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POSTERS

Food Waste Valorization for Sustainable Hydrogen Production in Kuwait

[1]Tuhl, A*., [2]Makhseed, S., [3]Al-Shawaf, M., [4]Aleissa, E., [1]Al-Salem, S.,

1. Environment and Life Sciences Research Centre, Kuwait Institute for Scientific Research, Box: 24885, 13109 Safat, Kuwait.
2. Chemistry Department, College of Science, Kuwait University, P.O. Box 5969, 13060 Safat, Kuwait
3. Department of Environmental Sciences, College of Life Sciences, Kuwait University, P. O. Box 5969, 13060 Safat, Kuwait
4. Industrial and Management Systems Engineering Department, College of Engineering and Petroleum, Kuwait University, P. O. Box 5969, 13060 Safat, Kuwait

*Email: atuhl@kisr.edu.kw

Abstract: Kuwait, a nation with one of the highest waste generation rates globally, is currently grappling with the pressing issue of food waste (FW) management and its associated environmental impact. This study explores the potential of FW valorization as a sustainable feedstock for biohydrogen (H_2) production, employing anaerobic digestion (AD) through dark fermentation, photo-fermentation processes, or a combination of both. A key feature of this research is the use of Metallophthalocyanine (MPc) complexes as crucial catalytic media, which significantly enhance reaction efficiency and hydrogen yield. Alternatively, the integration of microalgae and seaweed could be investigated to promote the biohydrogen pathway by improving biomass conversion and sustainability. Additionally, the solid residuals from FW treatment are repurposed into a nutrient-rich compost fertilizer, providing essential nutrients such as nitrogen (N), phosphorus (P), and potassium (K) to enhance soil health and agricultural productivity. Moreover, a life cycle analysis of hydrogen recovery (LCA) from FW will be conducted to identify the most effective method, offering the highest yield and energy recovery potential. This research underscores the transformative potential of waste valorization in mitigating greenhouse gas emissions, promoting circular economy principles, and supporting Kuwait’s transition toward a hydrogen-based energy sector, potentially revolutionizing the country's energy landscape.

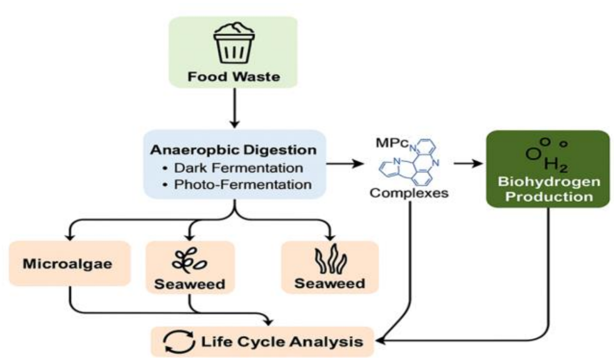

Fig. 1. Schematic Diagram Food Waste Valorization for Hydrogen Production

FTIR Analysis of Temperature-Dependent Degradation in Thermoplastic Starch (TPS) and Linear Low-Density Polyethylene (LLDPE) Films

Mohamed Kishk*, Hajar Karam, Kawther Al-Muhanna, Rita Rahmeh, Fahad Asiri, Ahmad Ben Hejji, Anish Shajan and Sultan Majed Al-Salem

Environment & Life Sciences Research Center, Kuwait Institute for Scientific Research, PO Box 24885 Safat, 13109, Kuwait

*Corresponding author: mwaheed@kisr.edu.kw

Abstract

Plastic residues persist in terrestrial environments where degradation proceeds slowly, leading to long-term accumulation. To evaluate their chemical transformation under environmentally relevant conditions, thermoplastic starch (TPS) and linear low-density polyethylene (LLDPE) films were incubated in a compost–soil matrix for 180 days at mesophilic (25 °C) and elevated mesophilic (37 °C) temperatures representative of Kuwait's arid soil conditions. Attenuated Total Reflectance Fourier-Transform Infrared (ATR-FTIR) spectroscopy was employed to monitor structural modifications and functional-group evolution during degradation, and to identify the mechanisms driving polymer transformation.

TPS spectra exhibited marked alteration following incubation. Broad O–H stretching (3200–3400 cm^{-1}) and intensified C=O absorption (~1700 cm^{-1}) indicated hydrolytic and oxidative cleavage, resulting in hydroxyl- and carboxyl-group formation. Variations within the 1000–1300 cm^{-1} fingerprint region confirmed backbone scission, with stronger effects at 37 °C reflecting temperature-accelerated oxidation. These structural changes correspond to higher CO_2 evolution measured for TPS under the same incubation conditions.

In contrast, LLDPE spectra remained unchanged. Characteristic C–H stretching (2916, 2848 cm^{-1}) and CH_2 bending/rocking (1465, 720 cm^{-1}) persisted without new absorptions, demonstrating high chemical stability and resistance to both abiotic and microbial degradation.

Overall, these results establish a systematic ATR-FTIR-based approach to resolve bond-level transformations linked to early polymer mineralization and to distinguish biodegradable formulations from persistent polyolefins in complex soil–compost substrate.

Keywords: ATR-FTIR spectroscopy; thermoplastic starch (TPS); linear low-density polyethylene (LLDPE); polymer mineralization; compost–soil matrix.

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The Effect of Antifouling Paints on the Microbial Community of the Sponge *Halichondria panicea*

[1]Al-Haddad[*], S.H., [2]Caldwell, G.S., and [3]Clare, A.S.
[1]Kuwait Institute for Scientific Research (KISR), Kuwait
[2,3] Newcastle University, UK
*shhaddad@kisr.edu.kw

Antifouling paints are widely used to prevent biofouling on submerged surfaces; however, their ecological effects on non-target marine organisms such as sponges remain poorly understood. This study examined how biocidal (Trilux 33) and non-biocidal (Ecopower Cruise) antifouling paints influence the microbial community of the model sponge *Halichondria panicea*. Following preliminary trials, sponge specimens were cultivated in 2-liter artificial seawater tanks with daily water renewal, exposed to 10 cm² painted glass plates. Water analysis revealed low but detectable copper and zinc levels (Cu median: 0.5 and 0.21 ppb; Zn median: 3.75 and 0.84 ppb for biocidal and non-biocidal paints, respectively). Copper concentrations in biocidal paint peaked on day 15, consistent with known leaching dynamics (Lagerström *et al*., 2018), while non-biocidal paint showed peak metal release on day 1, likely from the primer undercoat (Lagerström *et al*., 2020). Microbial profiling revealed treatment-specific changes. The biocidal paint reduced microbial diversity and shifted community structure, increasing disease-associated phyla including Spirochaetota, Firmicutes, Desulfobacterota, Campylobacterota, and Bacteroidota (De Castro-Fernandez *et al*., 2023; Gavriilidou *et al*., 2023), with *Endozoicomonas* dominating at 43.3% relative abundance (De Castro-Fernandez *et al*., 2023). The non-biocidal paint exhibited milder impacts. These findings suggest that *H. panicea* exhibits short-term resilience to low-level antifouling paint exposure; however, microbial community shifts raise concerns about potential long-term effects on sponge health and ecosystem stability.

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Environmental Candida species: Phenotypic Profiles and Antifungal Susceptibility

Haya Alsammar[1] and Toni Gaboldon[2]
1Department of Biological Sciences, Faculty of Science, Kuwait University
2 Mechanisms of Disease Program, Institute for Research in Biomedicine (IRB), Barcelona Institute of Science and Technology, Barcelona, Spain
*Correspondence: haya.alsammar@ku.edu.kw

Abstract

Candida species are commonly known as commensals in humans and animals; however, several species can cause invasive infections, particularly in immunocompromised individuals. Increasing reports of Candida species from natural environments, including marine environments, raise concerns about their potential role as reservoirs of opportunistic pathogens. Therefore, understanding the phenotypic diversity and antifungal susceptibility of these environmental isolates is essential to explain their adaptive capacity and possible involvement in clinical settings. In this study, environmental Candida isolates from Kuwait's coastal seawater and mangroves were compared to clinical strains for phenotypic traits and antifungal susceptibility. Growth was assessed using Quantitative Phenotyping and Antimicrobial Susceptibility Testing (QPHAST) at 30–40 °C and under stressors including NaCl, H_2O_2, DTT, pH, SDS, and calcofluor white. Antifungal susceptibility to fluconazole and anidulafungin was determined following EUCAST broth microdilution guidelines. Most Candida species showed optimal growth at 35 °C, while several C. glabrata isolates tolerated 40 °C, indicating thermotolerance. Tolerance to salinity levels higher than seawater was observed across most isolates. However, acidic pH, cell wall, and oxidative stress notably affected the growth of C. orthopsilosis and C. parapsilosis. C. glabrata strains exhibited marked phenotypic diversity in response to both temperature and stress conditions. Principal Component Analysis (PCA) revealed clear phenotypic separation of C. glabrata strains from the other tested Candida species based on temperature tolerance and stress response, whereas NaCl tolerance showed low variation among C. glabrata, C. parapsilosis, and C. orthopsilosis. Antifungal susceptibility testing revealed that some environmental C. glabrata isolates had MIC_{50} values exceeding the clinical resistance breakpoint for anidulafungin, while C. parapsilosis and C. orthopsilosis showed variable susceptibility patterns. These findings highlight the ecological adaptability of environmental Candida species and underscore their potential role in the emergence of antifungal resistance.

Starve to sustain—An ancient Syrian landrace of sorghum as a tool for phosphorous bio-economy?

Adnan Kanbar[1,2], Madeleine Mirzai[1], Eman Abuslima[1,6], Noemi Flubacher[1], Rose Eghbalian[1], Krassimir Garbev[3], Britta Bergfeldt[3], Angela Ullrich[3], Hans Leibold[3], Elisabeth Eiche[4], Mario Müller[5], Markus Mokry[5], Dieter Stapf[3] and Peter Nick[1]

[1] Molecular Cell Biology, Botanical Institute, Karlsruhe Institute of Technology, 76131 Karlsruhe, Germany
[2] National Unit for Environmental Research and Services, Kuwait University, Kuwait
[3] Institute for Technical Chemistry, Karlsruhe Institute of Technology, 76344 Eggenstein-Leopoldshafen, Germany
[4] Institute of Applied Geosciences, Karlsruhe Institute of Technology, 76131 Karlsruhe, Germany
[5] Agricultural Technology Center (LTZ Augustenberg), 76227 Karlsruhe, Germany
[6] Department of Botany, Faculty of Science, Suez Canal University, Ismailia 41522, Egypt
kanbaradnan@gmail.com

Abstract

Phosphorus (P) is an essential macronutrient, playing a role in developmental and metabolic processes in plants. To understand the local and systemic responses of sorghum to inorganic phosphorus (P_i) starvation and the potential of straw and ash for reutilisation in agriculture, we compared two grain (Razinieh) and sweet (Della) sorghum varieties with respect to their morpho-physiological and molecular responses. We found that P_i starvation increased the elongation of primary roots, the formation of lateral roots, and the accumulation of anthocyanin. In Razinieh, lateral roots were promoted to a higher extent, correlated with a higher expression of *SbPht1* phosphate transporters. Infrared spectra of straw from mature plants raised to maturity showed two prominent bands at 1371 and 2337 cm^{-1}, which could be assigned to P-H(H_2) stretching vibration in phosphine acid and phosphinothious acid, and their derivates, whose abundance correlated with phosphate uptake of the source plant and genotype (with a higher intensity in Razinieh). The ash generated from these straws stimulated the shoot elongation and root development of the rice seedlings, especially for the material derived from Razinieh raised under P_i starvation. In conclusion, sorghum growing on marginal lands has potential as a bio-economy alternative for mineral phosphorus recycling.

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Sweet versus grain sorghum: Differential sugar transport and accumulation are linked with vascular bundle architecture

Adnan Kanbar[1,2], Ehsan Shaker[1], Dema Alhajturki[3], Michael Riemann[1], Mirko Bunzel[4], Marco Tomasi Morgano[5], Dieter Stapf[5], Peter Nick[1]

[1] Molecular Cell Biology, Botanical Institute, Karlsruhe Institute of Technology, Germany
[2] National Unit for Environmental Research and Services, Kuwait University, Kuwait
[3] Max Planck Institute of Molecular Plant Physiology, Potsdam, Germany
[4] Institute of Applied Biosciences, Karlsruhe Institute of Technology, Germany
[5] Institute of Technical Chemistry, Karlsruhe Institute of Technology, Germany
kanbaradnan@gmail.com

Abstract

Sorghum (*Sorghum bicolor* L. Moench) is globally produced as a source of food, fiber, feed, and fuel. Sweet and grain sorghums differ in a number of important traits, including biomass production, stem sugar and juice accumulation. In this study, a sweet (KIT1) and a grain (Razinieh) genotype of sorghum were used to investigate major differences between sweet and grain sorghum in terms of stem-sugar accumulation. Differences in stem component traits such as internodes, stem anatomy, but also transcripts of key sucrose transporter genes and their response to salt stress were compared. While internodal traits were similar, differences on anatomical level were observed in internodes. Sugar accumulation was highest in the central internodes in both genotypes. However, phloem to xylem cross areas in internodes was correlated with the amount of sugar stored in stem. Sugar accumulation increased significantly under salinity in both genotypes. The expression of sugar-transporter genes *SbSUT1*, *SbSUT2*, and *SbSUT6* was higher in the leaves of KIT1 under normal conditions, but significantly increased in the stem of KIT1 under salinity stress. Nevertheless, transcriptional levels of *SbSUT* genes could not account for the big difference of sugar accumulation in stems between both genotypes. Thus, in addition to anatomical differences, additional (molecular) factors might regulate sugar accumulation in the stem.

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Diversity and Antimicrobial Activity of Yeast Communities from Mangrove Ecosystems in Kuwait

[1]Nouf AlMutairi, [1]Haya AlSammar, [1]Sheikha ALZarban
[1] Department of Biological Sciences, Faculty of Science, Kuwait University
*Correspondence: noof.almutairi@grad.ku.edu.kw

Abstract

Mangrove ecosystems are areas inhabited by facultative halophytic trees ,mainly found in the intertidal zone of coastal regions [1]. They contribute to the food web cycle and serve as feeding and breeding areas for organisms [2]. The diversity of microorganisms in these ecosystems has been extensively studied, however, yeasts were commonly overlooked [3].

This study investigated the abundance and diversity of yeasts in Kuwait's mangroves by sampling fresh leaves, dry leaves and soil surrounding Avicennia marina trees from three mangrove sites during winter and summer. Surface sterilized (FL/SS) and non-surface sterilized (FL/WOS) fresh leaves, dry leaves (DL), and soil were plated on Sabouraud Dextrose agar and Yeast Malt Peptone Glucose agar prepared with sea water and incubated at 20°C and 30°C. A total of 9535 yeasts and yeast-like fungi were recovered, of which 165 isolates were identified by sequencing the D1/D2 domain of 26S rDNA or the ITS region (ITS1-5.8s-ITS2). DL harbored the highest yeast counts, while FL/SS had the lowest number. The most frequently isolated genera were Aureobasidium spp., followed by Naganishia spp. and Candida spp..

Antimicrobial activity of yeast isolates was evaluated against the pathogenic bacteria Escherichia coli ATCC 25922, Bacillus cereus ATCC 14579, Salmonella typhimurium ATCC 7823 and Staphylococcus aureus ATCC 25923 using the spot test method. 71% of the isolated yeasts possessed antimicrobial activity against B. cereus, however, none of the isolates exhibited such activity against E. coli. Findings of this study suggests that yeasts are relatively abundant and diverse in Kuwait's mangrove ecosystems with potential antimicrobial activity.

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Preliminary Characterization of Endophytic Bacteria Associated with *Avicennia marina* in Kuwait's Mangroves

Dana Khalid, [1]Sheikha Alzarban and [1]Haya Alsammar
1Department of Biological Sciences, Faculty of Science, Kuwait University
*Correspondence: d.salem@ku.edu.kw

Endophytes are microorganisms, most commonly bacteria and fungi, which inhabit internal plant tissue during part of their life cycle without showing visible symptoms of infection. These microbes have been shown to promote plant growth, act as biocontrol agents, and produce bioactive metabolites such as extracellular enzymes and other compounds with medicinal, industrial, or agricultural applications. While endophytes in general are well documented, research on endophytic bacteria in mangroves, especially in Kuwait, remains underreported. In this study, endophytic bacteria were isolated from a mangrove tree (*Avicennia marina*) in Kuwait and characterized through screening for enzymatic and antimicrobial activity. A total of 25 endophytic bacteria were isolated from mangrove leaves. Nine representative isolates were identified molecularly by 16S rDNA sequencing, with the majority belonging to the genus *Bacillus*. The enzymatic profiles of these isolates were assessed using qualitative assays. Four out of the nine isolates tested positive for amylase, cellulase, and caseinase activity, while all nine exhibited gelatinase and catalase activity. Antimicrobial activity of the isolated species was tested against *Bacillus cereus* (ATCC 14579), *Escherichia coli* (ATCC 25922), *Salmonella typhimurium* (ATCC 7823), and *Staphylococcus aureus* (ATCC 25923) following agar diffusion method. Only two isolates inhibited the growth of *Bacillus cereus* (ATCC 14579), suggesting limited antimicrobial potential among the tested endophytes. The current study presents the first characterization of endophytes associated with *A. marina* in Kuwait, revealing their enzymatic potential. Profiling endophyte-produced compounds serves as the first step towards understanding their ecological roles in mangrove ecosystems and may contribute to supporting the health of and resilience mangroves in Kuwait, a threatened coastal habitat.

Significance of nano transition metal complexes as anticancer and antibacterial therapeutic agents.

Abdulaziz Alshehab, Dr. Laila Jaragh-Alhadad*

***Department of Chemistry, Faculty of Science, Kuwait University, Kuwait, 13060.**

Laila.alhadad@ku.edu.kw

Abstract

Since ancient times, metal complexes have been used in medicine for several purposes. They are known to have beneficial effects and are widely used as anti-inflammatory, anti-infective, antibacterial, antidiabetic, neurological, delivery, and diagnostic agents. Consequently, Co, Zn, and Cu metals synthesized with thiosemicarbazone ligand as complexes, and fully characterized by mass spectroscopy, proton and carbon NMR, FTIR, TGA, DSC, SEM, and DLS. The data reveled that the metal complexes in the nano range size. Also, the complexes were subsequently evaluated using the MDA-AMB-453 human breast cancer cell line as a surrogate model, the data revealed that the Cu-ligand complex exhibited the highest anticancer activity, followed by Zn and then the Co complexes. Molecular geometry of the metal complexes confirmed by the DFT theoretical calculations and were aligned with the biological evaluation and endorsed it. Moreover, the Co, Zn, and Cu complexes were evaluated for their biological activities against both gram-positive and gram-negative bacteria, and the results indicated that Cu>Zn>Co complex and exhibited a significant inhibitory effect on the growth of both types of bacteria. In conclusion, the copper complex demonstrated strong anticancer and antibacterial properties and could be utilized for future treatments.

Hydrodynamic Modelling for Umm Al-Namil Island, Kuwait Bay, Kuwait

Al-Mutairi, M., *Ali, M. and Alosairi, Y.

Environment and Life Science Center, Kuwait Institute for Scientific Research, Kuwait City, Kuwait

*Corresponding author: mohalikisr@gmail.com/Mohali@kisr.edu.kw

Abstract

This study presents a comprehensive hydrodynamic modeling analysis of Umm Al Namil Island using the Environmental Fluid Dynamics Code (EFDC), a three-dimensional modeling tool developed for coastal and estuarine applications. The research aimed to simulate water flow, sediment transport, and bed shear stress to understand the dynamic physical environment surrounding the island. Two computational domains, a coarse grid for Kuwait Bay and a fine grid for Umm Al Namil, were developed based on bathymetry, tidal levels, wind, and outflow data. Simulations showed that tidal currents are stronger during ebb tide, with flow directions shifting between northeast and southwest. Wave and current-induced bed shear stress were evaluated, revealing higher values on the island's northern side, suggesting significant sediment transport activity. The peak total bed shear stress reached 8.58 N/m^2, sufficient to mobilize sediment particles ranging from very fine gravel to medium gravel. These findings contribute valuable insights into sediment dynamics and coastal morphology, aiding in the development of sustainable coastal management strategies in Kuwait Bay.

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Phytoplankton Response to Eutrophication in the Industrialized Coastal Waters of the Gulf of Gabès (Mediterranean Sea, Tunisia)

[1]Qusaie, K., [1*]Ali, M., and [2]Annabi-Trabelsi, N.

[1] Environment and Life Science Center, Kuwait Institute for Scientific Research, Kuwait City, Kuwait

[2] Laboratoire Biodiversité Marine et Environnement (LR18ES30), Université de Sfax, Tunisia

*Corresponding author: mohalikisr@gmail.com/Mohali@kisr.edu.kw

Abstract

Phytoplankton assemblages were assessed along the eutrophication gradient of the industrialized coast of the Gulf of Gabès (Mediterranean Sea, Tunisia), a region heavily impacted by decades of agrochemical discharge and rapid urban development. During spring, fifteen coastal stations were surveyed, revealing consistently elevated nutrient concentrations and a pronounced eutrophication gradient extending from Zarrat to Gannouche. A total of 42 phytoplankton taxa were recorded, with diatoms (Bacillariophyta) overwhelmingly dominant, comprising 67.7% to 89.2% of total phytoplankton abundance. Key species such as *Chaetoceros costatus*, *Euglena acusformis*, and *Thalassiosira* sp. exhibited strong positive correlations with the Eutrophication Index, indicating their opportunistic growth under nutrient-enriched conditions. Despite high eutrophication levels, the Shannon–Weaver diversity index for phytoplankton remained relatively high, suggesting that these coastal waters, although nutrient-rich, still support diverse and resilient phytoplankton communities. These results underscore the adaptive capacity of certain taxa to anthropogenic stressors and their potential use as bioindicators of eutrophication in Mediterranean coastal ecosystems.

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Innovative Urban Agriculture Using Leucophyllum and Jojoba Plants and Their Chemical Extracts for Soil Quality Improvement within Kuwait Vision 2035 Framework

Ghezayel Alotaibi

Independent Researcher with a Background in Chemistry and Education, Kuwait

Email: GhezCreate@outlook.com

This study investigates the effects of biochar and coconut powder on soil quality and the economic viability of growing Leucophyllum and Jojoba plants in urban areas. Over ten days, different irrigation methods were applied according to plant and soil needs. Results showed better moisture retention and soil aeration in treated soils, improving plant health and air quality. The research proposes a sustainable urban agriculture model combining plant collection and chemical extraction, offering environmental and economic benefits in line with Kuwait Vision 2035. The chemical properties of jojoba oil [1] and biochar's impact on soil [2] underpin the system's theoretical basis.

Fig. 1. Urban plant collection system integrating schools, homes, towers, and institutions into a centralized truck-based model aligned with Kuwait 2035 vision.

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Assessing the Ecological Impacts of Green Analytical Techniques: A Comparison of Chemical Toxicity, Waste Production, and Energy Use: A Review

Dr. Mahasen Al-Qallaf
Kuwait Institute for Scientific Research (KISR) Environmental and Life Science Research Center (ELSRC) mqallaf@kisr.edu.kw

Abstract The growing demand for sustainable laboratory practices has accelerated the development of green analytical techniques (GATs). Through a particular focus on three sustainability indicators, energy consumption, waste generation, and chemical toxicity, this narrative review examines and compares the ecological effects of GATs and traditional analytical techniques. The study summarizes findings from over 30 recent peer-reviewed sources that demonstrate the significant environmental benefits of using green solvents, solventless extractions, and miniaturized systems. GATs exhibit lower energy requirements, reduced production of hazardous waste, and decreased use of toxic solvents compared to conventional methods such as gas chromatography (GC) and high-performance liquid chromatography (HPLC). In addition, standardized frameworks for assessing environmental performance are currently accessible through the utilization of greenness assessment tools, such as the Analytical Eco-Scale, Analytical Method Volume Intensity (AMVI), and Green Analytical Procedure Index (GAPI). The review concludes that GATs offer practical alternatives without compromising analytical quality, while also aligning with global sustainability goals. These results underscore the importance of GATs in mitigating the environmental impact of analytical labs. Keywords: GAPI, Green Analytical Technologies(GAT), Sustainability, Waste Reduction, Energy Efficiency, AMVI, Chemical Toxicity, Eco-Scale, Environmental Impact

Smartphone-Based Image Processing Low-Cost Detection of Petroleum Contamination in Soil

Kutay Icoz
Abdullah Al Salem University, Kuwait
kutay.icoz@aasu.edu.kw

Abstract

Petroleum contamination in soil poses serious environmental and health risks, particularly in oil-rich regions. Traditional detection methods rely on expensive spectroscopic or chromatographic equipment, limiting accessibility for in-field use. While techniques like near-infrared (NIR) spectroscopy and hyperspectral imaging have demonstrated accuracy, they require specialized instruments and controlled settings (Bingari et al., 2023), (Correa Pabón et al., 2019).

This study explores a low-cost, portable alternative using standard smartphone cameras and image processing techniques to detect visible signs of petroleum contamination in soil. Smartphone cameras, increasingly employed as signal readout mechanisms in various sensing platforms, were utilized here to capture visible cues of petroleum contamination (İçöz, 2016b, 2016a). A limited dataset of images—captured under uniform lighting from clean and artificially contaminated sand samples—was analyzed. Color features (mean and standard deviation from HSV and LAB spaces) and texture features (contrast, homogeneity, energy from GLCM) were extracted from center-cropped regions of each image.

A Random Forest classifier trained on these features achieved a cross-validated accuracy of 87%, with lightness (LAB) and GLCM contrast emerging as the most important discriminative features. Contaminated samples consistently showed darker tones, reduced color variance, and smoother textures.

This approach offers a promising proof-of-concept for rapid, non-destructive, and accessible screening of petroleum-contaminated soils. Ongoing work includes expanding the dataset and validating the method with real-world samples from diverse soil types across Kuwait (Falih et al., 2024).

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Ion Fluxes in Heavy Metal-Stressed Eisenia foetida Using Fick's First Law of Diffusion

1Al-Mansour, N.M. 1
Kuwait University, Stress Ecophysiology Laboratory, State of Kuwait
naeamah.almansour@ku.ed.kw

Soil macrofauna, particularly earthworms, are key indicators of ecosystem sustainability due to their role in bioremediating contaminated soils [1]. Among these, Eisenia fetida (Annelida, Oligochaeta) is widely recognized for its ability to tolerate and process toxic persistent metals and hydrocarbons [2]. This study aimed to assess the metal tolerance of E. fetida by examining ion fluxes across tissue interfaces, providing insights into its physiological resilience. We applied Fick's First Law of Diffusion to determine ion fluxes (J) within the segmented body tissues of E. fetida [3]. Earthworms were raised in $CdCl_2$ and $ZnCl_2$ spiked soils and used 14 days after metal stress (AMS) for laboratory studies. The elemental composition of tissues was quantified using an energy-dispersive X-ray (EDX) detector attached to a scanning electron microscope (SEM) at the NanoScope Centre, KU. Data indicated the efficiency of E. fetida in ion uptake (Fig.1) with noticeable changes in external tissue roughness showing numerous sensory cells (Fig.2). Potassium (JK) and magnesium (JMg) 14-day AMS levels in E. foetida exposed to 1.5 mg/kg Zn-spiked soils were measured at 214.8 and 37.02 mol/m^3, respectively. These levels significantly decreased to 161.0 and 28.79 mol/m^3, respectively, in earthworm populations exposed to 2 mg/kg $ZnCl_2$. There were no significant differences in the percentage of nitrogen (% Wt. N) in E. foetida populations under moderate and high Zn stress. The maintenance of tissue total carbon (C), nitrogen (N), calcium (Ca), and phosphorus (P) under stress appears to positively impact physiological functions, including nutrient absorption, fluid balance, and electrical signalling.

Land use/Land cover change assessment and relating to environmental impacts degradation land around Sabah Al-Ahmed city, South of Kuwait

Ahmed M. Helmy[1], and Sana A. Al-Saleh[1]
[1] National Unit for Environmental Research and Services (NUERS), Research Sector, Kuwait University, Kuwait.
Email-Corresponding author: ahmed.abdelrahman@ku.edu.kw

Land Use/Land Cover (LULC) change is a critical driver of environmental degradation, particularly in arid regions where ecosystems are fragile and vulnerable. This study provides a comprehensive assessment of the spatiotemporal dynamics of LULC and its profound impact on land degradation in the area surrounding Sabah Al-Ahmad City, a new urban development in the environmentally sensitive southern region of Kuwait. The present work utilizes image processing, Remote sensing and GIS techniques to determine most of the causes that result in intensive land degradations and recommends appropriate remedial measures. Using a multi-temporal approach, we analyzed cloud-free satellite imagery (e.g., Landsat ETM, OLI and Landsat 9) from 2005 (pre-development), 2015 (during construction), and 2025 (post-establishment) to classify LULC categories and quantify changes over a 20-year period. Some indices carried out to separate different classes like NDVI (vegetation), NDBI (built-up), NDSI (salinization land) and NDWI (water log) to enhance change analysis. The analysis revealed a drastic transformation of the natural landscape. The period saw a significant expansion of urban and built-up areas, directly correlated with a substantial decline in barren land and desert vegetation. Key findings indicate a severe land degradation such as water-logged, salt-affected soils, coastal erosion and sand dunes encroachment. The study quantitatively links the rapid urban sprawl to these adverse environmental outcomes, demonstrating that the replacement of stable desert surfaces with impervious surfaces and disturbed land has disrupted the delicate ecological balance. The findings underscore the urgent need for integrated urban planning and the implementation of sustainable land management practices in Kuwait's development projects.

Keywords: Land Use/Land Cover Change (LULC), Remote Sensing, GIS, Urban Sprawl, Sand Dunes, Kuwait, Sabah Al-Ahmad City.

Microbial Influences on Iron Cycling in Marine Sediments: Characterization of Bacteria Associated with Corroded Iron Flakes in Intertidal Zones

Samar Salamah & Huda Mahmoud
NUERS, Research Sector, Kuwait University, Kuwait
Département of Biological Sciences, Kuwait University, Kuwait
E-mail: samar.slameh@ku.edu.kw
huda.mahmoud@ku.edu.kw

Abstract

Understanding the iron cycle in marine sediments is essential for evaluating the long-term fate of corroded iron infrastructure in coastal environments. This study investigates the microbial diversity associated with iron flakes formed as corrosion byproducts in intertidal sediments and examines the role of these microorganisms in iron transformation under laboratory conditions.

Iron flake samples were collected from two coastal sites, and microbial biofilms on their surfaces were analyzed using scanning electron microscopy (SEM). Cultivable bacteria were isolated using four media types: a general-purpose marine broth (MB) and three iron bacteria-selective media (ASW, IOM, and IBIM). Aerobic and facultative anaerobic bacterial populations were quantified via culture-based methods, and isolates were identified by partial 16S rRNA gene sequencing.

SEM analysis revealed abundant biofilms with rod- and cocci-shaped bacterial cells on iron flake surfaces. Bacterial counts on selective media ranged from 10^3 to 10^6 CFU/mL, with Vibrio spp. and Shewanella spp. as dominant taxa. In laboratory assays, Priestia sp. demonstrated the highest impact on iron transformation, significantly reducing the weight of iron filings after three months of incubation in marine broth.

These findings highlight the significant role of bacteria in the biogeochemical cycling of iron in marine sediments and offer insights into the microbial processes influencing the fate of iron-based infrastructure in coastal environments.

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Facile Solid-State Conversion of Coordination Polymers into Corresponding Metal oxide Nanoparticles as Enhanced Visible-Light Photocatalysts

Mohamad Hasan[a], Mayada S. Ali[b] and Metwally Madkour[c]

[a] Chemistry Department, Faculty of Science, Kuwait University, P.O. Box 5969, Safat 13060, Kuwait.

[b] National Unit for Environmental Research and Services (NUERS), Research Sector, Kuwait University, P.O. Box 5969, Safat 13060, Kuwait.

[c] Nanotechnology Applications Program, Energy & Building Research Center, Kuwait Institute for Scientific Research (KISR), P.O. Box 24885, Safat, 13109, Kuwait.

E-mail of corresponding authors: mayyada.ahmed@ku.edu.kw,
mmadkour@kisr.edu.kw

Abstract

A novel polydentate malonohydrazide chelating agent, was synthesized, structurally confirmed by X-ray single-crystal analysis, and used to prepare its coordinated complexes with Co^{2+}, Cu^{2+}, and Ni^{2+} ions. These precursors were thoroughly characterized and utilized as single source precursors for preparation of metal oxide nanoparticles via solid-state thermal decomposition method. The novelty of this work lies in the development of a scalable, one-pot, environmentally benign, and renewable solid-state thermal decomposition methodology. This approach effectively converts the characterized metal-ligand coordinated precursors directly into highly pure transition metal oxide nanoparticles (NPs) including CuO, Co_3O_4, and NiO. A critical advantage of this method is the obviation of agitation and post-synthesis washing steps, ensuring systematic, efficient, and high-purity production. The synthesized NPs were analyzed using XRD, XPS, TEM, BET sorptometry, and UV-Vis spectroscopy to determine their crystal structure, purity, morphology, surface area, and optical properties. Finally, their photocatalytic activities were successfully demonstrated through the photodegradation of organic contaminants in wastewater, validating the potential of this solid-state precursor approach for large-scale, sustainable production of high-performance oxide nanomaterials.

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Detection of Organic Pollutants for Water Management Using Porous Sorbents and GC-MS

[1]Shereen A. Majeed, [1]Sana Al-Saleh, [2]Fatma Hussain Emamy, [3]Douaa AlMarzouq,[4]Ali Bumajdad, [4]Saad Makhseed, [1]Samar Salamah, and [1]Mayada Samir
[1]National Unit for Environmental Research and Services (NUERS), Kuwait University, Kuwait
[2]Chemistry Department, Abdullah Al Salem University, Kuwait
[3]Department of Environmental Health, The Public Authority of Applied Education and Training, Kuwait
[4]Chemistry Department, Kuwait University, Kuwait

Email of corresponding author: shereen.abdulmajeed@ku.edu.kw

Abstract

Organic pollutants represent one of the most challenging classes of water contaminants due to their persistence, bioaccumulation potential, and adverse effects on human health and ecosystems. Effective removal of these pollutants is therefore critical for sustainable water management and environmental protection. In this study, we report the application of novel porous materials as efficient sorbents for the remediation and monitoring of organic pollutants in aqueous systems.

The first material investigated was graphitized carbon, which demonstrated high adsorption efficiency for polycyclic aromatic hydrocarbons (PAHs), achieving removal rates exceeding 85% under optimized conditions. The second material, a hybrid sorbent consisting of carbon nanotubes conjugated with a metal-organic framework (CNT-MOF), exhibited excellent sensitivity and selectivity for benzophenone, enabling detection at trace levels (down to parts per billion). The analysis and quantification of these organic contaminants were carried out using gas chromatography coupled with mass spectrometry (GC-MS), ensuring high accuracy and sensitivity in detecting and monitoring pollutant concentrations.

Such hybrid systems combine the high surface area of carbon nanostructures with the tunable porosity of MOFs, offering a promising platform for both pollutant removal and real-time environmental monitoring. These findings emphasize the role of advanced porous materials in addressing emerging challenges in water pollution control and underscore their potential integration into future wastewater treatment technologies.

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Using Remote Sensing and Spatial-Temporal Modelling of $PM_{2.5}$ and NO_2 in Kuwait

[1]Mariam Malek,[1] Manar Al Saraf, [1] Hassan Al Attar,[1]Ali Al- Hemoud
[1,] Kuwait Institute for Scientific Research, Kuwait
mmalak@kisr.edu.kw

Kuwait is an almost flat area subject to subtropical high pressure, which causes high temperatures in the country. Air pollution in Kuwait City is caused by various anthropogenic and natural factors, including industrial emissions, vehicle exhaust, road dust, fossil fuel consumption, and sand and dust storms. Moreover, these emissions may include particulate matter, sulfur dioxide, nitrogen oxides, and other harmful pollutants. This study estimates the spatial and temporal distribution of $PM_{2.5}$ and NO_2 concentrations in Kuwait using remote sensing and ground station data.

In this study, we used remote sensing data from various satellite sensors, such as MODIS, OMI, and Sentinel-5P, to measure $PM_{2.5}$ and NO_2 concentration levels. We applied time series analysis using both ground station and remote sensing data to examine the trend and seasonality of $PM_{2.5}$ and NO_2. We also performed correlation analysis to investigate the role of atmospheric parameters, such as wind speed, wind direction, temperature, humidity, and pressure, on the variation of $PM_{2.5}$ and NO_2. We used hybrid prediction models, satellite Aerosol Optical Depth (AOD), visibility, land use, ground monitoring, and weather data to predict fine particulate matter ($PM_{2.5}$) concentrations in Kuwait and neighboring countries, at high spatial resolution (1x1 km). We also applied similar hybrid prediction models that use satellite Ozone Monitoring Instrument (OMI) NO_2, land use, ground monitoring, and weather data to predict NO_2 concentrations in Kuwait and neighboring countries, at high spatial resolution (1x1 km). These analyses were conducted for the period 2000-2020, 2005-2023 for $PM_{2.5}$ and NO_2, respectively, for Kuwait and the surrounding regions. In this paper, we present the PM2.5 and NO2 behavior in Kuwait on a yearly, seasonal, monthly, and hourly basis. We also present a spatial distribution map of PM2.5 and NO2 in Kuwait.