitive identity'. The concept of 'competitive identity' goes beyond the idea of 'nation branding' that focuses on the role of government. In the 'competitive identity' theory, people are essential component of branding the image of a nation. Kuwait has been recognized globally for its humanitarian role through traditional diplomacy and public diplomacy. This research project resonates with Kuwait National Development Plan of 2035 that aims to 'enhance Kuwait's regional and global presence'.

The first phase of the project looked at the digital identity of Kuwait. This phase, which was investigated in a collaboration with Bloom Consulting, looked at the digital demand on tourism, investment, talents and workforce, exports, and prominence in Kuwait. In the second phase of the project, a survey that examined the perspective of 423 social media users was conducted to understand how social media users can contribute to the image of Kuwait on social media, and their perspectives on the role of government and private sector.

In the third phase of the project, social media users conducted a three-week social media campaign was conducted between November 27, 2018 and December 13, 2018. Entitled “Unique Kuwait”, the primary goals of the campaign that were conducted on Facebook, Twitter, and Instagram, were: (1) To raise awareness among Kuwaiti citizens about the importance of branding the image of Kuwait, and (2) To promote the image of Kuwait talents (Jobs), culture, and investments among non-Arab expats in Kuwait. The campaign strategies aimed to make the ‘uniqueness of Kuwait more Visible for Kuwaiti citizens and for non-Arab expats. The selection of the campaign title was based on the perspective of the vast majority of respondents to the social media survey.

As this project is considered a participatory research, graphic design students designed several logos for the social media campaign. The main objective of this part of the project was create a visual identity that can be used to promote the image of Kuwait. The last part of the project will shed light on the role elites can play to sustain the image of Kuwait globally.

KFAS contribution: KWD 4,500
Total budget: KWD 4,500
A Framework to Integrate Smartphones as A Mobile Learning Tool in Kuwait University (PR17-11TT-01)

F. Al-Khezzi
Kuwait University

Project Progress - Abstract:
Smartphones today are ubiquitous and are influencing our everyday life and have unsettled many age-old tasks, activities, devices, gadgets, tools and technologies with their redefined usage and definitions. They have become excellent contrivance as an instant learning content provider, prompt and handy communicator, productivity agent and a multipurpose device. The understanding of parameters which govern their customized and personalized integration is the key to a successful acceptance and assimilation of this device as a learning tool.

In this study, technology acceptance models were used aiming at predicting and explaining the Kuwait university students’ behaviors towards the acceptance and usage of new technologies. Then, a framework to integrated Smartphone as a mobile learning tool in Kuwait university will be developed. The entire project task were broken down into activities and each of these activities was further allotted appropriate time and the required resources. Project planning lasted for three months. Ethical approval was acquired in the fifth month of the project progress. The main study data was collected for the next five months using opportunity survey technique. This activity was followed by data screening, data scraping, check for anomalies and initial data reliability testing. Intense data analysis was performed for four months, which included both descriptive and inferential analysis. In the next stage, based upon data output, the framework will be developed.

KFAS contribution: KWD 22,761
Total budget: KWD 48,591

Effect of Three Carbohydrates on The Growth of Nile Tilapia, Water Consumption and Water Quality in A Biofloc System (PR17-12SL-01)

M. Ridha
Kuwait Institute for Scientific Research

Project Progress - Abstract:
The biofloc technology (BFT) is a unique ecosystem consisting of aggregates of microbes, algae, protozoa, bacteria, uneaten food, and fish wastes suspended in water. BFT is used to improve water quality of the fish culture unit with zero water exchange. In BFT, carbohydrate is added as carbon source and energy in suitable amounts to force the heterotrophic bacteria to remove nitrogen in fish wastes and to utilize (immobilize) it in protein synthesis needed for the bacteria growth and multiplication.

This project aims to test the effect of three locally available carbohydrate sources: sugar, wheat flour and malt flour on the initiation and sustaining of the biofloc, and to evaluate the effect of biofloc on Nile tilapia growth, feed conversion, fish production rate, ammonia removal and water quality, reducing water consumption and amount of discharged effluent and the economics of tilapia farms.

The project consists of six tasks:
- Mobilization.
- Evaluation of the biofloc system.
- Monitoring the incidence of infectious diseases, bacterial load, and biofloc composition.
- Biochemical analyses.
- Economic assessment of the biofloc system.
- Data analyses and reporting.

KFAS contribution: KWD 16,600
Total budget: KWD 89,120
**Tissue Culture Technology Development for The Micropropagation Of Native Plants of Kuwait (PR17-12SL-04)**

L. Al-Sabah, C. Sudhersan, S. jibi, D. Al-Baijan, M.C. AL-Aswad and S. Al-Melhem

**Kuwait Institute for Scientific Research**

**Project Progress - Abstract:**

Kuwait’s native plant ecosystem has been greatly damaged due to anthropological activities. Several native plants are in endangered condition. Propagation and conservation of native plants are required for the desert greenery development, desert rehabilitation, and native plant biodiversity conservation. This research project is being carried out to develop micropropagation technology, optimization for mass production and to produce large number of plantlets through the newly developed micropropagation technology for few perennial native plants to use in the greenery program in Kuwait. The project study was initiated on 1st October 2017 and the experimental studies are ongoing at the KISR plant tissue culture laboratory. This progress report summarizes the research activities carried out during the period October 2017 to September 2018. During this one year period, Task 1. Mobilization and Plant collection was completed and Task 2. Development of micropropagation technology, Task 3. Germplasm conservation and Task4. Plant production and hardening, are ongoing. Micropropagation experiments for Caligonum polygonoides, Farsettia aegyptia, Helianthemum lippii, Acacia pachycerus, and Pennisetum divisum were initiated using immature seeds as explants.

Murashige and Skoog (MS) media with different concentrations and combinations of auxins and cytokinins were used for the study. A protocol was developed and standardized for the immature seed culture for Rhanterium, Acacia, Farsettia, Helianthemum and Calligonum. A protocol for adventitious shoot bud multiplication for the grass Pennisetum divisum was standardized using stem nodal segment explants.

**KFAS contribution:** KWD 44,500

**Total budget:** KWD 155,680

**Evaluating the Potential Use of Lytic Bacteriophages to Reduce Salmonella Contamination in Refrigerated Chicken Products (PR17-12SL-06)**

H. Al-Hashash, E. Al-Ali, B. Al-Feili. A. Akbar, D. Al-Baijan

**Kuwait Institute for Scientific Research**

**Project Progress - Abstract:**

Salmonella is a gram-negative flagellated rod shaped bacteria, and it is known for its remarkable ability to cause food poisoning especially in poultry. Moreover, Salmonella is considered as a vigorous food born pathogen fit for surviving under different threatening conditions. Different chemical and physical procedures are being applied to reduce Salmonella contamination both in poultry farms and in slaughter plants. However, the emergence of multidrug-resistant (MDR) Salmonella affected the efficiency of a number of frequently used antibiotics. Recently, bacteriophages, which are viral predators that only infect and multiply within their specific bacterial hosts, have been considered as a promising biocontrol method effective against foodborne pathogens, especially Salmonella. In addition, the post-slaughter treatment of poultry carcasses and skin demonstrated a great success in decreasing Salmonella contamination in processing plants. This project is aimed at evaluating the efficiency of an individual bacteriophage treatment against a mixture of them in reducing the recovery of selected S. enterica serotypes in locally refrigerated chicken products, and in assessing the best bacteriophage application method and duration. The current project was started in October 2017, with the mobilization and experimental design task in which the laboratory supplies were purchased, and the experiments were fully designed. For Tasks II and III, 3 types of Salmonella enterica serotypes (S. Enteritidis, S. Typhymurium, and MDR S. Enteritidis (MDRiSE)) were activated and checked for viability. In addition, 4 different phases which were isolated from the previous project FB099K, were activated and checked for viability too. All the chemical solutions and buffers were prepared. Experiments of Tasks II and III are ongoing as planned.

**KFAS contribution:** KWD 14,400

**Total budget:** KWD 89,900
Implementation of Mutation Induction to Improve Barley Production Under Harsh Environmental Conditions (The Case of Kuwait) (PR17-12SL-12)

H. Al-Menaie, O. Al-Ragam; M. A. Babu and A. AL-Shatti

Kuwait Institute for Scientific Research in collaboration with International Atomic Energy Agency (IAEA)

Project Progress - Abstract:

Increased agricultural production in arid and semiarid regions is a major challenge under Kuwait’s harsh climatic and environmental conditions and production of mutant crop varieties with enhanced traits such as increased yield and nutrition and tolerance to biotic and abiotic stresses is not introduced in Kuwait to enhance crop production. The current study addresses this gap and evaluates the potential of mutation breeding to breed new, improved crop varieties with desirable characteristics in an economically feasible manner within a short span of time in Kuwait. The project is aimed at enhancing sustainable forage production through the application of nuclear and biotechnology techniques in barley breeding programs in Kuwait. The project report covers all activities from January 2018 to 31 December 2018. About 1000 seeds each of three different varieties of barley were subjected to induced mutagenesis using gamma rays at Plant Breeding and Genetics Laboratory, Seibersdorf, International Atomic Energy Agency (IAEA). The radio-sensitivity was conducted prior to mutation induction to determine the lethal dose (LD50) of gamma irradiation for the three barley varieties which was found to be 450Gy. The M0 seeds of the barley varieties were subjected to preconditioning treatment followed by exposure to gamma irradiation of 450 Gy in a gamma cell to produce M1 mutated barley seeds. The M1 generation of barley mutant population was developed in the greenhouse and plant height, number of tillers, number of spikes, number of seeds and spikelength was recorded. The survival and fertility percentage of plants observed in the M1 generation revealed that both phenotypic and genotypic mutation has occurred in plants. The most intense mutagenic effect of gamma rays was observed in MKU5 barley variety, which recorded the lowest survival (27.1%) and fertility percentage (8.7%) when compared to other two varieties under study. The main spikes were harvested from each of the M1 plant to obtain M2 seeds. Presently the M2 seeds are planted under field conditions to develop M2 generation. Mutant screening and evaluation will be conducted in the second year to develop promising mutant barley lines adaptable to Kuwait’s environmental conditions with improved yield and quality.

KFAS contribution: KWD 44,800
Total budget: KWD 238,627

Depression, Disordered Eating and Obesity: A Qualitative Study (PR17-13MC-01)

N. Scull

Fawzia Sultan Educational Company in collaboration with American University of Kuwait

Project Progress - Abstract:

Obesity affects 43% of men and 59% of women in Kuwait (Ng et al., 2014). This is the highest rate of obesity among adults in the Middle East and in the top ten in the global population. Despite surmounting evidence of genetic, diet, and lifestyle factors that contribute to obesity, there is a lack of consensus regarding the relationships between depression, disordered eating patterns, and obesity. The purpose of this study is to interview people in Kuwait regarding their emotional wellbeing, their eating habits and perceptions of food, and how they feel these factors impact their weight and overall quality of life. Given that there may be a reciprocal relationship between depression and obesity based on previous studies, we also want to understand how people's weight impacts their emotional wellbeing. This study will be used to shed further light on the results of a previous, quantitative study (Psychological risk factors of obesity: using the eating attitudes test-26 and the patient health questionnaire - 9 as indicators). The interviews will be analyzed using content analysis and the themes generated will be used to gain a deeper understanding of how sociocultural variations in Kuwait influence these relationships. The purpose of this project to help physicians and allied health professionals identify the psychological risk factors of disordered eating and obesity to provide a more holistic, evidence based approach to clinical and lifestyle interventions for their patients with the goal of reducing the burden of obesity and associated risk factors in Kuwait.

KFAS contribution: KWD 3,465
Total budget: KWD 3,665
Assessment of Risk of Cataract Among Interventionalists And Actions on Prevention (PR17-13NR-01)

M. Alnuaimi
Ministry of Health

Project Progress - Abstract:

Conventionally radiation as radio-pharmaceuticals or as x-rays or high energy radiations) has been used in radiation departments (Nuclear Medicine, radiology and radiotherapy/ Radiation Oncology). There has been growing use of radiation mainly as x-ray fluoroscopy in clinical departments outside the imaging and therapy departments in recent years [1]. Unfortunately, clinicians in these departments (Cardiology, Electro-physiology, Vascular surgery, Urology, Orthopedic surgery, Gastroenterology to name a few) are not trained in radiation protection and that poses risks to patients and staff [1].

Recent studies under the leadership of Dr Madan Rehani published in reputed medical journals [2-6] has demonstrated eye lens opacities among 38 to 53% of main operators and 21-45% of nurses in cardiac catheterization labs. These lens opacities have the potential to lead to cataract.

This is a new observation and it has created new areas of research in which many countries in world are currently showing interest. Radiation induced cataract is a major threat among staff working in interventional suites. Nearly 16 million interventional procedures are performed annually in USA and the work load in most countries is quite large and is increasing. In Kuwait, there are more than five thousand interventional procedures performed every year. Roughly 7 doctors and 300 paramedical staff are involved in these procedures. They are scattered in Mubarak hospital, Sabah Alahmad Urology center, Chest Disease hospital, Jahra and AL Sabah hospitals.

The International Commission on Radiological Protection has reduced dose limit for staff by a factor of 7.5 (from 150 mSv/y to 20 mSv/y) [7]. At the moment no information is available on eye doses in staff working in interventional suites in Kuwait and there is similar lack of information from neighboring countries in the region. With increasing emphasis on radiation induced cataracts and reduction in threshold dose for eye lens, there is a need to assess the radiation doses to staff working in interventional suites in Kuwait.

KFAS contribution: KWD 47,000
Total budget: KWD 61,760

CO Oxidation Activity of Chromia Nanoparticles Dispersed on High Surface Area Graphene, Graphene Oxide or Alumina Support Materials (PR17-14SC-01)

A. Ali
Public Authority for Applied Education and Training in collaboration with Kuwait University

Project Progress - Abstract:

In this project, we successfully synthesized chromium oxide nanoparticles (Cr₂O₃ NPs), aluminum oxide nanoparticles (Al₂O₃ NPs), graphene oxide (GO) and reduced graphene oxide (rGO). The synthesized compounds were fully characterized via XRD, BET, XPS, TEM and HRTEM techniques. The results revealed that the α-Cr₂O₃ NPs are cubic in shape, whereas γ-Al₂O₃ NPs are tetrahedral with smaller particle sizes than Cr₂O₃ NPs. Furthermore, the particle sizes of Cr₂O₃ NPs ranged from 35 to 58 nm with increasing the calcination temperature from 400–800 °C, while the alumina NPs showed a smaller particle sizes ranging from 16 to 38 nm with increasing the calcination temperature from 600 to 1050 °C. It has been found that Graphene and graphene oxide have an extremely high surface-to-volume aspect ratio. Moreover, due to the carbon-vacancy defect and the functional groups presented, Cr₂O₃ NPs can be adsorbed onto their surfaces forming thermally stable composite materials which are promising to the oxidation of the toxic CO gas.

In addition, different hybrids of Cr₂O₃ NPs supported on Al₂O₃ NPs, graphene and graphene oxide have been successfully synthesized and characterized. The surface area observed for the synthesized Cr₂O₃ is 40 m²/g which increased to 67 m²/g for Cr₂O₃ supported by rGO and increased more to 112 m²/g and 147 m²/g for Cr₂O₃ supported by Al₂O₃ and Cr₂O₃ supported by GO, respectively.

Since the Cr₂O₃ is semiconductive material, it’s dispersion on the conductive GO or rGO expected to facilitate strong oxide-support electronic interactions, thus improving the redox-necessary surface electron-mobile environment. The synthesized nanocatalysts are being investigated for the CO oxidation at low temperatures and evaluate the effect of their surface areas and morphology on CO oxidation activity.

KFAS contribution: KWD 37,950
Total budget: KWD 189,966
Optical Nanosensors With Integrated Flexible Printed Nanoantennas For Water Quality Monitoring (PR17-15EE-01)

N. Shehata

Kuwait College of Science and Technology

Project Progress - Abstract:

This two-years project introduces an optical sensor used for water quality monitoring with two major contributions; design of optical nanosensor and developing printed nano-antennas for sensor nodes. Firstly, it is aimed to design optical nano-sensors to detect a set of parameters which indicate the water quality, such as dissolved oxygen concentration and tiny pollutants. These optical sensors use cerium oxide (ceria) nanoparticles as active sensing material due to the higher surface-to-volume ratio with corresponding higher sensitivity. The optical sensing mechanism is better than the electrochemical one with no need of reference electrodes. On the other hand, the used sensor nodes for communication will be embedded with printed flexible antennas using conductive nanoparticles ink for reduced cost. In the first year of the project, the sensing material of cerium oxide (ceria) nanoparticles has been synthesized whether structural and optical. In addition, ceria nanoparticles have been used as sensing material. In parallel, the characterization of the used ink for printing the antenna is presented along with a literature review of sensor network and management platform.

Publications:


KFAS contribution: KWD 49,900
Total budget: KWD 89,900

Implementation of A Study Skills Program Integrated with A Basic Algebra Developmental Course (PR17-16SM-02)

I. Winokur-Al Zaid

Gulf University for Science and Technology

Project Progress - Abstract:

This pilot study will focus improving the retention rate at the Math Foundation Unit (MFU) by integrating a study skills program in developmental math classes. At Gulf University for Science and Technology (GUST), we have a developmental math program which assists the students in their transition to college math courses. The MFU program includes Beginning Algebra (Math 095), Intermediate Algebra (Math 096), Beginning Algebra for English Majors (Math 094) and Pre-Calculus (Math 098). The students are placed in the respective math course according to their scores from the mandatory Accuplacer test. We also had adopted a 3:2 teaching model where three out of the weekly five classes are taught by the instructor and the remaining two are assigned for a practice lab with the TA. However, our retention rates are dropping. In his interview with H. Boylan (2011), P. Nolting quotes Bloom’s (1976) description of the variance contributing to the math success as 50% for cognitive entry skill and intelligence, 25% for quality of instruction and 25% for affective characteristics. His advice for developmental educators is “to improve quality of instruction, teach students math study skills and test anxiety reduction techniques, as well as help students improve their math self-efficacy.” Therefore, we decided to pilot his study skills program integrated with our regular developmental math courses.

KFAS contribution: KWD 9,800
Total budget: KWD 24,900

H. Temimi
Gulf University for Science and Technology

Project Progress - Abstract:
Stochastic differential equation (SDE) models play a prominent role in a range of application areas, including biology, physics, chemistry, epidemiology, mechanics, microelectronics, economics, finance, and many others, when uncertainties or random influences (called noises), are taken into account. Unfortunately, in most cases, analytic solutions of SDEs are not available and we are forced to use numerical methods to approximate their solutions. Existing numerical methods for solving such equations are of low accuracy and poor stability. The development of accurate, efficient, and stable numerical methods for SDEs is a young field of research in mathematics. In this project, we propose to develop, implement, and analyze new high-order efficient and accurate discontinuous Galerkin (DG) finite element methods for solving SDEs arising in various fields of biology, engineering, and finance. The DG method have been successfully applied to deterministic (no stochastic) differential equations arising from a wide range of applications. In this study, we propose to apply a stochastic analogue of the deterministic DG finite element method to SDEs. In particular, we will focus on application to SDEs arising in various applications, especially in biology, finance, and mechanical engineering. The goal is to construct efficient and stable numerical methods to approximate many important SDE models such as the standard stochastic SIR epidemic model, the famous stock-price stochastic financial model, and the mechanical vibration model. Full implementation details and analysis will be provided, including codes. Numerical experiments will be performed to show the convergence of the proposed schemes.

KFAS contribution: KWD 8,200
Total budget: KWD 8,600

Free Vibration of Composite Layered Cylindrical Shells Filled with Fluid Under Shear Theory (PR17-16SM-05)

V. Kannan
Kuwait College of Science and Technology

Project Progress - Abstract:
Analyzing free vibration of symmetric and antisymmetric angle-plylaminated circular cylindrical shell filled with fluid. The equations of motion of the circular cylindrical shells are based on first-order shear deformation theory. The fluid is assumed to be quiescent and inviscid. Applying the permeability condition on the fluid-shell interface to ensure the contact between fluid and the shell wall. Since the interaction of the fluid and shell wall happened in radial direction so that the fluid terms is added at the radial displacement of the equations of motion of circular cylindrical shells. The arbitrary number of layers oriented in symmetric and anti-symmetric manner is considered to analyses the frequency characteristic of laminated shells. The equations of motion of the shell will be obtained in terms of displacement and rotational functions under first order shear deformation theory. These functions are assumed in a separable form brings to a system of differential equations in terms of displacement and rotational functions. These functions are approximated using Bickley-type splines to obtain the generalized eigenvalue problem with appropriate boundary conditions. Parametric studies will be carried out to analyze the frequency parameters with respect to the material properties, number of layers, ply angles, thickness to radius ratio and length to radius ratio of the shell filled with fluid. The numerical results obtained using the spline approximation will be validated through existing literature. This study may be helpful for engineers to design the cylindrical shell structure using the materials applied in this study. This type of shell structures can be built in the petroleum, ship and civil industries to minimize the weight and maximize the stability of the structures, which is definitely helpful for the Kuwaiti society.

KFAS contribution: KWD 5,000
Total budget: KWD 9,500
On Certain 3-Transposition Groups in Exceptional Groups Over Fields K of Characteristic Two (PR17-16SM-07)

F. Alawam

Public Authority for Applied Education and Training

Project Progress - Abstract:

The purpose of this project is giving an explicit and elementary construction of the embedding $F_{i22} \leq E_6(2)$, using the notion of M - set introduced by the second author. We show the existence of $F_{i22}$ and from the existence proof, it is immediate that $F_{i22} \leq E_6(2)$. It is remarkable to mention that there is no reference in literature giving an existence proof of $F_{i22}$. To achieve this goal, we start with a 6-dimensional vector space $V$ over the Galois field $F_2$, endowed with a non-degenerate quadratic form $Q$ of minimal Witt-index. Then we define the Weyl group $W = \text{Aut}(V, Q)$ and the generalized quadrangle $(P, L)$. We also define the three forms, namely, bilinear, symmetric trilinear and distributive multiplication form on a 27-dimensional module $A$ with base $e_x$, $x \in P$. From these notions we were able to give a construction of the Lie algebra $\mathfrak{e}_6(K)$ of dimension 78 over $K$ and the Chevalley group $E_6$.

Then we define the dihedral group $D_i, i = 0, 1, 2$ using the notion of the generalized quadrangle $(P, L)$ and the diagonal matrix $dP$ for $P \in P$, and the transformation $ta$ and $h$ on $A$. From these notions we were able to show that $F_{i22}$ is a 3-transposition group in $E_6(2)$.

KFAS contribution: KWD 10,200
Total budget: KWD 30,800

Adaptive Learning Management System based on Justification Truth Maintenance System (PR17-18IQ-01)

T. Ali

Gulf University for Science and Technology

Project Progress - Abstract:

The main anticipated outcome of this research is a technique to provide dynamic adaptive learning paths to learners. The other objective is to design and implement a prototype of the proposed system that can provide adaptive capabilities to e-learning by enhancing the learning process.

Achieved Outcomes:

1. Summerring the related Work.
2. System architecture, design, and cost calculation for the proposed system.
3. Database design and implementation.

Under Progress:

1. Implementation of a server-side application (API) integrated with Learning management system (Moodle).
2. Implementation of a client-side application for end user integrated with server-side application.
3. Writing research papers related to the project research questions.

KFAS contribution: KWD 10,000
Total budget: KWD 19,900
Investigation of the Impact of Critical Success Factors on Using the Online Government Web Site of Kuwait (PR17-18IQ-02)

K. Rouibah
Kuwait University

Project Progress - Abstract:

The Kuwaiti government has attached a great importance to e-government as a strategic project and created the Central Agency for Information Technology (CAIT), under Decree No. 266 of 2006. CAIT was mandated to set up the official e-government portal of the state of Kuwait (e.gov.kw), to supervise the project, and to develop IT plans and policies at the national level as well as to oversee the implementation and coordination plans with the ministries and public institutions. While CAIT succeeded to develop the e-government portal and automates a large number of electronic services for the beneficiaries (citizens, foreigners, institutions and private sector), how to assess the success of the portal by different end-users remains problematic for both researchers and practitioners at CAIT. Many studies have addressed this important topic but have narrowed contribution since they focused on isolated factors. Therefore, adopting a holistic approach is needed, that combines psychological factors (covering different perceived trusts and perceived risks factors) and organizational quality factors (information quality, system quality of the portal performance, and services quality) combined with individual factors (perceived value/ benefit, and user satisfaction) and the impact of all these factors on intention to continue using the portal by potential users. In addition, the impact of demographic data (age, gender, educational background, etc.) on intention to continue using the e-government portal remains unaddressed.

This study aims to fill in these gaps and investigate the critical success factors that influence the success of the e-government portal of Kuwait, through this exploratory research, by reviewing the relevant literature, build a causal model and testing it using a random sample of potential users in Kuwait. It is expected that this study will have benefits and implications of research and practice.

KFAS contribution: KWD 7,825
Total budget: KWD 15,025


A. Almutawa
Kuwait University

Project Progress - Abstract:

In this research, a novel method based on the phase of noisy speech and noise signal will be proposed for Arabic speech enhancement. This research will be mainly focused on intelligibility enhancement with quality Arabic speech signal. Phase ratio based on two gain functions (G1 and G2) will be calculated and that gain functions will be used for correction of noisy phase to suppress noises coming from various noise sources. For the reconstruction, both gains G1 and G2 will be multiplied and that will neglect the lower values of the phases which will be helpful in Arabic speech intelligibility improvement. Objective speech intelligibility measures, informal subjective listening tests and spectrogram analysis will be used for finding the effectiveness of the proposed research work.

KFAS contribution: KWD 4,000
Total budget: KWD 8,400
Characterization and Identification of Micro-Organisms Associated with Airborne Dust in Kuwait
(PR17-42SL-01)

F. Al-Salameen, N. Habibi, S. Uddin

Kuwait Institute for Scientific Research

Project Progress - Abstract:

Kuwait lies in the hyper arid region of the world and experiences extremely high dust load during summers. Studies have demonstrated that biological materials including microbes are associated with the dust. Some of these biological materials could be pathogenic and can pose a risk to the ecosystem and public health. The microbial molecules such as endotoxins and fungal mycotoxins can trigger respiratory stress if they are adhered to inhalable dust particles. The dust is transported into and over Kuwait from remote locations via different pathways. This study is aimed at establishing baseline concentrations and taxonomic characterization of microbes associated with different size fractions of dust. The study also attempts to understand the spatio-temporal variation in microbial assemblages and concentrations over seasons and their dependence on trajectories of air mass. The culture-dependent approach revealed the occurrence of three bacteria (Bacillus, Paenibacillus and Streptomyces) and two fungal genera (Aspergillus and Fusarium) from two different sites (Abdalli and Kuwait City). The fungal genera are known as potentially allergenic and mycotoxin producing forms. The metagenomic analysis in the subsequent year will enhance our knowledge at the species level.

KFAS contribution: KWD 49,000

Total budget: KWD 184,315
Dictionary of the Holy Qur’ān (Special Project)

A. Al-Ghunaim

Project Progress - Abstract:

The dictionary of the Holy Qur’ān emanated from a noble directive. His Highness, the late Sheikh Jaber Al-Aḥmad Al-Jaber Al-Ṣabah, the former Amir of Kuwait, had vowed to present to the Muslim nation, in particular, and the world at large, a dictionary of the Holy Qur’ān that would make it easier to comprehend, elucidate its contents and explain its objectives in a contemporary style that meets the requirements of the average intellectual and does not fall short of the needs of the specialist in the field. In other words, it would be an ‘encyclopedia’ that deals with the Holy Qur’ān, its words and what may represent a technical term or a notion that deserves to be analyzed and clarified to qualify as an entry in a dictionary. His Highness, may Allah have full mercy on his soul, assigned the implementation of this significant project to the Kuwait Foundation for the Advancement of Sciences.

The Dictionary is the first to be published in Arabic, translated into English and French, and combines the legislative, historical, geographical, archeological, botanical, zoological and medicinal aspects in words, illustrative pictures and maps. It comprises two main divisions: (1) a series of studies that present the Qur’ān, its history, language, the ways of inferring rules from it, and all the basic issues related to the Qur’ān; and (2) the terms of the Qur’ān itself, i.e. the entries that express its substance and reveal its objectives. The reader can easily understand the term and its explanation, and identify the related terms.

The Dictionary included several lexicons each devoted to a specific subject in order to underscore the significance of the Qur’ān as the eternal Muslim Book, and the source of the various jurisprudential sciences and the course of Muslim life, whether doctrinal, worshipping, legislative or social, between Muslims or international relations with non-Muslims.

As an introduction to these Lexicons, several volumes were issued, that deal with the history, language and rules of the Holy Qur’ān, namely:

1. Introduction to the Holy Qur’ān, relating to its history and subject matter, written by a number of scholars, published in Arabic, English and French.
3. The Language of the Holy Qur’ān, by the late Professor Aḥmad Mukhtar Umar, in Arabic.

Several lexicons have also been included:

1. The Lexicon of Plants and Botanic Terms, in Arabic, English and French.
2. The Lexicon of Medicine, in Arabic and English.
3. The Lexicon of Zoology, in Arabic and English.
4. The Lexicon of the Terms of Civilization, in Arabic.
5. The Lexicon of Names: Part I – Proper Names, in Arabic and English.
6. The Lexicon of Names: Part II – Pseudonyms, in Arabic; an English version is in the press.
7. The Lexicon of Faiths.

The panel is currently engaged in continuing this large project which was well received by those interested in Islamic studies and by intellectuals in general.

- The Lexicon of Ethics.
- The Lexicon of Geography, Astronomy and Geology.
- The translation into English of other lexicons.

This project is related to the Book of Almighty Allah. Its treatment requires the utmost precision and attention. Therefore, the implementation of one volume/lexicon per year, in addition to following up translation work is what could be accomplished in this respect. With this great project, the vow taken by the Amir and the State of Kuwait to the Muslim world would be fulfilled.
New Projects

Comprehensive Survey of the System of Criminal Procedure on the State of Kuwait (P116-TILP-01)

A. Elqahwaji
Kuwait International Law School (KILAW)

Abstract:

The Comprehensive Survey of Penal Procedures System in the State of Kuwait is a research project that was approved and adopted by the Kuwait Center for Studies, Research and Consulting, an affiliate of Kuwait International Law School, with a view to show the deficiencies and imbalances in the laws, regulations and penal procedures; which often lead to the invalidity of criminal trials and impunity for perpetrators and criminals, in order to establish the general rules of criminalization and convictions, including that "doubt must always be interpreted in favor of the accused"; and that provisions of conviction and sentencing in the criminal law should not be based on a weak or dubious evidence; and that it does not harm to acquit one hundred accused without convicting and punishing an innocent person.

However, researchers and those interested have recorded a high percentage of acquittals issued by Kuwaiti courts due to invalidity of one or more aspect of the criminal procedures system with respect to the proceedings of trials. Thus, this has become a phenomenon whose aggravation would negatively affect the concept of criminal justice in the State of Kuwait. This project was met with a positive interaction among those in charge of investigation, referral and trial, including forensic evidence, arrest and investigation authorities, as well as public prosecutors, judges, advisers, lawyers and others.
The research project will assign a team of experts in penal code and penal procedures, that includes professors and teachers of criminal law with distinguished competence and accumulated and diverse experience at Kuwait International Law School, in collaboration with a team of three senior professors as advisors from the British University Queens Belfast, to conduct a total review of the laws, regulations and procedures that make up the system of penal procedures in Kuwait, and demonstrate its deficiencies and imbalances. It also includes collecting verdicts of acquittal due to invalidity of the proceedings, and consult a group of lawyers, deputy attorney generals and members of investigation panel and senior advisors of judges specialized in criminal cases about the most important imbalances in the procedures that can lead to acquittal due to nullity.

The research aims to identify, scientifically, the most important factors that lead eventually to rule that a defendant is not guilty due to invalidity of proceedings, and to ensure that the Kuwaiti legislation complies with international standards; and benefit from European and British experiences in this area. Also, it aims to develop and activate the role of the system of penal procedures, develop departments that are tasked with them, and; at the same time, avoid any damage to individuals and institutions due to acquittal of defendants as a result of laws in the proceedings, and ease the burden of judicial agencies by avoiding considering cases in which acquittal is inevitable due to invalidity of proceedings.

The importance of the project lies in the multiplicity of agencies that will benefit from it, including the Ministry of Justice, the Ministry of Interior, the Ministry of Commerce and Industry, Kuwait Municipality, Public Authority of Environment, the National Assembly, and specialized research centers and other entities. Its importance also includes large segments of the Kuwaiti society, which manifests itself through several aspects, where the project constitutes:

- A practical, urgent and necessary response to the needs of the Kuwaiti society, as represented by the official government agencies, including law enforcement, prosecution, courts, investigation department, and others, which will also be reflected positively on the citizens.
- A scientific and practical initiative to review the system of criminal procedures in order to achieve justice, security and stability.
- A necessary measure to end impunity due to invalidity of proceedings resulting from lack of texts or errors in implementation.
- A new step to promote respect of human rights and fundamental freedoms, and to ensure the rights of defendants and suspects and protect them from any excesses or violations.
- Thus, the project has a national dimension, and its implementation represents a response to a national need, where it achieves practical results that would benefit several social and governmental entities and the average citizen as well.
- A practical contribution to achieve sustainable development through promoting the concepts and values of the rule of law and state institutions.
- A Kuwaiti scientific research effort that is conducted through a Kuwaiti initiative, combining both theoretical and practical applied aspects, carried out by qualified local academics and experts in cooperation with foreign advisors and experts.

**KFAS contribution:** KWD 15,750

**Total budget:** KWD 294,984
Identification of Novel Drought-Responsive Genes in the Date Palm, (Phoenix Dactylifera L.) using a Combination of Illumina and Pacbio NGS-Based RNA-Seq Technologies (P116-125L-14)

S. Al-Mazrooei

Kuwait University in collaboration with CIPF institute Princeipe Felipe Center De Investigacion and DNA Link Service Company

Abstract:

Understanding the molecular mechanisms of plant tolerance to various environmental (abiotic) stresses is still a major challenge in biology. Drought is one of the most limiting factors for the growth and development of agriculture in the world. Searching for candidate drought-tolerant genes and the use of identified novel genes in improving economical crops growing in dry soil is therefore being one of the main interests of many plant biologists and breeders. The date palm Phoenix dactylifera is the oldest fruit crops grown in the arid regions, particularly in the Arabian Peninsula. The tree exhibits high levels of tolerance to the harsh arid environment and it can grow efficiently in very hot and dry climates, making it a valuable genetic resource to study drought stress tolerance. To identify those essential genes which enable date palm to survive under high drought stress conditions, we will identify the differentially expressed genes (DEGs) in drought-stressed leaf and root tissues of P. dactylifera variety Khlas growing under environmental controlled conditions using the Next-Generation Sequencing (NGS)-based (mRNA-Seq) and Single Molecule Third Generation (Iso-Seq) RNA sequencing technology. Full-length transcriptome construction, differential gene expression and further advanced analyses will be performed using various bioinformatics and biostatistics tools based on both genome-guided and genome-independent strategies. In addition, functional annotation and metabolic pathways assignment of detected DEGs will also be performed. Expression of candidate DEGs will be validated by quantitative real-time PCR (qRT-PCR), and their specific role in drought tolerance will be confirmed using the yeast functional screening system. To our knowledge, identification and analysis of DEGs in both leaf and root tissues of date palm in response to drought stress treatment by RNA-Seq method, followed by functional expression of heterologous protein-coding DEGs has not been reported yet. The discovery of promising novel drought-tolerant genes in date palm will contribute efficiently in improving crops tolerance against drought via genetic engineering. The proposed research study will lead to the development of a functional genomics-based system for studying the plants tolerance to various environmental stresses. This in turn will certainly build up and strengthen the research capacity and raise the scientific status of Kuwait, locally and internationally. The proposed project also coincides with the agricultural policies of the country in convoying the most advanced biotechnological approaches and will enhance the cooperation and exchange of knowledge and experiences with scientific foreign institutes.

KFAS contribution: KWD 71,765
Total budget: KWD 131,418

Socioeconomic Impacts on the Health Status, Distribution and Diversity of Marine Organisms along Kuwait’s Coastal Areas (P216-42WE-01)

A. Al-Zaidan

Environment Public Authority

Abstract:

Fish are known to be exposed to a vast array of chemicals and particulate contaminants either natural or man-made. Kuwait Bay experienced environmental catastrophe fish kill events which resulted in the loss of wild type species known as Mullet (Liza macrolepis) caused by harmful algal bloom Gymnodinium sp. and infection caused by the bacterium Streptococcus agalactia outbreaks due to the high levels of organic nitrogen mainly from the sewage outlets. Ammonia is one of the most studied contaminant, which is a common aquatic pollutant in the aquatic habitat affecting the health of fish. In this study the main objective is to use fish as a biomarker to investigate the effects of toxic ammonia (NH3) in establishing a measurable endpoints for chemical exposure and monitoring the biological responses of the affected target organs. Monitoring the degree of alterations is through the use of cellular techniques to assist with assessing the overall fish health and to detect the critical point affecting its health. The changes associated with fish health will lead to changes in cellular processes which are undetectable externally on the fish which ultimately affect the organism and give rise to population level effects leading to fish kill incidents.

KFAS contribution: KWD 35,143
Total budget: KWD 57,440.900
Assessment of Groundwater Quality Change in Water Fields of Kuwait (PN17-22SE-01)
T. Rashid
Kuwait Institute for Scientific Research

Abstract:
In arid Kuwait, rapid increase in population, developments of industry and agriculture sectors have placed heavy demand on single natural water resource, i.e., groundwater. This heavy demand of water resulted in inefficient extraction of groundwater (extraction more than recharge) from brackish water production fields. Inefficient extraction of groundwater has been showing serious adverse consequences such as groundwater quality deterioration as well as decline in groundwater levels. The continuous deterioration of groundwater quality may impose strict restriction on the use of groundwater. Therefore, it is important to control the deterioration of groundwater quality. To control the deterioration of groundwater quality, its reason(s) have to be understood precisely. A study “Assessment of Groundwater Quality Change in Water Fields of Kuwait” is therefore suggested. The study will help determine the reason behind deterioration of groundwater quality focusing on characterization and spatio-temporal evolution of groundwater quality at the locations of selected water fields of Kuwait. It is envisaged that the results of the study will be useful for authorities responsible for groundwater extraction and management.

KFAS contribution: KWD 47,736
Total budget: KWD 112,776

Novel Nanostructured Adsorbents for Water Purification from Heavy Metals (PN17-24SC-03)
A. Bumajdad
Kuwait University

Abstract:
This project addresses one of the main issues in the contemporary world i.e. the care for vanishing water resources and ensuring high security level for water consumers. The target he is to develop a nanomaterials that would be beneficial in water safety and purification technology. Contamination of water by heavy metal is an increasing economic, environmental, social and health problem. Increasing production and consumption of goods and energy accelerates the process of heavy metal ion access to nearly all resources of sweet and salty water. Because of their destructive influence on humans and the environment, the metal derivatives need to be eliminated from drinking water and from waste water as well. The overall primary objective of the project is to develop effective methods for the synthesis of carbon materials with a high content of nitrogen from organic materials and to investigate the mechanism of their formation. The fabricated materials will be used for the removal of selective heavy metal ions from water (key novelty 1.). Moreover, the second aim is to fully characterize the chemical and physical properties of carbonaceous adsorbents obtained including their ability to adsorb heavy metal ions from water environment. The added value of the project will comply with the principles of “green chemistry” (key novelty 2.). The growing demand for nitrogen-carbon materials with functional groups present in a different chemical environment, causes a continuous search for new precursors and effective methods of their transformation to effective adsorbents. The project proposes to focus on “green” and renewal precursors (chitin, chitosan, local palm fronds/leafs, Salix viminalis wood, etc.) which may be a good alternative for traditional raw materials (key novelty 3.). The project will additionally exploit several chemical modification methods of carbon adsorbents by means of heat treatment and the reactivity with selected reactants containing nitrogen atoms in their structure (so-called N-reagents). Furthermore, the project assumes the development of new theoretical models of the carbon materials incorporating various kinds of heteroatom functional groups, in particular nitrogen functional groups. Beside the standard/controlled laboratory tests, the removal of heavy metal from local waste water (from industry and desalination plant) and sea water (e.g. from Kuwait Bay and Kuwaiti Ports) samples will be tested as well.

KFAS contribution: KWD 79,193
Total budget: KWD 134,851
Fabrication of Porous and Hydrophobic Membranes for Kuwait Seawater Desalination by Membrane Distillation (PN17-25EM-02)

R. Kumar
Kuwait Institute for Scientific Research

Abstract:

Multi Stage Flash (MSF) and Reverse Osmosis (RO) are the two major seawater desalination technologies involved in the production of fresh water in Kuwait. Though RO is an advanced technology, it consumes energy in the range of 4-5kWh/m3 wherein its value is 24kWh/m3 for MSF and this energy will be supplied through fossil fuels. In Kuwait, the estimated desalination cost will be about a third of the Gross Domestic Product by 2025, unless new technologies and energy resources are applied to reduce the cost of desalination.

Desalination by Membrane Distillation (MD) is an emerging technology which can be operated using renewable solar or geothermal energy sources. The working principle involves vapor transport through the pores of hydrophobic microporous membrane driven by the vapor pressure gradient across the membrane. Most of the commercially available MD membranes are not suitable for this application. Since, they are generally designed for ultrafiltration and microfiltration applications and suffer from both low porosity and hydrophobicity. The development of high-performance membranes for MD with high thermal and mechanical stability, high porosity and sufficient wetting resistance are the current major challenges in this field.

The main objective of the project is to fabricate highly potential membranes for seawater desalination via MD technology. The significant membrane characteristics relevant to MD application such as porosity, morphology, surface chemical composition, contact angle, liquid entry pressure, water uptake and thermal stability will be determined using suitable instrumentation techniques. The desalination performance of the fabricated membranes will be evaluated for their potential application in Kuwait’s seawater desalination.

KFAS contribution: KWD 38,942
Total budget: KWD 111,092

Assessment of the Potential of Dibdibba as a Regional/Shared Aquifer (PN17-25EM-03)

A. Aliwei
Kuwait Institute for Scientific Research

Abstract:

Water challenges to secure safe drinking water and sanitary services in cities viable for residency with food and energy security and job opportunities have become imminent and requires better management of shared/regional water resources especially groundwater aquifers. The water challenges will become even worse due to the increase of population, economic growth and climate changes. This proposal will address water shortage problems in Kuwait and Saudi Arabia as they are two riparian countries to the Dibdibba aquifer through effective methods to assess it potential to water supply especially for agriculture. Dibdibba Aquifer is a strategic water source to both Kuwait and the Kingdom of Saudi Arabia (KSA). This aquifer provides brackish water to farms in northern Kuwait and northeastern Saudi Arabia. Dibdibba is being subjected to salinization due to over pumping; threatening its sustainability in both countries. This study is aimed at to determine the hydrogeological boundaries of Dibdibba Aquifer in Kuwait and KSA to improve the conceptual hydrogeological understanding and to simulate the movement of groundwater and its quality. It is expected to establish a better estimate of the water budget for Dibdibba as a shared aquifer. This budget will provide estimates of the abstracted water and its quality as well as the sustainable yield of the aquifer. This proposed project will recommend options for cooperation on development and integrated management for this aquifer, focusing on long- term sustainable use of its groundwater. The research will also improve the understanding of recharge mechanisms from rainfall and lateral inflow to Kuwait. This proposal will be implemented in cooperation between Kuwait Institute for Scientific Research Water Research Center, a counterpart from KSA university / research center and the United Nations Economic and Social Commission for West Asia with an agreed joint research plan and respective responsibilities of the institutions.

KFAS contribution: KWD 49,900
Total budget: KWD 196,800
Prediction of The Impacts of Climatic Changes on The Fresh/Usable Groundwater Accumulations at The Northern Watershed of Kuwait (PN17-32SE-01)

H. Al-Qallaf
Kuwait Institute for Scientific Research

Abstract:

Despite the controversy around their driving force, climatic changes are realities that become more clear every day. These changes are expected to impact many of the natural resources, especially water.

In Kuwait, the northern groundwater aquifers contain fresh to usable brackish water lenses in some of the natural depressions. These waters coexist with saline groundwater in a very delicate balance. While these waters present a valuable option for a secured strategic water reserve, they are particularly vulnerable to climatic changes that are likely to alter the fragile balance between fresh to usable brackish and saline groundwater. Plans to cope with the seemingly inevitable changes must be prepared with the assessment of the potential impacts of these changes on the groundwater as the rational starting point. Such an assessment is proposed in this document. The objectives of this study are to assess the spatial and temporal variability of rainfall and temperature, to develop stochastic models to reproduce the historic variability of rainfall and temperature, to assess the ability of various General Circulation Models (GCMs) to reproduce the historic climate, and to develop risk-based climate change impact assessment model for groundwater at northern Kuwait.

The historical rainfall and temperature records will be utilized to identify the key temporal and spatial scales of variability; then, stochastic modeling will be used to predict changes in climate and rainfall over Kuwait. A transfer function model will be developed, which predicts groundwater levels as a function of rainfall. This model will then be used to establish a baseline for natural variability risk assessment, and a GCM-informed risk assessment of climate change impacts on groundwater levels in northern Kuwait. The results will be assessed to quantify the increased risk associated with greenhouse gas emissions.

KFAS contribution: KWD 33,760
Total budget: KWD 167,825

The Effect of Technologically Critical and Non-Critical Elements Aftermath the Fish Kill Netuma Thalassina (Cat Fish) in the Kuwait Bay (PN17-44SC-02)

A. Bu-Olayan
Kuwait University

Abstract:

The use of technology critical elements (TCE) such as gallium, germanium, indium, tellurium, niobium, tantalum and thallium in the modern industries and their subsequent contamination in the aquatic system through non-technology critical elements (non-TCE) such as mercury, arsenic, lead and vanadium have been observed over the recent years. No trace of this study on the effect of these TCE’s was investigated in the Kuwait marine environment. Thus, TCE will be analyzed in the wastewater collected from the drain outfalls, coastal and offshore seawater and sediment of Kuwait sites using suitable spectrophotometry methods besides, their correlated effect on environmental parameters (temperature, pH, salinity, dissolved oxygen). Results will be categorized based on the spatial and temporal variations. The effect of TCE and Non-TCE’s will be evaluated by dispersion studies to ascertain the levels of their dispersion in the Kuwait Coastal waters and their subsequent effect to selected fish of commercial importance in the marine environment. The novel database of TCE and Non-TCE in Kuwaiti waters will also be deduced for the suspected cause of the recent “fish Kill” that affected the catfish Netuma thalassina (‘Cheim’) in 2017.

KFAS contribution: KWD 18,850
Total budget: KWD 30,635
The Impact of Bareec Program in The Development of Public Secondary Schools and Kuwait University Students’ Positive Trends in The State of Kuwait (PN17-51TP-01)

R. Hussain

Alnowair Al Kuwaitia – Bareec Program

Abstract:

Positivity is an all-encompassing word which, in the research literature has been measured by a variety of proxies such as subjective wellbeing, satisfaction with life, hedonic wellbeing or positive emotion as examples (Fredrickson, 2006; Hart & Sasso 2011; Joseph & Wood 2010; Kashdan, Biswas-Dincer & King 2008; Norrish & Vella-Brodrick, 2008). Irrespective of the term used, positivity is well correlated with improved learning outcomes, mental-health, prosocial behavior work productivity and life satisfaction. Yet much of the research surrounding the efficacy of positive psychology interventions (PPIs), empirically derived strategies designed to generate positivity, hails from Western nations. whether these could produce the same gains locally remined unknown; thus Alnowair, a non-profit committed to increasing positivity, developed a culturally-competent positive psychology program to verify.

The first phase of the Bareec program consisted of 15-minute weekly PPIs delivered to secondary and post-secondary students by trained instructors during the 2017 spring semester. The PPIs were selected from the literature for their efficacy towards the generation of positive affect (hedonic wellbeing) and flourishing (eudemonic wellbeing). PPI examples include engaging in mindful photography (Kurtz & Lyubomirsky, 2012) and good deeds (Pressman, Kraft, & Croft, 2015). Relative to control groups, Bareec university participants showed greater levels of flourishing (eudemonic wellbeing) while secondary school participants showed significant gains in positive affect (hedonic wellbeing). Results had similar effect sizes to those in existing studies (Bolier et al., 2013).

In this second phase, we propose to continue the delivery of additional PPIs to approximately 500 post-secondary students and 1500 secondary Kuwaiti school students during the Spring 2018 semester. We will measure satisfaction with life, levels of flourishing, and the frequency of positive and negative emotion as proxies for positivity compared to control groups. We will assess students at post-treatment the effect of change over time.

Invention of Remote, Rugged and Self-Referencing Optical-Fiber-Chemical Sensor Chip for Water Quality Monitoring (PN18-15EC-01)

M. Nazari

Australian College of Kuwait

Abstract:

Effective in-situ real-time remote water quality monitoring systems are required to be located in water, operating for many years to send regular information back to a central data monitoring unit, without the need for maintenance or re-calibration. These monitoring systems would be a part of larger systems which require to work at a low energy rate, and to be self-sufficient under a remote-control module in order to increase the frequency of data collection (in particular, in flood and other harsh conditions). They must maintain the required accuracy of measurement despite various environmental hazards they experience. The present study focuses on developing a low-cost optical-fiber chemical probe and self-referencing sensor to tailor an interrogation unit suitable for remote long-term deployment for monitoring the quality of the surface water and groundwater. It uses the recent advancement from optrode technology and design which eliminates the weaknesses of existent devices in the market. The research entails discovering or creating the most relevant chemical indicator (either from other areas of technology into sensor development or more likely through the developed synthesis methods for sensors). The output proposes a tailored optical and electronic interrogation and data processing system for a remote energy efficient water quality system.

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**Treatment of Oilfield Wastewater Using a Hybrid Photodegradation / Membrane System (PN18-15EC-02)**

S. Ghafoori

Australian College of Kuwait

**Abstract:**

Kuwait with an oil production reaching 3 million barrels/day is producing large amount of heavy oil wastewater (7 barrels/barrel). Major part of the produced water is dumped in the sea and desert that in turn has adverse impact on the surrounding environment. Since the wastewater contains various recalcitrant organic and inorganic pollutants, single technologies to date have not succeeded in rendering it to a reusable form or meeting disposal requirements. Therefore, in this study an integration of physicochemical processes is proposed as a promising technology not only to meet the regulatory limit but also to lead to a new source of water as scarcity of freshwater resources is also of great concern in Kuwait. In order to achieve this goal, an ultrafiltration membrane will be coupled with an advanced oxidation process as a green technology to degrade the dissolved organic pollutants in the wastewater. The microfiltration membrane will separate oil, grease, and suspended solids from the wastewater and then using UV radiation in combination with an oxidant (TiO2) the organic content of the wastewater will be degraded by attack of the generated hydroxyl radicals with great potential of oxidation.

**KFAS contribution:** KWD 7,500

**Total budget:** KWD 7,500


A. Al Ka‘bi

Australian College of Kuwait

**Abstract:**

International environmental agencies define green buildings as the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as a sustainable or ‘high performance’ building.

Therefore, the main objectives of green building designs and implementations are to reduce dependence on nonrenewable resources such as fossil fuel energy, increase the efficiency of energy consumption, and to avoid the negative impacts of buildings, facilities and infrastructure on the environment through their life cycle; and to create inhabitable, safe, and comfortable environments.

In this project, we are focusing on the efficient management of electrical energy consumption in green buildings, and we are aiming at developing control designs and programs using Programmable Logic Controllers (PLC’s) to enable efficient management of electrical energy consumption in green buildings.

**KFAS contribution:** KWD 9,700

**Total budget:** KWD 9,700

A. Sedaghat
Australian College of Kuwait

Abstract:
Recent studies suggest that thermal solar radiation can be reduced by 74% through windows equipped with solar window films. The harmful UV radiation for human skin and eyes can also be reduced by 99% using solar window films. This will further protect color changes of interior furniture of buildings. The Kuwait Green Building Council (KGBC) has been initiated in 2009 with different organizations including Universities, local authorities, Contractors, Architects, Engineers, Energy companies, and other leading private companies in Kuwait. The goal is to accelerate buildings energy efficiency in Kuwait in accordance with the World Green Building Council which has more than 100 national Green Building Councils worldwide with over 27,000 members as one of the largest organization globally. Along with the KGBC goals, we are proposing to conduct a jointly research focusing on reducing solar irradiation through windows using the most affordable market-ready mechanism, i.e. solar window films. We will implement two similar offices in the Australian College of Kuwait (ACK) with accurate measuring equipment, one with solar window films and the other without. In parallel, EnergyPlus and DesignBuilder software will be used to simulate these offices to study the effects of different solar window films and efficient thickness of wall layers in the offices. The radiative properties of soft thin film coatings will be calculated by Matlab. Effects of different thin film material, thickness, layer layout and temperature will be investigated. The optimum conditions will be obtained by Genetic Algorithm. The results will be compared with solar window films available in the market. Recommendations will be made to KGBC and corresponding organizations in Kuwait on the type of solar window films and the effective wall thickness layers to reduce the cooling loads in Kuwait offices during summer based on the meteorological condition of Kuwait, and therefore reduction of CO₂ emissions.

KFAS contribution:  KWD 7,000
Total budget:   KWD 7,000

Assessment of Viability and Effectiveness of Forward Osmosis Membranes and Polymer Draw Solutions for Seawater Desalination: Pilot Plant (PN18-15EM-04)

M. Ahmed
Kuwait Institute for Scientific Research in collaboration with Trevi Systems Inc., USA

Abstract:
The State of Kuwait is facing a truly difficult challenge of supplying freshwater in a sustainable way for domestic and for the development of various activities. This is due to lack of natural resources for freshwater and the increasing population growth rate associated with urban expansion as well as increasing growth in commercial, industrial and agricultural activities. Accordingly, Ministry of Electricity and Water (MEW) must rapidly expand their desalination facilities to alleviate the freshwater shortages and to meet the country’s freshwater needs. However, conventional desalination technologies (CDT) are prohibitively expensive and energy intensive. Therefore, it is required to seek for innovative desalination technology that eliminates the disadvantages of the CDT with a substantial reduction in operational costs. Over decades, the research studies have remarkably developed a number of promising membrane separation processes, including forward osmosis (FO), which differ in configurations, methods, and systems. FO process requires further research and development to bring the technology into developing competitiveness on the commercial level.

Therefore, the aim of this study is to assess the efficiency of the innovative hollow fiber FO membrane configuration for seawater desalination by utilizing a pilot plant test unit. Furthermore, this study will assess the efficiency of different recently developed polymer solutions as draw solution (DS). The most important deliverables of this study will include a referenced scientific and technical knowledge base on the performance characteristics of the proposed technology, hollow fiber membranes, and DS. The total in-kind contribution by Trevi Systems Inc. as capital and operating expenses is KD 105,000. This financial contribution is classified as in-kind according to KISR guidelines.

KFAS contribution:  KWD 49,599
Total budget:   KWD 225,513
Utilization of Local Waste Materials in High Performance and Self-Compacting Concrete (PN18-15EV-01)

S. Soleimani
Australian College of Kuwait

Abstract:
Concrete is the world's second most consumed material after water, and its widespread use is the basis for urban development. In Kuwait, construction projects that mainly utilize concrete are more than double the number of construction projects that mainly utilize any other construction material. The main focus of this project is to study the effect of using local waste materials on the properties of fresh and hardened high performance and self-compacting concrete. This sustainable and economical study intends to partially use waste material (in this instance, crushed ceramic products and steel slag from blast furnaces) in the production of self-compacting and high-performance concrete, which will be obtained from local factories in Kuwait. The methodology will include performing quality control tests on fresh concrete (such as workability, flow, air content, etc.) as well as hardened concrete samples (such as specific gravity, compressive strength, modulus of rupture, etc.). The importance of this project lies in its ability to transform waste materials into useful construction materials, especially seeing as the ceramics and steel production industries are some of the largest waste generators in the world. Another benefit of this project is to help reducing waste production on a local scale, therefore reducing the amount of waste being sent to a Kuwait's landfills.

KFAS contribution: KWD 8,250
Total budget: KWD 35,832


A. Alsulali
Kuwait University

Abstract:
Date palm plays an important role in the economic and social life of the people in the GCC countries and is considered a major agricultural crop in this part of the world. Industrial processing and consumption of dates generate considerable quantities of date seeds which are discarded as solid wastes. Utilization of date seeds in the treatment of wastewaters will lead to better waste management and cost savings. Therefore, the proposed study will include both experimental laboratory-scale as well as pilot-scale treatment of wastewaters using date seeds. The study will determine the physical and chemical properties of crushed date seeds obtained from 10 different varieties of dates produced in large quantities in the GCC countries, examine various methods of activation of date seeds to improve the adsorption capacity of the date seeds, determine the adsorption properties and isotherms of different date seeds and select the most effective ones, evaluate applications of selected date seeds in the treatment of municipal wastewater, greywater, and industrial wastewaters generated in Kuwait such as petrochemical wastewater, slaughterhouse wastewater, and food processing wastewaters, and finally develop design criteria for the application of date seeds in the treatment of wastewaters in Kuwait along with treatment cost estimation.

KFAS contribution: KWD 47,000
Total budget: KWD 98,080

T. Ahmed
Australian College of Kuwait

Abstract:

The increasing number of vehicles on the road resulted in a huge number of scrape tires. The disposal of these waste tires have been one of the big environmental problems in the modern society. Currently, there are several industrial applications that incorporate the recycling of waste tires in their processes. Some of these applications include new tires manufacturing, tire-derived fuel production, civil engineering applications and products, molded rubber products, agricultural uses, recreational and sports applications, and crumb rubber modified asphalt applications.

This research study aims to evaluate the rheological and adhesive/cohesive characteristics of CRM asphalt binders comparing to original asphalt binder. Several percentages of CR will be investigated in order to find out the optimum CR content that improves the performance of asphalt binder. In order to bring improve the produced asphalt binder properties, a warm mix asphalt (WMA) additive and anti-stripping agent will be added to the crumb rubber modified (CRM) asphalt and their effect on the CRM asphalt binder characteristics will be evaluated as well.

KFAS contribution: KWD 8,200
Total budget: KWD 11,800

Assessment of Time Use in Daily Living and Quality of Life Among Government Employees in Kuwait (PR17-11BS-01)

F. Manee
Kuwait University

Abstract:

Scarce information about Kuwaiti adults’ perceptions of quality of life (QOL) and health in regard to occupational performance and daily life patterns is available. Researchers identified a significant relationship between QOL and engagement in meaningful occupations. The study objectives are: to assess time use in daily occupations among employees working in government ministries; to evaluate their quality of life; and to examine the association between quality of life, health status, and time use. Methods: A cross sectional study employs a stratified random sampling technique. Stratification of government ministries to include 50% of the 17 government ministries. A random number of employees in the selected ministries will be chosen to reach a quota sufficient to have a representative sample, through applying a probability proportional to size sampling technique with a total sample of 2500 employees. Inclusion criteria: > 6 months duration of employment and age 21 years and above. Exclusion criteria: having any physical impairment/disability, or recent activity at home/workplace which has some additional duties, and pregnant women. A self-administered questionnaire contains participants’ socio-demographic data, a checklist of health status, smoking habit, and measuring weight, height, and blood pressure. The WHOQOL-BREF tool will assess QOL, which generates four domains: physical, psychological, social, and environmental. Additionally, records of participants’ time use of daily activities during a typical weekday and weekend within the last week using occupational questionnaire are included. Conclusion: According to literature, this is the first study to provide knowledge about time-use among government employees in Kuwait and its relation to health status and QOL. The findings of this study will help policy makers in different Ministries to consider promoting health programs in workplaces. Additionally, the results will guide the policy makers in Ministry of Health about the best time of Kuwaiti employees where they can join community preventive health campaigns.

KFAS contribution: KWD 7,500
Total budget: KWD 30,840
Language and Education in Kuwait: Attitudes, Identities and Ideologies (PR17-11TP-01)

M. Tryzna
Gulf University for Science and Technology

Abstract:
As part of its national development plan, the government of Kuwait, specifically The Ministry of Education, has focused heavily in recent years on enhancing educational outcomes in the country. Since 2002, Kuwait has seen the introduction of American-style universities with English as the language of instruction. It is a common assumption in the Middle East in general, and in Kuwait in particular, that English-medium and Western-curriculum schools provide quality education, creating better opportunities for the students in terms of advancing their language skills, critical thinking skills, and subject matter knowledge in sciences and humanities. However, due to the relatively recent changes in the respective areas of education, little is currently known about the impact these changes have had on the Arab students’ actual language practices, language attitudes, and identity. The present project tries to bridge this gap by tracing and assessing the development of and attitudes toward multilingualism in Kuwaiti society, including the pivotal role of English as a medium of instruction, English as a lingua franca, as well as the related phenomena of identity, language policy and language ideology. The study is divided into three phases, each with its own data collection instrument but with interrelated goals to provide a measurement of the study’s central concepts. Phase One consists of collecting autobiographical narratives on the students’ language learning experiences and analyzing them from the perspective of such sociolinguistic phenomena as identity and ideologies. Phase Two attempts to identify the beliefs and values underpinning language attitudes and ideologies by utilizing a survey targeting students as well as other segments of the Kuwaiti society. The survey will be distributed in both English and Arabic. Phase Three, based on the results of phases one and two, consists of semi-structured interviews with education practitioners, researchers, and policy makers to address the recurrent themes, relevant concerns, and potential developments in language and education. The combined data cover both deductive and inductive approaches, quantitative and qualitative methodologies, and illuminate the crucial aspects of language in education, key to national interests.

KFAS contribution: KWD 7,200
Total budget: KWD 7,200

Solar Photo Degradation of Endocrine Disrupting Compounds Existing in Wastewater in Kuwait (Phase-1) (PR17-12SC-01)

L. Al-Hajji
Kuwait Institute for Scientific Research

Abstract:
The increasing demand for water treatment recycling systems calls for new technologies on contaminant destruction. Endocrine disrupting compounds (EDCs) are chemicals that are found in wastewater streams as a result of combined hospital and industries discharges. EDCs have the ability to interfere with the normal endocrine function and have been linked to a variety of adverse effects and even cancer.

The proposed project is focused on EDCs degradation and is aimed at employing nanotechnology for safe and green treatment of wastewater contaminants. The challenge in this project is to achieve complete conversion of selected EDCs into CO$_2$ and water. This challenge may also be extended to the possibility of using solar energy in the degradation process.

In this project, titanium nanoparticles (TiO$_2$-NPs) and titanate nanowires (TiO$_2$-NWs) will be used competitively for nominated contaminant degradation. Gold nanoparticles will be added as a dopant in order to improve and enhance the photocatalytic behavior of TiO$_2$-NPs and TiO$_2$-NWs and to shift them into the visible region. Moreover, several chemical, physical, and morphological properties will be explored using sophisticated characterization approaches. The performance of the aforementioned photocatalytic materials in degrading EDCs under different operation conditions will be evaluated.

KFAS contribution: KWD 34,850
Total budget: KWD 113,425
Development of An Early Warning System for The Control and Prevention of Diseases in Kuwait
(PR17-12SL-05)

A. Al-Hemoud
Kuwait Institute for Scientific Research

Abstract:
Transboundary diseases of public and animal health importance have resulted in severe social and economic losses on national, regional, and global levels. Kuwait has suffered substantial public health and economic consequences from two major pandemic transboundary diseases, namely, Influenza Virus and Hepatitis Viruses. Disease surveillance is one of the most important components of an effective and efficient program for disease prevention and control. Thus, the objective of this project is to develop an automated interactive web-based early warning surveillance system to support decisions related to prevention and control of endemic, emergent and reemergent diseases in Kuwait. Selected disease data (including animal and human influenza and Hepatitis C and B) will be collected retrospectively from international and local agencies and combined to be uploaded into an Information Technology web-based system developed locally and will follow the footprint of a well-established system referred to as the Disease Bioportal. The developed web-based early warning system prototype will provide easy access, visualization, analyses and communication capabilities for the health authorities. Furthermore, advanced epidemiological analysis of the database will be conducted and will include cluster detection, genetic analysis, and risk mapping that will produce inferences and risk predictions in near real-time, and subsequently, will aid in guiding decision makers to early detect, prevent and control important diseases in Kuwait. This project will include five tasks (mobilization, data collection, modeling, education, and reporting). The technical outcome will include an IT system for disease surveillance with the capacity of rapid analysis and development of risk prediction models that will guide decision makers and will educate stakeholders. The main beneficiaries will be the public and animal health authorities.

KFAS contribution: KWD 43,900
Total budget: KWD 146,900

Performance and Feed Quality Evaluation of Selected Forage Species in A Mixed Cropping Agroforestry System
(PR17-12SL-08)

M. Anisul Islam
Kuwait Institute for Scientific Research

Abstract:
The effects of climate change and soil degradation is expected to significantly reduce native plant cover in coming years to put more strain on the availability of livestock feed. Despite having a thriving demand, forage production has been very limited in Kuwait. Currently, 95% livestock feed are imported and it is the main constraint to sustainable livestock production. KISR has evaluated the performance of barley, wheat and alfalfa in recent years. In most cases, studies have evaluated plant performance in a single cropping system involving annual crops. Considering the above facts, certain species like leucaena (Leucaena leucocephala) smooth bromegrass (Bromus inermis L.), sorghum (Sorghum bicolor) and Triticale (x Triticosecale) may become potential forage crops in Kuwait and their production in a mixed cropping system can increase on-farm biodiversity, ameliorate soil and microclimate as well as meet the year-long demand for feeds. Leucaena, a leguminous perennial, has high protein and has been extensively used as a feed in many arid countries. Sorghum and triticale can be used as a warm season and cool season crop, respectively, as they have been used as forage and grain products in many arid countries. Smooth bromegrass is a leafy, deep rooted perennial grass that can be grown as a cool season grass in Kuwait. The overall goal of this project is to evaluate the dry matter yield of these selected species as forage crops and their feed quality. Additionally, effects of mixed cropping will be also examined on soil properties, microbial population and disease incidents. Successful project implementation will deliver additional forage crops for livestock producers with positive economic impact. This in return will reduce uncontrolled grazing on the landscape.

KFAS contribution: KWD 48,000
Total budget: KWD 168,675
Improving Production and Water Use Efficiency of Forage Crops with Nuclear Techniques with Emphasis on Barley (PR17-12SL-11)

H. Al-Menaie

Kuwait Institute for Scientific Research in collaboration with International Atomic Energy Agency (IAEA), Austria

Abstract:

Agricultural production in dry areas is a major challenge due to harsh environmental conditions that includes salinity, aridity, water logging, and desertification. Conservation agriculture (CA) follows a set of soil management practices such as permanent soil cover, minimum tillage, and crop rotation to improve yield and water use efficiency of crops while conserving the environmental resources. Insufficient freshwater availability for irrigation and lack of efficient water management systems drastically affects the agricultural sector in Kuwait. Therefore, water use efficiency of crops is one of the main factors to be considered in any crop production systems under irrigation in dry areas. The use of isotopic and nuclear techniques in water management systems helps in assessing the performance of different irrigation water management technologies and in optimizing crop water requirements to increase area wide water use efficiency and crop water productivity. The proposed project is aimed at improving the production and water use efficiency of forage crops and the main objective is to establish suitable soil and water management system using nuclear-isotopic techniques under Kuwait’s harsh environmental conditions. The project constitutes nine tasks, which are mobilization and seed obtainment, soil physical and chemical analysis, soil management, water and fertilizer management, Isotopic Techniques: A selection tool for high water and fertilizer use efficiency, prediction of yield response, nutritional analysis of barley forage and grain, protein determination, and report submission. The major outcome of the project will be increased resource efficient forage productivity under reduced water use by cultivating crops with optimum water and fertilizer use efficiency in Kuwait. Thus, the proposed project tests the potential of conservation agricultural practices, improved water and fertilizer management practices using nuclear-isotopic techniques in enhancing barley productivity and water use efficiency by reducing irrigation water consumption in Kuwait.

KFAS contribution: KWD 38,869

Total budget: KWD 245,514

Improvement of Double Haploid Production in Tomato Via Anther and Microspore Culture (PR17-12SL-17)

A. Redha

Kuwait University

Abstract:

In recent years the biotechnological approach for the production of pure or homozygous lines is more efficient for several economically important crops than the traditional breeding methods. These techniques are based on androgenesis, which involves the production of double haploid lines from in vitro anther and microspore culture. The use of such techniques is becoming realistic and efficient in many crop species, unfortunately this is not the case for the recalcitrant solanaceous crops. Despite the economic importance of tomato (Solanum lycopersicum L.) worldwide, the application of double haploid technology is far from being routinely applied in breeding programs. Therefore, an advanced breeding technique is needed to meet its market demands. The study will focus upon screening several genotypes to test their responsiveness to the protocol, determine the right developmental stage of the anther and microspore that might lead to a higher induction of microspore derived embryos. Furthermore, the effect of several pre-treatments to be investigated at the induction phase such as: cold temperature, heat shock, colchicine and carbon source of the media. The effect of the stated factors will be evaluated based on the frequency of the microspore derived embryos and the regenerated haploid and double haploid plants.

KFAS contribution: KWD 27,200

Total budget: KWD 53,770
The Impact of Proximity to Desalination Plants on Algae and Seagrass Biodiversity and Abundance (PR17-12SL-18)

D. Al-Bader

Kuwait University

Abstract:

About 75% of the world’s installed capacity for seawater desalination is in the Arabian Gulf region, and with the increase in population, it is expected that there will be an increase in the number of the desalination plants. The harmful environmental impact of these plants includes the release of brine effluent which is associated with increase in turbidity and temperature in addition to high salinity and contaminants.

Especially vulnerable are shallow areas with restricted water exchange and high desalination activities such as the Kuwaiti coastal waters. This study proposes to explore the impact of desalination plants on the diversity and the abundance of intertidal benthic flora, including microalgae, macroalgae, and seagrasses. In addition to being primary producers, benthic floral communities are a habitat and a nursery for a variety of marine organisms whose well-being and abundance depends on it. Benthic floral communities are also a stabilizer of the marine sediment especially in the intertidal zone and contribute to a better seawater quality by lowering turbidity.

The impact of desalination plants on benthic flora is variable in different marine environments. The environment selected in this study in under a unique set of natural and man-made stresses, especially in the shallow, semi-enclosed and low water circulation Kuwait Bay. There are no available studies for such environment. The outcome of this study will fill a knowledge gap both internationally and locally, and provide scientific evidence that will be delivered to the relevant authorities and will be made public to create public awareness and direct the decision makers on the placement and operation of these facilities to minimize environmental impact and to protect the marine ecosystem as a valuable resource for future generations.

KFAS contribution: KWD 46,800

Total budget: KWD 89,080
Evaluating the Susceptibility of the White Fly (Trialeurodes vaporariorum) and the Black Fly (Aphis fabae) to Toxic Agents of (Salsola imbricata), A Wild Shrub in Kuwait with a Potential Insecticidal Effect (PR17-125L-19)

J. Al-Harbi

Public Authority for Applied Education and Training

Abstract:

Despite the existence of several beneficial insects, some of them are considered as a major source for pathogens contributing to several global infectious diseases. Using conventional insecticides over a long period has been recognized to endanger the health of consumers and adversely affect the ecosystem. Different insecticides and pesticides have been used to control insect infestation, but the cost of the subsequent damages outweighs their advantages. In the quest for a substitute to commercial hazardous control means, it was found that plants and botanical derivatives have been appreciated worldwide because they are less likely to engage in health-risks.

The proposed study aims to investigate the susceptibility of the white fly (Trialeurodes vaporariorum) and the black fly (Aphis fabae) to extracts collected from Salsola imbricata (Forssk) plant, in search for derivatives exhibiting insecticidal activities. The extracts will be tested against successive life-stages of the designated flies. Chemical compositions of the extracts will be analyzed using thin layer- and high-performance liquid chromatography. Field verification will be performed on naturally infested plants in Al-Aardya farm in Kuwait. Vulnerability assessment for the flies’ developmental life-stages will be determined in accordance with the percentage of extract concentration. Comparative studies will be executed to reveal seasonal and geographical variations in the composition and related toxicity of extract derivatives. Finally, antimicrobial and repellent activities displayed by Salsola plant will be identified.

The anticipated outcomes will point out:

1. The developmental stage of the flies with the highest susceptibility to treatments.
2. The phenotypic traits (body weight, instar age and sex of adults) that facilitate insects’ fitness.
3. The part of Salsola plant that exhibits the highest toxicity. The inclusive outcome will endorse Salsola plant as an alternative source for natural insecticides.

For future work, the extract derivatives that will reveal antimicrobial potency will be mixed with several categories of antibiotic drugs to be tested on bacterial infection and to control pest infestations.

KFAS contribution: KWD 10,000

Total budget: KWD 10,000
The Role of Genetic and Environmental Factors in the Etiology of Non-Syndromic Cleft Lip and Palate in Kuwait (PR17-13DS-01)

L. Al-Kharafi

Ministry of Health in collaboration with Kuwait University

Abstract:

INTRODUCTION: Non-syndromic cleft lip and palate (NCLP) is one of the most common craniofacial anomalies with the occurrence of 1.48/1000 live births in Kuwait.

OBJECTIVES:

1. Establish a cohort of patients with orofacial clefts and develop a Kuwaiti national registry.
2. Assess clinical phenotypes of oral cleft patients.
3. Investigate the genetic association of specific candidate genetic variants and development of NCLP.
4. Investigate environmental factors by conducting an interview with mothers of patients, aged 12 months and younger.

MATERIAL AND METHODS:

1. Subjects: The subject of this study will be at least 200 individuals with familial or sporadic non-syndromic cleft lip and palate (NCLP) attending Al-Amiri and Al-Adan Dental Centers, A1-Babtain Plastic Surgery Hospital, and Kuwait Medical Genetic Center. All subjects will be subjected to a thorough clinical examination, and mothers of patients 12 months and younger will be interviewed. Time to get access to patients’ data, collect the specimens, and conduct the study is estimated to be three years.
2. DNA Extraction: DNA will be extracted at Kuwait University Genetics Laboratories, Faculty of Sciences, from the venous blood or saliva of all subjects and relevant relatives according to the study protocol.
3. 10-15 variants that have been shown to be associated with NCLP or CP/0 from pervious GWAS studies will be analyzed.
4. Once an acceptable sample size is achieved, next generation sequencing (exome or whole genome) will be carried on patients and families with NCLP and/or NCPO.

ANTICIPATED FINDINGS:

Finding associations of certain genetic variants/ environmental factors with NCLP will contribute to the understanding of molecular mechanisms of the disease that may facilitate in enhancing prevention, management and intervention..

KFAS contribution: KWD 49,177

Total budget: KWD 211,949
Assessment of the Immune Status Against Measles, Mumps, and Rubella in Young Kuwaiti Population: MMR Vaccine Efficacy (PR17-13MI-01)

N. Madi
Kuwait University

Abstract:
Regardless of the availability of an effective vaccine against measles, mumps and rubella, outbreaks of these life-threatening diseases continue to be a major global public health concern. Therefore, comprehensive evaluation of measles, mumps, and rubella humoral immunity following vaccination with MMR is crucial for determining vaccine immunogenicity and efficacy. Kuwait introduced MMR vaccine in 1985, and since that time the number of cases of measles, mumps and rubella has declined dramatically. However, cases of measles, mumps and rubella are detected every year in Kuwait despite vaccination of children before school entry. The explanations behind these cases are unknown, it could be insufficient vaccine coverage, along with primary and secondary vaccine failure, early waning immunity, or other reasons. Therefore, the aim of this proposed study is to evaluate the immune status of two age groups of Kuwaiti population; 5-10 years old children and 11-20 years old young adults, against measles, mumps, and rubella after MMR vaccine. The results of this study will provide information on the seroprevalence of measles, mumps, and rubella IgG antibodies following MMR vaccine doses among children and young Kuwaiti population. Moreover, the information from this project will help to put recommendations on the necessity of repeated MMR vaccine campaigns offered by the Ministry of Health for the population in Kuwait.

KFAS contribution: KWD 10,000
Total budget: KWD 37,400

Polycystic Ovary Syndrome (PCOS) And Subclinical Hypothyroidism (SCH) (PR17-13MM-02)

M. Al-Qudhaiby
Ministry of Health

Abstract:
This research attempts to explore the manner of relation between two common clinical problems, the first is Poly Cystic Ovary Syndrome (PCOS), which is a status associated with abnormal hormones in particular hyperandrogenism with the presence of multiple peripheral small cysts in the ovaries, and the second is Sub-Clinical Hypothyroidism (SCH), which is an early and subtle state of thyroid hypofunction. The association between the clinical and biochemical parameters of PCOS and certain cutoff of thyroid status as represented by thyroid stimulating hormone (TSH) has been investigated by several authors. Many authors suggested positive correlation, however, others did not get this relationship. So, a uniform correlation has not been established yet in the medical literature. So, the aims of the current study is to explore whether there is an association between PCOS and SCH, to provide an understanding whether there is a cutoff level of TSH which correlates better with clinical and biochemical manifestations of PCOS, to analyze the relationship between selected clinical and metabolic parameters in young women with polycystic ovary syndrome and the status of subclinical hypothyroidism ,and to use this study as a template for another simultaneous/future study exploring the benefits of thyroid hormone treatment as a potential agent improving the clinical and metabolic consequences of PCOS, suggesting a better management plan. A cohort of 150 adult PCOS patients, newly diagnosed in the age group of 21-50 years and menstruating, will be recruited from our endocrine clinics in Mubarak Al-Kabeer hospital, over a period of 24 months. Subjects are excluded if they are known to have previous thyroid disease or having family history of thyroid disorders. The thyroid status for all subjects will be assessed on their initial visit, and will divide the patients in to euthyroid PCOS or those with SCH according to the most widely adopted biochemical definition of SCH. The candidates will be evaluated clinically and the biochemical parameters will be assessed by taking blood at the follicular phase of the cycle (a single sample of 10 cc blood). Thyroid and pelvic transabdominal U/S will be performed at baseline in radiology department in Mubarak Al-Kabeer hospital.

KFAS contribution: KWD 33,775
Total budget: KWD 89,729
Refined Risk Stratification for Personalized Medicine in Chronic Lymphocytic Leukemia: Focus on Biomarker Profiling (PR17-13MM-03)

S. Al Shemmari
Kuwait University

Abstract:
Chronic lymphocytic leukemia (CLL) accounts for about one-quarter of the new cases of leukemia, rendering it the most frequent adult leukemia and the risk is higher in men than in women. The clinical course of CLL is highly variable and ranges from rapid disease progression requiring early and frequent treatment to survival for decades with minimal or no treatment. However, CLL presently remains incurable, or at best is therapeutically converted into a chronic disease.

In CLL patients, tumor initiation and progression are linked to the interplay between cell-intrinsic and cell-extrinsic mechanisms. The science of using these tumor molecular profiles to select clinical trial participants or to optimize therapy for individual patients is an important clinical breakthrough. Here we propose the analysis of important predictive molecular markers in CLL cases reported in Kuwait, which are Immunoglobulin hyper mutation (IGHV) status, genetic aberrations (deletion 11q, 13q, 17p and trisomy 12) and recurrent gene mutations (TP53, NOTCH1, BIRC3, SF3B1, MYD88).

The IGHV un-mutated cases displays a more aggressive disease, high-risk cytogenetics and a poor outcome whereas mutated cases associated with more favorable clinical course and significantly longer overall survival. Deletion of 13q is associated with favorable outcome, trisomy 12 associated with intermediate one and deletion of 17p and 11q are associated with poor prognosis. Recurring mutations displays poor treatment outcome, shorter survival in CLL, among them some cases of TP53 and BIRC3 mutations are therapy resistant. The IGHV and recurring mutational analysis is done by specific PCR reactions and sequencing, chromosomal aberrations are analyzed by classic cytogenetic analysis and FISH.

From this work we will identify the impact of particular or combinations of predictive biomarkers on patient treatment outcome thereby design a personalized, biologically-orientated treatment for CLL in Kuwait while also serving as a paradigm for risk-adapted cancer management globally.

KFAS contribution: KWD 39,300
Total budget: KWD 64,620

A Study of The Risk Factors, Determinants and Prevalence of Chronic Obstructive Pulmonary Disease in The Kuwaiti Population (PR17-13MM-05)

S. Al-Mutairi
Kuwait University

Abstract:
Chronic obstructive pulmonary disease is one of the most common respiratory diseases that involve mainly the airways causing airflow obstruction. It is a progressive disease that can be preventable and treatable. The overall severity in individual patients is affected by exacerbation rate and comorbidities. Worldwide it is a leading cause of morbidity and mortality with an appreciable economic and social burden with an estimate to be the third leading cause of death Worldwide by 2020. Smoking is the most important risk factor for COPD among all other risk factors as genetic predisposition, environmental and occupational factors. The literature in our area about COPD prevalence, risk factors and burden in our area is spares and in Kuwait hardly any. Taking into account the high smoking rate in Kuwait and the Middle East, one would expect a much higher rate of COPD patients than the actual advanced cases that seek medical attention. The present project would screen for the actual COPD prevalence and risk factors among Kuwaiti population, and also estimate the burden of disease both on individual patients and the Society. Study design is population-based cross-sectional study using screening questionnaire to identify individuals who fit the epidemiological definition of COPD. Those individuals will be invited to the second stage detailed questionnaire, spirometry test and blood sampling (to explore the potential role of adipokines and inflammatory cytokines). The main importance of the study is that it would estimate disease prevalence, economic burden, potential risk factors and the putative role of inflammatory markers in the Kuwaiti population. The findings of the study might help to improve the strategies of care and prevention of the disease in the country and raise these up to recognized international standards.

KFAS contribution: KWD 49,508
Total budget: KWD 104,850
Personalized Medicine for Rare Diseases: Developing Patient-Specific Limb Girdle Muscular Dystrophy Induced Pluripotent Stem Cells Based Assays for Disease Modeling and Drug Screening (PR17-13MM-06)
L. Habib
Kuwait University in collaboration with Massachusetts Institute of Technology (MIT), USA

Abstract:

Limb-girdle muscular dystrophies (LGMDs) are a group of clinically and genetically heterogeneous disorders that share the primary symptom of progressive weakness and atrophy of the hip and shoulder muscles. Although LGMDs are classified as rare diseases, the autosomal recessive forms are largely overrepresented in Kuwait and the Middle East due to the high degree of consanguinity. These disorders have not been adopted by the pharmaceutical industry due to limited financial incentives and thus represent an unmet medical need that will greatly benefit from local and collaborative research efforts in Kuwait. A major challenge in LGMD research and the development of LGMD therapies is limited access to human disease-relevant cells to study and model the disease. We propose to exploit induced pluripotent stem cell (iPSC) technology to overcome this challenge as iPSCs are derived from the somatic cells of patients and have the capacity to self-renew and differentiate into any specialized cell type in the body to provide unlimited quantities of disease-relevant cells (myotubes and cardiomyocytes) containing each patient’s genetic makeup. This study aims to use the iPSC-derived cells to develop LGMD patient-specific cellular disease models to elucidate the mechanism underlying the disease and to screen for drugs in a personalized manner. Towards this aim, we have genetically diagnosed numerous LGMD patients in Kuwait and generated iPSC lines from all consenting patients. Our preliminary findings have shown LGMD2I (dystroglycanopathy) and LGMD2A (calpainopathy) to be the most prevalent forms of LGMD in Kuwait and therefore will be the focus of this research project. We hope to use the funds of this grant to: 1) assemble a panel of additional LGMD2A and LGMD2I iPSC lines that possess a variety of disease-causing mutations and display a broad spectrum of phenotypes, 2) differentiate patient-specific iPSCs into disease relevant cell types (myogenic and cardiomyocyte differentiation), and 3) develop high-throughput assays to model the LGMD2A and LGMD2I phenotypes and screen for drugs that reverse the disease phenotype.

KFAS contribution: KWD 41,034
Total budget: KWD 50,034

Radiation Decontamination Spray (PR17-13NR-03)
N. Al-Mea
Ministry of Defense

Abstract:

The aim of this project is localized radioactivity spill in areas of high radioactivity background in which standard detection instruments become unreliable. Radioactivity contamination is a serious issue that nuclear medicine departments in Kuwait and everywhere else are dealing with on daily basis as it effects the health of workers and patients alike. 99mTc-radiopharmaceuticals are the radioactivity solutions of interest as they are the main radiotracers in use in nuclear medicine. 99mTc-radiopharmaceuticals tracers have different pHs than saline, so if it’s possible to change colors due to the different pH then it will be possible to localize the contamination. The use of pH indicators is a method to change the color of the colorless radioactive drops from nonradioactive saline drops. Different pH indicators will be investigated until at least one that shows a drastic different in color between the two solutions. Upon finding the pH indicator then a solution will be made out of it to be used as a spray in the preparation laboratories, injection room and camera room.

KFAS contribution: KWD 7,120
Total budget: KWD 9,780
Benchmarking Antimicrobial Use in Kuwait Primary Health Care Centres: Development of Measures for And Comparison of Drug Use (PR17-13PP-01)

A. Alsubaiei
Ministry of Defence

Abstract:
Antimicrobial resistance, defined as the ineffectiveness of antimicrobials in treating infections to which the causing pathogens were previously susceptible, presents a major challenge to healthcare. This is especially important in the context of the slow development of new drugs and formulations. Countries across the world and the WHO have recognised this phenomenon and the need to make concerted efforts to control overuse and misuse of antimicrobials in ways that assist in reduction of emergence of resistant pathogens. One way for achieving this objective lies in the constitution of antimicrobial stewardship programmes at the hospital level. At the next level, the second approach is to institutionalise measurement and comparison of antimicrobial use across different healthcare facilities for benchmarking performance and regulation.

Kuwait also requires participating in this effort and developing effective antimicrobial stewardship programme for monitoring and controlling antimicrobial consumption.

Infection Control Directorate promotes appropriate antimicrobial usage for patients through awareness, education and adoption of best practices. The absence antimicrobial prescribing quality measures in Kuwait requires efforts to bring together the experience of different medical institutions in developed countries that will assist in institution of systems and stewardship programmes to rationalise antimicrobial use. These systems shall enable the primary care providers to follow changes over time and to promote positive health outcomes through information exchange and benchmarking practice against the best standards. This in turn shall help reduce development of antimicrobial resistance and improve patient outcomes.

The proposed study shall investigate universally accepted and easily implementable measures through a systematic review of prior research to arrive at the most appropriate measures for antimicrobial prescribing. The study shall also compare primary healthcare centres located in different geographic regions and attempt to correlate current levels of antimicrobial prescribing including the type, spectrum width, dose, and mode of delivery across clinics and hospitals in Kuwait.

The proposed research shall assist in developing an understanding of the different approaches and antimicrobial use levels across different primary healthcare institutions and further assist in the formulation of national level policies to measure and rationalise use. The expected outcome would be a reduction in antimicrobial use, lower incidence of resistance, and attendant savings in cost while improving patient health outcomes.

KFAS contribution: KWD 37,074
Total budget: KWD 52,174
Troger-Base Polymers of Intrinsic Microporosity via Click Reaction for Gas Adsorption and Separation
(PR17-14SC-02)

S. Al-Mousawi
Kuwait University

Abstract:

Microporous polymers have been identified as organic materials for the storage of CO$_2$ by physisorption. Previous works on our microporous polymers do possess noteworthy microporosity and notable CO$_2$ sorption capacities with significant quantities adsorbed at low pressures. Most importantly, the structure and composition of these polymers can be tailored via synthetic organic procedures and their microporosity can also be controlled by the selection of specific monomers with unique architectural features and incorporating certain functionalities. The present proposal is to establish a polymerization reaction process for the development of novel ‘Polymers of Intrinsic Microporosity’ (PIMs) and their applications as molecular containers for the storage of CO$_2$ as a green approach in the field of green chemistry. The polymerization reactions which is performed by click chemistry (CC), specifically, the Cu-catalyzed azide-alkyne cycloaddition (CuAAC) reaction, utilizes various Troger-base monomers (TBMs) containing either alkyne or azido functionalities forming rigid and contorted structures that incorporate high content of amino moieties. Such structural features exhibited by the bicyclic TBMs and 1,2,3-triazole linkages can strongly embraces the polymer chain together, resulting in microporous material suitable for trapping and storing CO$_2$. TBMs containing polymerisable alkyne or azido groups will be synthesized using previously reported methods. As per the proposed scheme, The CuAAC reactions will be adopted for the construction of linear or crosslinked PIMs. The prepared PIMs will be further characterized by the routinely techniques such as (GPC, FTIR, NMR, MALDI and elemental analysis). Surface area and porous properties will be analyzed by gas sorption technique and their capabilities in gas separation will be evaluated using single and mixed gas permeation measurements. In addition, the crosslinked PIMs, which will demonstrate reversible CO$_2$ mass loadings will be examined using CO$_2$ sorption. Most notably the proposed TBMs-based PIMs will be contributed in the area of green technology applications.

KFAS contribution: KWD 61,200
Total budget: KWD 117,220

Impact of Hydroprocessing Catalyst Properties and Compositions on Asphaltene Deposition
(PR17-14SC-05)

M. Singh
Kuwait Institute for Scientific Research

Abstract:

The project investigates a deposition of asphaltene on hydroprocessing catalyst. Asphaltene is present in heavy petroleum crude oils, bitumens and their residues, which dissolves in toluene and precipitates in n-alkane. Heavy oil and residue has low API gravity and source of heavy molecular weight carbon is mainly asphaltenes. Asphaltenes usually exist in the form of nano-aggregates, precipitate, adhere to surfaces, block catalyst pores, and decrease catalyst life. In the proposed project asphaltene will be separated as a solid and synthetic feedstock will be prepared with the separated asphaltene in order to identify the irreversible-adsorption capacity. Hence, the primary aim of this research project is to develop a methodology and understand catalyst behavior in the presence of asphaltene containing feedstock. Despite a significant research effort, the structure, aggregation and deposition of asphaltenes under refining conditions remain poorly understood. This proposal addresses the research and development activities required to perceive a refinery catalyst stability which is used for Kuwaiti atmospheric residue under hydroprocessing conditions. The proposed work is to evaluate asphaltene irreversible adsorption (deposition) on the surfaces of catalyst, which is expected due to the interfacial chemistry between asphaltene and catalyst (acid-base) nature with significant role of textural properties. In order to examine selective or molecular deposition on the catalytic sites, pure asphaltene will be separated from crude oil/residue. Subsequently, solid asphaltene will be dissolved in an aromatic solvent (toluene) and prepared as a synthetic feedstock for adsorption. Therefore, this project will investigate the model asphaltene deposition capacity as a function of catalyst composition, nature (acid-base), textural properties and oxide as well as sulfide catalyst that operates close to refining conditions.

KFAS contribution: KWD 41,600
Total budget: KWD 156,720

T. Al-Azemi
Kuwait University

Abstract:
Molecular recognition via noncovalent interactions play significant role in all biological systems, and one of the fundamental aspect of supramolecular chemistry. The important of anionic species in the environment, biological systems, and in medicine, drove considerable interests in the synthesis of supramolecular anion receptors. In this project, we are proposing the development of supramolecular anion receptors with unique structural features based on pillararenes which are recently discovered new class of macrocyclic compounds. The proposed well-defined macrocyclic receptors will be characterized by X-ray single-crystal diffraction techniques and spectral methods. Binding studies will be conducted with different size and shape anions to demonstrate the selectivity of these anion receptors.

KFAS contribution: KWD 83,200
Total budget: KWD 135,470

Lie Algebras and the Hyperbolic Conservation Laws (PR17-16SM-03)

Y. Benhadid
Public Authority for Applied Education and Training

Abstract:
The general hyperbolic conservation laws of a flux function are developed in a manifold based on Lie algebras (the Lie group theory). The basis is found to stably represent the solution for small viscosity. A special case (Burger's equation) is taken to apply a Total Variation Diminishing method which is presented to reduce or at least to control the oscillations at a shock associated with Gibbs phenomena. The Runge-Kutta scheme shows the order of the viscosity of the solution. A general algorithm is proposed to increase the efficiency of the method and the structure of the solution.

KFAS contribution: KWD 10,895
Total budget: KWD 10,895
Initiating the Impact Funding Ecosystem: Government Leading the Private Sector Towards Economic Sustainability (PR17-17IC-03)

S. Al-Abduljader
Gulf University for Science and Technology

Abstract:

It is documented in literature that impact investing/funding benefits arise from investing in companies and projects with the objective of financial return in addition to social and environmental impact (Harji and Jackson, 2012). Recently, however, some focus is drawn towards emerging markets and the unexplored ‘impact’ of impact investing/funding. The present literature lacked studies on impact investing in GCC economies let alone, the State of Kuwait.

The objective of this project is to examine the current landscape of impact funding in the Kuwait and propose a framework for government participation. I propose a framework of which government authorities in Kuwait can utilize to ensure data is captured, assessed and insight drawn towards further policy development and incentive schemes. Second, the absence of a regulatory, legal and legislative investigation pertaining to the incorporation of impact metrics has partially hindered government in undertaking more aggressive measures towards impact investing/funding adoption. Evidence-based policy making research and investigating best practices and initiatives such as the Global Impact Investing Network (GIIN), Community Interest Company (CIC) in the UK and the International Finance Corporation (IFC) would be conducted to assess the current and future landscape in relation to regional policy development.

KFAS contribution: KWD 10,000
Total budget: KWD 10,000

New Programming Models for Systematic Memory Isolation for Protecting Against Vulnerabilities in Large Rust Programs (PR17-18QS-01)

H. Almohri
Kuwait University

Abstract:

As the industry’s demand rise, the research community is called for proposing new platforms, paradigms, and languages for designing, developing, and deploying large-scale networked programs. The loop of demand and supply between the industry’s needs and the development in the research community has thus created an ever accelerating movement towards advancing the platforms on which today’s systems depend. One such movement is realized in the systems languages community. A particularly interesting development is taking place within the Mozilla community. The hope for a secure platform that gives birth to a reliable, robust, and long-term-supported browser engine is contributing towards a consistent development of a new language, named Rust, within a new family of systems languages that entertain strong compile-time memory safety guarantees, eliminating powerful classes of unintentional memory boundary violations that have been the basis for many classical security breaches.

As a research goal, the proposed research project is intended to investigate the shortcoming of the memory-safe systems languages family in terms of broader security goals. Will merely changing the implementation language of the application aspects of transport layer security (TLS) eliminate severe vulnerabilities such as Heartbleed? What are the guarantees that Rust can provide, out-of-the-box, to eliminate such attacks?

The proposed research project will attempt to design of a new programming model for memory-safe systems languages. This model is aimed to enable secure interaction between a safe and an unsafe program component. The benefit of secure interaction is in maintaining the basic guarantees of Rust while enabling largescale system design (especially for programs with heavy networking capabilities) with a reliable assistance of commodity libraries written in unsafe languages.

KFAS contribution: KWD 7,500
Total budget: KWD 20,300
Identifying Feedback Methods That Lead to Higher Learning Effectiveness When Learning Is Based on Computer Simulations
(PR17-19TT-02)

M. Jaeger
Australian College of Kuwait

Abstract:
The importance of formative feedback on students’ learning activities so as to facilitate high learning effectiveness, is a well-known instrument in engineering education and in education in general. However, the role of feedback on students’ learning activities, when learning engineering processes based on computer-based simulations, is much less well known. In particular, the impact on engineering students’ learning effectiveness when studying engineering processes, and when different types of feedback are used, has not been analysed so far and is therefore novel.

The purpose of this research project is to analyze the impact of “correcting feedback” (i.e. the feedback informs the student that a specific answer is wrong and provides the correct answer) versus “reflecting feedback” (i.e. the feedback includes a hint to encourage the student to re-think a specific answer) on learning effectiveness of engineering students, when using computer based simulation in order to learn engineering processes better.

Methodologically, the difference of learning effectiveness due to the two different types of feedback can be analysed by carrying out semi-quasi pre-test/post-test experiments using an experimental group of students and a control group of students. Practical and statistical significance will provide insights regarding the learning effectiveness of both feedback approaches and allow conclusions for the design of computer-based simulations of the learning engineering processes, as well as facilitating the learning of engineering processes in general.

The experiments will utilize a computer-based simulation of a typical continual improvement process since appreciating and internalizing the concept of continual improvement is paramount for any engineering related organization and society in general. Therefore, it will contribute indirectly to improving the situation related to energy, water and environment in Kuwait.

KFAS contribution: KWD 3,850
Total budget: KWD 9,880

Chemical Safety of Children’s Toys and Baby Products Sold in The State of Kuwait: A Preliminary Assessment
(PR17-41BO-01)

B. Gevao
Kuwait Institute for Scientific Research

Abstract:
Several studies around the world have reported high levels of metals and toxic organic compounds, such as flame retardants, bisphenol-A, and phthalates, in children’s toys, jewelry, and other products. These chemicals are intentionally incorporated in these items during their production to perform various desirable functions. As industrialized countries impose stricter criteria on the levels of these toxic compounds, the likelihood is that manufacturers will “dump” cheaper products that often contain these toxic compounds in countries where the enforcement mechanisms are weak. The Gulf countries have regulated toys under the “Gulf Cooperation Council Technical Regulation on Children’s Toys”, which came into force in 2014 and intended to ensure the safety of toys marketed in all member states. The primary goal of this project is to carry out a preliminary screening of a selection of toys and children’s products for the occurrence and concentrations of selected toxic chemicals, which are prohibited under the Gulf Cooperation Council directives. The ultimate goal is to build the capacity to monitor the levels of these compounds in a range of toys to assist the Public Authority for Industry of Kuwait determine the compliance with safety regulations of toy manufacturers exporting toys to Kuwait.

KFAS contribution: KWD 33,966
Total budget: KWD 161,396
Benthic Foraminifera as Proxies for the Environmental Quality Assessment of the Kuwait Bay (Kuwait): Morphological and Environmental DNA Metabarcoding Approached (PR17-42SE-01)

E. Al-Enezi
Kuwait Institute for Scientific Research

Abstract:

The increased urbanization and developmental activities in Kuwait and in the northern part of the Gulf (southern part of Iraq and Iran), and the consequent effluent discharges into marine environments have resulted in changes in the water and sediment quality of coastal and marine ecosystem. Sediments are known to be the final repositories of most organic and inorganic (i.e., heavy metals) pollutants that can persist in the sedimentary matrix, may be cumulated through the food-web, and affect marine biota. Biological monitoring enables the detection of unforeseen impacts and is more directly related to the ecosystem health than are chemical data. In this context, benthic foraminifera are of great importance as they can be used as early warning bio-indicators of the health quality of marine ecosystems. A few studies have considered the impact of pollution on the distribution of benthic foraminifera in Kuwait and within the Arabian Gulf. Given the great concern for environmental health and biodiversity, it is here proposed that the existing knowledge on foraminiferal distribution to complement with a large-scale field study over the Kuwaiti territorial waters and establishing the first culture foraminiferal lab for the region. Approximately 50 bottom sediment samples will be collected from the area to study the foraminiferal distribution and the sediment characteristics. The main aim of this research project is therefore to assess the environmental quality by using foraminifera as proxies of environmental quality. Specific objectives are as follows., i) understanding the response of benthic foraminifera to pollution; ii) the establishment of a foraminiferal culture lab. Such objectives will be covered with the implementation of 7 tasks.

KFAS contribution: KWD 38,900
Total budget: KWD 124,850

Usage of Groundwater Isotopes to Reconstruct the Paleoclimate of Kuwait For Water Resources Management Strategies (PR17-44SE-01)

S. Chidambaram
Kuwait Institute for Scientific Research

Abstract:

In addition to various geological and hydrogeochemical information, the knowledge of the past climates of Kuwait is very essential for the better understanding of the hydrology of its groundwater system. Any variation in the regime and quantity of precipitation, together with variations in temperature and evapotranspiration, affects groundwater recharge. The climate is expected to not only affect recharge and discharge but also influence the quality of groundwater. Information on severe droughts in the past and their impacts on groundwater quantity and quality in Kuwait could aid water managers in incorporating the same in the decision-making systems for the analysis of long-range water resources management strategies for future severe droughts. Several investigations on climatic changes during the Late Quaternary have been inferred from the isotopic composition of groundwater in other parts of the world but not in Kuwait.

The reconstruction of the paleoclimate of Kuwait during the Late Pleistocene based on isotopic ($^2$H, $^4$He, $^{13}$C, $^{14}$C, $^{17}$O, $^{18}$O, $^{222}$Rn, and $^{36}$Cl) fingerprinting of groundwater samples, in conjunction with noble gases (He, Ne, Ar, Kr, Xe) thermometry, is planned to be carried out in order to comprehend its control on the hydrology of the groundwater system.

KFAS contribution: KWD 39,136
Total budget: KWD 128,426
The Genotoxic Effects of Kuwait Crude Oil on Marine Fish (PR18-12SL-01)

Q. Karam
Kuwait Institute for Scientific Research

Abstract:

Studies have shown persistent presence of petroleum hydrocarbons in the marine environment of Arabian Gulf. Earlier studies conducted in KISR’s laboratory revealed structural and behavioral changes in fish larvae exposed to suboptimal concentrations of crude oil. Such toxic effects observed in early life stages of fish may be contributing to population decline reported in recent years. The present study is aimed at determining the effects of sobaity sea bream (Sparidentex hasta) fish larvae’s exposure to suboptimal concentrations of Kuwait Crude Oil (KCO) on mortality rates, developmental deformities and genetic anomalies like DNA damage, irregularities in gene expressions and phenotypes. The study will help in understanding if such toxic effects of petroleum hydrocarbons on early life stages are affecting fish population and disturb the food chain in the marine ecosystem.

KFAS contribution: KWD 48,900

Total budget: KWD 103,940

Vitamin D and Bone Mineral Density Among University Kuwaiti Future Mothers (PR18-13MM-01)

N. Al-Ayyadhi
Ministry of Health

Abstract:

Assessment Vitamin D levels in association with bone mass quality among young women at the peak of their bone mass, between the ages of 20 and 35 years, and the implementation of prevention strategies during young adulthood may be crucial prophylactic process for early identification and prevention of osteopenia to lower the risk for fracture-related morbidity and mortality (46), yet research examining the determinants of bone health in young women is limited especially in this part of the world.

The objectives of the study are:

2. To screen of bone mineral density (BMD) using Quantitative Ultrasonography Technique as indicative of bone mineral density for Kuwaiti young women.
3. To confirm, by DXA, the diagnosis of low BMD among those positives by QUS and/ or hypovitaminosis D.
4. To investigate underlying risk factors leading to vitamin D deficiency among Kuwaiti young female in the age group 18-35 years old.
5. To recommend a program for optimum attainment of bone health among future mothers based on the results of this study.

Participants will complete a self-administered questionnaire that fulfils data about: personal information, social habits, menstrual history (as age of menarche and regularity of menses), relevant dietary information, physical activity, sun exposure. Then an Ultrasound examination of your left foot. And a blood sample will be withdrawn for Vitamin D & Calcium. Completion of the questionnaire will take about 20-30 minutes. Positive cases will be informed to do confirmatory X-ray and treatment in their health centers.

Results will help researchers in identifying how big the problem of Vitamin D deficiency & its affection on bone health as osteopenia/osteoporosis and the risk factors associated with these conditions and help design future prevention strategies in preparing future mothers for having healthy babies.

KFAS contribution: KWD 7,700

Total budget: KWD 7,700
Brain Connectivity Patterns Based Emotional Impairment Analysis in Parkinson’s Disease Patients Using Wireless EEG Signals and Deep Learning Methods (PR18-13MM-08)

M. Murugappan
Kuwait College of Science and Technology

Abstract:

Parkinson’s disease is a neurodegenerative disorder which affects nearly 6 million of population around the world. Most of the patients who are affected by this disease are in the age range of 45 – 85 years and it mainly caused due to the degradation of dopamine chemicals in the Bessel ganglia region within the brain. The loss of dopamine severely affects the brain motor functions such as human postures, emotion, and cognitive processing. Thereby, the patients are not able to identify and express their precise internal feelings to the clinicians for effective treatment. Hence, the success rate on remedial treatment towards emotional impairment in PD is a challenging issue. Hence, most of the clinicians are looking for an autonomous system which can detect the emotional impairments in PD in a non-invasive and computationally efficient way. Emotional impairments in PD can be assessed through different modalities (verbal, lexical and facial expression's methods). However, these methods are highly subjective and fail to track the inherent emotions in PD. This study aims to analyze the Parkinson’s Emotional EEG Database for emotional impairment assessment in PD. A database has the EEG signal episodes for six different emotions (happiness, sadness, anger, fear, disgust, and surprise) of 32 PD patients and 32 Healthy Controls (HC) subjects and collected from Hospital Universiti Kebangsan Malaysia, Malaysia using 14 channels wireless-EEG system [48]. Another local or online database will be used to enrich the dataset. These signals will be processed using nonlinear signal processing methods, machine learning algorithms and deep learning methods. Two different approaches will be incorporated in this work to assess the emotional impairment in PD. Firstly, the nonlinear features extracted from the EEG data (PD and HC) will be used to analyze, how the different regions of brains get connected while the subjects experiencing different emotions using Brain Connectivity Patterns (BCP). Secondly, the nonlinear features will be used to map to the corresponding emotions in PD and HC using three machine learning (Support Vector Machine (SVM), Probabilistic Neural Network (PNN) and Extreme Learning Machine (ELM)) and deep learning methods. The graphical results through BCP and numerical values of emotion recognition rate through advanced machine learning methods would assist the clinicians to effectively diagnose the emotional impairment in PD. It also provides a path for the researchers to develop a real-time emotional impairment detection system for PD.
 Establishment of National DRL for CT in Hybrid Imaging Studies “The First National NM CT (PET) Dose Audit for KW Population – 2018” (PR18-13MN-01)

M. Masoomi
Ministry of Health

Abstract:

The role of CT in PET-CT imaging including diagnostic, anatomic localization and attenuation correction is providing a different function and a different scan length from a similar standalone CT and as such the standalone diagnostic CT DRL is not appropriate for reference. There are a limited number of studies investigating this. A comparative study to this project was a national survey conducted by the French Society of Nucl Med on whole body PET-CT oncologic procedures.

The project will be a multicentre study with the methodology based on UK – IPEM that will be carried out in collaboration and participation of the current 8 PET-CT centres and the future anticipated PET centres in the state of Kuwait. The project is the first of its kind to determine DRL based on CTDIvol and DLP for CT hybrid PET imaging operating in Kuwait.

Surveys of dose estimates from PET-CT imaging practice in Kuwait can highlight the substantial variations in dose (between the healthcare facilities) that occur and are not known at present. As such, this study will facilitate establishing a platform for standardization of dose for CT of hybrid imaging for various examinations to monitor practice and promote improvements in patient protection and quality care in Kuwait.

It is expected that the outcome of the study establishes a national reference doses for CT scans performed by PET-CT hybrid imaging systems in Kuwait and pave the way for a national database that will hopefully be adopted for execution via Ministry of Health (MOH) as part of improving the healthcare services for the Kuwaiti population.

The State of Kuwait could also be added to the list of countries that has carried out such studies for their facilities as part of the optimization of their healthcare imaging in particular and health care protection in general.

KFAS contribution: KWD 8,900

Total budget: KWD 9,600

Early Intensive Behavior Intervention for Autism: An Outcome Study of Children in Kuwait (PR18-13MQ-02)

A. Al-Ali
Applied Behavior Center Kuwait

Abstract:

Early Intensive Behavioral Intervention (EIBI) is a behavioral treatment program based on the principles and procedures of Applied Behavior Analysis; with its core features being that it begins early in a child’s development (4 years of age or younger) and that it is intensive (a minimum of 20 hours a week). Over the years EIBI continues to be supported by scientific evidence and thus has shape the health policies of many countries around the world that provide EIBI. In Kuwait, while EIBI is provided, research on its efficacy is non-existent. The objective of this study is to evaluated the efficacy of various factors of EIBI as it specifies to Kuwait. The present study aims to evaluate treatment progress for children receiving EIBI services at the Applied Behavior Center of Kuwait. Particularly the effect of treatment intensity on treatment outcomes, and how these outcomes vary by age. Between-subject ANOVAs will be conducted to predict treatment progress based on the average weekly treatment hours received and the child’s age at enrollment. Each of these variables is predicted to be a significant indicator of the variance in marked improvement. Implications of results for this study should go towards implementing a health policy that provides effective treatment for individuals with ASD.

KFAS contribution: KWD 4,450

Total budget: KWD 4,450
Accommodation and Strategies of People with Dyslexia in Kuwait (PR18-13OP-01)

E. Al Hamdan
Fawzec Educational Company

Abstract:
Dyslexia is a neurologically-based learning disability in which individuals have difficulties in reading and spelling which may be unexpected given their intelligence and educational opportunities. Difficulties related to dyslexia persist throughout one's life and such difficulties can lead to school failure as well as lower self-esteem levels if appropriate support is not given. The purpose of this study is to identify the accommodations and personal strategies that people with dyslexia in Kuwait perceived to be most successful in compensating for their difficulties. We propose to conduct one-on-one qualitative interviews on personal, academic, and workplace experiences of adults with dyslexia in Kuwait. Qualitative interviews allow a platform for participants to share opinions on what types of help they valued, but also the opportunity to make their own suggestions on interventions they feel may benefit others. This type of research is essential as there are currently no studies conducted on adults with dyslexia nor any dyslexia-focused qualitative interviews in Kuwait. We expect that accommodations will be viewed as helpful in overcoming difficulties. Additionally, we expect participants will rely strongly on technology, time management and organizational strategies, visual strategies, and support from family and friends. A long-term outcome of this study is to help inform educational and work policy in Kuwait for the benefit of stakeholders involved. This study would be the first step towards improving educational and work conditions for people with learning differences in Kuwait.

KFAS contribution: KWD 4,900
Total budget: KWD 4,900

The Relationship Between Learning Difficulties and Psychological Disorders Among University Students in the Australian College of Kuwait (ACK) (PR18-13OP-02)

Jasem Hajih
Australian College of Kuwait

Abstract:
The number of students with learning difficulties (LD) enrolled in postsecondary institutions has been growing dramatically. Furthermore, there is a relationship between mental health problems and learning difficulties among college students.

This research aims to explore the relationship between LD and psychological disorders, as well as to explore the relationship between the LD and certain demographic data. Therefore, the outcomes of the research will be highly important on many levels. For example, this research will provide scientific data that covers a clear research gap on this topic in Kuwait and other regional countries. Clearly, the research will provide a number of benefits on many different aspects; the results will be beneficial to both the LD student community in ACK as well as to LD students in Kuwait generally.

The LD students would have previously provided a psycho-educational report from a diagnostic center in Kuwait to support their case and to have them registered in the Student Support Centre at ACK. Once all instruments are implemented on the LD students, another controlling sample of 60 students will be taken from other ACK students who are not registered in the Student Support Centre as having LD. The results will later be analysed to explore the relationship of LD and psychological disorders.

KFAS contribution: KWD 5,550
Total budget: KWD 5,550
Evaluation of Adherence to Clinical Guidelines for Treating Patients with Chronic Cardiovascular Diseases in Kuwait (PR18-13PR-01)

D. Al-Taweel

Kuwait University

Abstract:

Globally, many health policy agendas have prioritized the measurement of the quality of healthcare, and for healthcare systems to develop and improve, it is essential that current practice is evaluated against published evidence.

Both developed and developing countries have seen the rise of deaths due to cardiovascular diseases in recent years. In Kuwait, coronary heart disease is the major cause of morbidity and mortality. It has been estimated that CVDs resulted in approximately 46% of all deaths. Effective treatment of CVDs involves not only the management of a specific disease, but also treating and preventing risk factors for CVDs, including hypertension, dyslipidemia and diabetes. Due to the complexity of the management of the CVDs, it is crucial that physicians use clinical guidelines in caring for patients with CVDs and risk factors for CVDs to make medical care more rational and cost effective, and thus improve the clinical outcomes of patients.

Information regarding the prescribing practice of physicians in the management of patients with chronic cardiovascular diseases in different healthcare sectors in Kuwait is lacking, particularly in secondary care. This highlights the need to acquire data in this field to assist top stakeholders including policy makers to plan for the best quality of medical management for patients with chronic CVDs in secondary health care settings in Kuwait. To our knowledge, this study demonstrates a novel approach to evaluate and identify gaps in the adherence of medication use to clinical guidelines for chronic CVDs in the secondary care setting in Kuwait and likely, in the Middle Eastern countries.

KFAS contribution: KWD 8,000

Total budget: KWD 8,000

Green Synthesis of Novel Biologically Relevant Tricyclic Systems of Pyridazinonaphthyridine Derivatives and Quinazolin Derivatives Utilizing High Pressure as Energy Source on Multicomponent Reactions (PR18-13SC-01)

S. Al-Mousawi

Kuwait University

Abstract:

We will study the effect of high pressure as a green energy source on the multicomponent reactions for synthesis of novel polyfunctional heteroaromatics of potential biological active with fused poly cycle and fused heterocycles which important in the field of metal free organic chromophores.

KFAS contribution: KWD 10,000

Total budget: KWD 10,000
Femtosecond Laser Induced Sub-Micron Structuring of Semiconductors, Glasses and Polymers (PR18-13SP-01)

S. Valappil
Kuwait College of Science and Technology

Abstract:
Surface properties of materials are significant in determining the applications of a material and the modifications of surface properties have been drawing wide attention. Laser matter interaction and the associated material removal resulting from ablation process has been active field of research ever since the invention of laser. As a result of laser ablation a comparatively rough surface depending on the rate of ablation is generated if the fluence is adequate. Apart from the random features formed specific ordered surface features can also be generated on the irradiated sample through controlled ablation by restricting the laser fluence near ablation threshold of the material. The generated surface features are generally referred as laser induced periodic surface structures or LIPSS. As a matter of fact, these surface features show a close correlation with various irradiation parameters as well as intrinsic physical properties of the target. It is worth to mention that it is possible to control the geometry of the structures by precisely controlling laser parameters such as polarization, number of pulses, pulse energy, angle of incidence and so on, that makes the process very flexible. The ambient of the process provide a further way to influence the spatial distribution of these structures. Since surface morphology plays a key role in numerous physical properties of a solid surface (e.g. optical, mechanical, wetting, chemical and biological), direct laser surface and 3D structuring is a striking tool since it can possibly offer feasible and effective ways to tailor or control material functionalities. In this project, femtosecond laser used surface and 3D structuring is employed to simultaneously modify the topography and nanostructure in different class of materials (semiconductors to polymers) to find suitability for applications in wide range of fields (solar cell to medicine). We look forward to developing the next generation of promising photonic materials and propose for better solar cell technology, and helping Kuwait play a stronger role in the research and development sector.

KFAS contribution: KWD 8,950
Total budget: KWD 8,950

Use of Nanoparticles to Enhance Coolant Fluid Performance (PR18-14SC-01)

K. Khanafer
Australian College of Kuwait

Abstract:
There is growing evidence that the Global economy is starting to pivot away from its past over-reliance on commodities, into value added to industries that rely primarily on technology, productivity and skilled labor. For the global manufacturing sector to be up to this change, it needs to address several challenges in terms of skilled workforce, efficient and sustainable operations and new machining technologies. Metal working fluids (MWF) are essential for machining processes leading to increase tool life, improve surface finish and chip removal from the cutting zone. However, MWF are being questioned extensively for their economics and environmental related issues. The broader goal of this research program is to achieve a more sustainable, productive and profitable machining processes by investigating economically and environmentally viable novel solutions such as the use of nanoparticles in the thermal management of the cutting tool. To this end, introducing and testing of hybrid coolant strategies for machining engineering materials opens the potential for more efficient machining processes with better surface quality, while reducing the environmental burden of the machining process. This entails performing a comprehensive experimental study of the different combinations of cutting parameters including novel and hybrid coolant strategies to develop an understanding of the effect of these parameters on the mechanics of the process. Building on previous experience and track record; the proposed research program aims at developing the knowledge, numerical models and tools needed to address both sustainability and technical challenges associated with machining of difficult- to -cut materials, in terms of tool wear, surface quality and integrity. This will allow wide spread applications of these materials throughout the manufacturing sector and will facilitate a more highly competitive environment in the global market.

KFAS contribution: KWD 9,100
Total budget: KWD 9,100
Atmospheric Concentrations of $^{210}$Pb $^{210}$Bi and $^{210}$Po in Kuwait (PR18-14SE-01)

M. Behbehani
Kuwait Institute for Scientific Research

Abstract:

$^{222}$Rn progenies such as $^{210}$Pb, $^{210}$Bi and $^{210}$Po emanate from soil into the atmosphere. These radionuclides are highly particle reactive and quickly adhere to aerosol particles, enabling long range transport. Due to limited research on and monitoring of radionuclide concentrations in the atmosphere in the northern Arabian Gulf, few data sets are available and are not sufficient to understand the atmospheric concentration and flux of $^{210}$Po, $^{210}$Bi and $^{210}$Pb. Data on volatile $^{210}$Po is quite limited in literature and there is no information published on the emission from oil producing countries. This proposed study will create baseline information and fill this data gap on atmospheric concentration of $^{210}$Pb, $^{210}$Bi, and $^{210}$Po. Size fractionated aerosol sample will be collected using high volume air sampler equipped with a six-stage cascade impactor along with collection of volatile $^{210}$Po. Besides, mapping the spatio-temporal variability of $^{210}$Pb, $^{210}$Bi and $^{210}$Po concentrations in atmosphere within different size fractions of dust and in volatile phase, this study will also attempt determining mean aerosol residence time using $^{210}$Po/$^{210}$Pb and $^{210}$Bi/$^{210}$Pb ratios and identification of possible sources. Baseline concentrations of volatile $^{210}$Po in air will be established.

KFAS contribution: KWD 24,350
Total budget: KWD 82,220

Autonomous and Portable Measuring System for Rheological Properties of Newtonian and Non-Newtonian Fluids (PR18-14SP-01)

M. Sabati
Australian College of Kuwait

Abstract:

In the process of extracting oil or other resources, drilling is a fundamental step and a difficult task to do. For the drilling to continue efficiently there is a drilling fluid (also known as drilling mud) which is used to ensure that the drilling machine is not damaged and to perform effectively. However, it is very important to know the viscosity of the drilling fluid for a smooth and efficient drilling. In oil and gas industry, therefore it is required to measure rheological properties of various liquids for quality control reasons by simple yet robust techniques. Manual marsh funnel is recognized as a widely used and reliable device utilized to measure viscosity of drilling liquids known as drilling muds. The discharge time for one quart of liquid from the funnel is the only measured parameter during field operation from which the only output parameter, i.e. the dynamic viscosity is determined by the expression $\mu = \rho(t-25)$, where $\rho$ is the density of the fluid and $t$ is the discharge time. Sedaghat (2017) developed a new method to determine three rheological parameters including apparent viscosity, plastic viscosity, and yield point of drilling fluids in the Marsh funnel by only measuring the full discharge time. The objective of the present project is to equip the Marsh funnel with a microprocessor and electronics to automate the entire process by controlling the discharge from the Marsh funnel, time measurement, and process calculations to measure and report three outputs of apparent viscosity, plastic viscosity, and yield point. Due to the current lack of such apparatus, it is strongly believed that the end product has the potential to be commercialized targeting oil and gas industry. Moreover, application of the proposed apparatus may be extended to other fields such as medicine, food, and cement slurry.

KFAS contribution: KWD 7,700
Total budget: KWD 8,825
Influence of Manganese Doping on the Physical Properties of Spray Deposited Zinc Oxide Thin Films
(PR18-14SP-08)

A. Alsmadi
Kuwait University

Abstract:

Diluted magnetic semiconductors (DMS) are materials which have magnetically polarized carriers at room temperature where the spin moments and the charge carriers can be coupled with an external magnetic field. By combining both semiconducting and ferromagnetic properties, these materials have several applications in spintronics, opto-electronics and magneto-electronic devices. Mn doped ZnO is one of the most promising DMS’s because of its unique physical properties. Despite the numerous publications on this material only few articles were devoted to the study of the magnetic and optical properties of films prepared using the ultrasonic spray pyrolysis method. Moreover, the literature shows contrary results about the nature of the observed ferromagnetism, as if it is intrinsic or extrinsic, and the origin of this ordering is still under debate and controversial. Therefore, it is a matter of great concern for researchers to understand the nature and the origin of ferromagnetism in these materials. In the present project, we propose to study the structural, chemical, magnetic and optical properties of Mn doped ZnO films prepared using the ultrasonic spray pyrolysis technique. The following characterization tools will be used: XRD, XPS, PPMS, transmission, reflectivity, and photoluminescence measurements. The overall results will be analyzed and discussed in order to provide a closer view on the nature and the origin of the ferromagnetic ordering in this material.

KFAS contribution: KWD 9,500
Total budget: KWD 10,450

The Sief Palace Project by The Finnish Architect Reima Pietila Revisited After 30 Years
(PR18-15EA-01)

T. Botz
Gulf University for Science and Technology

Abstract:

The famous Ministry of Foreign Affairs (built 1986) by Finnish architect Reima Pietilä is featured in the most important international books on modern architecture. It is as important as Utzon’s National Assembly or the Kuwait Towers. Since 2012 I have visited the buildings and taken photos. The buildings had never been visited by specialists of architecture since 1986. On December 1 2017, I took a guided tour with a delegation from the Dar al Athar al Islamiyyah and took photos. In my research I want to document changes and also re-evaluate Pietilä’s urbanization plan for Kuwait. I will:

• Talk to the Kuwaiti architects who have renovated the Ministry since the 1980s.
• See the report entitled “City of Kuwait: A Future Concept” in which Pietilä draws two alternative plans for the city center of Kuwait.
• See the plans of the Ministry buildings in order to assess what changes have been made.
• See all other writings by Pietilä and other authors on the project.
• Look for photos in the Pietilä Archive at the Museum of Finnish Architecture in Helsinki.
• Talk to the co-architect of the building, Raili Pietilä, who is still alive, as well as to other specialists of Pietilä.

I will write at least one article on this building and about the alternative urbanization plan linked to this building.

With the Finnish architect Dr. Gareth Griffith (Tampere University) I will organize an exhibition in the Department of Architecture of the Alvar Aalto University in Helsinki. We will show different aspects of this Kuwaiti building (planned for September 2018). A mini conference will be organized.

KFAS contribution: KWD 4,850
Total budget: KWD 4,850
Feasibility Study for the Economic and Reliability Enhancement of the Electric Power System Through Co-optimization of Energy and Water Desalination Resources (PR18-15EC-01)

Y. Al-Abdullah

Kuwait Institute for Scientific Research

Abstract:

Currently, system operators working in the power industry, particularly in North America and Europe, utilize Energy Management Systems (EMS) to optimize scheduling of generation assets with anticipated demand. As a result of adopting this technology, system operators have seen significant savings. The Ministry of Electricity and Water (MEW) has yet to adopt such technology. In addition to the generation of electricity, the MEW has the task of producing potable water for the State of Kuwait. Its water desalination units have a high-energy demand but are ‘schedulable’ loads, thus adding flexibility to the power system. The proposed research would build an optimization framework to account for scheduling of generation assets and water desalination units. By accounting for both within the optimization framework, both would be co-optimized, resulting in the most efficient electricity generation and water production dispatch while meeting demand and could potentially lead to significant improvements in economic efficiency and reliability. Furthermore, the proposed research could lead to enhanced system operations and reliability for not only the MEW, but also other Gulf Cooperation Council (GCC) members that rely heavily on desalination to produce potable water.

KFAS contribution: KWD 35,100
Total budget: KWD 124,600

Experimental Investigation of the Mechanical and Surface properties of Submicrometer Spherical Carbon Particles Used to Enhance Oil Tribological Performance (PR18-15EM-03)

A. Alazemi

Kuwait University and Kuwait Institute for Scientific Research

Abstract:

Mechanical failure and energy loss in most mechanical systems (such as engines) are mainly due to friction and wear. Energy loss can be reduced using submicrometer solid particles as dry powder or as additives to conventional oil lubricants. Spherical carbon particles with diameter range from 100 nm to 500 nm were demonstrated as effective solid additives for liquid lubricant to minimize friction and wear losses. The main objectives of this study are to experimentally investigate the lubricating mechanism as well as the surface and mechanical properties of the submicrometer carbon particles using an atomic force microscopy and scanning electron microscopy. The currently available atomic force microscopy will be instrumented to allow for adhesion, friction, and elasticity measurements for the spherical carbon particles. Furthermore, scanning electron microscopy will be utilized to obtain high resolution images and perform chemical analysis for carbon particles.

KFAS contribution: KWD 10,000
Total budget: KWD 10,770
Wave Forces on Offshore Structures Calculated with Smooth Particle Hydrodynamics and Physical Modeling (PR18-15EV-05)

N. Almashan
Kuwait University, Kuwait Institute for Scientific Research and Northwestern University, USA

Abstract:

Currently, computational fluid dynamics (CFD) models are utilized heavily in the aircraft and automotive industry for the computation of forces on the structures, but these models are not used in the oil industry for the design of offshore structures. (In fact, the design methodology for offshore design is the same as it was 40 years ago!) This project will show that a modern CFD code, GPUSPH, which is based on Smoothed Particle Hydrodynamics and has been shown to be appropriate for nonbreaking and breaking waves can be used for offshore structure design. As validation, we propose to model wave forces on two types of offshore structures - one similar to an offshore platform for oil & gas extraction, and the second, a floating wave energy device. The GPUSPH code is coupled with a multi-physics dynamics package Project Chrono to model the elastic behavior of the structures in the wave field. Concurrent with the numerical modeling it is proposed to carry out physical model testing of the same devices, with different wave environments, to provide a detailed validation data set for the numerical model and to explore for unexpected results, as often happens with physical model testing. In particular, resonance and near-resonance conditions will be explored.

It is expected that the validated and extended (with Project Chrono) open source GPUSPH code will be useful for design in the offshore and wave energy converter industries. Further, the validated model will be used on elastic structures of oil drilling platform and wave energy. The complete physical model work will be done in Kuwait Institute for scientific Research and the numerical modeling in Northwestern University, USA.

KFAS contribution: KWD 233,600
Total budget: KWD 364,180

Effect of Raveling on the Performance of Hot Mix Asphalt Under Arid Climatic Conditions: Case Study in Kuwait: Phase I: Postmortem Evaluation of In-Service Pavements (PR18-15EV-06)

T. Ahmed
Australian College of Kuwait

Abstract:

Raveling can be described as the dislodging of coarse aggregate particles. Raveling may be caused by insufficient asphalt binder, poor mixture quality, insufficient compaction, segregation, or stripping. This problem gets worse in the presence of severe climatic and operating conditions such as high temperature and heavy traffic. In arid areas like Kuwait, raveling has been the leading cause of poor performance in many of the flexible pavement surfaces.

This research study will investigate the cause of raveling in Kuwaiti roads and its impact on the performance of HMA pavements under arid climatic conditions in order to determine the best practice to deal with the raveling problem in Kuwaiti roads. The overall study is comprised of four phases, which includes; Phase I: Post-mortem Evaluation of In-service Pavements, Phase II: Materials and Asphalt Mix Designs, Phase III: Laboratory Performance Evaluation of Asphalt Mixtures, and Phase IV: Performance Life using Mechanistic-Empirical Analysis of Asphalt Mixtures. This research proposal will focus on Phase I of the overall research study.

KFAS contribution: KWD 9,441
Total budget: KWD 10,866
Application of Annihilator Extension’s Method to Classify Zinbiel Algebras (PR18-16SM-01)

A. Alenezi
Public Authority for Applied Education and Training

Abstract:
The project is devoted to application of extensions technique to a class of algebras Zinbiel called algebras. The research motivated by lack of essential classification results for this class of algebras unlike for classes of finite-dimensional algebras closely related to this class. First, we develop a theoretical background of the extension method then apply it to classify Zinbiel algebras in dimension up to 5. Classification methods applied earlier were based on study of the behaviour of structure constants under base change and they were applicable in low-dimensional cases only. Main idea behind of the extension method is construction of algebras in higher dimension having lists of isomorphism classes in low dimensions which are available due to structure constants technique mentioned above. The method enables us to use computer programs for some computations. In all the cases we propose 2-cocycles and respective annihilator extensions. The base change action is interpreted as an action of automorphism group of small algebras on cocycles. The approach proposed is new, gives complete list of Zinbiel algebras in dimension 5. Note that all the existing classification results of Zinbiel algebras are supposed to be over the field of complex numbers whereas the approach proposed in the project deals with algebras over any algebraic closed field of characteristic not two.

KFAS contribution: KWD 10,000
Total budget: KWD 10,000

On Properties of Certain Geometric Structures (PR18-16SM-02)

F. Alawam
Public Authority for Applied Education and Training

Abstract:
Affine planes, projective planes, spreads, translation planes, semifield planes and Desarguesian planes were extensively investigated by Buekenhout [1], Dembowski [2], Hering [3], Huheges and Piper [4], Kallaher [5], Knuth [6], Ostrom and Wagner [7], Johnson [8] and recently by Al Ali Bani-Ata [9], [10], [11], [12], [13], [14], [15] and [16] Let \( \Pi = (\mathcal{P}, \mathcal{L}) \) be the affine plane embedded into a projective plane \( \hat{\Pi} = (\hat{\mathcal{P}}, \hat{\mathcal{L}}) \) by adjoining a certain line \( \hat{\mathcal{L}}_{\infty} \). If \( G \) is the collineation group of \( \Pi \) and \( G^* \) is the collineation group of \( \hat{\Pi} \), then the first purpose of this proposal is to find the relation between \( G^* \) and \( G^* \cdot \hat{\mathcal{L}}_{\infty} \) the stabilizer of \( \hat{\mathcal{L}}_{\infty} \) in \( G^* \). Second we will study the relations among \( Aut(\hat{\Pi}) \) the collineation group of \( \hat{\Pi} \), the elations \( E(\hat{\Pi}) \) having axis \( \hat{\mathcal{L}}_{\infty} \) and \( (Aut(\hat{\Pi}))^* \cdot \hat{\mathcal{L}}_{\infty} \) the stabilizer group of \( \hat{\mathcal{L}}_{\infty} \) in the collineation group of \( \hat{\Pi} \). Thus we are lead to Hering’s question, that is if \( G_x \) is a given group, can one find a vector space \( V = \mathcal{V} \times (2^n, \mathbb{F}_q) \) and a spread \( \mathcal{K} \) of \( V \) such that \( G \leq G_{\mathcal{K}} \) where \( G_{\mathcal{K}} = \{ g \in Aut(\mathcal{V}) | g(\mathcal{K}) = \mathcal{K} \} \) ? Third we formulate Hering’s question as follows: We could try to find a semifield \( A \) with \( G \leq Aut(A) \) and investigate the relation between \( Aut(A) \) and \( G_{\mathcal{K}} \), where \( \mathcal{K} \) is the spread corresponding to \( A \). Furthermore we will investigate the relation between \( G \) and the autotopism group \( Aut_{\mathcal{K}} \mathcal{L}_{\infty} \) of \( \Pi \) \( (\mathcal{K}) \) and the translation plane corresponding to \( \mathcal{K} \), and \( \mathcal{L}_0 \), \( \mathcal{L}_{\infty} \) are two components in \( \mathcal{K} \) defined by \( \{(0, x)|x \in \mathbb{A}\} \) and \( \{(x, 0)|x \in \mathbb{A}\} \) respectively.

KFAS contribution: KWD 7,150
Total budget: KWD 7,150
Development of Real-Time Emotion Recognition System using only Facial Expressions Based on Machine Learning and Deep Neural Network Methods to Assist Physically Disabled People (PR18-18EE-01)

M. Murugappan

Kuwait College of Science and Technology

Abstract:

A human perceiving the emotions of another fellow human is natural and inherently accurate. Computers/machines recognizing emotions is an important research in Human Machine Interface (HMI). This work proposes to develop an intelligent real-time facial expressions recognition system for assisting physically disabled (deaf, dumb, and bedridden) using machine learning and deep learning methods. There are six universally accepted emotions (happiness, sadness, surprise, disgust, anger and, fear). Facial Action Units (FAUs) are used for detecting the facial reactions. The FAUs are small luminous stickers (or markers) or virtual markers that are manually or autonomously fixed at several locations of a human face. The placement of these markers is based on a Facial Action Coding System (FACS). Changes in emotions create facial reactions which modify the positions of markers, with time. The positions of the markers are video captured and the time responses of these markers are studied and co-related with every emotion. A set of initial work on detecting emotions through luminous stickers and virtual markers have been performed by the PI [13, 14]. Later, the emotions are detected by using a framework of Particle Swarm Optimisation (PSO) and statistical features. Detailed experiments have been performed and an average success percent in detecting correct emotions (six emotions) was found to be at 92.36% [13]. The present work aims to use the marker placement algorithm and lab setting (light intensity, distance between the camera and subject) from our earlier work along with the following three new research efforts: (i) Though the earlier works considered different lighting conditions in a controlled environment for emotion recognition, there is still a need to test the methodology under real-life lighting conditions. Hence, a new set of experiments will be carried out in different real-life lighting conditions (classrooms, lecture theaters, open halls, etc.) to improve the generalizability of the proposed emotion recognition system. (ii) A simple set of statistical features were analyzed in the earlier work for emotion recognition. The proposed work will investigate on extracting a new set of statistical (geometrical) features based on marker positions for improving the emotion recognition rate of the system without much computational complexity and with higher reliability and (iii) A new real-time emotion detection algorithm aims to be developed for recognising human emotions using optical flow algorithm, machine learning and deep learning approaches. The novelty lies on inputting the optical flow features of the virtual markers to the machine learning and deep learning method for emotional expression recognition and benchmark the experimental results with the Particle Swarm Optimization (PSO) method [13].

KFAS contribution: KWD 4,500
Total budget: KWD 4,500

Vision Based Activity Monitoring for Human Behavior Modelling (PR18-18QS-01)

E. Hassan

Kuwait College of Science and Technology

Abstract:

Face expressions, gestures and actions are primary cues to measure and analyse human activities and understand human behaviour under different situations such as formal conversation in one-to-one or group setting, or activities in an informal setting. The focus of the proposal is to develop novel computational models for human activity analysis using computer vision and image processing techniques for the purpose of behaviour modelling and prediction. Networked camera systems are omnipresent in the existing physical surveillance technologies doing non-intrusive sensing of the covered environment. We plan to exploit the video streams captured by surveillance cameras for activity analysis of human objects for modelling their behavioural responses. The major focus of the research would be to detect and analyze activity patterns and expressions of an individual, or a group in a learning environment - from the surveillance camera video streams. The behavioural responses of an individual in such environments has direct correlation in acquiring the social and communication skills, learning and understanding capabilities, and symptoms of mental/emotional disorders. Nevertheless, the research would also focus on the basic video analytics in indoor environments counting the footfall, dwell-time estimation, and anomalous activity detection. The behavioural cues from a group, at the gross level can definitely be considered as the feedback of group activities such as the response of training session, performance during a team task. The outcome of the research as software solutions would be customisable for behavioural analysis in learning environments. The solution would be useful in the educational institutes in Kuwait for more effective education delivery by understanding individual behaviours and attention requirements. The solution would be also useful for paediatric healthcare professionals in Kuwait for studying behaviour patterns in kids for early detection of neuro-developmental disorders.

KFAS contribution: KWD 8,000
Total budget: KWD 8,000
Capacity Building Program

Introduction

One of the main goals of the Research Directorate at the Foundation for the Advancement of Sciences is to build and enhance research capabilities amongst the Kuwait scientific community, in order to increase the quality of research and advancing competencies of researchers and scientists. Consistent with this goal, the Research Capacity Building Program has been added as a core program under the umbrella of the Research Directorate to promote an “Efficient Scientific Research Community” within the State of Kuwait.

Towards its objectives to elevate national research performance, enhance networking and collaboration and establish critical mass research groups; the program’s pipeline encompasses a diverse spectrum of activities and interventions aiming predominantly at establishing a culture of learning. These include targeted workshops, research networking events, PhD student supplementary grants, academic scientific missions, bridging scholarships, training support (internships, postdoctoral & interim research fellowships) and knowledge management activities in the form of national core-facility mapping.

Capacity building is an early intervention designed to impart long-term and sustainable impacts. As such, graduate students make up major assets of the program. During 2018, 11 supplementary grants were awarded to graduate students in support of the research element of their thesis whilst 3 graduate students were enabled to join the Arab Gulf University’s “Integrated Water Resources Management” program in Bahrain. Talented students and high-achievers were also awarded a well-deserved share of the program’s support in the form of 6 PhD scholarships and 3 post-doctoral and 2 interim research fellowships. Finally, during 2018 the highly demanded academic scientific missions scheme supported 288 applicants to present their homegrown research findings at reputable international conferences.

During the past five years, the number of applicants were variable. Nevertheless, the more scientific mission requests Research Directorate received the more were approved.
**Scientific Missions**

The below chart shows that most of the applicants are employees in the government or private sectors others are students pursuing their master/PHD degrees in 2018.
Supplementary Grants for Phd Students
Completed Grants

App-Delivered Therapy for Arabic Readers with Hemianopic Alexia (P114-63MC-02)
S. Al-Ragam
University College London, U.K.

Abstract:
Project Overview: The aim was to an effective, novel, and empirically supported reading treatment package for Arabic readers with Hemianopic Alexia (HA). The current project proposed to 1) translate a proven English HA treatment package into a novel Arabic application (App), 2) develop new Arabic reading test materials and 3) collect data from Arabic reading stroke patients in a Phase 2 clinical trial.

Progress: We created the App, consisting of 2 parts: an assessment part and a therapy part (the scrolling text which is the reading therapy). Patients can use this App alone or with the help of a speech therapist, carer or other health professional to improve their reading speed that has been affected following the stroke.

The App is freely available in the Apple store. The link can be found here: https://itunes.apple.com/app/id964478309.

In terms of the clinical trial to date six stroke patients with HA have used the App. All significantly improved both in terms of their reading speed and reading related eye- movement behaviours. Importantly, they all reported improvements in reading-related activities of daily living e.g., reading a book, reading a letter thereby improving their quality of life.
These preliminary data suggest the Arabic-Read Right therapy program (App) can be delivered effectively to Arabic-reading patients with HA and the results are promising. The next step is to advertise the App more widely in the Arabic reading world so we can recruit and collect data from many more HA users to quantify its clinical effectiveness.

Two scientific papers based on the development and data from this project are in preparation for publication in peer-review journals.

**KFAS contribution:** £ 20,000

**Total budget:** £ 20,000

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### Assessment of the Effect of Artificial Sweeteners on Gut Microbiota and Glucose Metabolism (P115-63MM-01)

**S. Ahmad**

**University of Manitoba, Canada**

**Abstract:**

**Background:** Recent research has shown potential negative health effects of non-nutritive sweeteners (NNSs). This study aims to determine the effect of sucralose and aspartame consumption on glucose metabolism in healthy subjects using a realistic dose of NNSs.

**Methods:** Healthy participants, between the ages of 18-45 years, with a body mass index (BMI) of 20-25, and a fasting blood glucose (FBG) < 5.7 mmol/L were recruited. Subjects undertook 2 two-week treatments periods, separated by four weeks washout periods in a randomized, double-blind crossover design. The sweeteners each participant consumes was a pure form of standardized dose of 14% (0.425 g) of the acceptable daily intake (ADI) for aspartame and 20% (0.136 g) of the ADI for sucralose. Blood samples were analyzed for glucose, insulin, active- glucagon-like peptide 1 (GLP-1), and leptin.

**Results:** Seventeen participants (10 females, 7 males, age 24 ± 6.5 y, BMI 22.9±2 kg/m2) participated in the study. There were no statically significant differences observed between aspartame or sucralose groups and baseline in mean fasting glucose, insulin, active GLP-1 and leptin concentrations at any visit following the 2-wk intervention period. Total area under the curve (AUC) values of glucose, insulin, active GLP-1 and leptin were similar in aspartame or sucralose settings compared to baseline in healthy subjects. There were no statistically significant differences in total AUC for glucose (p=0.59), insulin (p=0.23), active GLP-1 (p=0.36) and leptin (p=0.66) between sucralose and baseline in healthy subjects. There were no statistically significant differences in total AUC for glucose (p=0.56), insulin (p=0.11), active GLP-1 (p=0.50) and leptin (p=0.25) between aspartame and baseline in healthy subjects. There was no significant change in HOMA-IR (p=0.40), HOMA- %B (p=0.16), and HOMA-%S (p=0.67) after sucralose or aspartame treatment respectively compared to baseline in healthy subjects.

**Conclusions:** These findings suggest that daily repeated consumption of 1L of beverage sweetened with aspartame or sucralose for 2-wk have no effect on glucose metabolism among healthy adults. However, further studies with longer follow-up periods are required to confirm these findings.

**KFAS contribution:** KWD 10,000

**Total budget:** KWD 10,000
Developing an Integrated Strategy for the Assessment of Hazardous Substances in Kuwait’s Marine Environment (P115-645E-01)

H. Alsarawi
Plymouth University, U.K

Abstract

Kuwait has witnessed a major socioeconomic and industrial development following the oil exploitation. This has led to a variety of contaminants being discharged directly to the marine environment, including petroleum hydrocarbons, trace metals, nutrients. In addition, areas of natural oil seepage have been identified and are thought to be important point sources of contamination at various locations especially around the coastline.

The main objective of this PhD programme is to develop an integrated strategy to monitoring and assessing of hazardous substances in Kuwait’s marine ecosystem. To achieve this, a review of the impact of a range of industrial chemical pollutants on Kuwait’s marine environment was undertaken. In support of this, a field work was conducted to assess the use of biliary metabolites biomarkers in fish species to investigate the potential for the concentrations of contaminants present in Kuwait’s marine environment to induce any detectable levels of biological effects in biota.

Finally, given the extensive issue identified in relation to wastewater and sewage pollution an investigative study has been conducted to study the potential threat of such emerging contaminants pose in relation to promoting the presence of Anti-Microbial Resistance (AMR) in environmental microbial communities in Kuwait’s marine environments. Over 600 E. coli were derived from Kuwait seawater (n=357) and Venus clams (Circenita callipyga) (n=254). Samples were collected during summer and winter 2015-2016 from different sites along Kuwait coastline representing the main sewage polluted areas and reference sites. Isolates were screened for susceptibility against 23 antibiotics by micro-dilution (48-h incubation) method.

Resistance was observed from a number of locations (particularly associated with sewage outlets) for the majority of antibiotics (seawater: summer 89 - 64%; winter 90 - 57% and bivalves: summer 77%; winter 88%). Ampicillin was the most resistant antibiotics among the tested antibiotics. This study demonstrates the potential of AMR screening to be used in Kuwait to detect issues related to water quality and the consequences it may pose for human health. Thus, an integrated strategy is recommended to tackle this globally concern issue.

KFAS contribution: KWD 9,800
Total budget: KWD 9,800
Diagnosis of Low Speed Bearing Degradation Using Acoustic Emission Techniques (P116-65EE-01)

F. Alshimmeri

Cranfield University

Abstract

It is widely acknowledged that bearing failures are the primary reason for breakdowns in rotating machinery. These failures are extremely costly, particularly in terms of lost production. Roller bearings are widely used in industrial machinery and need to be maintained in good condition to ensure the continuing efficiency, effectiveness, and profitability of the production process. The research presented here is an investigation of the use of acoustic emission (AE) to monitor bearing conditions at low speeds.

Many machines, particularly large, expensive machines operate at speeds below 100 rpm, and such machines are important to the industry. However, the overwhelming proportion of studies have investigated the use of AE techniques for condition monitoring of higher-speed machines (typically several hundred rpm, or even higher). Few researchers have investigated the application of these techniques to low-speed machines (<100 rpm). This PhD addressed this omission and has established which, of the available, AE techniques are suitable for the detection of incipient faults and measurement of fault growth in low-speed bearings.

The first objective of this research program was to assess the applicability of AE techniques to monitor low-speed bearings. It was found that the measured statistical parameters successfully monitored bearing conditions at low speeds (10-100 rpm).

The second objective was to identify which commonly used statistical parameters derived from the AE signal (RMS, kurtosis, amplitude and counts) could identify the onset of a fault in either race. It was found that the change in AE amplitude and AE RMS could identify the presence of a small fault seeded into either the inner or the outer races. However, the severe attenuation of the signal from the inner race meant that, while AE amplitude and RMS could readily identify the incipient fault, kurtosis and the AE counts could not. Thus, more attention needs to be given to analysing the signal from the inner race.

The third objective was to identify a measure that would assess the degree of severity of the fault. However, once the defect was established, it was found that of the parameters used only AE RMS was sensitive to defect size.

The fourth objective was to assess whether the AE signal is able to detect defects located at either the centre or edge of the outer race of a bearing rotating at low speeds. It is found that all the measured AE parameters had higher values when the defect was seeded in the middle of the outer race, possibly due to the shorter path traversed by the signal between source and sensor which gave a lower attenuation than when the defect was on the edge of the outer race. Moreover, AE can detect the defect at both locations, which confirmed the applicability of the AE to monitor the defects at any location on the outer race.

KFAS contribution: £ 22,999

Total budget: £ 22,999
Translational Cross-Validation of Molecular Imaging and Magnetic Resonance Imaging Methods to Study Gastrointestinal Function in Health and in Crohn's Disease (CB17-63NR-01)

A. Khalaf
University of Nottingham, U.K.

Abstract

Purpose: Measurement of gastric emptying is of clinical value for a range of conditions. Gamma scintigraphy (GS) has an established role, but the use of magnetic resonance imaging (MRI) has recently increased due to its lack of ionizing radiation, multi-planar ability, spatial resolution and richness of contrast mechanisms. Previous comparison studies between MRI and GS showed good correlation but were performed on separate study days. In this study the two modalities were alternated rapidly allowing direct comparison of gastric emptying measurements with no intra-individual variability confounds.

Materials and methods: Twelve healthy participants consumed a 400g 99mTc-labelled soup test meal (204 kcal) and were imaged at intervals for 150 min alternating between MRI and GS modalities. The individual time to empty half of the stomach contents (T1/2) and retention rate (RR) were calculated for MRI and GS and data correlated.

Results: The average T1/2 was similar for MRI (44±6 min) and GS (35±4 min) with a moderate but significant difference between the two modalities (p<0.004). The individual T1/2 values measured respectively MRI and GS showed a good positive correlation (r=0.95, p<0.0001) as well as all the RRs at each time point up to 120 minutes.

Conclusions: Gastric emptying has been measured for the first time by MRI and GS on the same day. The assessments correlated well with GS T1/2 values being moderately shorter than for the MRI. This may help translating the use of this simple soup meal known to elicit reliable physiological and pathological gastrointestinal motor, peptide and appetite responses.

KFAS contribution: £ 20,000
Total budget: £ 20,000

M. Alkhabbaz

Liverpool School of Tropical Medicine (LSTM), U.K.

Project Progress - Abstract:

All data collection, data entry and data analyses took place from 2012 to 2015. This included conducting staff and patient surveys at baseline and follow-up, staff and patient focus group discussions and interviews with quality directorate personnel.

Data analysis showed that there was a difference in the quality of health care services between hospitals with broad implementation of accreditation (BIA) and hospitals with limited implementation of accreditation (LIA) at baseline, in favor of BIA hospitals. With the implementation of accreditation in LIA hospitals, the quality of care improved and the difference between LIA and BIA hospitals decreased. Actually, LIA hospitals exceeded BIA hospitals in some of the measured quality dimensions, from both staff and patient perspectives.

The implementation of accreditation in Kuwait has a positive influence on the quality of health care services in the public hospitals from both staff and patient perspectives. With the advance in the implementation of accreditation, it is expected that the quality of health care services will further improve.

Kuwait government should support the implementation of accreditation across all public hospitals.

Continuous monitoring of patient satisfaction is an important aspect of accreditation programs, as patients are the centre of any successful health care services.

KFAS contribution: £ 22,000

Total budget: £ 22,000

Ongoing Grants
Physical Medicine & Rehabilitation Awareness among Medical Students, Resident Physicians and Attending Physicians
(2013-6302-01)

H. Ali
University of Manitoba, Canada

Project Progress - Abstract:

Physical medicine and rehabilitation (PM&R), terminology varies from one country to another, as does the actual practice, although the general principles remain the same. The World Health Organization (WHO) estimates disability around the world by 10% (1,2,3). Furthermore, disability is estimated to be 50% among elderly (4). The prevalence of disability is growing due to aging population and the global increase in chronic health conditions (2).

Based on the reality that any patient may require rehabilitation, in addition to the dramatic drop in the number of medical schools integrating instructional course in PM&R (5,6). All physicians need to acquire at least basic knowledge of rehabilitation due to its importance in many medical and surgical specialties (1,7).

Developing educational modules and addressing the medical school's curriculum will be the best fit for the lack of PM&R education but it will take years to show it fruits. So the best solution would be through the assessment of PM&R awareness in the Canadian health system, which can be achieved through a survey questionnaire distributed among medical students, resident and attending physicians.

KFAS contribution: KWD 10,000
Total budget: KWD 10,000

Effects of a 12-week Cardiac Rehabilitation Programme for ST-Segment Elevation Myocardial Infarction Patients in Kuwait: A Quasi-Experimental Trial
(2013-6302-02)

F. Al-Ansari
Swansea University, U.K.

Project Progress - Abstract:

This study was designed to investigate effects of "Phase III" of an 8-week cardiovascular rehabilitation (CR) programme, which consists of exercise and educational sessions. The programme was developed for low-moderate risk myocardial infarction (MI) Arab patients in Kuwait. The aim of the study was to determine whether a supervised comprehensive CR programme can improve physical functional capacity, psychosocial status and healthy lifestyle adherence. Environmental and cultural factors usually affect adherence to healthy lifestyle habits, and regions of the Middle East and Kuwait are easily affected by these factors (e.g., hot climate, fatty food). A tailored programme was designed to manage cardiac events for the selected sample. This study was the first that investigated the effects of this new healthcare provision in Kuwait. The study's design was of a quasi-experimental nature since current provision of cardiac rehabilitation in Kuwait is provided at some hospitals, and receive the usual after-care following MI in their local based hospitals.

The aim of the study was to collect baseline information from the patients before and after the 8 week CR programme, to compare their outcome measures. The objective measurements for the study looked at the effects of change of the VO2max, for physical functional capacity, using the cardiopulmonary exercise testing (CPET). And a secondary outcome measure used the Health Promoting Lifestyle Profile II (HPLP-II) questionnaire. Adherence to the programme was evaluated via patients' interviews for those who attended the programme, and those who dropped out, which investigated the reasons for non-continuance. The study took place at the Dasman Diabetes Institute in Kuwait, and is in the process of documentation. CR is a new healthcare provision in Kuwait; many patients are either unaware of the benefits, not motivated or not referred. It is not the purpose of this study to question benefits of CR, but rather to determine if such a programme could be applicable to MI patients in Kuwait.

KFAS contribution: KWD 12,300
Total budget: KWD 12,300
The Use of $\textit{Alu}$ Elements in Forensic Medicine: A Study on an Arab Population (P114-63MC-01)

S. Abumarzouq

Arabian Gulf University, Kingdom of Bahrain

Project Progress - Abstract:

$\textit{Alu}$ elements represent a family of short interspersed DNA elements (SINEs) found in primate genomes. These are members of a group of transposable elements that integrate into the genome by the process of retro-transposition. Recent integrations of $\textit{Alu}$ elements within the human genome have generated presence/absence of variants useful as DNA markers in human population studies, as well as forensic analysis. Besides the ease of use, this type of marker is unique because the absence of the $\textit{Alu}$ represents the ancestral form. However, $\textit{Alu}$ repeats exhibit less variation than multiplex Short Tandem Repeat (STR) profiles would; therefore, most likely used to gain more information on an unknown sample rather than as an independent source of identification in forensic world. Because of these characteristics, polymorphic $\textit{Alu}$ elements are useful in studies of human genetic diversity and forensic analysis.

The aim of this study is to provide a database of $\textit{Alu}$ insertion polymorphism in Kuwaiti population to ascertain the inferred geographic ancestry of unknown human DNA samples. Also, it aims to search for an Arab-specific new $\textit{Alu}$ element in Kuwaiti population as a new tool in forensics. In addition, the application of $\textit{Alu}$ elements based methods will be studied as a new tool to be used in Kuwait forensic investigations, such as, identifying an unknown individual gender, as well as in medical and scientific applications. DNA will be extracted from 500 adult blood samples and the nature of the candidate $\textit{Alu}$ loci will be evaluated by its presence or absence in human samples. These samples will be subjected for genetic analysis using known $\textit{Alu}$ insertion polymorphisms and mobile element-based sex typing assay. Standard PCR reactions for agarose gel-based detection will be carried out for the amplification and population study. Also, the samples will be subjected for the identification of new $\textit{Alu}$ insertion that might be specific for Kuwait/Arab population using the recent mobile element scanning (ME-Scan) technique.

This project will offer new tools that can be used in Kuwait forensic medicine investigations. $\textit{Alu}$ elements-based methods are significantly useful in narrowing the pool of investigation, in addition to the identification of unknown sample gender. Moreover, this study will provide databases for Kuwait population that can be used latterly in different projects of application including pharmacogenomics, disease project and population genetics as well as forensic medicine.

KFAS contribution: KWD 7,300
Total budget: KWD 7,300

Techno-Economical Evaluation of the Production of Bio Drugs: Study of Two Processes for the Manufacturing of Recombinant Human Biodrug Interferon-Alpha (P114-63MM-01)

D. Al-Otaibi

Arabian Gulf University, Kingdom of Bahrain

Project Progress - Abstract:

Biodrugs are set to dominate the pharmaceutical market. Fifty-seven percent (57%) of the drugs currently in development are biodrugs. Currently, the market cost of biodrugs is very high, which restrict their large availability and make their use an economic burden to the healthcare system. Therefore, mastering of the techno-economic aspects of the production of biodrugs is crucial for the development of new biopharma industry in the gulf countries. In addition, controlling the techno-economic aspect of their manufacturing will contribute to lowering the prices of drugs. This work consists of analyzing the techno-economic aspect of the manufacturing of recombinant human interferon alpha, an important multi-indication biodrug considered to be life-saving in hepatitis B and indicated in 14 types of cancer. The work shall be carried out on two manufacturing processes that were developed by my PhD supervisor. The two processes hold international patents. The first allows the production of recombinant human alpha interferon from Escherichia coli bacterium and the second from the yeast Pichia pastoris. The evaluation of the techno-economic aspect of the production of interferon alpha using each process will be carried out throughout the development of a pilot study in a 20 liter fermenter. Each of the upstream (biomass production) and the downstream process (purification) will be monitored for capital cost and running breakdowns. The fixed capital investment will be approximated using the Lang factorial method with factors in the range of 4-7 that are more suitable for the biopharmaceutical sector. Operation costs related to the manufacturing processes will be calculated. Finally, the economic performance of each process will be compared, taking into consideration the yield and specific activity for the final product from the two processes.

KFAS contribution: KWD 9,500
Total budget: KWD 9,500
Expression and Role of miRNA in Thyroid Cancer (P115-63MM-02)

I. Jahanbani

Kuwait University

Project Progress - Abstract:

MicroRNAs (miRNA) are endogenous noncoding RNAs that negatively regulate gene expression by binding to specific mRNA targets and blocking their translation. miRNAs play important roles in many biological process, including cell proliferation, differentiation and, death. They exert their functional role by regulating diverse cellular activities such as signal transduction, immune response, and neurotransmitter synthesis. Deregulation of miRNA expression has been reported to contribute in the pathogenesis of several diseases, especially cancer. Increasing rate of the thyroid cancer incidence, as well as, absence of non-invasive reliable diagnostic method justify the need to search for biomarkers with diagnostic, prognostic and therapeutic potential. miRNAs with their important regulatory role can be the good candidate. The availability of miRNAs in circulation takes the idea of miRNAs as cancer biomarkers to a higher dimension. These circulating miRNAs can be the ideal way towards noninvasive and more cost-effective testing. In this project, we aim at establishing a miRNA signature that will direct the diagnosis and prognosis of PTC patients in Kuwait. This will be done by profiling miRNAs in circulation and thyroid tissue of thyroid cancer patients. The functional role of the differentially expressed miRNA will be analyzed by studying different signaling transduction pathways in primary thyroid cultured cells before and after inhibition or expression of the specific miRNA. We believe that identification and functional characterization of miRNAs will have an important clinical impact on thyroid cancer patient management and the development of therapeutic targets.

KFAS contribution: KWD 10,000
Total budget: KWD 10,000

Methane Emission in Kuwait and their Isotopic Signature (P115-64SC-01)

A. Alshalan

Royal Holloway University of London, U.K

Project Progress - Abstract:

National and EDGAR inventories suggest that the dominant sources of methane in Kuwait are leaks from gas flaring and distribution (92%) and landfills (5%), with additional smaller emissions from sewage (wastewater) treatment and ruminant animals. New measurements during 2015 and 2016 suggest that the inventories differ greatly from observations. Regular weekly bag samples have been collected from three sites in Kuwait, one NW of the city, one to the SE and one in the city from the rooftop of Kuwait College of Science. These take turns to have the highest recorded mole fractions, depending on wind direction. Associated with higher mole fraction is a consistent depletion in $^{13}$C of methane, pointing to a national source mix with $\delta^{13}$C of -54.8‰. This is significantly different from the calculation using inventories that suggest a mix of -51.3‰.

Mobile plume identification using a Picarro G2301 analyser, coupled with Tedlar bag sampling for isotopic analysis, reveals that by far the largest observed source of methane in Kuwait is from landfill sites ($\delta^{13}$C of -57‰), with smaller contributions from fossil fuel industry (-51‰), wastewater treatment (-50‰) and ruminant animals (cows, -62‰; camels -60‰, sheep -64‰).

Many of these isotopic signatures are close to those observed for the same source categories in other countries, for example landfill emission signatures have the same range as those calculated for UK and Hong Kong (-60 to -55‰), even to the level that older closed and capped landfills emit smaller amounts of methane at more enriched values (-55 to -50‰), due to small % of topsoil oxidation.

Our findings suggest that many more top down measurements must be made to verify emissions inventories, particularly in middle eastern countries where a significant proportion of emissions are unverified calculations of fossil fuel emissions.

KFAS contribution: KWD 9,310
Total budget: KWD 9,820
The Effect of Rifampin on the Pharmacokinetics/ Pharmacodynamics and the Safety of Metformin and its Anti-Hyperglycemic Effect in Diabetic Patients Infected with TB (P116-63MR-01)

O. Alfarisi
Johns Hopkins University

Project Progress - Abstract:

Diabetes mellitus (DM) affects more than 10% of the global population. Kuwait is among the three countries with the highest prevalence of DM – approximately 20% of the adult population in 2015. In Kuwait, DM is considered to be the leading risk factor for tuberculosis (TB). Meanwhile, about one third of the world’s population has latent TB infection (LTBI), and among those that progress to TB disease, around 20% - 30% are diabetic. Each disease impacts the pathogenesis and/or the treatment of the other. Metformin, for example, is the most commonly used DM drug globally. However, rifampin, the key sterilizing drug in TB treatment may impact hepatic uptake of metformin, thus theoretically affecting metformin’s anti-glycemic effects (by upregulating transporters and increasing delivery of the drug to the liver, where it acts by hindering gluconeogenesis). Rifampin may also impact renal excretion of rifampin, by upregulating renal transporters, affecting metformin pharmacokinetics (PK). A side-effect of the rifampin-induced augmentation of metformin delivery to the liver, however, may involve increasing the risk of lactic acidosis associated with metformin intake.

Therefore, we are going to investigate, for the first time, the impact of rifampin-based TB treatment on the pharmacokinetics and the pharmacodynamics of metformin in 35 diabetic patients with TB who are participating in the currently-enrolling study entitled, “The Impact of Diabetes on TB Treatment Outcomes,” and who are receiving rifampin as part of their anti-TB treatment and metformin for their DM. We will assess the effect of rifampin on metformin PK (by measuring the drug in plasma and urine) and on metformin pharmacodynamics (by measuring blood glucose over time following dosing). We are also going to evaluate the safety of co-administering rifampin with metformin, focusing specifically on lactic acidosis. In this sub-study, patients will participate in three visits (two during TB treatment, one following completion of TB treatment). At each visit, there will be blood and urine sampling of metformin with the assessment of plasma glucose values, and measurement of lactate and bicarbonate. Pharmacokinetic and pharmacodynamic modeling to assess the impact of rifampin co-administration on metformin PK and metformin’s glucose-lowering effects and safety will be performed using Phoenix WinNonLin software.

KFAS contribution: US$ 63,080
Total budget: US$ 63,080

Inequalities in Cancer Survival in Kuwait (P116-63NH-01)

E. Al-Awadhi
London School of Hygiene and Tropical Medicine, United Kingdom

Project Progress - Abstract:

Cancer is the second leading cause of death in Kuwait after cardiovascular disease. The three main cancer control metrics are incidence, mortality and survival. While incidence and mortality are annually reported and monitored in Kuwait, cancer survival is not. Cancer survival is crucial in monitoring the effectiveness of the health systems in dealing with cancer.

This study will provide a new approach to obtain complete and accurate follow-up data on vital status of all Kuwaiti cancer patients, using data from the Kuwait Cancer Registry, essential to performing the first population-based survival analyses in Kuwait. Trends in survival for 18 of the most common cancers will be assessed for patients diagnosed in 2000-2013. Moreover, this study will allow the KCR to participate in the Global Cancer Survival Surveillance Programme (CONCORD), led by the London School of Hygiene & Tropical Medicine (LSHTM). This will enable survival estimates in Kuwait to be robustly monitored and compared internationally with over 70 other countries.

The findings of this study will contribute to evaluating the effectiveness of the health system in Kuwait, to aid policymakers to target investments in cancer services and cancer policies, to improve cancer survival and to reduce any inequalities in outcome.

KFAS contribution: KWD 4,380
Total budget: KWD 4,380
Characterization of Thin Film Solar Cells Using Deep Level Transient Spectroscopy and Related Techniques (P116-65EE-02)
K. Alajmi
The University of Utah

Project Progress - Abstract:
This proposal addresses the work and research related to identify and quantify the defects in thin film photovoltaic devices such as CdTe and CZTS that negatively affect the open circuit voltage (V_{oc}) and efficiency using electrical and electro-optical characterization techniques such as deep level transient spectroscopy (DLTS) and optical DLTS (ODLTS).

KFAS contribution: US$ 33,500
Total budget: US$ 33,500

Reform and Renewal in Contemporary Islamic Thought and Praxis in the Arabian Peninsula (CB17-61OS-01)
B. Saif
Georgetown University, U.S.A.

Project Progress - Abstract:
Both the Arabian Peninsula (AP) and religious reform and renewal (RR) are elusive constructs. The AP’s profile has significantly arisen since the Arab uprisings, and calls for RR have similarly occupied a more visible space under the pretext of articulating Islam’s contemporary role in the public square. After (re)constructing novel paradigms for both the AP and RR, I simultaneously examine both concepts to understand the mutual impact of the AP and RR on one another. My main research questions are – how do the RR themes of freedom and diversity form and circulate in the AP and across its knowledge production domain? How do the AP’s religious scholars and intellectuals understand and generate RR? What impact does that have on both Islamic thought and the AP? There are scant references and studies that tie RR and the AP in a transnational and intersectional way. By presenting both a novel intellectual history of the AP and a history of contemporary Islam through the AP’s RR creative lens, I aim on unraveling the AP’s RR platform by establishing its main themes and trajectory, thereby creating a unique RR paradigm. I then critically analyze how these ideas are put into practice, ending with an examination of the opportunities, challenges, and future of AP’s RR. The working hypothesis identifies a distinctive strand of religious intellectual production in the AP markedly different from other centers of Islamic learning, yet constrained by and struggling against traditional analytical tools or restrictive circumstances on the ground. Further research will affirm, debunk, or modify the working hypothesis. Supported by a basket of theoretical constructs and methods, phased-out interviews, and primary literature cited for the first time, I conduct a comparative and critical textual analysis that is then interlaced with both a macro and micro contextual review of structural elements guiding both the RR themes and the thinkers’ thoughts, writings, and actions.

KFAS contribution: US$ 26,658
Total budget: US$ 26,658
Role of Mitochondrial Dysfunction in the Development of Hyperinsulinemia (CB17-63MM-01)

N. Alsabeeh
Boston Medical Center, U.S.A.

Project Progress - Abstract:

A hallmark of type II diabetes is impaired insulin secretion resulting from pancreatic beta cell mitochondrial dysfunction. Impairment of insulin secretion results from progression of disease in obese and pre-diabetic subjects in which basal hypersecretion of insulin and insulin resistance exhaust beta cell secretory capacity over time ultimately leading to beta cell failure. However, the molecular mechanisms underlying basal insulin hypersecretion and how it may lead to beta cell failure are not well understood. This proposal will explore a novel mechanism that regulates basal insulin secretion. Our preliminary data indicate that both a high fat diet and an in vitro model of chronic nutrient overload increase mitochondrial proton leak in beta cells and that mitochondrial proton leak is sufficient to promote insulin secretion. Furthermore, we identified the molecular entity responsible for the proton leak. We hypothesize that nutrients enhance mitochondrial ROS production, inducing mitochondrial proton leak through activation of the mitochondrial Permeability Transition Pore (mPTP), increasing insulin secretion at basal glucose concentrations and leading to hyper-insulinemia of the pre-diabetic state. We will address this hypothesis by a) determining the role of mPTP mediated proton leak in basal hypersecretion of insulin under excess nutrient conditions and by b) determining the role of ROS in induction of mitochondrial proton leak under excess nutrient environment. For these studies we have developed both in vivo and in vitro systems where proton leak, ROS and insulin secretion will be measured with both pharmacologic and genetic inhibition of the mPTP. Identifying mechanisms of basal insulin hypersecretion may provide an avenue for early treatment of obese and prediabetic patients, preventing/delaying development of type II diabetes.

KFAS contribution: US$ 37,439
Total budget: US$ 37,439

Immune Response to Major Antigenic Proteins of Mycobacterium Tuberculosis Specific Regions and their Role in Immunomodulation of Asthma in Mice (CB17-63MM-03)

H. Safar
Kuwait University

Project Progress - Abstract:

The overall aim of this project is to characterize the immune response (in terms of Th1. Th2, Th17 and Treg cytokines) and the modulation of asthma in mice after immunization with low molecular weight protein antigens encoded by M. tuberculosis-specific regions previously identified as Th1-inducers in human studies in vitro. i.e. PE35. ESXA. ESXB. Rv2346c. Rv2347c. Rv3619c. Rv3620c. The immunizations are to be performed in the 2nd year of the project using various adjuvants and delivery systems (chemical adjuvants. DNA vaccine plasmids and non-pathogenic mycobacteria) and the modulation of asthma. to be studied in the third year of the project, in ovalbumin-challenge model in mice. However. to obtain the above proteins and the recombinant constructs to perform the experiments in mice. it was essential to clone and express the above mentioned genes in various expression systems. And purify the recombinant proteins. Hence. the aims of the project during the first year were:

1. To amplify the genes of M. tuberculosis-specific antigens PE35. ESXA. ESXB. Rv2346c. Rv2347c. Rv3619c and Rv3620c from the genomic DNA of M.tuberculosis using gene-specific primers in polymerase chain reaction (PCR).
2. To clone the genes of M. tuberculosis-specific antigens PE35. ESXA. ESXB. Rv2346c. Rv2347c. Rv3619c and Rv3620c in the cloning vector pGEMT-Easy.subclone them in the expression vector pGES-TH1. express the proteins in Escherichia coli and purify the recombinant proteins to homogeneity.
3. To clone the genes of M. tuberculosis-specific antigens in shuttle plasmid vectors (pDE22 and pUMVC6) capable of expressing the cloned genes in mycobacteria and eukaryotic cells. respectively.

To fulfill the above stated aims. the genomic DNA was isolated from in vitro grown M. tuberculosis H37Rv. The forward and reverse primers corresponding to pe35. esxa. esxb.
rv2346c, rv2347c, rv3619c and rv3620c genes were designed and synthesized. Using these primers, all the target genes were successfully amplified in PCR, from the genomic DNA of M. tuberculosis. The PCR-amplified DNA fragments were purified from PCR reaction tubes and cloned into the cloning vector pGEMT-Easy. DNA of all the genes cloned in the pGEMT-Easy vector were sequenced to confirm their identity. The cloned genes were released from the recombinant pGEMT-Easy vector by restriction digestion and subcloned into the 3 expression vector, pGES-TH1, and expressed in E. coli with glutathione-S-transferase (GST) fusion partner at the amino terminus and His tag at the carboxy terminus. The expression of recombinant proteins was detected by SDS-PAGE and Western immunoblotting, and the recombinant proteins, free of the GST fusion partner, were purified to homogeneity by affinity chromatography using anti-GST and Ni:NTA columns. In addition, the genes released from the recombinant pGEMT -Easy were subcloned into the shuttle vector pDE22, electroprated into two non-pathogenic mycobacterial species, i.e. M.smegmatis and M. vaccae, and mRNA expression of the cloned genes in mycobacteria was confirmed by reverse-transcription (RT)-PCR. Furthermore, all the genes (pe35, esxa, esxb, rv2346c, rv2347c, rv3619c and rv3620c) released from the recombinant pGEMT -Easy were also cloned into DNA vaccine vector pUMCV6 for expression in eukaryotic cells.

The above abstract and the details given in the submitted report show that all of the tasks intended for the first year of the project have been fully completed. There were no deviations from the approved project.

**KFAS contribution:** KWD 8,636

**Total budget:** KWD 8,636

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**Environmentalism and Environmental Citizenship in Kuwait: Perspectives from the Environmental Public Authority (CB17-64SE-01)**

A. Awadhi

State University of New York, U.S.A.

**Project Progress - Abstract:**

The purpose of this research is to develop a theoretical framework of what constitutes environmental citizenship in Kuwait from the perspective of the Environment Public Authority (KEPA). The concept of environmental citizenship has evolved in western literature and it was never examined in the Arabian Gulf States particularly Kuwait. Using participant observation, and semi-structured interviews conceptualized within the social theory of symbolic interaction, and constructivist grounded theory methods I will be able to generate thick description and explanation of what this concept looks like in Kuwait. Consequently, this study will contribute substantively to the existing literature as it examines environmental citizenship in a unique socio-political atmosphere and in an authoritarian State which heavily depends on fossil fuels.

**KFAS contribution:** US$ 4,260

**Total budget:** US$ 4,260
The Relationship of Feeding Styles, Feeding Practices and Child Weight Status in the Context of Living with Extended Family Among Kuwaiti Mothers (CB18-61MC-01)

N. Alawadhi
Columbia University, USA

Abstract:
Kuwait has been ranked among the top countries in the rising rate of obesity worldwide. Parents act as eating-gatekeepers, directly determining their child’s environment through feeding practices, and indirectly influencing the child’s eating behavior and attitudes through feeding styles (authoritative, authoritarian, indulgent, and uninvolved). In the absence of information about the parental feeding styles and practices of Kuwaiti parents, a mixed method approach will be used to further explore this relationship. A questionnaire will enable the researcher to test existing instruments that have been validated among other Arab and ethnic populations (e.g. Middle-Eastern, Non-Hispanic White American, Hispanic-American, African-American, British), while also accounting for possible moderators (e.g. living condition and feeding responsibility). A subsample will be interviewed to further explore how Kuwaiti mothers navigate feeding their children in relation to living with extended family versus those who live independently. The findings of this study will contribute to developing more tailored interventions in dealing with childhood obesity in Kuwait, and aid health professionals to enhance recommendations in adopting appropriate feeding styles and practices while addressing potential influences.

KFAS contribution: KWD 7,411
Total budget: KWD 14,744
Ecology and Systematics of Commensal Pea Crabs (Crustacea, Arthropoda) and their Sand Dollar Hosts (Echinoids, Echinodermata) in the Eastern Gulf of Mexico (CB18-62SL-01)

F. Jamal
University of Florida, U.S.A.

Abstract:
Echinoids are an important part of marine ecosystems and provide a broad suite of ecosystem services. Many echinoid species are infested by pinnotherid crabs: obligatory commensals or parasites of echinoid hosts. Because of the ecological importance of echinoids, a rigorous understanding of the nature of this biotic interaction is relevant to environmental sciences, conservation, and commercial and recreational fisheries. This project will investigate the association between the pinnotherid crab Dissodactylus sp and multiple species of echinoids found in marine subtidal habitats along the eastern Gulf coast of peninsular Florida. The goal is to document demographic, biogeographic, ecologic, and genetic aspects of this interaction.

Each host with its symbionts will be hand-collected individually in Ziploc bags while SCUBA diving at multiple locations in the eastern Gulf of Mexico. All sampling will be conducted from 2017 through 2019. Pilot data indicate that numerous echinoid specimens infested by crabs can be readily collected from shallow water habitats off the coast of Florida. The data will be used to investigate the geographic distribution, abundance, morphometrics of pea crabs and their echinoid hosts. The assessment will also include estimates of infestation rates, mean burden of crabs per sand dollar (number of crabs/sand dollar), male to female crabs ratios and the crabs distribution by sex. Measurements of host length, width and depth as well as carapace width and length of crabs will be made using Vernier calipers with a digital gage.

Moreover, both echinoid hosts and associate crabs will be analyzed for molecular data using the PCR method with suitable primers and COI mtDNA barcoding to isolate the organisms’ DNA and discriminate species and populations in genetic terms. Sequences for analysis will be obtained both from specimens specifically collected for this project and from FLMNH invertebrate zoology collections. The main objectives are as follows: (1) to document the geographic distribution, abundance, demography, and morphology of echinoid hosts and associated crabs along the northeastern margin of the Gulf of Mexico; (2) to compare infestation rates and mean burden of crabs among and within host species; and (3) to estimate crab male to female to juvenile ratios within and across host species.

KFAS contribution: KWD 7,450
Total budget: KWD 10,300

Facial Mucosal Level Determinants for Single Implants Evaluated by Novel Ultrasoundography (CB18-63DD-01)

A. Bushahri
The University of Michigan, USA

Abstract:
Facial mucosal recession still poses a threat to long-term success of implant therapy especially esthetic appearance. To study the timing and extent of mucosal recession and the associated risks, a prospective study is strategically important. We will be able to collect valuable longitudinal data about facial mucosal level changes, peri-implant tissue dimensions, and implant/restoration parameters that are considered critical for determining the mucosal level. Subjects will be recalled at a minimum timeframe of 12 months after implant placement. Subjects that have existing relevant clinical data that include mucosal level and thickness, radiographs, cone beam computed tomogram (CBCT) scans, study casts and intra-oral photographs at baseline and one year follow up to implant placement will be invited to participate in this study. Subjects that volunteer to participate will have a clinical examination with research measurements, an ultrasound scan and an impression of the implant. The primary outcome will analyze the changes in the facial mucosal level, by superimposing the digital images of the stone models that were taken previously. On ultrasound images, peri implant tissue parameters, implant positions, restoration contour, etc., will be measured and recorded. The primary outcome will then be equated with clinical and radiographic readings, and ultrasound parameters, along with timing of provisionalization or final restoration, in regression analysis to identify factors related to facial mucosal recession. The results of this study can potentially lead to novel surgical and restorative methods to reduce the incidence of esthetic complications. Ultrasoundography used in this proposal could shed light on new methodology to study and monitor peri-implant tissues and structures.

KFAS contribution: US$ 30,000
Total budget: US$ 30,000
The Cost of Coronary Artery Disease in Kuwait: The Case of the Afia Insurance Program (CB18-63MM-01)

S. Al Sarhan
University of Texas, USA

Abstract:

IMPORTANCE: The Government of Kuwait launched the Afia insurance program in 2016 for the Kuwaiti retirees. There is a crucial need to understand the health care costs of Coronary Artery Disease (CAD), the leading cause of cardiovascular mortality worldwide. The prevalence and cost of CAD have not been prospectively quantified.

OBJECTIVE: To quantify the prevalence and the economic burden of CAD on Afia members undergoing treatments for CAD in the private health care sector and to describe the CAD healthcare costs for this group.

DESIGN, SETTING, PARTICIPANTS: Retrospective cohort study of patients undergoing treatments for CAD between 2016 - 2018, using a claims data set of 117,617 insured members.

MAIN OUTCOMES AND MEASURES: We will investigate inpatient cost variables, including total CAD inpatient expenditures. We will explore the relationship between three categories of factors - comorbidities, demographic, and provider characteristics - and the costs for Afia's patients undergoing treatments for CAD.

KFAS contribution: US$ 17,498
Total budget: US$ 17,498

The Effect of Progesterone on Placental Nutrient Transporters in Dexamethasone-Induced Intrauterine Growth Restriction (CB18-63MO-01)

M. Alawadi
Kuwait University

Abstract:

Progesterone is an important hormone during pregnancy. Progesterone is recommended in pregnancies at high risk of preterm delivery, aiming to delay labor. Recent evidence showed that progesterone treatment improves fetal wellbeing in intrauterine growth restriction (IUGR) pregnancies. Smaller fetuses of IUGR result from smaller placentas and down regulation of nutrient transporter across the placenta, most importantly glucose transporters (GLUT1 and GLUT3). These transporters are up-regulated in the uterus by progesterone during early pregnancy. In addition, IUGR pregnancies are manifested by lower levels of progesterone in maternal plasma. Therefore, we hypothesized that progesterone restores GLUTs expression and reverts IUGR. The present study aims to evaluate the effect of progesterone on dexamethasone-induced IUGR on the following parameters:

1. maternal, fetal, and placental weights,
2. placental GLUT1 and GLUT3 gene and protein expression,
3. maternal plasma progesterone levels,
4. gene and protein expression of placental progesterone receptor,
5. gene and protein expression of placental vascular endothelial growth factor (VEGF),
6. the pathway through which progesterone mediate its effect on the placenta.

This will be achieved by using real-time polymerase chain reaction, Western Blotting, immunohistochemistry, ELISA, and PCR array.

KFAS contribution: KWD 10,000
Total budget: KWD 10,000
Transferring Robotic Surgical Skills from the Simulator to the Operating Room: A Randomized Controlled Study Assessing Transferability of Robotic Technical Skills in Residents Performing Robotic Radical Prostatectomies (CB18-63MS-01)

A. Al-Marzouq
McGill University, Canada

Abstract:

Background: Urological Surgery has incorporated minimally invasive approaches since the early 1900s. Since the advent of the Robot in Urology in the early 2000s several cancer surgeries are now performed robotically as the standard of care. The most commonly performed procedure is robotic prostatectomy for prostate cancer. The procedure has a long learning curve due to its complexity. Therefore, surgical trainees have difficulty mastering this procedure without requiring extra training. Since the introduction of simulation into surgical education several studies have shown the benefit of incorporating surgical simulators into surgical training to accelerate the learning curve. We aim to assess the transferability of technical skills from the simulator to the operating room when performing robotic prostatectomies.

Methods: Fourteen Urology residents were randomized to two groups of seven residents. One group practiced a pre-defined curriculum on the simulator and the second group had to meet a certain score on each the curriculum prior to proceeding to the operating room. The score was established based on performances by 5 expert Robotic urological surgeons in our institute. The score cut off was defined as 1 standard deviation below the expert mean, which is an established method of defining unknown Norms. The performances were all recorded on the simulator and the residents were then progressed to the operating room. For the assessment in the operating room 2 steps in the procedure that incorporated the practiced technical skills were assessed. These were the take down of the urinary bladder and the urethra-vesical anastomosis (for chief residents only). These performances were then assessed using Global Evaluative Assessment of Robotic Skills (GEARS). Which is a validated tool for this type of assessment.

Results: we have completed collecting all the data from the simulator phase and currently 71% of the data from the operating room was collected. We are near completion of all data collection (predicted completion date is Mid July 2018). The analysis is pending the services of C-Sat who specialize in evaluating these videos by crowd sourcing and have published and validated their findings.

KFAS contribution:  US$ 42,700
Total budget:  US$ 42,700

Transcriptomic Responses to Iron Bioavailability From Virus-Mediated Lysates in Marine Prokaryotes (CB18-64SE-01)

A. Al-Qattan
University of British Columbia, Canada

Abstract:

Iron has been demonstrated to be an essential micronutrient for all organisms, including marine phytoplankton. Also, over the past decades, it has been increasingly apparent that iron controls primary productivity in large areas of the world oceans, as well as nitrogen fixation in some regions. Although Fe is the fourth most abundant element in the earth's crust, the bioavailability of Fe dependent on its redox chemistry, and which controls Fe availability to phytoplankton. Therefore, the average dissolved iron concentration in the sea is very scarce due to extremely low iron supply and due to its low solubility in oxygenated water. Also, more than 99% of the dissolved Fe (III) in the ocean is strongly complexed to natural organic ligands. However, in recent years, the potential importance of marine viruses in the biogeochemical cycles of the global oceans has been acknowledged. Also, it has been reported that marine viruses are important agents in the oceans particularly in high nutrient, low chlorophyll (HNLC) regions by providing essential nutrients including iron to the primary producers and heterotrophic bacteria thus enhancing the recycling of nutrients. As our needs to understand the biogeochemical cycles of the global oceans increase, so our need to understanding the role of marine viruses in the nutrient cycles including iron cycle.

KFAS contribution:  CAD$ 26,700
Total budget:  CAD$ 26,700
Spatial Print Trajectories  
(CB18-65EA-01)  
S. Al-Othman  
Harvard University, USA  

Abstract:  
Initiated in the Fall of 2017 as part of SCI 6317 course, Spatial Print Trajectories is a result of digital design and fabrication research that developed an unprecedented spatial 3D printing process which involved controlling print parameters (e.g. speed and extrusion rate) to create a material system that can form complex self-supporting lattices while considering the viscous property of clay.  

However, the process exhibited unaccounted material effects and local fabrication tolerances which necessitated human intervention to ensure precise fabrication of a given geometry. The integration of real-time printing technique with embedded sensor feedback that constantly negotiates between the physical and digital platforms is the core focus of the proposed research, where the development of a dynamic fabrication system will be pursued for robotic constructions of inhabitable structures.  

KFAS contribution: US$ 20,771  
Total budget: US$ 20,771

Photo-electrochemical Etching of Wideband Gap Materials for Sensing and Energy Applications for Harsh Environments  
(CB18-65EC-01)  
B. Alhalaili  
University of California, Davis, USA  

Abstract:  
Nanotechnology can be used as a tool to advance the sensors industry, especially in increasing the efficiency and quality of electronics. One possibility is to use the photoelectrochemical (PEC) etching process to create high aspect ratio structures utilizing wide bandgap materials. This process can create highly anisotropic and selective nanostructures and also protect sidewalls and surfaces from damage. We demonstrate an optical system based on illumination of a specific wavelength with a high-power laser for a controlled PEC etching process. Our work focuses on PEC etching of wide bandgap semiconductors such as GaN, SiC, and Ga2O3. The overall objective of this project is to develop a nanosensor for nuclear and/or energy applications that can offer instant information. Specifically, the presence of different materials will be identified according to physical or chemical changes in the nanosensor as a result of the detected materials.  

KFAS contribution: US$ 36,768  
Total budget: US$ 36,768
Imaging of Temperature Variations in the Near-Wall Region of an Optical Reciprocating Engine Using Laser-Induced Fluorescence (CB18-65EM-01)

M. Alzuabi
University of Michigan, USA

Abstract:
Predicting heat transfer processes within internal combustion (IC) engines is important for engine design and development due to their impact on performance, efficiency and emissions. This requires an understanding of the behavior of the thermal boundary layer that develops near the combustion chamber walls, but boundary layer flows in IC engines are unsteady and not fundamentally understood yet. The heat transfer properties of such flows vary locally and temporally because of continuous changes in external flow, temperature and pressure. This results in quick fluctuations in heat fluxes within the engine cylinder and imposes difficulties in developing accurate heat transfer models for engine heat transfer capable of capturing the structure and dynamics of the thermal boundary layer. Experimental techniques in the past provided inadequate insights into the nature of the near-wall region of IC engines; however, recently developed laser-based imaging techniques have high frame-rate capabilities and are now used extensively to substantially resolve the flow inside IC engines. Improvement! in laser sources and cameras have enabled the development of high-speed temperature imaging using laser-induced fluorescence (LIF). It is a non-intrusive technique that depends on the property of some atoms and molecules to absorb light at a particular wavelength and to subsequently emit light of longer wavelength. It provides instantaneous flow visualization that is sensitive to local temperatures with high spatial and temporal resolution, which makes it suitable for temperature imaging in combustion systems. This work aims to experimentally characterize the thermal boundary layer in an optical IC engine using high-speed planar LIF temperature imaging. It presents preliminary results of two dimensional relative temperature fields of the near-wall region collected at low-speed rate from a motored engine test. Proposed plans also include performing simultaneous heat flux measurements at the engine head.

KFAS contribution: KWD 4,000
Total budget: KWD 10,000

Physics-Based Damage Modeling of Composites for Extreme Heat Environments (CB18-65EM-02)

M. Alabdullah
University of California Los Angeles, USA

Abstract:
High-temperature composite materials have broad applications in the energy, petroleum and transportation sectors because of their unique capabilities to sustain strength at elevated temperatures, inert interaction with some coolants, and their high strength-to-weight ratio. These encompass C/C and SiC/SiC composites, developed as cladding in fission reactors, wellheads used in oil and gas extractions, turbine blade materials for advanced jet engines and combustion liners. Cyclic thermal and mechanical loading of these composites leads to wide-spread and progressive micro-cracking that leads to loss of thermal conductivity and further enhancement of thermo-mechanical damage. At some critical stage of this wide-spread micro-cracking, dominant distinct cracks develop, leading eventually to catastrophic failure. A physics-based model of wide-spread microcracking is developed within the thermodynamic framework of continuum damage mechanics. Evolution equations for damage parameters that describe the growth of continuum damage are developed, where the material variables are obtained from experiments. The model novelty is in coupling thermal damage, including loss of thermal conductivity and creep to traditional mechanical damage in composites. A number of mechanical and thermal experiments are planned to confirm model parameters. A critical continuum damage condition is proposed, where transition occurs from the continuum damage state to discrete cracks. A research proposal is laid out, where measurements and literature data will be used to determine this critical state. The representation of that critical state will be formulated as a fracture initiation criterion which will rely on the damage development history. Experimentally-based continuum damage parameters will be determined in this research and will be used to predict the deformation history of high-temperature composite components and their potential failure conditions.

KFAS contribution: US$ 32,993
Total budget: US$ 32,993
Flagship Projects Program

The main objective of the Flagship Program is to foster sustainable approaches to challenges in national priority areas namely water, energy and environment by promoting the implementation of new and proven technologies and applications through pilot and assigned projects, endorsing sustainable economy and environment, fostering the development of sustainable policies.

Program achievements in 2018:

• Chief Science Officers Program for School Students organized by the Scientific Culture Directorate: guide and direct students, as well as present a lecture about energy auditing in buildings, which may be implemented by students during the next academic year (2018-2019.)

• Annual meeting of the American Association for the Advancement of Science (AAAS), held in Austin, Texas: organization of International Collaboration Session for international collaboration projects with KFAS, in addition to organizing the exhibition which was held during the conference.

• Organization of the Scientific Collaboration Conference of the Gulf States and the United Kingdom, in cooperation with the Capacity Building Program, titled: “Wastewater: Treatment and Reuse” in collaboration with the British Council and the British Embassy in Kuwait, in addition to the British Science and Innovation Network (SIN) and the British Ministry of Business, Energy and Industrial Strategy (BEIS), with the participation of scientists from various universities and research institutions, as well as a number of existing and emerging companies and government bodies from the Gulf States and the United Kingdom.

• A request for proposal for a commissioned project was prepared regarding investigating the potential of radiative cooling of selective surfaces technology to cooling building spaces in Kuwait. This is related to a recently developed selective surfaces materials known as “radiative cooling material” that can achieve day and night cooling via longwave radiation exchange with the outer space. Research institutions in Kuwait have been approached to submit proposals to assess the current state of the technology and identify its potential applications when used to cool buildings, as well as assess the technical and economic feasibility of these applications. A number of proposals were received and peer reviewed to evaluate their scientific merits. Coordination is underway with to use the innovative developed materials for testing during the project implementation.

• Presented (Sustainable National Energy Strategy) White Paper to the Economic Committee - Council of Ministers. The “Supreme Energy Committee” was formed headed by the Minister of Oil and the Minister of Electricity and Water to activate the implementation of the energy security strategy in Kuwait. Two meetings were held and coordination is underway, through the technical committee, with Kuwait Institute for Scientific Research, Ministry of Electricity and Water and Kuwait Petroleum Corporation to follow up the recommendations of the Supreme Energy Committee.

• Funded a pilot project titles “Smart Building Integrated Systems” in collaboration with the Kuwait Institute for Scientific Research and “Baiti Lenjaz Establishment”. The project aims to implement air conditioning and lighting control systems and applied technologies for water and energy conservation in KFAS building.

• A contract was signed for an assigned project with ASHARE (American Society for Heating, Refrigeration and Air Conditioning Engineers) to Develop the HVAC systems standards for Kuwait to meet international requirements and specifications. The experience of this international society was used to prepare a study on the development of standards for air conditioning and cooling systems in cooperation with the Ministry of Electricity and Water to meet the new international requirements and specifications.

• Organizing and holding the second Kuwait-imec Symposium under the theme: “Energy and ICT: A Crucial Combination for Deploying a Sustainable Energy”. The symposium included a number of lectures presented by the Interuniversity Micro Electronics Center (imec) in Belgium, and the European Research Institute for Sustainable Energy and Intelligent Energy Systems (EnergyVille), as well as a presentations of joint projects between these bodies, Kuwait University and Kuwait Institute for Scientific Research. In addition, presentations of the latest advances in photovoltaic (crystalline silicon and thin film photovoltaic), energy storage systems and developments in integrated photovoltaic systems on building facades were presented. Around 250 researchers from the Kuwait Institute for Scientific Research, academics from Kuwait University and private universities in addition to engineers from the Ministry of Electricity and Water and the oil sector and diplomatic corps of some Arab and European countries in Kuwait attended the event.
- Organized and Participated in the “Deployment of Renewables: Barriers, Options, and Lessons for the GCC” workshop in cooperation with the Oxford Institute for Energy Studies (OIES), held in Oxford, UK. Discussions included the renewable energy market and the current status of renewable energy policy in Kuwait and the rest of the GCC States, the most significant barriers, options and lessons learned. The workshop was attended by officials, researchers, academics and specialists from Europe and GCC countries. The program funded specialists from the Kuwait Institute for Scientific Research, Kuwait University, the Kuwait Authority for Partnership Projects and the Ministry of Education to attend and participate workshop.

- Organizing and holding an exploratory seminar on “Thermal Energy Storage - Sources and Applications”. The aim of the seminar was to present a range of modern thermal energy storage systems that can be later used optimally in a number of different applications. The seminar was attended by about 40 engineers and researchers from various institutions including the Kuwait Institute for Scientific Research, Kuwait University, Ministry of Electricity and Water, EQUATE, National Technologies Enterprises Company in addition to some private cement and glass manufacturing companies.

- Funded a pilot project titled “Assessment of the performance of Electric Vehicles under extreme climate conditions and Development of a Framework for Kuwait City to be EV-Ready” in collaboration with Kuwait Institute for Scientific Research to evaluate the performance of electric vehicles (EVs) in the Kuwaiti environment and build a solar electric charging station in addition to identifying guidelines and procedures to transform Kuwait City into a EV ready environment.

- Organizing and holding a workshop on “Innovative and Sustainable Technologies for Power Plants in Kuwait” in cooperation with General Electric (GE). A group of GE’s experts presented lectures on the current and future applications of a variety of technologies in a number of vital fields related to power plants. The workshop was attended by 70 participants from various institutions including Kuwait Institute for Scientific Research, Kuwait University, Public Authority for Applied Education and Training, Ministry of Electricity and Water and EQUATE in addition to some private cement and glass manufacturing companies.

- Funded a pilot project titled: “Biodegradable Kyphoplasty Balloon System Design and First in Man Study” in collaboration with GTIMD Catheter Solutions, Dr. Abdulrazzaq Alobaid and Sabah Al Ahmad Center for Giftedness and Creativity. The patent developed by Dr. Alobaid is an advanced step in enhancing patient safety and reducing side effects when performing spinal adjustments surgeries especially in outpatient clinics.
High-Voltage Research Powers-up National Development

Ongoing projects under KFAS Flagship Projects Program, in collaboration with research, government and industry sectors gathered momentum in addressing some emerging challenges confronting the nation in national priority areas namely energy, water, environment and health.

In keeping with the developmental undertakings in Kuwait, the successful installation of solar photovoltaic systems (PV) on the rooftops of 150 homes, application of new energy and water conservation technologies, exploration of novel methodologies through research and workshops in national priority areas are significant pointers to a promising future at the national level.

Joint efforts between KFAS, Sabah Al-Ahmad Center for Giftedness and Creativity (SACGC) and GTIMD Catheter Solutions, U.S.A., were initiated to conduct the first medical study on humans, utilizing biodegradable Kyphoplasty balloon system design.

A new paradigm shift in transportation technology and framework was proposed by researchers with the introduction and promotion of electric vehicles in Kuwait with promising sustainable impacts on the environment and economy.
Abstract:
The installed electrical capacity for Kuwait has been rising at an alarming rate over the past few years. This is expected to continue as Kuwait is moving toward a major development plan. Therefore, serious action has to be taken and new technologies including renewable energies should be adopted in Kuwait. Based on a request from Kuwait foundation for the Advancement of Sciences (KFAS), Kuwait Institute for Scientific Research (KISR) will utilize its experience in energy management to oversee the completion of energy auditing and retrofitting of cooperative facilities that will be carefully selected according to the set criteria. Cooperative societies are being targeted for the implementation of this service, because they are government controlled, have great potential for energy savings in lighting, refrigeration, and air conditioning, and are widely used by the general public, hence, facilitating public awareness. The total planned implementation is at least 2 energy efficiency retrofits for the selected cooperative facilities.

This project aimed to achieve energy generation in the cooperative society supermarkets by implementing solar photovoltaic (PV) systems at the parking areas. The achievements include the tasks, tendering and selection of vendors and implementation and safety and PV system design and expected future wide-scale implementation.

Site surveys were completed on several potential cooperative societies, and two appropriate sites were selected: Adeiliya and Zahra cooperative society. Requests for proposals were prepared, and several qualified bidders were invited to submit bids for the project. The bidders were evaluated, and one was selected, and final approval on the selection was obtained from the steering committee. The contractor carried out the installation according to industry standards. The PV systems’ sizes were determined (as well as expected output of each), and PV system types were compared and chosen for the project (mono-crystalline and thin film).
The solar PV installations at the two selected cooperative society supermarkets were about 1.060 MW. The project was delayed more than the predicted five-months period due to delay in obtaining official approvals. Finally, monitoring systems were integrated into the PV installations to evaluate their performance and provide essential data for future studies and projects; the data evaluation is provided in this report to provide a comparison between what was predicted and the actual performance. Also, water consumption for cleaning and other parameters was mentioned. Additional information was provided such as engineering procurement and commissioning and the operation and maintenance costs versus the energy yield, which is invaluable for future projects and studies in this field.

It is hoped that this project will:
1. Produce around 3,450 MWhr of electrical energy annually.
2. Save at least 2,120 barrels of oil per year.
3. Reduce CO\textsubscript{2} emissions by at least 3,125 tons per year.

KFAS contribution: KWD 99,220
Total budget: KWD 99,220

Building Integrated Solar Photovoltaics (PV) for Kuwaiti Homes (2013-5508-02)

A. Al-Qattan
Kuwait Institute for Scientific Research

Abstract:
This pilot project aims to design, construct, operate, and monitor rooftop grid-connected photovoltaic (PV) systems for a total of 150 Kuwaiti homes. The installed capacity of the PV system for 150 homes is around 1.5 MWp. The project is implemented in cooperation with the Kuwait Institute for Scientific Research and the Ministry of Electricity and Water.

The installation of the systems has completed in 150 houses in December 2017. The performance and analysis of the data were monitored for one year until December 2018. It is hoped that this project will:
- produce around 2,440 MWh of electrical energy annually.
- Save at least 1,500 barrels of oil per year.
- Reduce CO\textsubscript{2} emissions by at least 1,750 tons per year.

KFAS contribution: KWD 1,963,580
Total budget: KWD 1,963,580
Grant Agreement between KFAS and The Oxford Institute for Energy Studies (2017/2018) (PN17-751C-01)

B. Fattouh

Oxford Institute for Energy Studies (OIES)

Abstract:

KFAS funding has enabled OIES to maintain a strong research ‘hub’ that builds on its unique capacity in analysing global and regional energy developments of importance for the GCC economies. OIES share KFAS’ objectives and goals of advocating science and education, and the scholarly study of one of the world’s most important oil and gas producing regions, supporting knowledge and capacity-building inside Kuwait as well as the wider region.

OIES-KFAS Programme publications:

OIES have fulfilled the number of published studies stipulated under the OIES-KFAS agreement by publishing three specific programme studies over the duration of the academic year 2017/2018, as well as a special issue of the Oxford Energy Forum as detailed below:

4. The Oxford Energy Forum (OEF), No.112, Disruptive Change in the Transport Sector, published in April 2018

OIES organised a dedicated roundtable workshop. The workshop provided a high-level forum to discuss key challenges faced by the GCC countries in the development of renewables in the midst of a selected group of academics, government and industry representatives. The workshop was held in Oxford, UK on 20 April 2018.

KFAS contribution: US$ 100,000

Total budget: US$ 100,000
The electricity and water tariffs in Kuwait have recently increased two and a half times its previous value for most of the consuming sectors. As a result, many large office-building owners, such as the Kuwait Foundation for the Advancement of Sciences (KFAS), are looking for solutions to cut down and control the consumption of their utilities. In response to the requirements of KFAS, the Kuwait Institute for Scientific Research is proposing here a work plan to reduce the consumption of electricity and water in their headquarters building in collaboration with the Baiti Synergy Corporation. The goal of this project is to make use of readily available, proven technology to improve energy and water efficiency in KFAS building. This technology will be incorporated by developing and implementing a smart integrated energy building (SIEB) devices that will reduce at least 25% of the current building consumption of electricity and water.

KFAS contribution: KWD 99,795
Total budget: KWD 99,795
New Projects

Development of Effective Visualization of Solar Farm Performance Data (AP18-35EM-02)

M. Khajah
Kuwait Institute for Scientific Research

Abstract:
Photovoltaic (PV) technology continues to spread throughout Kuwait, making it important to convey to the public how much these devices are helping with energy production. Common statistics such as the amount of energy produced are useful for experts but are almost certainly useless for the average person because they are not intuitive. As such, effective and engaging visualization of the performance of PV farms is essential to increase public awareness and promote the use of energy efficient technologies. In this project we will implement a modem, fault-tolerant, bilingual (Arabic/English) visualization system in four sites in Kuwait: two co-ops at Al Zahraa and Al Adiliya, the Scientific Center, and the Kuwait Science Club. Unlike the existing systems, the proposed system will gracefully handle network issues and will utilize modern web-design trends.

KFAS contribution: KWD 7,750
Total budget: KWD 7,750
Biodegradable Kyphoplasty Balloon System Design and First in Man Study (PN18-13MM-01)

A. Alobaid

Sabah Al-Ahmad Center for Giftedness and Creativity (SACGC) and GTIMD Catheter Solutions, USA

Abstract:

Dr. Abdulrazzaq Alobaid has developed a novel biodegradable balloon and a corresponding biodegradable balloon system for encapsulating cement inserted into a cavity in a vertebra during kyphoplasty. The procedure is designed to provide structural stability and reduce pain caused by damaged vertebrae. The standard technique, vertebroplasty, is a minimally invasive procedure where high pressure cement is injected into the vertebrae. Complications can arise with cement leakage. Kyphoplasty, creating a void in the vertebrae, was developed to utilize a low-pressure cement injection as a way to decrease the leakage problems. However, complication with cement leakage still occur. Dr. Alobaid’s technology involves a patented biodegradable cement encapsulation balloon that is inserted in similar fashion as the standard cavity creating balloon in kyphoplasty, but the balloon is not retrieved. It is maintained in-situ and filled with a medical cement. The balloon is sealed with a special valve that prevents extravasation of the bone cement, mitigating complications related to cement leakage. The balloon dissolves at a later stage after the cement material is solidified.

Preliminary animal studies have been successfully completed with Dr. Alobaid’s biodegradable encapsulation balloon and support the functionality of the concept. Use of the biodegradable encapsulation balloon may represent a significant advancement that will provide improved safety and reduced risk when performing vertebral augmentation therapy, particularly in an outpatient setting. The goal of this research project is to conduct a thorough First in Man study to demonstrate the medical practicality and commercial viability of Dr. Alobaid’s invention. The following proposal provides a detailed approach to accomplishing this goal using industry standard medical practices aligned with international ethics and regulations.

KFAS contribution: KWD 279,395
Total budget: KWD 279,395

Assessment of the Performance of the Electric Vehicle Under Extreme Climate Conditions and Development of a Framework for Kuwait City to be “EV-Ready” (PP18-35EM-01)

H. Hamwi

Kuwait Institute for Scientific Research

Abstract:

The growth in the use of electric vehicles (EV) is gaining an increased momentum in the developed world. This is a result of recent advancements in battery technologies and the support demonstrated by numerous governments through incentives, promotions, and building the infrastructure for the EV to spread. This support has its sustainable impacts on the environment and economy of each individual country. In order for the EV trend to become fully viable, cities need to foster a variety of aspects that include the development of the relevant infrastructure, a supportive regulatory and operating environment, and ultimately the public readiness for this new paradigm shift in transportation technology. The current project aims to identify the actions that must be taken to turn Kuwait City into an “EV Ready” environment. The results of this study, including both recommendations on policy and charging station location recommendations, along with the necessary framework for the government to begin its efforts promoting EV use within the city and the surrounded region. In addition, the complete study includes information on EV public awareness program, results of the AC’s performance in Kuwait’s climate and a checklist for EV readiness that can be utilized by other authorities in their upcoming efforts to support EV’s. The coordination between the various stakeholders including the Traffic Department, Public Authority for Road and Transportations (PART), and chiefly the Ministry of Electricity and Water (MEW) for the establishment of the new policies and regulations, is the paramount challenge will face the project team. This project will be submitted to Kuwait Foundation for Advancement of Science (KFAS) not only for funding, but also to assume the lead in this campaign. Tangible output of the study will be the first EV charging station operated by solar panels to be installed in front of the KFAS headquarters. This station will serve the public for charging their EV’s and also to promote the public awareness how prompt this charging procedure can be.

KFAS contribution: KWD 12,500
Purchase of Car: KWD 15,000
Total budget: KWD 128,545
Collaborative Research Unit

Strategic Joint Initiatives Promote Optimal Scientific Configurations

For decades KFAS has supported collaborative research with international institutions, organizations and among researchers and thus widened the scope of research undertakings and triggered academic and scientific growth at the national and regional levels.

Collaborative scientific efforts by Massachusetts Institute of Technology (MIT) and Kuwait University (KU) capitalized on implementing novel and integrated technologies for optimal treatment of Kuwait's desalination and wastewater plants in order to accomplish sustainable renewable energy with reduced carbon emission in the State.

Another major research mission by MIT and KISR paved the way in not only setting up the groundwork for collective work to enhance cutting-edge genomics and urban informatics capacities in Kuwait but also to promote scientific expertise within the State and the region.

During the financial year, extended work on a signature project focused on indigenous ground motion modeling and structural monitoring of tall buildings, which was expected to yield vital results for scientific referential purposes.
New Generation Brine Desalination and Management for Efficiency, Reliability and Sustainability (P314-75EC-01)

J. Han and B. Al Anzi
Massachusetts Institute of Technology and Kuwait University

Project Progress – Abstract:

The aim of this project is to increase both energetic and environmental sustainability of Kuwaiti water management by developing/validating novel ideas and interfacing them optimally with existing plant workflow. Three major themes of the project are:

1. Electrical desalination for brine management: Capitalizing on unique advantages of electrical desalination for pre- and post-treatment of source water to enhance the efficiency of the existing desalination plant. This will serve as our primary application. Proof-of-concept systems will be tested at both Massachusetts Institute of Technology (MIT) and Kuwait, coupled with a detailed techno-economic analysis toward optimized integration. We will use the strategy of multi-stage optimization, which achieves energy efficiency by minimizing irreversibility in the overall process through local management of concentration differentials.

2. Power generation using brine and wastewater: Pressure Retarded Osmosis (PRO) and Reverse Electrodialysis (RED) are emerging, membrane-based technologies for recovering energy from concentration differences between water streams. We will examine the potential of using PRO and/or RED to recover energy from Kuwait's desalination and wastewater plants while simultaneously reducing the salinity of the discharged brine by membrane-regulated dilution with wastewater and/or seawater. Coastal discharge configurations will be designed, and methods to fully mitigate the environmental impact of the discharged streams will be evaluated. This study will result in clear assessment of the potential of combining brine and wastewater discharge to lessen environmental impacts on the Kuwaiti coast while reducing the overall cost of water treatment through the recovery of renewable energy with reduced carbon emission via PRO or RED.
3. Engineering for Increased Reliability: We will also address the significant challenge of bio-fouling, scale formation, and particulate removal, by employing recent innovations in surface coating and microfluidic separation processes. Antifouling membrane coatings appropriate to the combined streams will be developed.

During the second year, the developments are summarized as follows:

1. The research team of the project was reorganized in a manner that better reflects the contributions/expertise of participating investigators.

2. A significant communication/collaboration has been initiated with a few government agencies in Kuwait, to better disseminate the outcomes of the project. Collaboration with the Ministry of Electricity and Water (MEW) was initiated and formally approved in April 2016, yet the implementation of this collaboration has been rather slow, which remains a challenge.

3. Several key collaborations between KU and MIT researchers have been initiated, including the collaboration to study scale formation, and joint supervision of new KU students pursuing master’s degree.

KFAS contribution: US$ 5,500,000
Total budget: US$ 5,500,000

The Underworlds Project: A Smart Sewage Infrastructure for Kuwait (P315-75EV-01)

Massachusetts Institute of Technology, Kuwait Institute for Scientific Research and Kuwait University

Project Progress – Abstract

The Underworlds Project envisions a future in which the vast reservoir of information on human health and behavior that lives in our sewage is mined to inform policy makers, health practitioners, and researchers alike. The project is an innovative, open, cross-disciplinary data platform for monitoring urban health patterns, shaping more inclusive public health strategies, and pushing the boundaries of urban epidemiology.

We are developing a prototype smart sewage platform, called Underworlds, consisting of physical infrastructure, biological and chemical measurement technologies, and the downstream computational tools and analytics necessary to interpret and act on our findings.

This report outlines the preliminary activities that are underway, introduces the key researchers involved, and proposes a research plan through the end of the funding years.

The Underworlds Project consists of two main activities:

Method Development: Building the Underworlds platform. The first stage of the project is to develop and validate prototypes of all components of the platform (cyber-physical and biological).

Application Projects: Collaborative MIT-Kuwait Application projects. Once the platform is established, we will work together with Kuwaiti stakeholders to implement a series of projects ranging from infectious diseases tracking (influenza, rotavirus, etc.), to the emergence of antibiotic resistance, to the effects of policy on public health (e.g., obesity).

A design of a prototype system will be established in Boston during the first two years and Kuwait in the final year of the project. During the first two years, the MIT team will work to establish the method and protocols for application projects. Kuwaiti researchers will be trained in MIT laboratories in years 1 and 2, and MIT staff will help establish identical facilities in Kuwait during years 2 and 3. Finally, work will be carried out by MIT-trained Kuwaiti staff on-site in Kuwait in the final project year.

The project will serve to expand cutting-edge genomics and urban informatics capacities in Kuwait, as well as to aggregate the expertise necessary for leading other countries in the Gulf region.

KFAS contribution: KWD 1,219,824.625
Total budget: KWD 1,219,824.625
New Projects

Ground Motion Modeling and Structural Monitoring of Tall Buildings (PN18-15EO-01)

J. Al-Qazweeni

Kuwait Institute for Scientific Research

Abstract:

The proposed project is an extension of the sig nature project between Kuwait Institute for Scientific Research (KISR) and Massachusetts Institute of Technology (MIT) financed by Kuwait Foundation for the Advancement of Sciences (KFAS). In this project, Al-Hamra tower will be instrumented and building response data will be measured and transferred to KISR continuously in real time. Data analysis will be carried out in real time at KISR. Accelerometers, tilt meters, Global Positioning System (OPS), temperature sensors, wind sensors, etc. will be installed. Building movement will be measured using OPS. The results will be compared against the estimated values from the accelerometers. OPS technology is not yet well-established in monitoring building movements. In this project, application of OPS in the Structural health monitoring (SHM) technology will be investigated in detail. It may be noted that there are no local building codes that exist in Kuwait. Tall buildings in Kuwait are designed based on the International Building Code (IBC) or Euro codes. These design codes may not be directly applicable especially for earthquake and wind loads. In this project, a detailed review of the design codes will be carried out. The outcome of the continuous measurement and data analysis will partially contribute to the development of local tall building design codes.

KFAS contribution: KWD 214,600

Total budget: KWD 359,350
Plunging Liquid Jet Reactors for Dilution and Aeration of Brine Discharged from Seawater Desalination Plants
(PN18-15EV-07)

Bader S. Al-Anzi

Kuwait University in collaboration with Massachusetts Institute of Technology, U.S.A.

Abstract:

Brine from seawater desalination plants is often returned to the ocean via a submerged multiport diffuser. Depending on their design, submerged diffusers can create significant dilution, thereby reducing the excess salinity and concentration of contaminants (e.g., anti-foulants, products of corrosion) contained in the discharge. Because the brine is negatively buoyant, it tends to spread on the seafloor, impeding vertical mixing, and possibly leading to oxygen depletion. While significant research has been devoted to mixing from brine discharges, there has been far less study of how brine discharges impact dissolved oxygen, and how this impact may be mitigated.

The proposed project investigates the viability of utilizing Plunging Liquid Jet Reactors, both (CPLJR) and unconfined (PLJR) as an aeration technology. The study involves investigating the effect of operating conditions (jet velocity, jet length, downcomer diameter, downcomer length, and nozzle diameter) on dissolved oxygen concentration (DO) and contaminant.

KFAS contribution:  KWD 181,684
Total budget:  KWD 216,164
## Completed Projects

### European and US Policies towards Inward Investment from the Gulf in Strategic Industries
**(Project Code: 2010-1103-03)**  
**Project Leader:** M. Thatcher  
**Affiliation/Beneficiary:** London School of Economics and Political Science

### Use of Estimated Average Glucose and Adipokines as Screening Tests for Categories of Glucose Intolerance – The Kuwait Adipokines and Derived Average Glucose Study (KADAGS)
**Project Leader:** N. Abdella  
**Affiliation/Beneficiary:** Kuwait University, Faculty of Medicine, Medicine Department.

### The Collapse of Kuwait's Fishery Stocks: Analysis and Identification of the Causes, Data Needs and Remedial Management Actions
**(Project Code: 2011-1401-06)**  
**Project Leader:** M. Al-Husaini  
**Affiliation/Beneficiary:** Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Ecosystem-based Management of Marine Resources Program

### Establishment of National Unrelated Hematopoietic Stem Cell and Cord Blood Donor Registry
**(Project Code: 2012-1302-04)**  
**Project Leader:** S. Al-Shemmari  
**Affiliation/Beneficiary:** Kuwait University, Faculty of Medicine, Department of Medicine

### National Sickle Cell Disease Registry
**(Project Code: 2012-1302-07)**  
**Project Leader:** A. Adekile  
**Affiliation:** Kuwait University, Faculty of Medicine, Department of Pediatrics  
**Beneficiary:** Ministry of Health

### The Effect of Developments in Mesopotamian Marshland on Boubyan and Warba Islands
**(Project Code: 2012-1401-01)**  
**Project Leader:** Y. Alosairi  
**Affiliation/Beneficiary:** Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Coastal Management Program.

### The Standardization of Wechsler Intelligence Scale for Children- Fifth Edition (WISC-V)
**(Project Code: 2013-1109-04)**  
**Project Leader:** F. Hadi  
**Affiliation/Beneficiary:** Kuwait Society for the Advancement of Arab Children.

### Spaces of living: Urban reflections of Kuwaiti society
**(Project Code: 2013-1401-01)**  
**Project Leader:** S. Alshalfan  
**Affiliation/Beneficiary:** AGI Architects

### The Effect of Dietary Probiotics and Prebiotics on the Performance of Broiler Chickens in Kuwait
**(Project Code: P114-12SL-06)**  
**Project Leader:** H. Al-Khalaifa and A. Al-Nasser  
**Affiliation/Beneficiary:** Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Aridland Agriculture and Greenery Department.

### Designing and Constructing a Social Accounting Matrix (SAM) for the State of Kuwait
**(Project Code: P114-17IA-01)**  
**Project Leader:** A. Gelan  
**Affiliation/Beneficiary:** Kuwait Institute for Scientific Research, Techno Economics Division, Economic Public Policy Program
Cloud Computing for Health Care Institutions in Kuwait
(Project Code: P114-18NH-01)
Project Leader: I. Omran
Affiliation/Beneficiary: Gulf University for Science and Technology, Computer Science Department.

Media Effect on Citizenship in the Gulf States: Case of Kuwait and Oman
(Project Code: P115-11AM-02)
Project Leader: A. Dashti
Affiliation/Beneficiary: Gulf University for Science and Technology, Mass Communication Department

Statistical Predictive Modeling of Cytokine Profiles in Normal and Complicated Human Pregnancy
(Project Code: P115-12SL-06)
Project Leader: K. Dingle
Affiliation/Beneficiary: Gulf University for Science and Technology, Mathematics & Natural Science Department

Performance of Some Forage Crops Under Different Cropping Systems
(Project Code: P115-12SL-07)
Project Leader: H. Al-Menaie
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment & Life Sciences Research Center, Desert Agriculture and Ecosystems Program.

Knowledge and Attitude of Primary Care Physicians towards Palliative Care in Kuwait
(Project Code: P115-13MC-03)
Project Leader: A. Al-Ansari
Affiliation/Beneficiary: Ministry of Health

A Novel Biologically Inspired Algorithm for Optimization Based on Worm’s Behavior
(Project Code: P115-18EO-02)
Project Leader: J. Arnout
Affiliation/Beneficiary: Gulf University for Science and Technology, Business Administration Department

The Role of Lipoxygenases in Testicular Ischemia Reperfusion Injury, An Experimental Model for Testicular Torsion
(Project Code: P116-13MB-01)
Project Leader: M. Al-Maghrebi
Affiliation/Beneficiary: Kuwait University, Faculty of Medicine, Department of Biochemistry.

Speech Restructuring and Speech-Anxiety Treatment: Comparing Order and Outcomes of Stuttering Therapies in Kuwait
(Project Code: P116-13MC-09)
Project Leader: M. Alameer
Affiliation/Beneficiary: FAWSEC Educational Company

Development of Ipad Interactive Story and Sequences Application for The Treatment of Speech Disorders and Enhancement of Speech
(Project Code: P116-13MC-12)
Project Leader: G. Al Naqi
Affiliation/Beneficiary: Kuwait Institute for Scientific Research

On Root-Involutions and Root-Sub-Groups of the Chevalley Group E6 (K), Over a Field K of Characteristic 2
(Project Code: P116-14SM-01)
Project Leader: S. Alkhafeeri
Affiliation/Beneficiary: Public Authority for Applied Education and Training, College of Basic Education, Mathematics Department.

On the Stabilizer of a 2-dimensional Vector Space Of 27-dimensional Module of Type E6 over a field of Characteristic Two
(Project Code: P116-16SM-01)
Project Leader: Y. Alkhezi
Affiliation/Beneficiary: Public Authority for Applied Education and Training, College of Basic Education, Department of Mathematics
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<td>P214-42SL-02</td>
<td>Genetic Characterization of Haloxyon Salicornicum and Rhanterium Epapposum Native Plant Species of Kuwait by DNA Markers</td>
<td>F. Al-Salameen</td>
<td>Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Biotechnology Program</td>
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<td>Investigation of Soil Microbial Communities and Vegetation for Baseline Database Development at Selected Sites in Kuwait Desert</td>
<td>A. Quoreshi</td>
<td>Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Desert, Agriculture and Ecosystems</td>
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<td>Approaches to Enhance the Sustainability of Energy Systems in Kuwait: Environmental Impact and Cost Estimation of Changing Fuels in Kuwait's Electricity Grid</td>
<td>N. Alhajeri</td>
<td>Kuwait University, Department of Environmental Technology Management</td>
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<td>Evaluation of Tsunami Hazards along the Kuwaiti Coastline Due To Possible Earthquake and Landslides</td>
<td>K. Al-Salem</td>
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<td>P215-42SL-01</td>
<td>Restoration Potential of Selected Native Plant Species in Kuwait</td>
<td>M. Suleiman</td>
<td>Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Biodiversity of Terrestrial Ecosystems Program</td>
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<td>P215-42SL-02</td>
<td>Studies on the Biocatalytic Desulfurization of Diesel: Phase I</td>
<td>H. Mahmoud and W. Al-Moslimany</td>
<td>Kuwait University, Faculty of Science, Department of Biological Sciences and Arabian Gulf University, Bahrain</td>
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<td>P215-42SL-03</td>
<td>Ecological Assessment and Restoration Plan of Terrestrial Biodiversity in Umm Al Namil Island, Kuwait</td>
<td>M. Al Mutairi</td>
<td>Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Biodiversity of Terrestrial Ecosystems Program</td>
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Establishment of Mangrove Plantations Phase II
(Project Code: P215-42WE-01)
Project Leader: N. Bhat
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Desert Agriculture and Ecosystems Program

Mechanical and Physical Evaluation of High Content Waste/Virgin Polyolefin Blends Exposed To Natural and Accelerated Weathering
(Project Code: P215-44EC-01)
Project Leader: S. Al-Salem
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Petroleum Research Center, Polymeric Product Enhancement & Customization Program

Calibration and Validation of NASA (SMAP) Satellite for the Retrieval of Soil Moisture and the Application to Environmental Modeling in Kuwait (Phase 2)
(Project Code: P215-44SP-01)
Project Leader: H. Al Jassar
Affiliation/Beneficiary: Kuwait University, Faculty of Science, Physics Department.

The Extent and Determinants of Students' Perception of Sustainability in GCC Universities
(Project Code: P215-49TM-01)
Project Leader: A. Al-Mutairi
Affiliation/Beneficiary: Gulf University for Science and Technology, Economics & Finance Department

Assessment of the Microplastic Pollution of Kuwait's Marine Environment
(Project Code: P216-42SE-01)
Project Leader: T. Saeed
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Environment Pollution and Climate Program.

Trophic Transfer of $^{210}$PO in Marine Environment in Northern Arabian Gulf
(Project Code: P216-44SP-01)
Project Leader: S. Uddin
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Environmental Management Program

Education for Sustainability: Training Educators and Civil Society Leaders in Participatory Environmental Research and Action
(Project Code: P216-44WE-02)
Project Leader: E. Franceschinis
Affiliation/Beneficiary: The En.V Initiative

Design of Iptycene Polymers: A New Generation of Gas Separation Nanomaterials for Energy Applications
(Project Code: P314-34SC-01)
Project Leader: B. Alameddine
Affiliation/Beneficiary: Gulf University for Science and Technology, Mathematics & Natural Science Department

Investigation of Cleaning Methods for Photovoltaic Systems under Kuwait Environment
(Project Code: P314-35EM-04)
Project Leader: F. Alzubi
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Energy & Building Research Center, Renewable Energy Program

Efficient Separation of Dilute Oil Contaminations from Wastewater by Functionalized Magnetic Nanoparticles
(Project Code: P315-25EC-01)
Project Leader: A. Al-Haddad
Affiliation/Beneficiary: Kuwait University, College of Engineering and Petroleum, Department of Chemical Engineering
Assessing the Feasibility of Offshore Wind as an Alternative Source of Energy for the State of Kuwait
(Project Code: P315-34SE-02)
Project Leader: W. Al-Nassar
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Energy & Building Research Center, Renewable Energy Program

A Modular Multi-Terminals PV Interfacing System
(Project Code: PN17-15EE-01)
Project Leader: B. Alajmi
Affiliation/Beneficiary: Public Authority for Applied Education and Training

Aligned PVDF Nanofibers Embedded with Carbon Nanotubes for Energy Harvesting
(Project Code: PN17-35EE-02)
Project Leader: N. Shehatah
Affiliation/Beneficiary: Kuwait College of Science and Technology, Department of Physics

Benchmarking the Energy Use Intensity of Kuwait's Residential and Commercial Building Sectors
(Project Code: PN17-35EV-01)
Project Leader: E. Aazar
Affiliation/Beneficiary: Kuwait Municipality

Quantifying the Impact of Human Actions on The Energy Performance of Kuwaiti Residential Buildings
(Project Code: PN17-35EV-02)
Project Leader: E. Aazar
Affiliation/Beneficiary: Kuwait Municipality

Man And Human Society In Literature Of Ismail Fahad Ismail, A Critical Study
(Project Code: PR17-11AA-01)
Project Leader: S. Arkadan
Affiliation/Beneficiary: Gulf University for Science and Technology, Humanities & Social Sciences Department

Studies on The Biogeochemical Role of Dolomite Forming Microbes Isolated from A Kuwaiti Sabkha
(Project Code: PR17-12SL-10)
Project Leader: H. Mahmoud
Affiliation/Beneficiary: Kuwait University in collaboration with University of Toronto

Multi-Parametric Testing of Immunological and Biochemical Markers of Osteoporosis in Postmenopausal Women
(Project Code: PR17-18SL-01)
Project Leader: F. Azizieh
Affiliation/Beneficiary: Gulf University for Science and Technology, Mathematics & Natural Science Department

Relationship Share an Outcome of Customer Relationship Management: A Comparative Study of Kuwait & U.S. Firms
(Project Code: PR17-18SM-01)
Project Leader: D. Al-Saleh
Affiliation/Beneficiary: Gulf University for Science and Technology, Business Administration Department.

Telecommunication Services for Emergency Crisis: Kuwait Vs U.S.A.
(Project Code: PR17-18SM-03)
Project Leader: D. Al-Saleh
Affiliation/Beneficiary: Gulf University for Science and Technology, Business Administration Department.

Natural Radioactivity Exposure to The Kuwaiti Populace from The Ingestion of Fish
(Project Code: PR17-44SE-02)
Project Leader: T. Al-Refae
Affiliation/Beneficiary: Kuwait University, Faculty of Science, Department of Physics.
Ongoing Projects

The Biology of Marine Bivalves and Their Environment in Kuwait, Phase I: Population, Structure, Reproduction and Mitochondrial DNA
(Project Code: 2012-1207-02)
Project Leader: S. Al-Mohanna
Affiliation/Beneficiary: Kuwait University, Department of Biological Sciences.

Identification and Characterization of Post-Translational Modifications in the Raf Kinase Inhibitory Protein: Implication for a Molecular-Based Therapy of Breast Cancer
(Project Code: 2012-1302-01)
Project Leader: M. Bitar
Affiliation/Beneficiary: Kuwait University, Faculty of Medicine, Department of Pharmacology and Toxicology.

Concomitant Anti-EGFR Antibody (Cetuximab) Plus Hyper-Fractionated Radiotherapy versus Chemotherapy Plus Hyper-Fractionated Radiotherapy in Advanced Non-Metastatic Head and Neck Cancer
(Project Code: 2012-1302-06)
Project Leader: K. Al-Saleh
Affiliation/Beneficiary: Ministry of Health

Development of an Optimal Implementation Model For Seawater Multiple Effect Distillation Technology in Kuwait
(Project Code: 2012-2505-03)
Project Leader: G. Al-Nuwaibit
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Water Research Center, Thermal Desalination Technologies Program

Composition of Steroids and other Lipid Fractions and Proteins: The Anti-Inflammatory, Anti-Cancer Activities in Preparations from the Skin of the Arabian Gulf Catfish (Arius Bilineatus, Valenciennes)
(Project Code: 2013-1207-1A)
Project Leader: J. Al-Hassan and P. Yang
Affiliation/Beneficiary: Kuwait University and MD Anderson Cancer Center

Composition of Steroids and other Lipid Fractions and Proteins: The Anti-Inflammatory, Anti-Cancer Activities in Preparations from the Skin of the Arabian Gulf Catfish (Arius Bilineatus, Valenciennes)
(Project Code: 2013-1207-1B)
Project Leader: J. Al-Hassan, Faculty of Science
Affiliation/Beneficiary: Kuwait University and Hospital for Sick Children, Toronto

Composition of Steroids and other Lipid Fractions and Proteins: The Anti-Inflammatory, Anti-Cancer Activities in Preparations from the Skin of the Arabian Gulf Catfish (Arius Bilineatus, Valenciennes)
(Project Code: 2013-1207-1C)
Project Leader: J. Al-Hassan and W. Renno
Affiliation/Beneficiary: Kuwait University and MD Anderson Cancer Center

Using Value Methodology for Deployment of Scrap Tires to Fight Desertification in Kuwait and Ration Water
(Project Code: 2013-1501-01)
Project Leader: F. Al-Anzi
Affiliation/Beneficiary: Kuwait University, College of Computing Sciences and Engineering, Computer Engineering Department
Studying the Genetics of Congenital Thoracic Anomalies in Consanguineous Kuwaiti Families Caused by Cilia Dysfunction
(Project Code: P114-13MG-01)
Project Leader: D. Al-Mutairi
Affiliation/Beneficiary: Kuwait University, Faculty of Medicine, Department of Pathology

Assessment of Body Composition of Kuwaiti Infants by Using Air Displacement Plethysmography (PEA POD)
(Project Code: P114-13MK-01)
Project Leader: T. Al-Ati
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Food and Nutrition Program

Synthesis, Characterization and Theoretical Investigations of Water Soluble Cationic Phthalocyanines and Their In Vitro Studies for Photodynamic Therapy
(Project Code: P114-14SC-01)
Project Leader: S. Makhseed
Affiliation/Beneficiary: Kuwait University, Faculty of Science, Chemistry Department

Challenges and Opportunities in Establishing Technology Commercialization Programs at GCC Universities
(Project Code: P114-17IM-08)
Project Leader: M. Al-Fahad
Affiliation/Beneficiary: Kuwait University, College of Business Administration, Center of Excellence in Management

Viral Nerve Cacrosis in Hamoor: Detection in Brookstock and Prevention in Larvae through Egg Disinfection
(Project Code: P115-12SL-01)
Project Leader: A. Saheb
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment & Life Sciences Research Center, Aquaculture Program.

Biofuel and Side Products from Kuwait's Microalgae
(Project Code: P115-12SL-04)
Project Leader: B. Al-Hamar
Affiliation/Beneficiary: Kuwait University, Faculty of Science, Department of Biological Sciences

Genetics of Eczema in Kuwait
(Project Code: P115-13MC-05)
Project Leader: A. Ziyab
Affiliation/Beneficiary: Kuwait University, Faculty of Medicine, Department of Community Medicine and Behavioural Sciences

Retinitis Pigmentosa and Leber's Congenital Amaurosis in an Extended Kuwaiti Family
(Project Code: P115-13MM-01)
Project Leader: J. Al-Merjan
Affiliation/Beneficiary: Ministry of Health, Al-Bahar Eye Center.

Implementation of Distress Assessment and Response Tool (DART) Screening Tool in Kuwait Cancer Control Center (KCCC)
(Project Code: P115-13MQ-01)
Project Leader: M. Al-Awadhi
Affiliation/Beneficiary: Kuwait University, Faculty of Medicine, Psychiatry Department.

Polymeric Nanoparticles as New Smart Contrast Agent for Breast Cancer Early Detection via MRI
(Project Code: P115-14SC-02)
Project Leader: M. Fouzi
Affiliation/Beneficiary: Kuwait University, Faculty of Science, Department of Chemistry.
Towards A Portable and Miniaturized System for The Detection of Drugs of Abuse Through Ru(Bpy)32+ Chemiluminescence Reaction
(Project Code: P115-14SC-04)
Project Leader: E. Al-Hetlani
Affiliation/Beneficiary: Kuwait University

Towards a Series of Truly Water Soluble Sugar Conjugate Phthalocyanines for Optimum Cancer Treatment Using Photodynamic Therapy (PDT)
(Project Code: P115-14SC-05)
Project Leader: S. Makhseed
Affiliation/Beneficiary: Kuwait University, Faculty of Science, Department of Chemistry.

Advanced Crystalline Silicon Photovoltaics Research Program (Phase II)
(Project Code: P115-15EE-01)
Project Leader: Y. Abdulraheem
Affiliation/Beneficiary: Kuwait University, College of Engineering and Petroleum in collaboration with IMEC, Belgium

Energy Subsidy and Price Reform in Kuwait: An Assessment Using a Computable General Equilibrium Model
(Project Code: P115-17IA-02)
Project Leader: A. Gelan
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Techno-Economics Division, Economics Public Policy Program.

Enhancing Scientific Literacy and English Language Proficiency of Public High School Students in Kuwait through Science-Based Writing Projects
(Project Code: P115-19TO-02)
Project Leader: M. Tryzna
Affiliation/Beneficiary: Gulf University for Science and Technology, English Department.

Evaluation of Techniques to Enhance Seed Germination and Evaluation of Seedling Establishment in Selected Native Plants
(Project Code: P116-12SL-03)
Project Leader: M. Suleiman
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Biodiversity of Terrestrial Ecosystems Program

Evaluation of Fig Trees for Developing Potential Fruit Production and Cultural Practices in Kuwait
(Project Code: P116-12SL-04)
Project Leader: H. Al-Zalzaleh
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment & Life Sciences Research Center, Desert Agriculture and Ecosystems Program.

Ecofriendly Green Synthesis of Silver Nanoparticles and Its Application in Wastewater Treatment Under Solar Energy Photo-Catalytic Effect from Contaminated Dyes (Methyl Orange) And Water-Borne Disease Bacteria Using Red Algae (Laurencia Papillosa)
(Project Code: P116-12SL-05)
Project Leader: M. Montasser
Affiliation/Beneficiary: Kuwait University

Investigation of Lamb Mortality in Kuwait: Improving Immunity and Vaccination
(Project Code: P116-12SL-07)
Project Leader: H. Burezq
Affiliation/Beneficiary: Kuwait Institute for Scientific Research in collaboration with Public Authority for Agriculture Affairs & Fish Resources
Genetic Characterization of Naemmi Breed and Investigations of their Life-Time Performance
(Project Code: P116-12SL-11)
Project Leader: S. Abbas
Affiliation/Beneficiary: Kuwait Institute for Scientific Research in collaboration with Public Authority for Agriculture Affairs & Fish Resources

Effect of Ocean Acidification on Growth and Abundance of Penaeus Semisulcatus in the Northern Arabian Gulf
(Project Code: P116-12SL-13)
Project Leader: L. Al-Musallam
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment & Life Sciences Research Center, Environmental Pollution and Climate Program.

Enhancement of Native Forage Species Production as Local Feed Resources for Livestock in Kuwait - Phase II
(Project Code: P116-12SL-15)
Project Leader: T. Madouh
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment & Life Sciences Research Center, Desert Agriculture and Ecosystems Program.

Effects of Commercial Microdiets And Weaning Strategies on The Rearing of Sobaity (Sparidentex Hasta) Larvae
(Project Code: P116-12SL-16)
Project Leader: S. El-Dakour
Affiliation/Beneficiary: Kuwait Institute for Scientific Research

Using Marine Algae as Poultry Feed
(Project Code: P116-12SL-17)
Project Leader: H. Al-Khalaifa
Affiliation/Beneficiary: Kuwait Institute for Scientific Research in collaboration with Kuwait United Poultry Company

Investigating the Use of Native Plants in Poultry Feed in Kuwait
(Project Code: P116-12SL-18)
Project Leader: A. Al-Nasser
Affiliation/Beneficiary: Kuwait Institute for Scientific Research

Cancer Pain Control Before and After Palliative Care Center Referral
(Project Code: P116-13MC-01)
Project Leader: A. Al-Ansari
Affiliation/Beneficiary: Ministry of Health, Palliative Care Center.

Determination of The Nutritive Values of Highly Consumed Dishes in Kuwait
(Project Code: P116-13MC-05)
Project Leader: B. Dashti
Affiliation/Beneficiary: Kuwait Institute for Scientific Research

Estimation of Salt Intake Assessed By 24 Hour Urinary Sodium Excretion in The Adult Kuwaiti Population
(Project Code: P116-13MC-06)
Project Leader: N. Al-Hamad
Affiliation/Beneficiary: Public Authority for Food and Nutrition (PAFN)

The Use of Killer-Cell Immunoglobulin-Like Receptor (KIR) Genotyping in Related Stem Cell Transplantation
(Project Code: P116-13MC-08)
Project Leader: R. Ameen
Affiliation/Beneficiary: Kuwait University, Faculty of Allied Health Sciences, Medical Laboratory Sciences Department.
Anticoagulation in Advanced Cancer Patient Receiving Palliative Care
(Project Code: P116-13MC-11)
Project Leader: A. Al-Ansari
Affiliation/Beneficiary: Ministry of Health

Identification and Characterization of RKIP Network in Breast Cancer Metastasis: A Focus on Metalloproteinases
(Project Code: P116-13MG-02)
Project Leader: F. Al-Mulla
Affiliation/Beneficiary: Kuwait University

National Registry for Children with Cancer in Kuwait from 2004 - 2018
(Project Code: P116-13MK-01)
Project Leader: M. Bourusly
Affiliation/Beneficiary: Ministry of Health, NBK Hospital, Sabah Hospital.

Clinical Classification of the Sickle Cell Disease (SCD) According to Bone Involvements and Other Systemic Complications
(Project Code: P116-13MM-01)
Project Leader: H. Al-Jafar
Affiliation/Beneficiary: Ministry of Health, Amiri Hospital.

Kuwait Obstructive Lung Disease Initiative: KOLD Study
(Project Code: P116-13MM-04)
Project Leader: F. Al-Hurish
Affiliation/Beneficiary: Ministry of Health in collaboration with Fawzia Sultan Rehabilitation Institute

The Effect of High Density Lipoprotein on Ischemia-Reperfusion Injury in Spontaneously Hypertensive Rats
(Project Code: P116-13MM-05)
Project Leader: A. Al-Jarallah
Affiliation/Beneficiary: Kuwait University

The Effect of Metabolic Surgery on The Uncoupling Proteins
(Project Code: P116-13MM-06)
Project Leader: M. Jamal
Affiliation/Beneficiary: Kuwait University

The Identification of The Toxic Pathways Induced by The Mutant SOD1 Protein Associated with Canine Degenerative Myelopathy: A Potential Novel Model for Amyotrophic Lateral Sclerosis
(Project Code: P116-13MM-07)
Project Leader: T. Alfahad
Affiliation/Beneficiary: Kuwait University in collaboration with University of Glasgow

Molecular Aberrations Among Patients with Myeloproliferative Neoplasms: Focus on Myelofibrosis
(Project Code: P116-13MM-08)
Project Leader: S. Alshemmari
Affiliation/Beneficiary: Kuwait University

Advanced Strategies for Attenuation Correction and Synergistic Reconstruction in Dynamic Time-Of-Flight PET/MRI
(Project Code: P116-13MN-01)
Project Leader: T. Alrefae
Affiliation/Beneficiary: Kuwait University in collaboration with Geneva University Hospital, Geneva

Knowledge and Attitude of Emergency Physicians towards Palliative Care in Kuwait
(Project Code: P116-13NO-01)
Project Leader: A. Al-Ansari
Affiliation/Beneficiary: Ministry of Health, Palliative Care Center.
Investigations into the Anti-Inflammatory Mechanisms and Therapeutic Effects of Onion Bulb Extract and its Active Constituents in Animal Models of Inflammation

(Project Code: P116-13PT-01)
Project Leader: A. El-Hashim
Affiliation/Beneficiary: Kuwait University, Faculty of Pharmacy, Department of Pharmacology and Therapeutics.

Modelling and Design of Nano-Structures: Multilayer Nanoplasmonics Configurations

(Project Code: P116-15EC-01)
Project Leader: H. Kurkcu
Affiliation/Beneficiary: Gulf University for Science and Technology, Department of Mathematics.

Reliability-Based Assessment of Existing Structures

(Project Code: P116-15EV-01)
Project Leader: Z. Sakka
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Energy and Building Research Center, Sustainability and Reliability of Infrastructures Program

Wool Production Potential of Naemi Sheep: Assessing Quantitative and Qualitative Status of Wool in Kuwait

(Project Code: P116-15SE-01)
Project Leader: S. Abbas
Affiliation: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Desert Agriculture and Ecosystems Program
Beneficiary: Al Sadu Co-op Handicrafts Society

The National Study of the Future Forecast for the Need of the Jobs That Based on Knowledge, Innovation and R&D in the Public and Private Labor Markets during the Next Five Years

(Project Code: P116-17IC-04)
Project Leader: K. Al-Hashash
Affiliation/Beneficiary: Supreme Council of Planning and Development

Utilizing Applied Behavioral Research to Execute Subsidy Reform in Kuwait

(Project Code: P116-17IC-05)
Project Leader: H. Al-Ojayan
Affiliation/Beneficiary: Kuwait University, College of Business Administration, Department of Finance

Bubbles in The Hotel/Lodging Real Estate Sector

(Project Code: P116-17IM-02)
Project Leader: F. Almudhaf
Affiliation/Beneficiary: Kuwait University

Identifying Systems Models Characteristics Affecting the Propagation of a Change

(Project Code: P116-18QS-01)
Project Leader: N. Almasri
Affiliation/Beneficiary: Gulf University for Science and Technology, MIS Department.

Levels of Pesticides Residue in Raw Milk and Selected Dairy Products in the Kuwait Market with Emphasis on Public Health

(Project Code: P214-42NM-01)
Project Leader: M. Al-Fayez
Affiliation/Beneficiary: Public Authority for Applied Education and Training, College of Health Science, Food Science and Nutrition Department

Biochemical Potential of Conocarpus Lancifolius to Uptake of Carcinogenic Polyaromatic Hydrocarbons and Heavy Metals

(Project Code: P214-42SL-05)
Project Leader: R. Al-Hasan
Affiliation/Beneficiary: Kuwait University, Faculty of Science, Department of Biological Sciences.
A Revision on the Marine Algal Flora of Kuwait with Special Emphasis on the Epiphytes
(Project Code: P214-42SL-06)
Project Leader: R. Al-Hasan
Affiliation/Beneficiary: Kuwait University, Faculty of Science, Department of Biological Sciences.

Development of an Emission Inventory for the State of Kuwait
(Project Code: P214-44SC-03)
Project Leader: A. Ramadan
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Air Quality Program.

Feed Production Utilizing Greenery and Agricultural Residues: Evaluation of Feeds for Livestock in a Pilot-Scale Operation
(Project Code: P215-42SC-01)
Project Leader: M. Razzaque
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Desert Agriculture and Ecosystems Program.

Dead Animals Disposal - Sheep
(Project Code: P215-42SC-02)
Project Leader: T. Al-Sabbagh
Affiliation: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center
Beneficiary: Livestock Transport & Trading Co.

Developing Sustainable and Environmentally Safe Strategies to Mitigate Overuse of Toxic Pesticides on an Invasive Pest
(Project Code: P215-42WE-03)
Project Leader: M. Jallow
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Desert Agriculture and Ecosystems Program.

Development of a Decision Support System for Radioecologically Sensitive Areas in Kuwait (DESSAK)-Phase I: Experimental Studies, Modeling and Development of Database for Radioecology
(Project Code: P215-44SP-02)
Project Leader: A. Aba
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Crisis Decision Support Program.

Estimating Internal Radiation Dose Due to Airborne Radioactive Dust in Kuwait
(Project Code: P215-44WE-02)
Project Leader: A. Isameel/ A. R. Khan
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Crisis Decision Support Program.

Designing Mixed Air Distribution Systems to Reduce Micro-Particle Indoor Concentrations
(Project Code: P216-42WE-04)
Project Leader: W. Chakroun
Affiliation/Beneficiary: Kuwait University, College of Engineering and Petroleum, Department of Mechanical Engineering.

Internal Wave Climate and Turbulence Mixing on the Continental Shelf of the Northwestern Arabian Gulf, Off the Kuwaiti Coast
(Project Code: P216-44SE-01)
Project Leader: F. Al-Sena
Affiliation/Beneficiary: Kuwait University, Faculty of Science, Department of Marine Science. Texas A&M

Hydrodynamic Studies on Slotted Vertical Wave Barriers
(Project Code: P216-44SE-03)
Project Leader: S. Neelamani
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Coastal Management Program.
Preliminary Assessment of the Spatial Variations in the Atmospheric Concentrations of Persistent Organic Pollutants in the West Asian Sub-Region  
(Project Code: P216-44WE-01)  
Project Leader: B. Gevao  
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Environment Pollution and Climate Program.

Modeling and Analysis of the Coupled Gulf-Atmosphere System  
(Project Code: P216-45EV-01)  
Project Leader: D. AlRukaibi  
Affiliation/Beneficiary: Kuwait University, College of Engineering and Petroleum, Department of Civil Engineering.

Energy Efficient and Sustainable Communications Network  
(Project Code: P314-35EO-01)  
Project Leader: M. Awad  
Affiliation/Beneficiary: Kuwait University, College of Computing Sciences and Engineering, Computer Engineering Department.

Irrigation Studies in Date Palm (Phoenix Dactylifera L.) Phase II: Development of Precision Irrigation Scheduling Under Kuwaiti’s Environmental Conditions  
(Project Code: P315-22SL-01)  
Project Leader: N. Bhat  
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Desert Agriculture and Ecosystems Program

Measurement and Characterization of Solar Irradiance and Climatological Factors for Assessing Solar Conversion Technologies in Kuwait  
(Project Code: P315-34SE-01)  
Project Leader: M. Al-Rasheedi  
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Energy & Building Research Center, Renewable Energy Program

Synthesizing of MgH2-Nb2O5-based Nanocomposite Powder Particles for the Manufacturing of Hydrogen Storage System for Light Duty Vehicles, Phase II  
(Project Code: P315-35EC-01)  
Project Leader: M. El-Eskandarany  
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Energy & Building Research Center, Nanotechnology - Advanced Materials Program

Characterization and Assessment of Industrial Wastewater in Kuwait  
(Project Code: P316-25EC-01)  
Project Leader: A. Al-Haddad  
Affiliation/Beneficiary: Kuwait Institute for Scientific Research

Assessment of Viability and Efficiency of Two Forward Osmosis Membrane Technologies for Seawater Desalination: Pilot Plant Scale  
(Project Code: P316-25EC-02)  
Project Leader: M. Ahmed  
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Water Research Center, Innovative Desalination Technologies Program

Pilot Hybrid Biofilm Reactor for Treatment of Industrial Wastewater  
(Project Code: P316-25EC-03)  
Project Leader: M. Ahmed  
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Water Research Center, Wastewater Treatment and Reclamation Technologies Program

Extraction of Magnesium Oxide from Concentrated Brine: Pilot Plant  
(Project Code: P316-25EC-04)  
Project Leader: M. Ahmed  
Affiliation/Beneficiary: Kuwait Institute for Scientific Research
Conducting a Periodic Statistical Study in Educational Facilities for Measuring the Water Consumption
(Project Code: P316-25EM-02)
Project Leader: S. Al-Muzaini
Affiliation: Kuwait Water Association
Beneficiary: Ministry of Education (MOE)

Evaluation of Surface Runoff Along the Wadis of Northern Kuwait
(Project Code: P316-25SE-02)
Project Leader: A. Mukhopadhyay
Affiliation/Beneficiary: Kuwait Institute for Scientific Research

Continuous Synthesis and Isolation of Magnetic Nanoparticles Using Droplet Microfluidics for Wastewater Treatment
(Project Code: PN17-24SC-01)
Project Leader: E. Alhetlani
Affiliation/Beneficiary: Kuwait University

Hybridization Appraisal of Forward Osmosis and Membrane Distillation Processes for Seawater Desalination
(Project Code: PN17-25EM-01)
Project Leader: M. Ahmed
Affiliation/Beneficiary: Kuwait Institute for Scientific Research in collaboration with Ministry of Electricity and Water

Versatile Polymers for Organic Field Effect Transistors: Sustainable Materials for Photovoltaic Cells and Sensing Applications
(Project Code: PN17-34SC-01)
Project Leader: B. Alameddine
Affiliation/Beneficiary: Gulf University for Science and Technology, Mathematics & Natural Science Department

Development of Advanced Perovskite Solar Cells
(Project Code: PN17-34SC-02)
Project Leader: Y. Abdulraheem
Affiliation/Beneficiary: Kuwait University

Solar Cells Efficiency Improvement Using Optical Nanostructures Coating Layers
(Project Code: PN17-35EE-01)
Project Leader: A. Hajjiah
Affiliation/Beneficiary: Kuwait University

Experimental Study to Investigate the Effect of Nano-Particle on Improving Heavy Kuwaiti Oil Recovery
(Project Code: PN17-35EP-01)
Project Leader: O. Alomair
Affiliation/Beneficiary: Kuwait University

Pollutant Dispersion Within Built-Up Environment Under Changes of Atmospheric Stability and Building Configurations
(Project Code: PN17-44SE-01)
Project Leader: M. Yassin
Affiliation/Beneficiary: Kuwait Institute for Scientific Research

Sustaining the Competitive Identity of Kuwait: The Role of Elite and Social Media Users
(Project Code: PR17-11AM-01)
Project Leader: Y. Abdelrahim
Affiliation/Beneficiary: Gulf University for Science and Technology, Mass Communication and Media Department

A Framework to Integrate Smartphones as A Mobile Learning Tool in Kuwait University
(Project Code: PR17-11TT-01)
Project Leader: F. Al-Khezzi
Affiliation/Beneficiary: Kuwait University
Effect of Three Carbohydrates on The Growth of Nile Tilapia, Water Consumption and Water Quality in A Biofloc System
(Project Code: PR17-12SL-01)
Project Leader: M. Ridha
Affiliation/Beneficiary: Kuwait Institute for Scientific Research

Tissue Culture Technology Development for The Micropropagation of Native Plants of Kuwait
(Project Code: PR17-12SL-04)
Project Leader: L. Al-Sabah
Affiliation/Beneficiary: Kuwait Institute for Scientific Research

Evaluating the Potential Use of Lytic Bacteriophages to Reduce Salmonella Contamination In Refrigerated Chicken Products
(Project Code: PR17-12SL-06)
Project Leader: H. Al-Hashash
Affiliation/Beneficiary: Kuwait Institute for Scientific Research

Implementation of Mutation Induction to Improve Barley Production Under Harsh Environmental Conditions (The Case of Kuwait)
(Project Code: PR17-12SL-12)
Project Leader: H. Al-Menaie
Affiliation/Beneficiary: Kuwait Institute for Scientific Research in collaboration with International Atomic Energy Agency (IAEA)

Depression, Disordered Eating and Obesity: A Qualitative Study
(Project Code: PR17-13MC-01)
Project Leader: N. Scull
Affiliation/Beneficiary: Fawzia Sultan Educational Company in collaboration with American University of Kuwait

Assessment of Risk of Cataract Among Interventionalists And Actions on Prevention
(Project Code: PR17-13NR-01)
Project Leader: M. Alnuaimi
Affiliation/Beneficiary: Ministry of Health

CO Oxidation Activity of Chromia Nanoparticles Dispersed on High Surface Area Graphene, Graphene Oxide or Alumina Support Materials
(Project Code: PR17-14SC-01)
Project Leader: A. Ali
Affiliation/Beneficiary: Public Authority for Applied Education and Training in collaboration with Kuwait University

Optical Nanosensors With Integrated Flexible Printed Nanoantennas For Water Quality Monitoring
(Project Code: PR17-15EE-01)
Project Leader: N. Shehata
Affiliation/Beneficiary: Kuwait College of Science and Technology (KCST)

Implementation of A Study Skills Program Integrated with A Basic Algebra Developmental Course
(Project Code: PR17-16SM-02)
Project Leader: I. Al-Zaid
Affiliation/Beneficiary: Gulf University for Science and Technology, Foundation Program Unit

New Efficient and Accurate Discontinuous Galerkin Methods for Stochastic Differential Equations Arising in Biology, Finance and Mechanical Engineering
(Project Code: PR17-16SM-04)
Project Leader: H. Temimi
Affiliation/Beneficiary: Gulf University for Science and Technology, Mathematics & Natural Science Department

Free Vibration of Composite Layered Cylindrical Shells Filled with Fluid Under Shear Theory
(Project Code: PR17-16SM-05)
Project Leader: V. Kannan
Affiliation/Beneficiary: Kuwait College of Science and Technology (KCST)
On Certain 3-Transposition Groups in Exceptional Groups Over Fields K of Characteristic Two
(Project Code: PR17-16SM-07)
Project Leader: F. Alawam
Affiliation/Beneficiary: Public Authority for Applied Education and Training

Adaptive Learning Management System Based on Justification Truth Maintenance System
(Project Code: PR17-18IQ-01)
Project Leader: T. Ali
Affiliation/Beneficiary: Gulf University for Science and Technology, Computer Science Department.

Investigation of The Impact of Critical Success Factors on Using the Online Government Web Site of Kuwait
(Project Code: PR17-18IQ-02)
Project Leader: K. Rouibah
Affiliation/Beneficiary: Kuwait University

A New Novel Approach for Single-Channel Arabic Speech Enhancement Using Phase Ratio
(Project Code: PR17-18SM-05)
Project Leader: A. Al-Mutawa
Affiliation/Beneficiary: Kuwait University

Characterization and Identification of Micro-Organisms Associated with Airborne Dust In Kuwait
(Project Code: PR17-42SL-01)
Project Leader: F. Al-Salameen
Affiliation/Beneficiary: Kuwait Institute for Scientific Research

The Dictionary of the Holy Qur’an (Special Study)
Project Leader: A. Al-Ghunaim
Affiliation/Beneficiary: Kuwait Foundation for the Advancement of Sciences

New Projects

Comprehensive Survey of the System of Criminal Procedure on the State of Kuwait
(Project Code: P116-11LP-01)
Project Leader: A. Elqahwaji
Affiliation/Beneficiary: Kuwait International Law School (KILAW)

Identification of Novel Drought-Responsive Genes In The Date Palm, (Phoenix Dactylifera L.) Using A Combination of Illumina And Pacbio NGS-Based RNA-Seq Technologies
(Project Code: P116-12SL-14)
Project Leader: S. Al-Mazrooei
Affiliation/Beneficiary: Kuwait University, Faculty of Science, Department of Biological Sciences

Socioeconomic Impacts on the Health Status, Distribution and Diversity of Marine Organisms along Kuwait’s Coastal Areas
(Project Code: P216-42WE-01)
Project Leader: A. Al-Zaidan
Affiliation/Beneficiary: Environment Public Authority

Assessment of Groundwater Quality Change in Water Fields of Kuwait
(Project Code: PN17-22SE-01)
Project Leader: T. Rashid
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Water Research Center, Water Resources Development and Management Program

Novel Nanostructured Adsorbents for Water Purification from Heavy Metals
(Project Code: PN17-24SC-03)
Project Leader: A. Bumajdad
Affiliation/Beneficiary: Kuwait University, Faculty of Science, Chemistry Department.
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Utilization of Local Waste Materials in High Performance and Self-Compacting Concrete  
(Project Code: PN18-15EV-01)  
Project Leader: S. Soleimani  
Affiliation/Beneficiary: Australian College of Kuwait, Civil Engineering Department.

Utilization of Dates Seeds as Waste Material in The Treatment of Wastewaters  
(Project Code: PN18-15EV-05)  
Project Leader: A. Alsulaili  
Affiliation/Beneficiary: Kuwait University, College of Engineering and Petroleum, Department of Civil Engineering.

Investigation of the Rheological and Adhesive/Cohesive Characteristics of Crumb Rubber Modified Asphalt Binders Mixed with Warm Mix Asphalt Additive and Antistripping Agent  
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Project Leader: T. Ahmed  
Affiliation/Beneficiary: Australian College of Kuwait, Civil Engineering Department

Assessment of Time Use in Daily Living and Quality of Life Among Government Employees in Kuwait  
(Project Code: PR17-11BS-01)  
Project Leader: F. Manee  
Affiliation/Beneficiary: Kuwait University, Faculty of Allied Health, Occupational Therapy Department

Language and Education in Kuwait: Attitudes, Identities and Ideologies  
(Project Code: PR17-11TP-01)  
Project Leader: M. Tryzna  
Affiliation/Beneficiary: Gulf University for Science and Technology, English Department.

Solar Photo Degradation of Endocrine Disrupting Compounds Existing in Wastewater in Kuwait (Phase-1)  
(Project Code: PR17-12SC-01)  
Project Leader: L. Al-Hajji  
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Energy and Building Research Center, Nanotechnology and Advanced Materials Program

Development of An Early Warning System for The Control and Prevention of Diseases in Kuwait  
(Project Code: PR17-12SL-05)  
Project Leader: A. Al-Hemoud  
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Crises Decision Support Program

Performance and Feed Quality Evaluation of Selected Forage Species in A Mixed Cropping Agroforestry System  
(Project Code: PR17-12SL-08)  
Project Leader: M. Anisul Islam  
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Desert Agriculture and Ecosystems Program

Improving Production and Water Use Efficiency of Forage Crops with Nuclear Techniques with Emphasis on Barley  
(Project Code: PR17-12SL-11)  
Project Leader: H. Al-Menaie  
Affiliation/Beneficiary: Kuwait Institute for Scientific Research in collaboration with International Atomic Energy Agency (IAEA), Austria

Improvement of Double Haploid Production in Tomato Via Anther and Microspore Culture  
(Project Code: PR17-12SL-17)  
Project Leader: A. Redha  
Affiliation/Beneficiary: Kuwait University, Faculty of Science, Department of Biological Sciences.
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(Project Code: PR17-14SC-02)
Project Leader: S. Al-Mousawi
Affiliation/Beneficiary: Kuwait University, Faculty of Science, Chemistry Department.

Impact of Hydroprocessing Catalyst Properties and Compositions on Asphaltene Deposition
(Project Code: PR17-14SC-05)
Project Leader: M. Singh
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Petroleum Research Center, Optimization of Petroleum Refinery Processes

(Project Code: PR17-14SC-07)
Project Leader: T. Al-Azemi
Affiliation/Beneficiary: Kuwait University, Faculty of Science, Chemistry Department.

Lie Algebras and the Hyperbolic Conservation Laws
(Project Code: PR17-16SM-03)
Project Leader: Y. Benhadid
Affiliation/Beneficiary: Public Authority for Applied Education and Training

Initiating the Impact Funding Ecosystem: Government Leading the Private Sector Towards Economic Sustainability
(Project Code: PR17-17IC-03)
Project Leader: S. Al-Abduljader
Affiliation/Beneficiary: Gulf University for Science and Technology, Economics & Finance Department

New Programming Models for Systematic Memory Isolation for Protecting Against Vulnerabilities in Large Rust Programs
(Project Code: PR17-18QS-01)
Project Leader: H. Almohri
Affiliation/Beneficiary: Kuwait University, College of Computing Sciences and Engineering, Computer Sciences Department.

Identifying Feedback Methods That Lead to Higher Learning Effectiveness When Learning Is Based on Computer Simulations
(Project Code: PR17-19TT-02)
Project Leader: M. Jaeger
Affiliation/Beneficiary: Australian College of Kuwait, Civil Engineering Department.

Chemical Safety of Children's Toys and Baby Products Sold in The State of Kuwait: A Preliminary Assessment
(Project Code: PR17-41BO-01)
Project Leader: B. Gevao
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Environmental Pollution and Climate Program

Benthic Foraminifera as Proxies for the Environmental Quality Assessment of the Kuwait Bay (Kuwait): Morphological and Environmental DNA Metabarcoding Approached
(Project Code: PR17-42SE-01)
Project Leader: E. Al-Enezi
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Environmental Pollution and Climate Program

Usage of Groundwater Isotopes to Reconstruct the Paleoclimate of Kuwait For Water Resources Management Strategies
(Project Code: PR17-44SE-01)
Project Leader: S. Chidambaram
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Water Research Center, Water Resources Development and Management Program
The Genotoxic Effects of Kuwait Crude Oil on Marine Fish
(Project Code: PR18-12SL-01)
Project Leader: Q. Karam
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Environmental Pollution and Climate Program

Vitamin D and Bone Mineral Density Among University Kuwaiti Future Mothers
(Project Code: PR18-13MM-01)
Project Leader: N. Al-Ayyadhi
Affiliation/Beneficiary: Ministry of Health

Brain Connectivity Patterns Based Emotional Impairment Analysis in Parkinson’s disease Patients Using Wireless EEG Signals and Deep Learning Methods
(Project Code: PR18-13MM-08)
Project Leader: M. Murugappan
Affiliation/Beneficiary: Kuwait College of Science and Technology, Electronics and Communication Engineering Department.

Establishment of National DRL for CT in Hybrid Imaging Studies “The First National NM CT (PET) Dose Audit for KW Population – 2018”
(Project Code: PR18-13MN-01)
Project Leader: M. Masoomi
Affiliation/Beneficiary: Ministry of Health

Early Intensive Behavior Intervention for Autism: An Outcome Study of Children in Kuwait
(Project Code: PR18-13MQ-02)
Project Leader: A. Al-Ali
Affiliation/Beneficiary: Applied Behavior Center Kuwait

Accommodations and Strategies of People with Dyslexia in Kuwait
(Project Code: PR18-13OP-01)
Project Leader: E. Al Hamdan
Affiliation/Beneficiary: Fawzec Educational Company

The Relationship Between Learning Difficulties and Psychological Disorders Among University Students in ACK
(Project Code: PR18-13OP-02)
Project Leader: J. Hajih
Affiliation/Beneficiary: Australian College of Kuwait, Student Support Center.

Evaluation of Adherence to Clinical Guidelines for Treating Patients with Chronic Cardiovascular Diseases in Kuwait
(Project Code: PR18-13PR-01)
Project Leader: D. Al-Taweel
Affiliation/Beneficiary: Kuwait University, Faculty of Pharmacy, Department of Pharmacy Practice.

Green Synthesis of Novel Biologically Relevant Tricyclic Systems of Pyridazinonaphthyridine Derivatives and Quinazolin Derivatives Utilizing High Pressure as Energy Source on Multicomponent Reactions
(Project Code: PR18-13SC-01)
Project Leader: S. Al-Mousawi
Affiliation/Beneficiary: Kuwait University, Faculty of Science, Chemistry Department.

Femtosecond Laser Induced Sub-Micron Structuring of Semiconductors, Glasses and Polymers
(Project Code: PR18-13SP-01)
Project Leader: S. Valappil
Affiliation/Beneficiary: Kuwait College of Science and Technology, Physics Department.

Use of Nanoparticles to Enhance Coolant Fluid Performance
(Project Code: PR18-14SC-01)
Project Leader: K. Khanafar
Affiliation/Beneficiary: Australian College of Kuwait, Mechanical Engineering Department.
Atmospheric Concentrations of $^{210}$Pb, $^{210}$Bi and $^{210}$Po in Kuwait
(Project Code: PR18-14SE-01)
Project Leader: M. Behbehani
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Environmental Pollution and Climate Program

Autonomous and Portable Measuring System for Rheological Properties of Newtonian and Non-Newtonian Fluids
(Project Code: PR18-14SP-01)
Project Leader: M. Sabati
Affiliation/Beneficiary: Australian College of Kuwait, Electrical Engineering Department.

Influence of Manganese Doping on the Physical Properties of Spray Deposited Zinc Oxide Thin Films
(Project Code: PR18-14SP-08)
Project Leader: A. Alsmadi
Affiliation/Beneficiary: Kuwait University, Faculty of Science, Department of Physics.

The Sief Palace Project by The Finnish Architect Reima Pietila Revisited After 30 Years
(Project Code: PR18-15EA-01)
Project Leader: T. Botz
Affiliation/Beneficiary: Gulf University for Science and Technology, Humanities & Social Sciences Department

Feasibility Study for the Economic and Reliability Enhancement of the Electric Power System Through Co-optimization of Energy and Water Desalination Resources
(Project Code: PR18-15EC-01)
Project Leader: Y. Al-Abdullah
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Energy and Building Research Center, Renewable Energy Program

Experimental Investigation of the Mechanical and Surface properties of Submicrometer Spherical Carbon Particles Used to Enhance Oil Tribological Performance
(Project Code: PR18-15EM-03)
Project Leader: A. Alazemi
Affiliation/Beneficiary: Kuwait University in collaboration with Kuwait Institute for Scientific Research

Wave Forces on Offshore Structures Calculated with Smooth Particle Hydrodynamics and Physical Modeling
(Project Code: PR18-15EV-05)
Project Leader: N. Almashan
Affiliation/Beneficiary: Kuwait University in collaboration with Kuwait Institute for Scientific Research and Northwestern University, USA

Effect of Raveling on the Performance of Hot Mix Asphalt Under Arid Climatic Conditions: Case Study in Kuwait: Phase I: Postmortem Evaluation of In-Service Pavements
(Project Code: PR18-15EV-06)
Project Leader: T. Ahmed
Affiliation/Beneficiary: Australian College of Kuwait, Civil Engineering Department.

Application of Annihilator Extension's Method to Classify Zinbiel Algebras
(Project Code: PR18-16SM-01)
Project Leader: A. Alenezi
Affiliation/Beneficiary: Public Authority for Applied Education and Training

On Properties of Certain Geometric Structures
(Project Code: PR18-16SM-02)
Project Leader: F. Alawam
Affiliation/Beneficiary: Public Authority for Applied Education and Training
Development of Real-Time Emotion Recognition System using only Facial Expressions Based on Machine Learning and Deep Neural Network Methods to Assist Physically Disabled People
(Project Code: PR18-18EE-01)
Project Leader: M. Murugappan
Affiliation/Beneficiary: Kuwait College of Science and Technology, Electronics and Communication Engineering Department.

Vision Based Activity Monitoring for Human Behavior Modelling
(Project Code: PR18-18QS-01)
Project Leader: E. Hassan
Affiliation/Beneficiary: Kuwait College of Science and Technology, Computer Science and Engineering Department

**Capacity Building Program**

**Completed Projects**

App-Delivered Therapy for Arabic Readers with Hemianopic Alexia
(Project Code: P114-63MC-02)
Project Leader: S. Al-Ragam
Affiliation/Beneficiary: University College London, UK

Assessment of the Effect of Artificial Sweeteners on Gut Microbiota and Glucose Metabolism
(Project Code: P115-63MM-01)
Project Leader: S. Ahmad
Affiliation/Beneficiary: University of Manitoba, Canada

Developing an Integrated Strategy for the Assessment of Hazardous Substances in Kuwait’s Marine Environment
(Project Code: P115-64SE-01)
Project Leader: H. Alsarawi
Affiliation/Beneficiary: Plymouth University, UK

Diagnosis of Low Speed Bearing Degradation Using Acoustic Emission Techniques
(Project Code: P116-65EE-01)
Project Leader: F. Alshimmeri
Affiliation/Beneficiary: Cranfield University, U.S.A.

Translational Cross-Validation of Molecular Imaging and Magnetic Resonance Imaging Methods to Study Gastrointestinal Function in Health and in Crohn's Disease
(Project Code: CB17-63NR-01)
Project Leader: Asseel Khalaf
Affiliation/Beneficiary: University of Nottingham, UK

**Ongoing Projects**

The National Accreditation Program in Kuwait: Its Development, Implementation and Impact on Quality Improvement in Public Hospitals
(Project Code: 2011-6302-01)
Project Leader: M. Alkhabbaz
Affiliation/Beneficiary: Liverpool School of Tropical Medicine, UK
Physical Medicine and Rehabilitation Awareness among Medical Students, Residents Physicians and Attending Physicians  
(Project Code: 2013-6302-01)  
Project Leader: H. Ali  
Affiliation/Beneficiary: University of Manitoba, Canada

Effects of a 12-week Cardiac Rehabilitation Programme for ST-Segment Elevation Myocardial Infarction Patients in Kuwait: A Quasi-Experimental Trial  
(Project Code: 2013-6302-02)  
Project Leader: F. Al-Ansari  
Affiliation/Beneficiary: Swansea University, USA

The Use of Alu Elements in Forensic Medicine: A Study on an Arab Population  
(Project Code: P114-63MC-01)  
Project Leader: S. Abumarzouq  
Affiliation/Beneficiary: Arabian Gulf University, Bahrain

Techno-Economical Evaluation of the Production of Bio Drugs: Study of Two Processes for the Manufacturing of Recombinant Human Biodrug Interferon-Alpha  
(Project Code: P114-63MM-01)  
Project Leader: D. Al-Otaibi  
Affiliation/Beneficiary: Arabian Gulf University, Bahrain

Expression and Role of miRNA in Thyroid Cancer  
(Project Code: P115-63MM-02)  
Project Leader: I. Jahanbani  
Affiliation/Beneficiary: Kuwait University, Faculty of Medicine, Department of Pathology

Methane Emission in Kuwait and their Isotopic Signature  
(Project Code: P115-64SC-01)  
Project Leader: A. Alshalan  
Affiliation/Beneficiary: Royal Holloway University of London, UK

The Effect of Rifampin on the Pharmacokinetics/ Pharmacodynamics and the Safety of Metformin and its Anti-Hyperglycemic Effect in Diabetic Patients Infected with TB  
(Project Code: P116-63MR-01)  
Project Leader: O. Alfarisi  
Affiliation/Beneficiary: Johns Hopkins University, U.S.A.

Inequalities in Cancer Survival in Kuwait  
(Project Code: P116-63NH-01)  
Project Leader: E. Al-Awadhi  
Affiliation/Beneficiary: London School of Hygiene and Tropical Medicine (LSHTM), UK

Characterization of Thin Film Solar Cells Using Deep Level Transient Spectroscopy and Related Techniques  
(Project Code: P116-65EE-02)  
Project Leader: K. Alajmi  
Affiliation/Beneficiary: The University of Utah, U.S.A.

Reform and Renewal in Contemporary Islamic Thought and Praxis in The Arabian Peninsula  
(Project Code: CB17-61OS-01)  
Project Leader: B. Saif  
Affiliation/Beneficiary: Georgetown University

Role of Mitochondrial Dysfunction in The Development of Hyperinsulinemia  
(Project Code: CB17-63MM-01)  
Project Leader: N. Alsabeeh  
Affiliation/Beneficiary: Boston Medical Center
Immune Response to Major Antigenic Proteins of Mycobacterium Tuberculosis Specific Regions and Their Role in Immunomodulation of Asthma in Mice
(Project Code: CB17-63MM-03)
Project Leader: H. Safar
Affiliation/Beneficiary: Kuwait University

Environmentalism and Environmental Citizenship in Kuwait: Perspectives from the Environmental Public Authority
(Project Code: CB17-64SE-01)
Project Leader: R. Alawadhi
Affiliation/Beneficiary: State University of New York, USA

New Projects

The Relationship of Feeding Styles, Feeding Practices and Child Weight Status in The Context of Living with Extended Family Among Kuwaiti Mothers
(Project Code: CB18-61MC-01)
Project Leader: N. Alawadhi
Affiliation/Beneficiary: Columbia University, USA

Ecology and Systematics of Commensal Pea Crabs (Crustacea, Arthropoda) and their Sand Dollar Hosts (Echinoids, Echinodermata) in the Eastern Gulf of Mexico
(Project Code: CB18-62SL-01)
Project Leader: F. Jamal
Affiliation/Beneficiary: University of Florida, USA

Facial Mucosal Level Determinants for Single Implants Evaluated by Novel Ultrasonography
(Project Code: CB18-63DD-01)
Project Leader: A. Bushahri
Affiliation/Beneficiary: The University of Michigan, USA

The Cost of Coronary Artery Disease in Kuwait: The Case of the Afia Insurance Program
(Project Code: CB18-63MM-01)
Project Leader: S. Al Sarhan
Affiliation/Beneficiary: University of Texas, USA

The Effect of Progesterone on Placental Nutrient Transporters in Dexamethasone-Induced Intrauterine Growth Restriction
(Project Code: CB18-63MO-01)
Project Leader: M. Alawadi
Affiliation/Beneficiary: Kuwait University

Transferring Robotic Surgical Skills from the Simulator to the Operating Room: A Randomized Controlled Study Assessing Transferability of Robotic Technical Skills in Residents Performing Robotic Radical Prostatectomies
(Project Code: CB18-63MS-01)
Project Leader: A. Al-Marzouq
Affiliation/Beneficiary: McGill University, Canada

Transcriptomic Responses to Iron Bioavailability from Virus-Mediated Lysates in Marine Prokaryotes
(Project Code: CB18-64SE-01)
Project Leader: A. Al-Qattan
Affiliation/Beneficiary: University of British Columbia, Canada

Spatial Print Trajectories
(Project Code: CB18-65EA-01)
Project Leader: S. Al-Othman
Affiliation/Beneficiary: Harvard University, USA
Photo-electrochemical Etching of Wideband Gap Materials for Sensing and Energy Applications for Harsh Environments  
(Project Code: CB18-65EC-01)  
Project Leader: B. Alhalaili  
Affiliation/Beneficiary: University of California, Davis, USA

Imaging of Temperature Variations in the Near-Wall Region of an Optical Reciprocating Engine Using Laser-Induced Fluorescence  
(Project Code: CB18-65EM-01)  
Project Leader: M. Alzuabi  
Affiliation/Beneficiary: University of Michigan, USA

Physics-Based Damage Modeling of Composites for Extreme Heat Environments  
(Project Code: CB18-65EM-02)  
Project Leader: M. Alabdullah  
Affiliation/Beneficiary: University of California Los Angeles, USA

Flagship Program

Completed Projects

Energy Efficiency and Photovoltaic Systems Pilot Applications for Selected Cooperative Society Supermarkets  
(Project Code: 2012-5508-02)  
Project Leader: A. Al-Qattan  
Affiliation/Beneficiary: Kuwait Institute for Scientific Research in collaboration with National Technology Enterprises Company (NTEC) and Ministry of Electricity and Water

Building Integrated Solar PV for Kuwaiti Homes  
(Project Code: 2013-5508-02)  
Project Leader: Ayman Al-Qattan  

Grant Agreement between KFAS and The Oxford Institute for Energy Studies (2017/2018)  
(Project Code: PN17-75IC-01)  
Project Leader: B. Fattouh  
Affiliation/Beneficiary: Oxford Institute for Energy Studies

Ongoing Projects

Smart Integrated Energy Building "SIEB" System  
(Project Code: PP17-35EM-01)  
Project Leader: F. Alghimlas  
Affiliation/Beneficiary: Kuwait Institute for Scientific Research in collaboration with Baiti Synergy Corporation

New Projects

Development of Effective Visualization of Solar Farm Performance Data  
(Project Code: AP18-35EM-02)  
Project Leader: M. Khajah  
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Science and Technology Sector, Systems and Software Development Department.

Biodegradable Kyphoplasty Balloon System Design and First in Man Study  
(Project Code: PN18-13MM-01)  
Project Leader: A. Alobaid  
Affiliation/Beneficiary: Sabah Al-Ahmad Center for Giftedness and Creativity (SACGC) and GTIMD Catheter Solutions, USA
Assessment of the Performance of the Electric Vehicle Under Extreme Climate Conditions and Development of a Framework for Kuwait City to be “EV-Ready”  
(Project Code: PP18-35EM-01)  
Project Leader: H. Hamwi  

Collaborative Research Unit

Ongoing Projects

New Generation Brine Desalination and Management for Efficiency, Reliability and Sustainability  
(Project Code: P314-75EC-01)  
Project Leader: Bader Al Anzi and J Han  
Affiliation/Beneficiary: Massachusetts Institute of Technology and Kuwait University

The Underworlds Project: A Smart Sewage Infrastructure for Kuwait  
(Project Code: P315-75EV-01)  
Affiliation/Beneficiary: Massachusetts Institute of Technology, Kuwait Institute for Scientific Research and Kuwait University

New Projects

Ground Motion Modeling and Structural Monitoring of Tall Buildings  
(Project Code: PN18-15EO-01)  
Project Leader: J. Al-Qazweeni  
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Energy & Building Research Center, Sustainability and Reliability of Infrastructure Program

Plunging Liquid Jet Reactors for Dilution and Aeration of Brine Discharged from Seawater Desalination Plants  
(Project Code: PN18-15EV-07)  
Project Leader: Bader S. Al-Anzi  
Affiliation/Beneficiary: Kuwait University in collaboration with Massachusetts Institute of Technology, USA