



THE NIGERIAN ACADEMY OF SCIENCE

5TH NAS ANNUAL SCIENTIFIC CONFERENCE

Theme: Transdisciplinary Research as
Catalyst for Nigeria's Sustainable
Development

Tuesday 23rd and Wednesday 24th January, 2024
Tayo Aderinokun Auditorium, University of Lagos, Lagos

BOOK OF ABSTRACTS



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Contents

About the Nigerian Academy of Science.....	4
About the 2024 NAS Scientific Conference	5
Conference Organizing Committee	7
Abstract Reviewers.....	8
Abstracts	9
Keynote Presentation	9
Lead Presentations.....	11
Oral Presentations..	17
Poster Presentations	37
Appendix	94
Conference Agenda	95
List of Abstracts (Oral Presentations)	99
List of Abstracts (Poster Presentations).....	100

About the Nigerian Academy of Science

The Nigerian Academy of Science (NAS), established in 1977 (but incorporated in 1986), is the foremost independent scientific body in Nigeria. NAS is uniquely positioned to bring scientific knowledge to bear on the policies/strategic direction of the country and is also dedicated to the development and advancement of science, technology, and innovation (STI) in Nigeria. The aims and objectives of the Academy are to promote the growth, acquisition, and dissemination of scientific knowledge, and to facilitate its use in solving problems of national interest. Over the years, the Academy has done this by:

- Providing advice on specific problems of scientific or technological nature presented to it by the government and its agencies, as well as private organizations
- Bringing to the attention of the government and its agencies problems of national interest that science and technology can help solve
- Establishing and maintaining the highest standards of scientific endeavours and achievements in Nigeria, through the publication of journals, organization of conferences, seminars, workshops, and symposia, recognition of outstanding contributions to science in Nigeria, and the development of a working relationship with other national and international scientific bodies and academies.

As with national academies in other countries, NAS is a not-for-profit organization with a total membership (since inception) of 289 Fellows, elected through a highly competitive process, who have distinguished themselves in their fields both locally and internationally. Some of her members have served as vice-chancellors of universities, directors-general of government parastatals, and ministers in federal ministries. The Academy, given its clout, also can attract other experts from around the country and internationally when needed. NAS is Nigeria's national representative on such bodies as the International Science Council (ISC) – the umbrella body for all science associations and unions, and the InterAcademy Partnership (IAP) – the umbrella body for all national science academies globally. The Academy is also a founding member of the Network of African Science Academies (NASAC).

About the 2024 NAS Scientific Conference

The 2024 NAS Scientific Conference is the fifth edition of the conference since the inception of the annual conference in 2020. The overall aim of the NAS Scientific Conference is to create a platform for knowledge sharing, as well as effective networking and collaboration among researchers, industry, government, and technology hubs. The objectives of the Conference are to:

- Showcase original scientific research and innovations,
- Disseminate scientific information concerning issues of national relevance,
- Create a platform for various stakeholders (academics, government, and private sector, etc) to discuss scientific issues of societal significance,
- Foster mentorship, networking, and collaboration among Nigerian scientists.

The theme for the 2024 edition - *Transdisciplinary Research as Catalyst for Nigeria's Sustainable Development* - was selected to showcase scientific research and innovations with the potential of addressing national challenges. This year's conference features presentations under the following subthemes:

1. *Artificial Intelligence and other Emerging Technologies for Nigeria's Development* - Covering research on the use of artificial intelligence and other emerging technologies in all aspects of national development including healthcare delivery, industrial production, and education.
2. *Transdisciplinary Research for Healthcare in Nigeria* - Transdisciplinary science research, including one-health research, with implications for healthcare delivery, drug policy, drug security, and drug discovery.
3. *Smart Agriculture and Food Security* - Transdisciplinary research that addresses climate change, and provides solutions for sustainable food security in Nigeria.
4. *Emerging Technologies for Sustainable Energy Production and Usage* - Transdisciplinary research that explores the use of technologies for achieving sustainable energy production and consumption for an improved energy sector in Nigeria.
5. *Smart Cities and Emerging Technologies* - Research that showcases the potentials of emerging technologies for revolutionizing Nigeria's transportation, manufacturing, housing, security, infrastructure, and data management.
6. *Emerging Technologies in Emergency Preparedness and Response* - Research that illustrates emerging technologies as tools for preparing, and responding to emergency situations such as flooding, other natural disasters, public health emergencies etc.

The NAS, through its initiatives and international links, is uniquely positioned to advocate for the use of evidence-informed policies for national growth and development. With the right strategies and support, the unique knowledge base and skills in Nigeria's institutions, access to funding, and leveraging of global interfaces, latent capabilities can be unleashed, to drive even greater dimensions in knowledge development and innovation.

Conference Organizing Committee

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The Committee acknowledges the contributions of the following towards the review of submitted abstracts for presentation at the Conference:

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Abstracts

Keynote Presentation

Promoting Transdisciplinary Research to Ensure Sustainable Development

Neta Hanien – Vice President, Programs and Partnerships, Innov8 Hub

The pursuit of sustainable development in Nigeria necessitates a holistic approach that addresses diverse challenges across social, economic, and environmental spheres. Transdisciplinary research, as a pivotal methodology, transcends disciplinary confines to foster collaboration and knowledge integration, generating innovative solutions. This presentation delves into the crucial role of the triple helix synergy which comprises the academia, government, and industry in shaping the enduring impact and efficacy of transdisciplinary research.

Practical insights gleaned from three innovative solutions developed by a team of researchers together with a local team of experts at Innov8 Tech Hub during the year-long TEFAIR initiative, sponsored by TETFUND will illuminate nuanced characteristics and potentials of transdisciplinary research in driving sustainable development in Nigeria.

The program highlights the significant impact of involving end-users extensively and integrating relevant knowledge from practical experiences, encompassing both business development and scientific research. This approach aims to produce socially robust outcomes with the potential to catalyze sustainable impact. Throughout this process, the program addresses unique opportunities and challenges within the Nigerian context, focusing specifically on overcoming obstacles in translating research-driven solutions into practical and sustainable implementations.

Best Case Studies and Success Stories: Sixteen teams, comprising various researchers with diverse expertise, sponsored through TETFAIR (TETFUND's initiative, implemented by Innov8 Hub), developed 16 different innovative solutions. These case studies serve to:

1. Demonstrate characteristics of transdisciplinary research and its potential in achieving sustainable development in Nigeria. The emphasis is on in-depth user participation and the integration of relevant knowledge from both practice and research in real-world problem contexts, producing socially robust results that contribute to sustainability and drive impact.
2. Identify Unique Opportunities and Challenges in the Nigerian context. Focusing on overcoming barriers to translating research-based solutions into practical, sustainable implementations.
3. Provide recommendations to relevant stakeholders to foster transdisciplinary research in Nigeria. Possible pathways for strengthening the triple helix synergy by developing policies and establishing models of collaborations that incentivize all parties to join forces.

Lead Presentations

Transdisciplinary Research for Healthcare in Nigeria

Akinyinka Omigbodun, FAS - Professor of Obstetrics & Gynaecology, College of Medicine, University of Ibadan

The landscape for knowledge-generation for the health of populations has evolved rapidly over the past two decades in the direction of transdisciplinary research, that integrates knowledge across academic disciplines and with non-academic stakeholders, to address societal challenges. It involves co-production by all stakeholders (scientists and members of the community), including the joint definition of problems, framing of goals and consensus on what information to gather, as well as how best to collect the information. The transdisciplinary approach to research integrates the natural, social and health sciences, breaking down barriers and encouraging the use of shared conceptual frameworks drawn from the theories and perspectives of the different disciplines. The complex health problems confronting humanity, including those related to emerging infectious diseases, lifestyle issues, and those arising from climate change, can only be effectively tackled through transdisciplinary research. Transdisciplinarity in research creates unified intellectual frameworks beyond disciplinary constraints, and the product of such research is more likely to be utilised by policymakers and practitioners. In order to encourage the transdisciplinary approach in health research, those being trained for careers in research, such as doctoral students, should have their training curricula shaped to facilitate their exposure to collaborative transdisciplinary research from the onset of training. The Consortium for Advanced Research Training in Africa (CARTA) is one organization that has adopted this approach, and several Nigeria-based researchers have had the benefit of such exposure through its doctoral fellowships. These CARTA graduates are inculcating the transdisciplinary approach into the next generation of Nigerian health researchers.



Smart Agriculture and Food Security

Michael Abberton - Director, R4D West Africa, International Institute of Tropical Agriculture, Ibadan

There are a number of different components of smart agriculture including:

- Enhanced livelihoods and poverty alleviation
- Climate resilience
- Improved nutrition
- Protection of biodiversity
- Maintaining or improving soil health
- Integrity of environmental services

To achieve this within a framework of sustainable integration, key requirements are improved varieties, diversification, and the bio- circular economy.

Modern tools such as digitization can be applied to many of these aspects. Examples from the work of IITA, particularly in West Africa, will be given.



Emerging Technologies for Sustainable Energy Production and Usage in Nigeria

Femi Oye – CEO, Green Energy and Biofuels (GEB)/Co-Founder, SMEFUNDS

Nigeria stands at a pivotal point in its energy journey. Overreliance on fossil fuels has brought environmental challenges, economic vulnerability, and unsustainable resource depletion. But a brighter future beckons, powered by the sun, wind, and abundant bounty of nature.

Imagine vast landscapes bathed in sunshine, not smog. Solar, with its falling costs and rising efficiency, offers hope for clean electricity generation, off-grid electrification, and powering a vibrant future.

From fertile fields to lush forests, Nigeria's wealth of agricultural waste and renewable resources holds immense potential for biogas, biofuels, and sustainable energy solutions.

Transitioning to renewables requires more than just technology. Empowering micro-enterprises, fostering research and development, and crafting supportive policies are key to unlocking the full potential of these clean energy sources.

This presentation invites you on a journey exploring Nigeria's renewable energy landscape. Discover the challenges, unveil the solutions, and witness the real-life examples driving the change. Together, let's embrace a future powered by clean energy, securing a sustainable and prosperous Nigeria for generations to come.



Smart Cities and Emerging Technologies

Stella Chiemeka - Vice Chancellor, University of Delta, Agbor

Smart cities have emerged as a critical urban innovation that utilises cutting-edge technologies to enhance efficiency, sustainability, and the overall quality of life for their residents. With Nigeria's burgeoning population, estimated to double to an estimated 400 million people by 2050 according to the United Nations (UN) estimates, the imperative for the adoption of smart city principles becomes increasingly pronounced. The scalability and adaptability of these technologies offer a pathway for addressing the complex challenges associated with rapid urbanisation, providing a framework for sustainable development, and improved resource management in the face of unprecedented demographic growth.

Emerging technologies, such as the internet of things (IoT), artificial intelligence (AI), and advanced data analytics, are catalysing and powering smart cities, and are instrumental in reshaping the urban landscape towards unparalleled levels of connectivity, efficiency, and sustainability. The integration of IoT enables the seamless interconnection of devices and infrastructure, facilitating real-time data exchange and fostering a responsive and interconnected urban environment. Artificial intelligence plays a pivotal role in enhancing decision-making processes by analysing complex datasets, predicting patterns, and optimising resource allocation. Advanced data analytics further refines the

understanding of urban dynamics, offering valuable insights for evidence-based policymaking. These emerging technologies converge to create a synergistic ecosystem that empowers smart cities to address multifaceted challenges. IoT sensors gather data on energy consumption, traffic patterns, and environmental conditions, allowing AI algorithms to optimise energy usage, manage traffic flow, and mitigate environmental impact. The result is a more adaptive and resilient urban infrastructure that responds intelligently to the needs of its inhabitants.

Developing smart cities and unlocking their full potential is not automatic, but requires a concerted effort in several key areas. First and foremost, it necessitates robust investment in digital infrastructure. The establishment of reliable and expansive network infrastructure is paramount to support the connectivity requirements of IoT devices, and facilitate the seamless flow of data essential for smart city operations. Additionally, a comprehensive regulatory framework is imperative to guide the ethical and secure deployment of emerging technologies. Policies addressing data privacy, cybersecurity, and the ethical use of AI are essential to instill public trust, and ensure the responsible implementation of smart city initiatives. Furthermore, collaboration between the public and private sectors is vital in fostering innovation, attracting investments, and aligning strategic goals for the sustainable development of smart cities.

Education and awareness programs are equally crucial components of the equation. Ensuring that both urban planners and residents are well-informed about the benefits, risks, and proper utilisation of smart city technologies is pivotal for successful implementation. This approach ensures a collective understanding and engagement, laying the groundwork for a more inclusive and participatory smart city development.

By addressing these fundamental aspects, Nigeria can navigate the complexities of urbanisation, and harness the power of emerging technologies to build resilient, sustainable, and citizen-centric smart cities for the future.



Emerging Technologies in Emergency Preparedness and Response

Mustapha Habib Ahmed – Director General, National Emergency Management Agency

Disaster management is a complex task that continues to unfold with increasing complexity of incidents induced by human and natural factors. Science and technological advancement that are not properly managed often create consequential by-products that influence or exacerbate disasters. I am happy that our scientists have risen to the occasion and today we are here to discuss about technology and disaster management.

I consider it a privilege to rub minds with you on the compelling theme of “Emerging Technologies in Emergency Preparedness and Response” as we gather to explore the intersection of technology and emergency management; we are presented with a profound opportunity to leverage innovation for the betterment of our communities and the world at large.

The term “emerging technologies” encompasses a vast array of cutting-edge innovations that have the potential to revolutionize our approach to emergency preparedness and response. From the advent of artificial intelligence and machine learning to the utilization of drones, internet of Things (IoT) devices, big data analytics, and beyond, these technologies offer a transformative palette of tools and capabilities to enhance our ability to predict, mitigate and respond to emergencies with unprecedented precision and efficiency.

Consider, for instance, the profound impact of harnessing advanced data analytics to anticipate and strategize responses to natural disasters. Furthermore, the deployment of drones equipped with state-of-the-art sensors can provide invaluable real-time reconnaissance and aid in the swift and precise execution of search rescue operations in hazardous and hard-to-reach environments.

Technology aided forecast and prediction of hazards have continued improve with reasonable level of accuracy and provide useful data t for disaster managers to prepare ahead of anticipated untoward situations.

In leveraging on the benefits of technology for efficient disaster management, the National Emergency Management Agency has acquired the following infrastructures:

1. COSPAS SARSAT Nigerian Mission Control Centre. The facility is a satellite based technology that uses Cospas-Sarsat system to track distress signals from 406 signals from anywhere in the world for rescue operation. The facility is a product of partnership and cooperation among countries that signed up to its usage. Nigeria, South Africa and Algeria are the only countries in Africa that are presently on the COSPAS-SARSAT platform. The technology is used mostly in relation with operators in the maritime and aeronautics sectors but can also be useful for other sectors and personal utilization.
2. Hytera Radios for real-time communication.
3. Infrared Search and Rescue life locator
4. Search tap and braking system

However, as we embrace the promise of emerging technologies, it is incumbent upon to recognize and address the challenges and considerations that accompany their integration into emergency preparedness and response efforts. We must conscientiously navigate issues such as data privacy, cybersecurity, infrastructure constraints, and the imperative need for comprehensive training to ensure the responsible and effective implementation of these technologies.

One of the most pivotal factors in leveraging the full potential of emerging technologies lies in fostering collaboration among an array of stakeholders. This entails nurturing partnerships between technology developers, emergency responders, governmental bodies, and the broader community to co-create innovative solutions tailored to the unique exigencies of each locality and scenario.

As we venture into this technological frontier, it is paramount that we remain attentive to the ethical and moral implications of employing emerging technologies in emergency situations. We must

vigilantly navigate the potentials biases in decision-making algorithms, address privacy concerns, and ensure that the utilization of technology is consistently underpinned by the principles of fairness, equity, and the preservation of human dignity.

The integration of emerging technologies in emergency preparedness and response presents an extraordinary opportunity to fortify our collective resilience in the face of adversities. As we press onward, let us remain resolute in addressing the challenges, embracing the prospects for collaboration and innovation and unwavering in our dedication to upholding the ethical considerations that accompany this technological evolution.

Conclusively, I implore all of us to persist in our pursuit of adapting and harnessing emerging technologies with a steadfast commitment to enhancing our emergency preparedness and response capabilities while upholding the fundamental values that define our shared humanity.

Oral Presentations

SUB-THEME 1: ARTIFICIAL INTELLIGENCE AND OTHER EMERGING TECHNOLOGIES FOR NIGERIA'S DEVELOPMENT

AI-Enhanced Fault Detection and Protection in Solar Mini-Grids for Sustainable Energy Production

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As the global community intensifies its efforts to address energy sustainability, solar mini-grids have emerged as promising solutions to provide reliable and clean electricity to off-grid and remote areas. However, solar mini-grids, like other renewable energy technologies are very expensive and so represent a very large capital investment. Hence, the need to protect its system component is very important. Also, the reliable operation of these mini-grids is crucial to ensure their effectiveness.

An ideal protection scheme for a mini-grid is one that operates or isolates the mini-grid system for all types of internal faults, and block the operation during normal and inrush conditions. Our work focuses on harnessing artificial intelligence (AI) and advanced data analytics to enhance fault detection and protection in solar mini-grids, ultimately contributing to sustainable energy development.

The scheme involves the simulation of various operating conditions - normal operation where all the solar PV mini-grid systems are working as intended, combinations of different faults in individual system components (internal), and different types of faults in the distribution network and from the loads (external) on MATLAB Simulink. This scheme has been realized by creating a real-life solar PV mini-grid on the software. Simulations for the conditions have been carried out by varying the system's parameters, changing the states of the system components, and/or creating faults inside and outside of the grid. The data generated served as input to an artificial neural network to develop an improved algorithm for fault detection and protection of the mini-grid.

ANN is used as a pattern classifier for fault detection and protection of the mini-grid, which makes the discrimination among the various conditions to give a trip signal for all types of faults. These schemes have been realized through ANN architectures, which are designed and trained using feed forward back propagation algorithm with the experimental data simulated on MATLAB Simulink. Five types of architectures were realized based on different input sets, and one that gives the best accuracy (100%) in terms of classification amongst the various operating conditions of the mini-grid was obtained. Rigorous testing was done with expanded data on the selected architecture and the results amply demonstrate the capabilities of ANN in terms of accuracy and speed for identification of different events of solar PV mini-grids. The trained and tested results indicate that it is fast and 100% accurate.

Keywords: AI, fault detection, solar mini-grids, sustainable energy, protection



Deep Learning for Breast Cancer Detection using Ultrasonographic Images

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Background: Breast cancer is the foremost contributor to cancer-related fatalities among women worldwide. Chances of survival depend largely on early detection and treatment to prevent or slow down the disease progression to the fatal malignant stage. Researchers, cognizant of this imperative, have fervently pursued diverse methodologies to enhance the precision of breast cancer detection. The aim of this study is to develop deep learning models for breast cancer detection using ultrasonography images.

Methodology: In this study, we harnessed the power of deep learning to address the challenge of breast cancer detection, utilizing ultrasonographic images from the Breast Ultrasound Image Dataset sourced from Baheya Hospital for Early Detection & Treatment of Women's Cancer in Cairo, Egypt. Our approach encompassed three distinct methods: Artificial Neural Feedforward Networks, Convolutional Neural Networks, and Transfer Learning. The study utilised ultrasonographic image dataset obtained from Baheya Foundation for the Early Detection & Treatment of Breast Cancer. The images were pre-processed and converted into pixel values between 0 and 255 and rescaled to values between 0 and 1. The dataset was divided into training, test and validation data using the ImageDataGenerator class imported from TensorFlow. Afterwards, training and testing of the entire network were executed using the TensorFlow functions.

Results: The study revealed that Transfer Learning gave the highest accuracy (81%) followed by Artificial Neural Feedforward Networks (56%). Convolutional Neural Networks attained the lowest accuracy (49%). There is need for further investigation to improve the accuracy of the results in order to significantly enhance breast cancer detection capabilities, offering a powerful tool for early diagnosis and intervention.

Conclusion: Our study underscores the pivotal role of deep learning, particularly Transfer Learning, in advancing the field of breast cancer detection using ultrasonographic images. With an accuracy rate of 81%, Transfer Learning has proven to be one of the most effective methods for early breast cancer diagnosis. The application of deep learning techniques holds promise in improving breast cancer outcomes and reducing mortality rates.

Keywords: Breast Cancer, Deep Learning, Artificial Neural Feedforward Network, Convolutional Neural Networks, Transfer Learning



Development of Face Spoofing Attack Detection Using Deep Convolutional Neural Network to Help Business Owners Detect Fraud

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Background: Spoofing – an act of using fake information to impersonate a person or computer, poses a significant threat across various domains such as sports, business, politics, academia,

agriculture, health, security, among others. Phishing, a form of spoofing, involves obtaining unauthorized access through false information, often using facial recognition manipulation or biometric identity theft. Facial spoofing attacks – characterized by using fake faces to deceive biometric systems, present a significant existential threat. For instance, by placing a photo, video, mask, or 3D mask of the target in front of the camera, one can trick facial recognition algorithms. Spoofing involves the visible attack of a company's name and reputation, in contrast to other types of online crime, such as hacking, which can be carried out privately. Organizations need to have robust cyber-security in place, in addition to having a spam filter, which is not yet a common feature today. The threat it presents is such that despite putting in place some of these precautions, a phishing fraud may succeed and inflict severe damages. Financial loss, additional costs, legal fees, and negative impacts on intellectual property are some of the consequences of identity theft that can potentially harm an organisation's bottom line. In order to curb this prevailing endemic, researchers have developed machine learning algorithms to detect spoofing attempts, with deep learning methods.

Methodology: A convolutional neural network (CNN) that can be trained to recognize face-flow attacks has been highlighted in this piece. In training this model, 2041 images were used where 960 were spoofed images and 1081 images were actual cases. It employed a deep CNN technique that made use of several levels of data to detect facial spoofing. This method learns classification using a ConvNet operating on the convolutional neural network (CNN) principle. The creation of a questionnaire was not necessary for this project as the research used a secondary dataset sourced from Kaggle – an online secondary data repository. This system was created using the Python programming language and pertinent Python libraries connected to the experiment.

Results: The model was able to achieve an accuracy of 61%. In predicting spoofing, the system achieved values of 62% precision, 71% recall and 66% f1 score, while for predicting correct cases, the precision, recall and f1 scores were 61%, 51% and 55% respectively.

Conclusion: This research delved into the challenges faced in biometric systems, particularly in facial recognition, due to the ease of spoofing. Attackers exploit vulnerabilities, such as 3D masks, to deceive these systems. The study emphasized the need for robust security measures and the development of detection algorithms to combat spoofing.

Keywords: Facial Spoofing, Biometrics, Neural Network, Machine Learning



SUB-THEME 2: TRANSDISCIPLINARY RESEARCH FOR HEALTHCARE IN NIGERIA

Anticancer Effect of a Copper (II) Complex with Vanillin 3-ethyl-thiosemicarbazone Ligand in Triple-negative Breast Cancer

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Background: Breast cancer is the most prevalent cancer in females. Triple-negative breast cancer is a subset of breast cancer with early onset stage, poor survival rate and resistance to chemotherapy. Since the discovery of cisplatin – a platinum drug – metal complexes have drawn significant attention as potential drug molecules for different diseases including cancer. This study was aimed at investigating the anticancer effect of Copper (II) vanillin 3-ethyl-thiosemicarbazone (CuTScVa) in triple-negative breast cancer.

Methodology: Triple-negative breast cancer (MDA-MB-231-VIM-RFP) and normal breast cancer (MCF-10A) cell lines were exposed to different concentrations (3.125, 6.25, 12.5, 25, 50 and 100 μ M) of CuTScVa to determine cytotoxic effect using the Cell Counting Kit 8. The effect of CuTScVa on caspases 3/7 and 9 was investigated using the bioluminescence method, and its effect on the production of reactive oxygen species (ROS) and cell cycle was analyzed using flow cytometry. The effect on mitochondria function was analysed by measuring the oxygen consumption rate (OCR), and extracellular acidification rate (ECAR) using a sea horse analyzer, and the NADP/NADPH ratio using the bioluminescence method.

Results: The IC₅₀ of CuTScVa was 2.45 and 12.05 μ M in MDA-MB-231-VIM-RFP and MCF-10A cells respectively. The complex increased the production of ROS and induced a time-dependent caspase 3/7 and 9 activities. A decrease in OCR and spare capacity, and an increase in ECAR was observed, as well as an increase in NADP/NADPH ratio.

Conclusion: CuTScVa was selectively cytotoxic to the triple-negative breast cancer cell line via increased ROS production, induction of apoptosis and mitochondrion dysfunction.

Keywords: Triple-negative breast cancer, apoptosis, ROS production, mitochondrion dysfunction



COVID-19 Deaths and Vaccination in Nigeria

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Background: World Health Organization (WHO) championed timely access to COVID-19 vaccines globally to save lives everywhere and set vaccination targets of 40% and 70% to be achieved globally in 2021 and 2022 respectively. However, some estimates based on modeling data indicates that by 2021 ending, more people in Africa Nigeria inclusive have died of COVID-19 as a share of the vulnerable populations than in other regions due to late and inadequate vaccination. For this reason, we compared COVID-19 deaths before and after vaccination commenced in order to observe how vaccination impacted COVID-19 deaths with the global public health emergency phase of terrifying daily COVID-19 deaths formally declared over on May 5, 2023.

Methodology: COVID-19 cases, deaths and vaccination rates in World Health Organization database up to 07 June 2023 and other variables of interest unavailable there and found in other open-sources were extracted and examined. Case fatality rate (CFR) per 1,000 for the period prior to vaccination (CFR1) and the period after vaccination commenced (CFR2) was computed. Simple statistics were used in data analysis.

Results: Between when the first case was documented and 07 June 2023, Nigeria recorded 3,155 COVID-19 deaths with majority (61.84%) occurring between 19 March 2020 and March 5, 2021 when vaccination commenced. COVID-19 deaths declined to 61.7% of pre-vaccination figure overlapping with a vaccination era that delivered partial, primary and booster rates of 39.94%, 33.86% and 5.97% respectively. The cumulative COVID-19 deaths by population size was $8.94/10^6$ pre-vaccination with COVID-19 deaths in vaccination era adding $5.510/10^6$ mortalities to the final mortality of $14.44/10^6$. These mortality figures were against national background death rates of $12.4/10^3$, $13.1/10^3$, $13.0/10^3$, $13.0/10^3$, $13.2/10^3$, $13.4/10^3$, $13.6/10^3$, $13.6/10^3$, $13.8/10^3$, $13.9/10^3$, $14.0/10^3$, $14.2/10^3$ and $14.3/10^3$ in years 2022, 2021, 2020, 2019, 2018, 2017, 2016, 2015, 2014, 2013, 2012 and 2011 respectively; and the calculated CFR1 and CFR2 rebased were 1.24% and 1.04% respectively.

Conclusion: COVID-19 deaths declined 38.1% over the two years of ongoing vaccination just as progressive decline in background death rates in Nigeria since 2011 remains largely unaffected by the pandemic thus far.

Keywords: COVID-19 deaths, vaccination, Nigeria



Development of a Recombinant DNA Vaccine Candidate for the Prevention of Lassa Fever

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Background: Lassa fever is a re-emerging acute hemorrhagic fever with huge threat to public health especially in West Africa. Despite the apparent disease under-reporting due to limited surveillance infrastructure in the affected regions, up to 300,000 cases and at least 5000 deaths are said to occur annually. The aetiology of the disease is a linear, bisegmented, single-stranded RNA virus, which mainly spreads to humans through contact with an infected rodent vector, *Mastomys natalensis*. Although since 1969, Lassa fever has been causing huge mortality and morbidity almost annually in West Africa, the disease still remains a neglected tropical disease in the entire subregion. Considering its continuous global health and socioeconomic burden, the World Health Organization has recently included it in the list of the priority diseases against which vaccines are urgently needed. This has stimulated several research efforts with the view to developing effective vaccines against the disease. However, to date there are no licenced preventive vaccines for Lassa fever. One of the major challenges of Lassa fever vaccine development is the enormous genetic diversity of the virus which currently has about seven genetically distinct lineages. Thus, the aim of our study is to take advantage of the advances in computational biology to rationally design a highly effective Lassa fever vaccine, using the recombinant DNA approach. To further make our approach unique, several genetic adjuvants were used in the vaccine constructs to improve the immunogenic potentials of the candidate DNA vaccines.

Methodology: Our study entailed the use of cutting edge bioinformatic pipelines to predict the immunodominant epitopes conserved across all the lineages of the Lassa virus prevalent in Nigeria. This is followed by customized gene synthesis of different vaccine antigens each containing unique genetic adjuvants. Subsequently, the vaccine candidates were constructed using standard molecular cloning techniques followed by the study of their transcriptional and translational expression in mammalian cells (293T cells).

Results: Using state-of-the-art in silico tools, we have successfully designed a number of Lassa fever DNA vaccine constructs with demonstrable evidence of robust T and B cell immune responses, as indicated by elevated levels of helper T-cell concentrations, satisfactory macrophage activity, sustained generation of INF-gamma and IL-2 among others. We have also shown that at least one of the candidates constructed, has a strong neutralizing activity against Lassa virus lineages I, II and III, the only variants currently known to circulate in Nigeria. Furthermore, we have successfully verified most of these bioinformatic predictions in a number of wet lab experiments including molecular and cell culture-based approaches.

Conclusion: We have successfully developed a novel recombinant DNA vaccine candidate against all the lineages of Lassa virus prevalent in Nigeria. This is potentially the first ever developed Lassa fever DNA vaccine candidate in Nigeria. As it advances for further development, we remain optimistic that the vaccine candidate has the potential to reduce the burden of Lassa fever in the country.

Keywords: DNA; Lassa fever; Vaccine



SUB-THEME 3: SMART AGRICULTURE AND FOOD SECURITY

A Smart Biofilm from African Star Apple Seed Starch and its Application as a Real-time Freshness Indicator

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Background: Globalization and modernization have changed lifestyles, food habits, and diets, and led to the commercialization of foods. As a result, food must be distributed widely and served fresh while maintaining high quality. The quality, safety, and shelf life of processed food are at risk. To mitigate against this, active and smart packaging can be used to extend the shelf life of packaged foods by maintaining a controlled environment and protecting food from physiological, physical, chemical, and microbiological processes. However, the present smart indicator tends to monitor directly bacterial infection on fruits and vegetables, therefore, it is necessary to develop an intelligent indicator that studies the deterioration of fresh foods indirectly monitoring the change of pH values.

Methodology: In this research, starch was extracted from the African star apple (*Chrysophyllum albidum*) and was subjected to physical, chemical and dual modification processes through Microwave treatment, Acetylation, and Microwave-acetylation respectively. Both the native and modified African star apple starches were used for the synthesis of bioactive starch-based film. Anthocyanin extracted from *Hibiscus sinensis* was incorporated into the film matrix as a smart indicator, and the films were characterized for their physiochemical, antioxidant, antimicrobial, and colour variation due to pH change.

Result: The results indicated that the films made with modified African star apple starches had a higher thickness, solubility, total phenol content, and antioxidant activity than the control film. The addition of anthocyanin extract improved the antibacterial activity of starch-based films. The fabricated films indicated significant colour changes from purple to green as pH changed from 4 to 9. The pH-sensitive indicator film also changed from purple to green with TVB-N development during the storage period of fresh fish.

Conclusion: In conclusion, the starch-based biofilm containing anthocyanin extract can be used as an indicator to monitor the freshness of fish and poultry products, hence, combating food insecurity.

Keywords: Smart packaging; Biofilm; Intelligent indicator



Duplication and Evolution of CYPs in Rice Diterpenoid Biosynthesis

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Background: Rice produces an extensive array of diterpenoid natural products, which serve various physiological roles including as not only antimicrobial phytoalexins but also acting to control stomatal opening and in defense against nematode herbivores. The underlying metabolism requires numerous cytochrome P450 (CYP) mono-oxygenases. Notably, these largely stem from the

CYP76M and CYP71Z sub-families, often those found in the three associated biosynthetic gene clusters (BGCs). Strikingly, in several cases it is now apparent that these CYPs have arisen from relatively recent and often local gene duplication events. This raises the question about the driving force underlying the selection for the BGCs containing such duplicated CYPs in this important cereal crop plant species.

Methodology: Our group employs biochemical characterization methods to understand where and how these CYPs incorporate oxygen and transform their olefin substrates towards more soluble active diterpenoids. We metabolically engineer bacteria to produce potential precursors and co-express one or more CYPs. Compounds are then extracted in hexane and analyzed via Gas Chromatography-Mass Spectrophotometry (GC-MS). Identified products are purified via HPLC before structural elucidation with Nuclear Magnetic Resonance (NMR) spectroscopy. We also investigate the hypothesis that, despite their often-overlapping biochemical activity, these CYP duplicates have evolved distinct biosynthetic roles in rice diterpenoid metabolism. To achieve this, we use reverse-genetic approaches to investigate the effect of gene mutation or outright deletion of the CYPs on rice diterpenoid composition.

Results: The CYP76M subfamily members are capable of oxygenating several olefins tested at different positions as confirmed by NMR. CYP76M7 and M8 are of particular significance due to their close phylogenetic relationship, reflecting their arrangement as a tandem pair in the chromosome 2 BGC (c2BGC) and similarity in biochemical activity observed in our metabolic engineering system. However, reverse-genetic study shows these two CYPs have distinct roles in diterpenoid biosynthesis. In particular, CYP76M7 is more important for phytocassane biosynthesis, consistent with the presence of the genes encoding the upstream enzymes for this pathway in the c2BGC, while CYP76M8 is more important for momilactone biosynthesis, despite the upstream genes falling within the BGC on chromosome 4 (c4BGC). Intriguingly, deletion of c2BGC that houses these CYPs not only predisposed rice to blast fungal infection by *Magnaporthe oryzae* and bacterial blight disease occasioned by *Xanthomonas oryzae*, but also led to a lesion mimic phenotype. While not observed with the single mutants, double *cyp76m7/8* mutants exhibited the same phenotype.

Conclusion: Our results have shown that these two CYP76M subfamily members have developed distinct biosynthetic roles of physiological value despite their largely overlapping biochemical activity observed in recombinant settings. Regardless, the CYP76M subfamily is vital for defense against invasive pathogens in rice plants.

Keywords: Diterpenoids, evolution, CYP450, genetics



Heavy Metal and Polycyclic Aromatic Hydrocarbons (PAHs) Accumulation in *Chrysichthys nigrodigitatus* obtained from Ogun River: Human Health Implication

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Background: Heavy metals and Polycyclic Aromatic Hydrocarbons (PAH) are priority environmental concern contaminants with high toxicity. Their persistence and bioaccumulative potentials make them of priority concern. This present study evaluated the accumulation of Heavy metals and PAH in the tissue of *Chrysichthys nigrodigitatus* and the health risk associated with the consumption.

Methodology: The fish species was obtained from Ogun River and the tissues (liver, kidney and gills) were harvested for heavy metals and PAH quantification. The concentration of arsenic (As), cadmium (Cd), cobalt (Co), chromium (Cr), manganese (Mn), nickel (Ni), and lead (Pb) in gill, muscle, and liver of fish was measured using Atomic Absorption Spectroscopy while PAH in the fish tissue was extracted and identified by Gas Chromatographic Flame Ionization Detector (GC-FID). The Estimated Daily Intake (EDI), Targeted Hazard Quotient (THQ), and Carcinogenic Risk (CR) of the metals and PAH were estimated for the human health risk. Principal Component Analysis (PCA) was employed for the analysis of heavy metals and PAH distribution in the tissue of the fish species using Minitab Statistical Software.

Result: Result of the study showed that arsenic ($120.0 \pm 7.00 \times 10^{-5}$ mg/kg) was only detected in the gills of the fish whereas, the level of other heavy metals was below the permissible limits. Nickel and lead were the most abundant accumulated heavy metals in the tissue of the fish species. Benzo [e] pyrene ($8.18 \pm 4.45 \mu\text{g/g}$) and Benzo [j] pyrene (10.08 ± 6.11) accumulated the most in the gills of the fish while PAH accumulation in the muscle of the fish showed abundance of fluoranthene ($6.15 \pm 5.52 \mu\text{g/g}$). The human health risk due to consumption of the heavy metals and PAH from the fish indicated carcinogenic risk as the cancer risk estimation exceeded the $\times 10^{-5}$ index whereas the THQ value was below 1. The EDI calculated for the heavy metals and PAH was also lower than the recommended daily intake.

Conclusion: Although, the levels of the heavy metals and PAHs in the tissue of the fish species was below the permissible limits, accumulative effects due to frequent consumption of the fish might result in cancer risk.

Keywords: *Chrysichthys nigrodigitatus*, heavy metals, PAH, cancer risk, and Ogun River



SUB-THEME 4: EMERGING TECHNOLOGIES FOR SUSTAINABLE ENERGY PRODUCTION AND USAGE

Addressing Industrial Energy Needs in Lagos with Small Modular Reactors (SMRs)

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Lagos, as one of Africa's largest and most rapidly growing industrial hubs, with a GDP of 120 billion naira, faces an ever-increasing demand for reliable and sustainable energy sources to support its industrial activities. Ensuring affordable and clean energy is a vital component of the Lagos State Development Plan (LSDP) 2052, and the implementation of small modular reactors (SMRs) can expedite the realization of this vision. This paper explores the potential of small modular reactors as a viable solution to bridge the energy supply gap and promote sustainable industrial growth in Lagos. SMRs are compact, scalable nuclear reactors with enhanced safety features, making them an attractive option for meeting the city's industrial energy demands, while mitigating greenhouse gas emissions. This paper reviews the current energy landscape in Lagos, highlighting the challenges posed by limited capacity, intermittent power supply, and environmental concerns. It examines the advantages of SMRs, including their high energy density, reduced greenhouse gas emissions, and potential for distributed energy generation. Furthermore, this study considers the regulatory and infrastructural requirements for implementing SMRs in Lagos, including safety protocols, waste management, and public acceptance. Ultimately, this work seeks to provide valuable insights into the potential of SMRs as a sustainable solution for addressing industrial energy needs in Lagos. By considering the technical, economic, and regulatory aspects, this paper contributes to the ongoing discourse on how to ensure a stable and eco-friendly energy supply for the city's burgeoning industries.



Effective Utilization of an Agro By-Product as Substrate for Biomass Energy

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Background: A lot of changes are going on globally today, largely driven by technological innovations. It is therefore important to harness technology in creative ways to solve teething problems that daily life presents. Renewable energy constitutes an important element of climate change adaptation and mitigation. One of the useful resources is biomass energy which has a high-capacity factor. The type that was adopted in this project is biogas; its usefulness spans across electricity, fuel for transport, clean cooking gas, organic manure. Biomass use for energy is multi-faceted, as it spans across residential and industrial heating, electricity, transport - all of which have high commercialization prospects.

Methodology: An anaerobic digester was designed and cited within the University of Ibadan's farm premises with cattle dung used as substrate. A water scrubber which removes carbon (IV) oxide and small quantities of hydrogen sulphide was also set up. In order to generate electricity using biogas, the first step is the generation of biogas. The quantity of gas generated depends on a number of factors such as type of substrate, the carbon to nitrogen ratio (C:N), the size of the digester, its operating conditions e.g. temperature, level of agitation. Therefore, for this work, a 10m³ fixed dome underground digester with a stirrer was used. A 2 kilowatts (Kw) generator that can supply power for basic electricity applications such as for lighting was used. A compressor (1 Kw compressor for the scrubbing process) was used as well as a biogas storage vessel - low pressure storage high pressure storage - 50 litre capacity.

Results: About 60-70% of the biogas obtained was used in heating water that served the purpose of scalding feathers of slaughtered poultry (broilers). Thus, the chicken raised on the farm were dressed and well packaged, attracting premium value. A portion of the gas was also used to power a regular generating set (which had been converted to a gas carburetor), thus lighting the section of the farm where the project was conducted.

Conclusion: This was a multi-disciplinary project organized by the Centre for Petroleum, Energy Economics and Law, University of Ibadan. It demonstrated the potential of greenhouse gas reduction, efficient waste management and utilization for productive purposes. It is recommended that projects of this kind should be upscaled in a bid to efficiently stem agriculture's contribution to climate change, thus ensuring food security. In addition, it can serve as a spin-off of cottage industries through the use of energy for productive purposes.

Keywords: biogas, dung, anaerobic digester, renewable energy

Exhaust Energy Analysis and Design of a Turbo-Driven Mechanism for Automotive Air Conditioning Application

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Background: Investigation of an exhaust gas powered turbocharger radial inflow turbine for automotive air conditioning application is presented. This device, powered by the waste energy of exhaust gas, is used to drive the compressor of an automotive air conditioner to eliminate the parasitic load imposed by conventional engine-driven air conditioning systems.

Methodology: The exhaust gas properties at the exit of the exhaust gas manifold were obtained by the engine simulation conducted using AVL BOOST engine simulation software in order to ascertain

the turbocharger turbine required. A 2.7 litre V6 engine was used for the simulation. In order to match the speed of the turbine with that of the compressor of the air conditioning unit, since the turbine speed is considerably larger than the speed required by the compressor of the air conditioner, a speed reduction mechanism was incorporated.

Results: The results obtained from the engine simulation show the availability of energy in the exhaust gas capable of driving the compressor at all engine speeds. The study reveals that the power available for the air conditioner compressor increases with the engine speed, and it is considerably low at idling for a turbo-driven air-conditioning system. This available power for the compressor directly affects the cooling capacity of the air-conditioning system. Hence, a better cooling effect occurs at high engine speeds.

Conclusion: This study has further revealed the viability of this waste energy recovery device for vehicle air conditioning system application and its advantage in terms of improving engine performance.

Keywords: Waste Energy, Engine Performance, Air Conditioner, AVL BOOST, Simulation



SUB-THEME 5: SMART CITIES AND EMERGING TECHNOLOGIES

Cloud – Based Vehicular AD – HOC Network and Traffic Control Strategy for Sustainable Development in Nigeria

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Background: The fast-growing increase of vehicles in the developed and developing countries is disturbing and this calls for the need to provide a smart system that will be able to control the traffic so as to limit the rate of occurrence of an accident in our major roads and to pave ways for free flow of vehicles. Traffic congestion always has negative effects on lives and environment such as fuel consumption and air pollution. Existing traffic flow models are inadequate in handling mixed traffic stream. The traditional traffic congestion control system is based on the time-based scheduling approach where there is a change in colours from red to green at a particular time interval to control the vehicles. This approach is not sufficient to meet the demands of the increasing number of vehicles that ply roads on daily basis.

Methodology: This research develops a conceptual framework for traffic control strategy and a route guiding scheme to make routing decisions easy for drivers. The developed traffic control strategies are implemented with VISSIM traffic simulation tool, cloud Sim simulator and JAVA programming language. Percentage of improvement (POI) is used to evaluate the simulation framework. Root mean square Error (RMSE) and Root mean square Normalized Error (RMSNE) are used to validate the simulation model. Route information system is developed for drivers to make routing decision.

Results: Evaluation results revealed that free flow traffic is achieved by approximately 54% and 34.5% when drivers are guided with route information over traffic in non – signalized traffic stream and traffic control with traffic signal respectively.

Conclusion: This research has demonstrated that a route choice guiding scheme can reduce traffic congestion. The conceptual framework of traffic control strategy using cloud-based AD – HOC network has been developed as information system for the traffic control authorities. Route alternation guiding scheme that can make routing decision easy for drivers to reduce road traffic congestion has been proposed. A free flow is achieved by approximately 54% and 34.5% when drivers are guided with route information over traffic in non – signalized traffic stream and traffic control with traffic signal which is the existing solution in Nigeria.

Keywords: Traffic, Vehicular, AD – hoc Network, VISSIM, Cloud Sim simulator



Design and Performance Analysis of an Energy Efficient Building in Owerri, Nigeria

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Background: Building cooling load depends on heat gains from the outside environment. Appropriate orientation and masonry materials play vital roles in the reduction of overall thermal loads buildings.

Methodology: A net-zero energy building performance has been analyzed in order to ascertain the optimum orientation and wall material properties, under the climatic conditions of Owerri, Nigeria. Standard cooling load estimation techniques were employed for the determination of the diurnal interior load variations in a building incorporating renewable energy as the major energy source, and compared with the situation in a conventionally powered building.

Results: The results show a 19.28% reduction in the building's cooling load when the brick masonry was used for the wall construction. It was observed that a higher heat gain occurred when the building faced the East-West direction than when it was oriented in the North-South direction. Significant diurnal cooling loads variation as a result of radiation through the windows was also observed, with the east facing windows contributing significantly higher loads during the morning hours while the west facing windows contributed higher amounts in the evening. The economic analysis of the net-zero energy building showed an 11.63% reduction in energy cost compared to the conventional building, with a 7-year payback period for the use of Solar PV systems.

Conclusion: Therefore, the concept of net-zero energy building will not only help in energy conservation, but also in cost savings, and reduction of carbon footprint in the built environment.

Keywords: Renewable Integration, Built Environment, Energy Efficiency, Building Orientation, Cooling Load



Smart Cities vs. The Heatwave: IoT-Driven Strategies to Beat the Urban Heat in Lokoja

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The phenomenon of urban heat islands (UHIs) presents a growing challenge to the livability and sustainability of Lokoja city. Urban heat islands (UHIs) are like cities' hotspots. They happen because buildings, roads, and all the concrete and asphalt in a city absorb and hold on to heat. So, cities end up being hotter than the surrounding countryside. It's a bit like how a sidewalk can feel scorching in the sun, even if the grass nearby is cooler. UHIs can make cities uncomfortably warm, especially in the summer, and they can also lead to higher energy use for cooling. UHIs result from the increased heat absorption and retention of energy in densely populated areas, leading to elevated

temperatures compared to their surrounding rural areas. In this context, the present research delves into innovative strategies for mitigating UHIs through the deployment of data analytics and Internet of Things (IoT) sensors in the framework of smart cities. The aim is to optimize urban infrastructure and create an environment where cooling and heating systems can be dynamically adjusted to reduce the heat island effect in Lokoja town. This research investigates the implementation of data-driven approaches, enabled by IoT sensor networks, to continuously monitor and analyze various environmental parameters contributing to UHIs, including air temperature, humidity, and surface materials within Lokoja city. Leveraging on advanced data analytics, machine learning, and predictive modeling, these sensors collect real-time data and provide insights into UHI formation and evolution in Lokoja. The gathered data empowers city planners and policymakers to make informed decisions in the pursuit of UHI mitigation. Smart infrastructure, as a key component of this strategy, integrates with IoT sensor networks to create a responsive urban environment. This infrastructure includes adaptive shading systems, cool roofs, green spaces, and intelligent HVAC systems that can autonomously respond to changing environmental conditions. For instance, when a heatwave is detected, cooling systems are activated, and shading devices adjust to reduce the impact of solar radiation. Conversely, during colder periods, heating systems can optimize energy consumption. The results of this research show significant promise in enhancing urban livability and sustainability. By reducing UHIs, not only can the health and well-being of Lokoja residents be improved, but also the energy efficiency and environmental impact of other cities can be optimized. Moreover, the mitigation of UHIs aligns with broader climate change mitigation goals by reducing energy consumption, greenhouse gas emissions, and the urban heat-related health risks associated with extreme temperatures. In conclusion, leveraging on data analytics and IoT sensors to combat UHIs in smart cities especially in Lokoja city is a pivotal step toward creating more resilient and sustainable urban environments. The ability to dynamically adjust cooling and heating systems through smart infrastructure offers a practical and effective solution for mitigating UHIs, improving urban livability, and contributing to the overall goals of a smarter and more sustainable future. This research paves the way for the city of Lokoja to address the challenges posed by UHIs and underscores the potential for data-driven and IoT-enabled approaches in urban planning and environmental management.

Keywords: urban, heatwave, islands, internet, cooling



SUB-THEME 6: EMERGING TECHNOLOGIES IN EMERGENCY PREPAREDNESS AND RESPONSE

A Framework for Enhancing Emergency Response Systems with Artificial Intelligence and Predictive Analytics

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Background: Effective emergency response systems play a critical role in mitigating the impact of disasters and critical events, ensuring the safety and well-being of communities. In an era characterized by data abundance and rapid technological advancement, this paper presents a comprehensive framework for the enhancement of emergency response systems through the strategic integration of artificial intelligence (AI) and predictive analytics. The growing complexity and unpredictability of modern emergencies necessitate a paradigm shift in response strategies. This framework aims to harness the power of AI algorithms and predictive modelling to provide timely, data-driven insights that optimize resource allocation, improve response coordination, and, ultimately, save lives.

Methodology: The paper begins by elucidating the fundamental components of the proposed framework. It addresses the critical stages of data acquisition and preprocessing, laying the foundation for robust AI-driven analysis. Machine learning algorithms are then explored in-depth, showcasing their potential to predict, classify, and analyze various emergency scenarios based on historical and real-time data. Moreover, the framework emphasizes the significance of real-time monitoring and decision support systems. It elucidates how AI can continuously analyze incoming data streams to identify emerging threats and inform immediate response actions. The integration of predictive analytics further refines this process, allowing for proactive measures that anticipate critical events before they unfold. Case studies and practical applications form a pivotal part of this paper, offering a real-world perspective on the successful implementation of AI and predictive analytics to strengthen emergency response systems. These case studies span a spectrum of disaster scenarios, from natural calamities like hurricanes and earthquakes to public health emergencies such as pandemics. Ethical considerations and data privacy issues associated with the utilization of AI in emergency response are also addressed.

Results: The framework underscores the importance of responsible and transparent practices, ensuring that the use of technology in emergency response aligns with ethical standards and safeguards sensitive information.

Conclusion: The framework presented herein serves as a valuable resource for policymakers, emergency management agencies, and researchers seeking to harness the potential of AI and predictive analytics to create more resilient and responsive emergency response systems.

Keywords: artificial intelligence (AI), predictive analysis, emergency response

Molecular Identification of Endosymbiotic Microbial Populations Associated with Mosquitoes from Breeding Sites in Osogbo, Nigeria

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Background: Mosquitoes are arthropod vectors that spread pathogens responsible for diseases of public health concern such as malaria and dengue fever. The internal tissues of mosquitoes are colonized by microbial species, which influence survival, vectorial competence, reproduction, and pesticide resistance in mosquitoes. Molecular techniques are reliable for identifying the microbial population associated with mosquitoes and also provide insight into their biological roles. This study applied molecular techniques to identify microbes associated with mosquito species in Osogbo, Nigeria

Methodology: Mosquito eggs and larvae were collected from water in abandoned containers and tyres at Sabo, Ajegunle, Bishop's Court, and stagnant rainwater from Ilesa Garage, Osogbo, Osun State, Nigeria. Adult mosquitoes that emerged from eggs and larvae reared under standard laboratory conditions were identified using entomological keys and surface sterilized with ethanol. Mosquitoes were pooled and crushed in sterile phosphate buffer solution, and homogenates were cultured on nutrient agar and potato dextrose agar for the isolation of bacteria and yeast, respectively. Molecular identification of bacterial and yeast isolates was based on PCR and sequencing of the 16S rRNA gene and the internal transcribed spacer region, respectively.

Results: A total of 586 mosquitoes belonging to four genera, which include *Aedes* (69.28%), *Anopheles* (11.77%), *Culex* (11.43%), and *Toxorhynchites* (7.50%), were raised from the eggs and larvae collected from the four mosquito breeding sites. A high occurrence of the Genus *Aedes*, an important vector for dengue virus and yellow fever virus, was recorded in this study. *Aedes* sp. and *Culex* sp. were obtained from all the breeding sites. By molecular techniques, Gram-negative bacteria isolated from the internal tissue of the mosquitoes shared percentage identity with sequences of *Enterobacter bugandensis* (98.07-98.09%), *Pantoea dispersa* (97.91%), *Sphingobium yanoikuyae* (98.50%), *Enterobacter hormaechei* (97.28%), and *Enterobacteriaceae bacterium* (72.37%). Gram-positive bacteria include *Staphylococcus haemolyticus* (99.89%), *Staphylococcus capitis* (99.77%), and *Aerococcus urinaeequi* (96.07%), while the yeast isolates were identified as *Candida orthopsilosis* (100%), *Meyerozyma caribbica* (99.83%), and *Rhodotorula mucilaginosa* (99.66%). The genera *Enterobacter*, *Pantoea*, and *Staphylococcus* have the potential to establish a stable association with mosquitoes, which is consistent with previous studies. Genus *Sphingobium* can degrade complex chemical compounds; hence, its role in pesticide degradation in mosquitoes needs further study. The identification of *C. orthopsilosis*, an emerging human fungal pathogen, suggests the potential of mosquitoes as its vector.

Conclusion: This study reported the high occurrence of *Aedes* sp. in Osogbo metropolis and underscored the potential of mosquitoes serving as vectors for potential pathogens such as *C.*

orthopsilosis. Further studies on the biological roles of mosquitoes' microbial community are recommended.

Keywords: mosquito, bacteria, yeast, molecular techniques, Nigeria

Preparation and Characterization of Novel Mixed Nano-metal Oxides Compositing with Activated Kaolinitic Clay (CeO₂/TiO₂/AKC) for Photodegradation of Rhodamine B

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Background: The spate of water pollution from textile industries is a malaise that has captured the world's attention for over two decades. The textile industry uses large volumes of water in their daily operations, hence discharging large amounts of effluents, containing high concentrations of dyes, heavy metals, nitrates, among others, into the environment. The effect of dyes in the environment adversely impacts both humans and aquatics which includes reduction in dissolved oxygen and interruption of photosynthetic processes. Most of these reactive dyes, such as rhodamine B (RhB) are said to be carcinogenic. The conventional methods of treating textile wastewater are often ineffective due to the high concentration, toxicity, and non-biodegradability of the contaminants. It is therefore imperative to develop methods that can degrade toxic organic compounds such as dyes. One such method is advanced oxidation processes (AOPs) with a particular bias to the use of heterogeneous photocatalysis which has been considered an efficient treatment technology for dye wastewater leading to total mineralization. However, the application of bare nano-metal oxides associated with high cost, broadband gap energy, rapid aggregation, and electron-hole recombination in solution results in decreasing photocatalytic efficiency. Therefore, this research aimed to investigate the use of a novel prepared mixed nano-metal oxides (cerium (IV) oxide-titanium (IV) oxide) compositing with activated kaolinitic clay as photocatalyst for the treatment of RhB dye in aqueous media. The objectives of the study were to: prepare mixed nano-metal oxides compositing with activated kaolinitic clay; characterize the nanocomposite by spectro-analytical techniques; evaluate and optimize the photodegradation efficiency of the nanocomposite on RhB dye by conventional and response surface methods; investigate the photodegradation activity of the as-prepared nanocomposite on a typical textile effluent; and evaluate the photodegradation kinetic data.

Methodology: The nanocomposite was prepared by hydrothermal technique and characterized using Point of Zero Charge (pHpzc), BET Surface Area, EDX, FTIR, SEM, TEM, Uv-DRS, and XRD. The nanocomposite was applied for the photodegradation of RhB dye and typical textile wastewater under visible light by batch method. And the influence of various operational parameters (pH, initial RhB dye concentration, time, and dosage) was examined.

Results: The results showed that CeO₂/TiO₂/AKC nanocomposite was successfully prepared with a BET surface area (85.02 m²/g) and pore diameter (12.5 nm); The average crystallite size and particle

diameter of the nanocomposite were found to be 22.09 nm and 23.28 nm respectively with a narrow band gap energy compared to the precursors. FTIR results displayed characteristic peaks that suggest composite formation. The photocatalytic degradation results showed a higher degradation efficiency (96.35%). And the process depends on all the operational parameters. Box Behnken design successfully predicts the optimum conditions (pH 4, 20 mg/L, 0.3 g catalyst dosage, and 90 min) for the degradation process. The photodegradation kinetic data fitted better into the first-order model and its mechanism followed both parabolic diffusion and modified Freundlich models.

Conclusion: The as-prepared nanocomposite was successfully prepared, and it performed satisfactorily in the treatment of RhB dye in aqueous media.

Keywords: Box Behnken design, nanocomposite, photodegradation, rhodamine B



Poster Presentations

SUB-THEME 1: ARTIFICIAL INTELLIGENCE AND OTHER EMERGING TECHNOLOGIES FOR NIGERIA'S DEVELOPMENT

Applying Emerging Technologies of Internet of Things in the Conduct of Teaching Practice among College of Education Students: A Study in Plateau State

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Background: The internet of things (IoT) has permeated every sphere of life in the twenty-first century. It has now become common ground to see one form of its implementation or the other. The education sector is not an exception. In this study, IoT webcams were used to conduct research whereby Teaching Practice (TP) exercises could be supervised remotely by the supervisor without necessarily being present in the field. The benefits of using IoT rather than the conventional method of conducting TP are enormous; the lecturer is expected to conduct the supervision 3 times within the span of six months but with this setup, the supervisor can have access to the classroom at all times within working hours. Although the initial cost of buying the needed hardware will be high, in the long run, there will be significant savings to both the student and the Institution sending out the student for the TP exercise. It is no secret that insecurity in Nigeria has affected every part of our existence. Conducting TP is no exception because most the schools are in rural areas where students and supervisors are vulnerable to kidnapping or robbery. Since a recording of the entire exercise will be available, the student and the supervisor can have a reflection of the entire exercise upon completion. The grades given to the student will have a better reflection of the students' performance throughout the exercise.

Methodology: To create and execute a setup like this, having an internet connection is necessary so that the IoT webcam can transmit the video to the supervisor who will be located at work. Another important factor to consider is having a source of power to power both the webcam and the source of internet connectivity. A questionnaire and interviews will be conducted on both the supervisor and the supervisee before and after the exercise is carried out. From these sources of information, we will be able to draw insights that will corroborate or dispel the hypothesis set out from the beginning of the study.

Results: As expected, the result of the experiment shows a significant increase in quality of feedback from the mentor (supervisor) to the mentee (student). This has also put the students on their toes as they are always available throughout the six-month period. Before implementing this, students were always truant and only made themselves available when they hear supervisors are coming. The expenses on the supervisor and the student greatly reduced throughout the exercise. This has also exposed the students to emerging technologies of IoT.

Conclusion: To narrow the digital divide between developed and developing nations, power and internet services have to be made a right and not a privilege. This is in tandem with the Sustainable Development Goals of the United Nations. The government needs to spend a higher percentage of her budget on education. The days of in person education are fast becoming a thing of the past. We have to embrace a hybrid mode of education where smart technologies will be incorporated into the teaching and learning process. The success of this study is not without challenges, internet isn't available in all towns and villages across Plateau State hence we had to select schools with cellular network within their environment.

Keywords: internet of things (IoT), teaching practice and webcam



Benefits and Challenges of Utilizing Chat-GPT and Gamma.App in Teaching, Learning and Assessment of 21st Century Colleges of Education Vocational Students

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Background: Vocational education generally refers to the study of technologies and related sciences and obtaining of practical skills, attitudes, understanding and knowledge relating to works in various sectors of economic and social life (Reko and Maxwell, 2016). Regrettably, vocational education curriculum in Nigeria is seldom reviewed or updated to accommodate the tremendous technological innovations and changes accompanying everyday life. Also, many of the vocational educators may take a long time before getting acquainted with the updated versions of practical vocational projects and may also be limited by time. Evidently, in the wake of all the potentially glaring contributions of vocational education in Nigeria, prioritizing its teaching, learning and assessment, leveraging on Chat-GPT and gamma.app will improve content delivery, skill acquisition and efficient achievement of desired learning outcomes. This has not been accorded adequate attention. Chat-GPT and gamma.app would offer both the teachers and the student's equal and unlimited access to unlimited vocational educational resources in different formats. In the present tech-driven world, not using AI tools such as Chat-GPT and gamma.app when teaching and learning is taking place in traditional methods and assessments such as multiple-choice tests, may not capture the creative, productive and social potential of a 21st century vocational education student in a College of Education (Mosca *et al.*, 2019). Exploring the use of Chat-GPT and Gamma.app tools in addition to the curriculum contents is critical to ensure they acquire the necessary skills including problem-solving, critical thinking and collaboration. For instance, Chat-GPT (Generative Pre-trained Transformer) being designed to simulate human-like conversation, can be used in a variety of applications including chatbots, virtual assistants, and language translation tools. Gamma.app is also a powerful tool that has the potential to transform the way students interact with technology, enabling more natural and intuitive communication between the students and learning aids.

Methodology: A survey research design was used with 3 research questions guiding the study. Three hypotheses were formulated; tested at 0.5 level of significance and 38 degrees of freedom. The population for the study was 80, made up of 40 vocational educators and 40 vocational education students. A 3-sectioned questionnaire was developed and used for data collection for the study. Three experts validated the instrument. The data collected was analyzed with mean, standard deviation, and t-test statistics.

Results: Analysis of the data revealed 22 opinions of vocational educators and vocational education students, 16 benefits and 12 challenges of utilizing Chat-GPT and Gamma.app in teaching, learning, and assessing of 21st century vocational education students at Colleges of Education. Testing of the three hypotheses revealed that there was generally no significant difference in the opinions of the respondents.

Conclusion: It was concluded among others; that students be provided with Wi-Fi-powered internet connectivity within the Colleges of Education campuses to enable vocational education students and vocational educators explore Chat-GPT and gamma.app during teaching, learning and assessment while at the same time, the epileptic power situations in the campuses need to be seriously addressed.

Keywords: Chat-GPT, gamma.app, vocational education students

Creating Agricultural Training Video/Audio Content to Improve Quality Impact for Farmers and Other Stakeholders

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Background: Too seldom do third world policy makers consider learning in their own native languages compared to foreign languages for farmers' training - especially for agricultural food security development.

Methodology: This presentation therefore shares decades of acquired knowledge, around the globe, on how to improve quality impact for farmers/stakeholders' capacity development purposes using "farmers helping the farmers" model approach. Challenges of audiovisual training to impact farmers' learning; as well as benefits of creating video/audio contents in farmers' own languages are discussed.

Results: Opportunities for improving horticultural extension outreach research impact and collaboration with the international community through Access Agriculture NGO are highlighted. Presented as well are downloadable demonstration horticultural training videos; created to improve quality impact for farmers and other stakeholders' easier technology adoption, even in situation of electricity supply failure.

Conclusion: All that is needed is to translate our research findings into action by training farmers/stakeholders with videos/audios in local languages.

Keywords: training, policy, video, research, language

Explainable Artificial Intelligence (XAI) for Smart and Sustainable Healthcare Delivery in Nigeria

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Background: Smart and sustainable healthcare delivery is key to Nigeria's development, and medical diagnosis plays a vital role. Medical image segmentation in clinical diagnosis has contributed immensely to medical care delivery. With the speedy development of deep learning, medical image segmentation processing based on deep convolutional neutral networks (CNNs) has become a research interest. Explainable Artificial Intelligence (XAI) provides pathways for useful Medical Decision Support Systems (MDSSs). The necessity for XAI in Medical Decision Support Systems is largely based on ethical, fair decision making, strengthening means of chronological procedures and unfairness that should be revealed during medical image segmentation processes.

Methodology: In this study, we provide an enhanced application of Fuzzy C-Means and Artificial Neural Network Algorithm for medical image segmentation with system architectures and program flowcharts used for medical image detection purposes.

Results: Studies have shown that an inaccurate diagnosis is as a result of not identifying the limits of a pathological lesion or organ. It is clear that the likelihood of survival can be improved if the tumor is identified and classified properly at its early stage.

Conclusion: Explanation given to these AI processes creates medical decision confidence, trustworthiness, acceptability and potentials for its incorporation in the medical image segmentation workflow. Based on the discussions on human pathological tissues and organs, the specificity between them and their classic segmentation algorithms is revealed.

Keywords: explainable artificial intelligence, artificial neural network, medical decision support systems, convolutional neutral networks, magnetic resonance image

Okun Handwritten Character Recognition Model

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Background: Okun is an artificial referent to a number of Yoruba groups (i.e., *Bunu*, *Ijumu*, *Owe*, *Oworo*, and *Yagba*) in present day Kogi State, Nigeria. It is a sub-dialect of the Yoruba language

spoken in Kogi State, Nigeria, and represents one of the countless underrepresented languages in the realm of handwritten character recognition (HCR). While a lot of work has been put into recognizing English, Arabic, and other popular languages, it has been found that little to no work has been done on Okun handwritten characters. However, three issues are addressed in this study: data, effectiveness, and distinctiveness.

Methodology: The Cross-Industry Standard Process for Data Mining (CRISP-DM) was chosen as the technique for this research because of its iterative nature and unique ability to find specific traits, which is peculiar to this research. The Okun Bible, a well-known and thoroughly researched work of literature in the language, served as the source for the dataset. Sixty literate speakers offered to rewrite the 38 characters that made up the retrieved text. More than 2000 photos of handwritten text have been found in the dataset. Standard deep learning picture preparation methods were employed, and binarization received a lot of attention. The diacritics property of the data was captured for the feature extraction using pixel intensity with a 3x3 stride, and a 16x16 feature sequence was then generated. Convolutional Neural Network (CNN) using SoftMax activation function was used to train the model for 40 epochs.

Results: To evaluate the model, metrics such as accuracy, confusion matrix, and area under the ROC curve (AUC) were used to assess the model's performance. A 70:20:10 ratio was used for training, testing and validation stages after which we employed CNN to extract distinctive features with major focus on the diacritics and underdots to uniquely distinguish the characters because of their unique character set, and an overall accuracy of 99.17% was achieved.

Conclusion: Convolutional Neural Network (CNN) was used in this study to recognize Okun Handwritten Characters, which represents a significant progress in the field. Our study demonstrates the efficacy of deep learning approaches in the field of character identification, achieving an excellent accuracy rate of 99.17% after rigorous training on a dataset consisting of 2000 photos. The findings of this study highlight the possibility for further integrating cutting-edge neural networks with Okun language processing, opening up new opportunities for improved human-computer interaction and document analysis.

Keywords: artificial intelligence deep learning, neural network, image classification, human computer interaction, image recognition and document analysis

Sequence Analysis for SNP Detection and Phylogenetic Reconstruction of SARS-Cov-2 Isolated from Nigerian COVID-19 Case

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Background: In December 2019, a novel coronavirus known as SARS-CoV-2 was discovered.

Within months of its discovery, the disease it causes - COVID-19, became a pandemic. For this study, we downloaded whole genome sequences of SARS-CoV-2 isolated from COVID-19 cases from GISAID database.

Methodology: A total of 18 sequences that satisfied quality assurance (length>29,700 nts and number of unknown bases denoted as N<5%) were used. In addition, genome sequence of SARS-CoV-2 obtained from the index case (Accession ID: EPI_ISL_413550) and the reference genome (Accession NC_045512.2) were obtained from GISAID and GenBank databases, respectively. Multiple sequence alignment (MSA) was done in MAFFT (Version 7.471), SNP calling was implemented in DnaSP (Version 6.12.03) and visualized was in Jalview (Version 2.11.1.0). Phylogenetic analysis was with MEGA X software.

Results: There was 99.9% genomic similarity with four large conserved genomic regions. A total of 66 SNPs was identified out of which 31 were informative. Nucleotide diversity assessment gave $P_i = 0.00048$ and average SNP frequency of 2.22 SNPs per 1000 nts. Non-coding genomic regions particularly 5'UTR and 3'UTR had a SNP density of 3.77 and 35.4, respectively. The region with the highest SNP density was ORF10 with a frequency of 8.55 SNPs/1000 nts). This value was significantly higher ($P < 0.01$) than the spike gene. Majority (72.2%) of viruses in Nigeria are of L lineage with preponderance of D614G mutation which accounted for 11 (61.1%) out of the 18 viral sequences. Nigeria SARS-CoV-2 revealed 3 major clades namely Oyo, Ekiti and Osun on a maximum likelihood phylogenetic tree. There was a preponderance of L lineage and D614G mutants. Also, ORF1ab was the region with the highest SNP density when compared to the spike region.

Conclusion: The implication of this distribution of SNPs for the empirical lower infectivity of SARS-CoV-2 in Nigeria is discussed.

Keywords: COVID-19, Nigeria, phylogeny, SARS-CoV-2, SNPs



SUB-THEME 2: TRANSDISCIPLINARY RESEARCH FOR HEALTHCARE IN NIGERIA

6-Gingerol Rich – Fraction of *Zingiber officinale* Prevented Cerebral Cortex and Cerebellar Dysfunction Caused by Mercury chloride in Male Wistar Rats: Behavioural, Biochemical and Immunohistochemical Studies

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Background: This research investigated the effects of 6-gingerol-rich fraction (6-GINRIF) of *Zingiber officinale* on cerebral and cerebellar dysfunctions caused by mercury chloride (HgCl₂) in male Wistar rats.

Methodology: Thirty-five (35) male Wistar rats were randomly divided into five (groups), n=7. I: control, received 0.5ml normal saline, II: received HgCl₂ alone (5mg/kg), III: received N-acetylcysteine (NAC) (50mg/kg) plus HgCl₂ (5mg/kg), IV: received 6-GINRIF (100mg/kg) plus HgCl₂ (5mg/kg), V: received 6-GINRIF (200mg/kg) plus HgCl₂ (5mg/kg) for fourteen (14) days. All drugs were administered orally. The rats were subjected to behavioural tests (fore limb grip strength and Beam walking balance tests). The rats were then euthanized to obtain brain tissues for the determination of inflammatory markers (tumour necrosis factor-alpha (TNF- α), nuclear factor kappa-B (NFK-B), interleukin 1 β (IL-1 β), and interleukin-6 (IL-6)). Immunohistochemical study (glia fibrillary acidic protein (GFAP) and neuronal nuclei (NeuN)) was also carried out on the cerebrum and cerebellum.

Results: The result revealed a significant (p<0.05) decrease in the drop-off time and a significant (p<0.05) increase in the beam walking latency and foot slip scores in the rats that were exposed to HgCl₂ only. However, 6-GINRIF protected against the observed behavioural deficits. Similarly, HgCl₂ exposure caused a significant (p<0.05) increase in the brain inflammatory parameters and GFAP levels and a significant decrease in NeuN level. Similar to the standard drug, NAC, 6-GINRIF (100 and 200 mg/kg) significantly (p<0.05) increased brain NeuN, and decreased inflammatory markers and GFAP.

Conclusion: This study concludes that 6-GINRIF prevented cerebral cortex and cerebellar dysfunctions caused by HgCl₂ via protection against behavioural deficits, inflammatory effect, and astrocytes reactivity.

Keywords: neurotoxicity, 6-gingerol-rich fraction (6-GINRIF), mercury chloride, oxidative stress, *Zingiber officinale*



Assessment of the Baseline Requirements of Active Pharmaceutical Ingredients (APIs) among Nigerian Pharmaceutical R&D and Manufacturing Companies

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Background: The global supply chain disruption by the COVID-19 pandemic resulted in the vulnerability of many developing countries to the non-availability of essential medicines, vaccines, and commodities to deal with the associated and emerging health issues, exposing the need for national and regional medicine security. Local capacity for the production of active pharmaceutical ingredients (APIs) is an essential step in developing an effective pharmaceutical manufacturing hub for regional or national medicine security. This study assesses the baseline of API use in Nigeria with a view toward identifying potential APIs feasible for economic scale production in Nigeria, as well as challenges in the roadmap for local API production.

Methodology: The study used a structured online questionnaire-based survey tool to obtain required information from top executives of pharmaceutical manufacturing companies and key industry stakeholders. The data was analyzed as descriptive statistics using Microsoft Excel.

Results: Nearly 55% of manufacturers import over 15 tons of APIs annually. The APIs used for analgesics, antibiotics, antimalarials, and antitussives were indicated as the top four imported into the country. About 58%, 50%, 25%, and 25% of manufacturers procure large amounts of APIs for analgesics, antibiotics, antimalarials, and antitussives (cough relief medication) respectively. India About 66.7%, 58.3% and 33.3% of manufacturers source most of their APIs from India, China, and the European Union, respectively. The challenges of the industry include an unfavorable investment environment, poor access to technology transfer, access to funds, low-skilled manpower, port bureaucracy, quality of imported APIs, and sources for a fair deal.

Conclusion: Local production of APIs in Nigeria is economically viable for the four major classes of APIs (analgesics, antibiotics, antimalaria, and antitussive). The results also indicate that most other medications are imported as finished pharmaceutical products (FPP) into the country. Support for technology transfer and API manufacturing R&D, long-term funding for investment in local production of API, as well as government market guarantees, are needed for a feasible API manufacturing hub in Nigeria.

Keywords: active pharmaceutical ingredient, local pharmaceutical manufacturing, medicine security



Buchholzia coriacea Seed Attenuates Scopolamine-Induced Memory Impairment in Mice by Down-Regulating Oxidative Stress

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Background: Amnesia is a common feature of neurodegenerative disorders. Bioactive phytochemicals in certain edible seeds have been shown to possess neuroprotective properties. *Buchholzia coriacea* seed is used in folkloric medicine for managing nervous disorders, but this has yet to be proven. Hence, this study was designed to evaluate *Buchholzia coriacea* methanol seed extract (MEBC) on scopolamine-induced memory impairment in mice.

Methods: Memory deficit was induced with scopolamine at 3 mg/kg which was administered i.p. 30 male Swiss mice (23-27 g) were divided into 6 treatment groups (n=5): vehicle (10 mL/kg), scopolamine (3 mg/kg, i.p), MEBC (50, 100, 200 mg/kg, p.o) and donepezil (reference drug 1 mg/kg, p.o), respectively. Memory function was assessed using Morris Water Maze Test (MWMT) and Y-maze Test (YMT). On the 7th day of administration, AchE, MDA, GSH, Catalase and Nitrite were estimated to evaluate the neuroprotective action of *Buchholzia coriacea* via AchE inhibition and antioxidant activity. The hippocampus and prefrontal cortex were grossed for histological analysis.

Results: The scopolamine treatment resulted in a decrease in percentage alternation, whereas mice pre-treated with MEBC prior to scopolamine had increased percentage alternation in YMT. The mean target quadrant time was significantly increased in the mice pretreated with MEBC. During the probe trial, mice administered with scopolamine had increased search error and chance level of time spent in target quadrant region. However, MEBC pre-treated mice prior scopolamine had increased duration in the platform region in MWMT. Scopolamine-mediated changes in MDA and catalase activity were significantly attenuated by MEBC. There is increased in neuronal cells count of the hippocampus and prefrontal cortex region in groups treated with MEBC. These findings suggest that MEBC seems to be a potent neuropharmacological agent against amnesia, and its mechanism(s) might be modulation of lipid peroxidation and oxidative stress activity associated with Alzheimer type of amnesia.

Keywords: amnesia, *Buchholzia coriacea*, scopolamine, malondialdehyde, Morris Water Maze

Computational Study on *Securidaca longipedunculata* Secondary Metabolites Modulation of the GABA-A Receptor Benzodiazepine Active Site

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Background: Gamma-Aminobutyric acid A (GABA-A) receptor plays a crucial role in the neurotransmission of inhibitory signals in the central nervous system. Modulating this receptor has potential therapeutic implications, especially in conditions such as epilepsy. While many synthetic molecules have been developed to target this receptor, they often come with debilitating side effects.

Hence, the search for plant-derived compounds with potential GABA-A modulatory activity without these drawbacks becomes imperative.

Methodology: This study employed an integrated computational approach to investigate the modulation of GABA-A receptor benzodiazepine site by plant-derived compounds. Initial identification of potential agonists was facilitated through pharmacophore modeling, which screened compounds based on essential molecular binding features. This was succeeded by molecular docking, which provided insights into potential binding modes, and MM/GBSA dG binding studies, which quantified the binding free energies to gauge the affinities of the selected compounds. To predict the pharmacokinetics and potential toxicity of these molecules, *in silico* ADMET evaluations were conducted using QikProp. Furthermore, AutoQSAR was employed to build an optimal model to predict the bioactivity of the identified hits. Throughout this investigation, Diazepam (DZP) served as the reference compound for comparison.

Results: From the two hundred and eighty-three investigated phyto-compounds, five displayed superior binding affinities to the GABA-A receptor benzodiazepine site than the reference compound DZP. Interestingly, these compounds exhibited crucial molecular interactions with the key amino acid residues responsible for GABA-A receptor modulation, mimicking the interaction pattern of DZP. Furthermore, these compounds displayed a favorable ADMET profile and shared molecular recognition features with DZP, and showed promising bioactivity predictions.

Conclusion: The research uncovered five potential plant-based compounds that demonstrate promise as therapeutic agents for epilepsy, based on their interaction with the GABA-A receptor, superior ADMET profiles, and bioactivity predictions. This suggests that stem bark of *Securidaca longipedunculata* phyto-compounds may be a valuable resource in the search for novel anti-epileptic drugs.

Keywords: GABA-A receptor, molecular docking, plant-derived compounds, epilepsy, ADMET



Development of Antigen-Based Multiplex Immunodiagnosics for Two Predominant *Schistosoma* Parasites in Sub-Saharan Africa

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Background: Schistosomiasis is a disease of poverty that is highly prevalent in sub-Saharan African countries. Cross-reacting proteins in *Schistosoma mansoni* (Sm) and *S. haematobium* (Sh) have been alluded to pose diagnostic challenges in the development of serological diagnostics. Proteins specific to these two parasites can leverage diagnostic challenges associated with cross-reactivity and the development of a multiplex diagnostic tool for the two parasites. The aim of the study is to identify protein markers from *S. mansoni* and *S. haematobium* for concurrent diagnosis of the two parasites.

Methodology: High-quality protein extracts were prepared from the eggs (soluble egg antigen (SEA), and adult worms - *Schistosoma* worm antigens (SWA)) of *S. haematobium* and *S. mansoni*. The diagnostic performance of the proteins was evaluated using a quantitative ELISA method with sera obtained from *S. mansoni* - infected mice. The immunoreactive proteins in the helminths were identified by conventional western blot analyses and the specific protein markers for concurrent diagnosis of the two parasites were confirmed by double-binding Western blot analyses.

Results: Sm SEA gave the best diagnostic performance (Sensitivity (SS) = 1.00, Specificity (SP) = 0.96, AUC = 0.96). Sh SEA slightly performed better in diagnosing *S. mansoni* infection (SS = 0.96, SP = 0.87, AUC = 0.95) compared to Sm SWA (SS = 0.91, SP = 0.95, AUC = 0.93). Diagnostic protein markers of size 100 kDa in Sh SWA, > 250 kDa (Sh SEA), 25-37 kDa (Sm SWA), and 50-150 kDa (Sm SEA) were specific for the concurrent diagnosis of *S. mansoni* and *S. haematobium*.

Conclusion: The study showed the plausibility of developing multiplex immunodiagnostic tools for *S. mansoni* and *S. haematobium*.

Keywords: Schistosomiasis, common diagnostic markers, immunoassays, Africa

Establishing a “Plug and Play” Vaccine Platform for Emerging Infectious Diseases in Nigeria: A Recombinant COVID-19 DNA Vaccine as a Prototype

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Background: Despite consuming approximately a quarter of the world's vaccine output, Africa still imports more than 99% of its vaccines. The COVID-19 pandemic has highlighted the excessive reliance of African countries on external aid and assistance. During the pandemic, high-income countries secured a significant portion of available vaccine doses through advanced purchase agreements, leaving fewer doses available for low and middle-income countries, including those in Africa. Furthermore, many countries prioritized vaccinating their own populations first, making it challenging for African nations to obtain the doses they needed to fight the pandemic. These problems, largely driven by the lack of vaccine R&D and limited manufacturing capabilities on the continent, underscore the necessity to establish local vaccine production capacity aiming to improve accessibility and cost-effectiveness for the African population. More so, enhancing Africa's capacity to produce vaccines locally prepares the continent to handle future public health crises. It is common knowledge that Africa currently has the highest burden of infectious diseases in the world. In addition, climate change, flood, urbanization, as well as human activities such as deforestation among others will continue to favor pathogen adaptation and emergence of new infectious diseases throughout the continent. Resuscitating vaccine production in the continent should therefore not only be limited to establishing fill-and-finish plants, but should also include building capacity in antigen

discovery and the entire process of vaccine development. This can be achieved through the establishment of a robust vaccine platform such as recombinant DNA vaccination approach. This approach is simple, stable, and safe. It also provides robust cell mediated and humoral immune responses in the vaccinated host. Most importantly, once it is established for some disease, it allows a seamless plugging of novel antigens to produce new or updated DNA based vaccines against the newly emerged diseases. Therefore, here, we report the establishment of an efficient recombinant DNA vaccine platform in our laboratory using SARS-COV-2 immunogens as models, which can easily be replaced with any potential antigen against future public health threats in the country.

Methodology: Consensus nucleotide sequence of the complete SARS-COV-2 spike protein was retrieved and immuno-informatically analyzed for antigenicity, allergenicity, toxicity and other physicochemical properties using cutting edge *in silico* tools. Next, the sequence was synthesized and cloned into a mammalian expression vector (pVax-1). Subsequently, the constructs were purified, produced in large scale, and later transfected into 293T cells for protein expression analysis.

Results: Our findings revealed a successful design of a highly immunogenic and safe DNA vaccine construct against COVID-19 as predicted by high resolution bioinformatics tools. Our protocols for DNA vaccine construction have been well optimized using wet lab molecular cloning techniques such as restriction digestion and DNA sequencing. We have also demonstrated evidence of *in vitro* expression of the vaccine constructs in mammalian cells.

Conclusion: A robust DNA vaccine development platform has been established in our laboratory using SARS-COV-2 immunogens as models. This is a giant stride in pandemic preparedness as it allows for a swift development of new vaccines against future emerging infectious threats.

Keywords: DNA, COVID-19, vaccine, bioinformatics, immunogenicity



Evaluation of Antidepressant and Antioxidant Activities of Ethanolic Leaf Extract of Fig Tree (*Ficus capensis* thunb.) in Wistar Rats

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Background: Depression is a pervasive psychiatric condition of high incidence and debilitating effect. Search for herbal remedies as alternative treatment course for depression has been on the rise in recent years.

Methodology: The study aimed at evaluating the antioxidant and antidepressant properties of the aqueous ethanolic leaf extract of *Ficus capensis* (FC) in a Clonidine-induced depression model. Adult male Wistar rats weighing 180 ± 20 kg were divided into five groups: Control (distilled water); Clonidine (0.5 mg/kg); FC (100 mg/kg) + Clonidine; FC (200 mg/kg) + Clonidine; and Fluoxetine (20 mg/kg) + Clonidine, respectively. At the end of ten days of administration, behavioural tests (Open field test (OFT) and Forced swim test (FST)) were conducted, after which biochemical analyses were carried out on the serum and brain homogenates.

Results: The results revealed increased locomotory and rearing activity of the rats by the extract in the OFT, as well as a reduction in the immobility time in FST by the rats, compared with the Clonidine group. Also, the extract significantly depleted monoamine oxidase levels, and increased the levels of serotonin (5-HT), norepinephrine (NE) and acetylcholinesterase activity in the brain of treated rats. Furthermore, clonidine-induced rats exhibited elevated levels of malondialdehyde (MDA), indicating oxidative stress, which was effectively mitigated by the extract, suggesting potential antioxidant properties.

Conclusion: The aqueous ethanolic leaf extract of *Ficus capensis* demonstrated antidepressant-like effects in the clonidine-induced rat model of depression. These effects may be attributed to the preservation of monoamine neurotransmitters and antioxidant properties.

Keywords: depression, antioxidant, serotonin, norepinephrine

Evaluation of the Biochemical Effect of Aqueous Leaves Extract of *Basella alba* on Wistar Rats Fed with Bouillon Cubes

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Background: The use of bouillon cubes as a sweetener in daily cooking has remained a long-term tradition. Despite the mineral fortification of bouillon cubes, its long-term adverse effect due to frequent consumption is yet to be fully established. The safety and biomedical significance of this widely used food additive is still an area of research deliberation. The possible protective effect of *Basella alba* extract on long term consumption of bouillon cubes is yet to be fully elucidated. Therefore, this study evaluated the biochemical effect of the aqueous leaves extract of *Basella alba* on Wistar rats fed with bouillon cubes.

Methodology: Twenty (20) albino Wistar rats were used for this study. They were distributed into four groups of five animals per group. Group A, the control group, orally received normal saline. Group B received a dose of 50 mg/kg bouillon cubes. Group C received 150 mg/kg of the *Basella alba* aqueous extract. Group D received a mixture of 200 mg/kg of the Bouillon cubes and *Basella alba* extract every day for 21 days and were monitored accordingly. Qualitative and quantitative phytochemical analysis and total antioxidant activities of the plant extract were evaluated. Blood samples from experimental animals administered with the bouillon cubes and *Basella alba* extract were taken by cardiac puncture for biochemical analysis spectrophotometrically. Statistical analysis was done by one-way analysis of variance (ANOVA) using windows SPSS software package.

Results: Phenol, tannin, alkaloid, cardiac glycosides, reducing sugar, saponin, and flavonoids were present while steroid, terpenoids, and phlobatanin were absent. The DPPH scavenging activity (% Inhibition) of the *Basella alba* aqueous extract at 25, 50, 75, and 100 µg/ml revealed a dose dependent antioxidant activity of 42.75, 51.81, 67.88, and 77.46 compared to ascorbic acid standard control of 52.54, 64.31, 79.17, and 91.67 respectively (p<0.05).

Conclusion: Bouillon cubes and *Basella alba* extract consumption did not show any adverse effect on the experimental animals. The aqueous extract enhanced antioxidant activity and the concentration of *in vivo* antioxidant enzymes. Therefore, bouillon cubes may be presented as a safe food additive. *Basella alba*'s therapeutic mode of action and safety profile should be explored as a potential nutraceutical for novel drug discovery.

Keywords: *Basella alba*, bouillon cubes, phytochemicals, antioxidants, food additive

Exploring Anti-Malarial Efficacy: A Bioactivity-Guided Study on Solvent Fractions from *Combretum glutinosum* Root Extract in *Plasmodium berghei*-Infected Mice

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Background: *Combretum glutinosum* Perr., family Combretaceae is a small tree native to Africa with a long history of traditional use in treating infection, cancer, and malaria. Drug resistance poses a challenge to malaria control measures. The growing resistance of malaria parasites to chemotherapy and the increasing resistance of vectors to insecticides necessitates the development of safer, more potent, and novel anti-malarial drugs. This study therefore was initiated to compare the antimalarial activity of various fractions of *Combretum glutinosum* against *Plasmodium berghei*-infected mice and to further ascertain the anti-malarial activity of the most active fraction.

Methodology: The air-dried and pulverized root of *Combretum glutinosum* was extracted sequentially with solvents of differing polarity viz n-hexane, ethyl acetate, and methanol using a Soxhlet apparatus. The fractions were evaporated to dryness and the percentage yield was calculated. A preliminary phytochemical study following standard procedures and oral acute toxicity testing using Lorke's method were carried out on the three fractions. A pilot study was done to determine the most active fraction of the plant using 500 mg/kg of each fraction sample against *Plasmodium berghei*-infected mice with chloroquine and artemether/lumefantrine as positive control and normal saline as negative control. The best fraction was then subjected to antimalarial studies using chemo-suppressive, curative, and prophylaxis tests at doses of 125, 250, and 500 mg/kg. The level of parasitemia in the infected mice for each test was determined.

Results: The percentage yield of the n-hexane, ethyl acetate, and methanol fractions were found to be 2.6, 1.3, and 4.7% respectively. Saponins, steroids, and phenolic compounds were each present only in n-hexane, ethyl acetate, and methanol fractions respectively. All fractions showed no obvious signs of toxicity and/or mortality at all dose levels in acute toxicity testing and thus have oral LD₅₀ greater than 5000 mg/kg in mice. In the pilot study, parasitemia was significantly reduced ($p < 0.001$) by the n-hexane (96.4%) and methanol (93.99%) fractions at 500 mg/kg when compared to the negative control. Ethyl acetate fraction trailed behind with a percentage reduction of 84.51%. A greater reduction (96.40%) was seen with the n-hexane fraction which was better than that of both chloroquine (90.90%) and artemether/lumefantrine (95.76%). The n-hexane fraction at all doses

significantly reduced the parasitemia in chemo-suppressive, curative, and prophylaxis tests with the greatest reduction seen at 500 mg/kg in the prophylaxis (98.8%) test.

Conclusion: The findings showed that the oral LD₅₀ of the fractions (n-hexane, ethyl acetate, and methanol) of *Combretum glutinosum* is greater than 5000 mg/kg. *Combretum glutinosum* is endowed with antimalarial properties. The varying degrees of antimalarial activity in the fractions suggest that non-polar and polar principles could be responsible for the observed activity. The activity observed could be due to the presence of secondary metabolites that act independently or in synergy. Even though the n-hexane fraction showed notable activity in chemo-suppressive, curative, and prophylaxis tests, the best activity was seen in prophylaxis treatment. Further studies are ongoing to isolate and characterize the compound responsible for this activity.

Keywords: malaria, *Combretum glutinosum*, *Plasmodium berghei*, chloroquine, parasitemia

Extract of Teak Leaf (*Tectona Grandis*): An Alternative Broad Spectrum Antibiotic Product to Selected Over-The-Counter Antibiotic Drugs

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Background: Rising cases of microbial infections globally is a great call for concern. Some of the infectious diseases studied so far keep changing pathogenetically and symptomatically. The problem of resistance that bacteria develop against antibiotic drugs has plagued antibiotic therapy from the earliest days. The spread of such bacterial resistance is caused by the indiscriminate and inaccurate use of antibiotics. An antibiotic may destroy virtually all the bacteria causing certain disease in a patient, but a few bacteria may still survive because genetically, they are less vulnerable to the effects of the drug. Over-the-counter antibiotic drugs with narrow or broad spectrum of activities are being used over the years but these are not without triggering other medical conditions in the users due to contraindications and side effects.

Methodology: This research work compares the spectra of antibiotic activities of the crude leaf extract of *T. grandis* collected in Bali metropolis, Taraba State, Nigeria on six selected pathogenic bacteria (three Gram positive - *Staphylococcus aureus*, *Streptococcus pneumonia* and *Streptococcus pyogenes*; and three Gram negative; *Escherichia coli*, *Klebsiella pneumonia* and *Pseudomonas aeruginosa*) with those of five over-the-counter antibiotic drugs (Ciprofloxacin, Chloramphenicol, Amoxicillin, Ampicillin and Azithromycin. Agar well diffusion method was employed, using dimethyl sulfoxide (DMSO) as control. Zones of inhibition were measured in millimeter and the result compared with the Karby-Bauer antimicrobial chart.

Results: The result showed that *Staphylococcus aureus* was resistant to amoxicillin, ampicillin and ciprofloxacin with zone of inhibition of 16.4mm, 27.5mm and 13.0mm respectively while moderate sensitivity was recorded for azithromycin with 16.2mm while high susceptibility to chloramphenicol was observed at 23.0mm. The resistance to amoxicillin and ampicillin is unconnected to the strain

of *Staph. aureus* used, Methicillin Resistant *Staphylococcus aureus* (MRSA). To *T. grandis* extract, 19.7mm indicates moderate susceptibility of *Staph. aureus*. *Streptococcus pneumonia* and *S. pyogenes* are Group A Streptococci and they both demonstrated high susceptibility to all the antibiotics including *T. grandis* extract. Higher susceptibility to the plant extract was recorded in the latter with 26.0mm. *E. coli* was sensitive to all the tested antibiotics; highest sensitivity was seen in azithromycin with 26.3mm while the least was observed in chloramphenicol with zone of 16.4mm. Moderate sensitivity to *T. grandis* at 19.5mm was also observed. *Klebsiella pneumonia* showed high sensitivity to ciprofloxacin with 23.8mm, moderate sensitivity to chloramphenicol, azithromycin and the leaf extract with 17.0mm, 15.0mm and 16.5mm respectively. Very high resistance was observed against amoxicillin and ampicillin at 6.3mm and 8.8mm respectively. Same was observed in *Pseudomonas aeruginosa* against other antibiotics except in ciprofloxacin where susceptibility was established with 21.7mm zone and moderate sensitivity to the leaf extract with 18.2 was observed.

Conclusion: Considering the results of the research work, extract of the leaf of *T. grandis* is a potential broad-spectrum antibiotic and a safer alternative to over-the-counter antibiotic drugs being a natural product, but further research should be conducted to ascertain the correct concentrations and the possibility of synergistic activities with other natural products with antibiotic activities.

Keywords: microbial infections, microbial resistance, antibiotics, *Tectona grandis*

Heavy Metals Evaluation and Median Lethal Dose of the Methanol Leaves Extracts of *Moringa oleifera* Lam. (Moringaceae) and *Carica papaya* L. (Caricaceae)

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Background: Traditional medicine has been recognized as one of the major components of treatment for many diseases all over the world. Many studies showed that herbal specimens could be contaminated with heavy metals which could be detrimental to the health of the consumers if their concentrations exceed the allowable limits, thus, the present study was aimed at evaluating the levels of heavy metals, phytochemical constituents and median lethal dose (LD₅₀) of the methanol leaves extracts of *Moringa oleifera* and *Carica papaya*.

Methodology: The heavy metals and phytochemical constituents were evaluated using standard qualitative methods, while the median lethal dose (LD₅₀) was determined using Lorke's method.

Results: The results showed that zinc, arsenic, copper, nickel, cobalt and manganese were detected in the leaves of both plants, while lead was only detected in the leaves of *Carica papaya*. However, none of the plants was found to contain cadmium. The phytochemical analysis revealed the presence of saponins, carbohydrates, flavonoids, tannins, cardiac glycosides and steroids in both extracts, while alkaloids were only detected in the methanol extract of *Carica papaya* leaves. On the other

hand, the median lethal dose (LD₅₀) of the two extracts was estimated to be above 5000 mg/kg body weight.

Conclusion: The findings in this study showed that both extracts are practically non-toxic, and the levels of heavy metals detected didn't exceed the permissible limits approved by the World Health Organization (WHO). Thus, the leaves of *Moringa oleifera* and *Carica papaya* are safe for human consumption.

Keywords: Heavy metals, phytochemical constituents, permissible limits, safe



Illuminating the Epidemiologic Triad of Human African Trypanosomiasis in Selected Hamlets, Oyo State, Nigeria: One Health Approach

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Background: Human African trypanosomiasis (HAT) also known as sleeping sickness is a vector-borne disease constituting serious public health concerns in sub-Saharan Africa with about 55 million people at risk. Its occurrence is driven by intact epidemiologic triad comprising *Trypanosoma brucei gambiense* (protozoan parasite), tsetse flies (haematophagous arthropod vector), human and animals (vertebrate hosts), and propitious environment. HAT transmission is distinctly geospatially confined to tsetse distribution belt; although, cases resulting from sexual, laboratory, and congenital transmissions has been reported outside tsetse distribution belt. Despite the advancement in diagnostics, the actual status of HAT in Nigeria is unknown due to waned surveillance and poor case-reporting, hence the specious categorization of Nigeria under 'zero case report' by WHO. This study employed One Health approach comprising human and animal populations survey, entomological and ecological assessments to illuminate the status of HAT in the study areas.

Methodology: Cross-sectional study design was adopted. Inclusion criteria were permanent residency in the study areas and informed consent. FTA dry blood blots were prepared from human and animal blood samples collected via finger prick and venipuncture respectively. Tsetse were captured using odour-baited biconical traps. Geospatial data of capture points were collected. Tsetse diversity, distribution, and preferred host were assessed. Trypanosome species in wild-caught tsetse, human and animal blood, and sources of tsetse blood meal were detected using colorimetric-LAMP. Epi Info and SPSS software were used for data management and statistical analyses. Geospatial representations of inferences were developed using QGIS software.

Results: Captured tsetse were *Glossina palpalis palpalis* with 24/142 (16.90%; 95% CI=11.14%-24.10%) *Trypanosoma brucei gambiense* infection rate. Humans were preferred bloodmeal source (10/24, 41.67%, $\chi^2=21.873$, $p<0.01$). Alaho has highest tsetse density 10.33F/T/D and human-tsetse contact with transmission risk index 80787.31. Anthropogenic activities and ecological conditions

elicited significant impacts on tsetse density ($p < 0.05$). Prevalence of *T. b. gambiense* among humans and domestic animals were 29/72 (40.28%, 95% CI=28.88%-52.50%) and 59/145 (40.69%, 95% CI=32.62%-49.15%) respectively. Oloya has highest HAT rate (11/35, 37.93%). Illiteracy ($\phi_c=0.4110$, $p=0.010$), game hunting (aOR=11.2584, 95% CI=0.6357-199.3841), livestock keeping (aOR=3.832, 95% CI=0.1697-86.5615), open defecation in the forest (aOR=18.3662, 95% CI=3.1133-108.3493) were significant occupational and behavioural determinants of HAT occurrence. Forest-related activities (aOR=100.9660, 95% CI >1.0E12) and tethering (aOR=0.2824, 95% CI 0.0943-0.8459) were significant determinants of infection in animals.

Conclusion: The study areas are HAT transmission hotspots with impending outbreak warranting treatment and intensified surveillance to identify other hotspots. Urgent One Health-guided strategic cross-sectoral and trans-disciplinary integrated control approach is imperative to prevent HAT an epidemic.

Keywords: tsetse fly, trypanosomiasis, Oyo, sleeping sickness, One Health

Inhibitory Effect of Methanol Extract of *Annona muricata* Flower on Postprandial Glucose Concentration in Diabetic Rats and its *In-vitro* and *In-silico* Mechanistic Properties

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Background: Diabetes mellitus is a major global cause of death. A management option is the inhibition of postprandial hyperglycaemia associated with the disease. The inhibition of postprandial hyperglycaemia is achieved by the inhibition of the activity of carbohydrate-metabolizing enzymes such as alpha-amylase, alpha-glucosidase, maltase, and sucrase. Unfortunately, the majority of the drugs able to inhibit these enzymes are associated with gastrointestinal side effects. Therefore, a search for an effective therapeutic alternative is essential, particularly from natural sources such as plants. Fortunately, phenolics have been observed to inhibit alpha-amylase-catalyzed reactions, and the methanol extract of *Annona muricata* (*A. muricata*) is known to contain a substantial amount of phenolics, namely ellagic acid, vanillic acid, quercetin, ferulic acid, and caffeic acid. Therefore, this study investigated the inhibitory effect of the methanol extract of *A. muricata* flower on postprandial glucose concentration in diabetic rats. Its alpha-amylase inhibitory property and molecular docking attributes were assessed to elucidate the mechanism of action of the extract.

Methodology: The powdered sample of *A. muricata* was extracted in methanol to obtain the phenolic extract. Diabetes mellitus was induced using streptozotocin and nicotinamide. The inhibitory effect of the extract on postprandial glucose concentration was assessed in diabetic rats using starch as the carbohydrate source and the alpha-amylase inhibitory property of the extract was assessed using starch as the substrate. The computational analysis of the interaction of the phenolics (obtained from a literature search) with human pancreatic alpha-amylase (PDB ID: 2QV4) was investigated via

molecular docking and visualization techniques and the compounds were taken through bioavailability estimation.

Results: The in-vivo study revealed that the extract inhibited postprandial hyperglycaemia as observed in the area under the curve of the diabetic control (14472.00 ± 1215.90 mg. min/dL) compared with the extract-treated group (11344.00 ± 410.62 mg. min/dL). Also, the extract demonstrated in-vitro alpha-amylase inhibition at 1.5 mg/mL to $35.31 \pm 1.59\%$. Kinetic analyses revealed that the extract exhibited a non-competitive inhibition pattern on alpha-amylase-catalyzed reaction at 1.5 mg/mL. The in-silico study revealed that the phenolic-ellagic acid-possessed the highest binding affinity (-7.5 Kcal/mol) to human pancreatic alpha-amylase but failed the insaturation and polarity bioavailability tests.

Conclusion: It can be concluded that the methanol extract of *A. muricata* flower possesses the ability to manage postprandial hyperglycaemia associated with diabetes mellitus via the inhibition of the alpha-amylase-catalyzed reaction. Also, ellagic acid is the primary phenolic involved in the alpha-amylase inhibitory activity of the extract. However, the bioavailability estimation of ellagic acid shows that it needs to be optimized to allay possible bioavailability concerns.

Keywords: *Annona muricata*, phenolics, postprandial hyperglycaemia, alpha-amylase inhibition, diabetes mellitus



Investigating Hydrokinetic Properties for Aquifer Zonation Applying Indexed-Based Models

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Background: Groundwater serves as a useful source of freshwater for man. Its discrimination into hydraulic flow units (HFU), assessment and protection from potential exposure to contamination is imperative, as failure in its exploitation and remediation when contaminated is extremely challenging.

Methodology: Electrical resistivity method employing Schlumberger electrode configuration was carried out in thirty (30) different locations of Nsukka area with the aim of discriminating the study area aquifer sequence into HFUs. Physicochemical analysis of groundwater was carried out on five groundwater samples in the study area with the aim of evaluating the degree of groundwater pollution indices and the risks associated with the pollution of groundwater.

Results: The vertical electrical sounding survey delineated four to five geoelectric layers with fourteen (14) characteristic curve types. The utmost exploitable potential water-bearing geologic units in the study area were mostly delineated within the fourth layers with lithological nature ranging from fine to medium coarse-grained sand. Aquifer discrimination into hydraulic flow units revealed a total of five classes of HFUs along the aquifer sequence of the study area. These hydraulic flow units based on efficiency ranking and classification, range from barrier units with tight flow

capacity efficiency to superconductor units with good flow capacity efficiency. The results of Physicochemical analysis on groundwater samples in the study area revealed an acidic (pH = 4.6) to alkaline (pH = 7.2) groundwater condition, with an average pH range of 5.6 indicating a weak acidic condition. Results of the pollution indices characterized the groundwater with a very high degree of contamination and a moderate to very high pollution index of groundwater. Groundwater pollution risk index results delineated an integrated potential ecological risk ranging from moderate to very high risk. Human health risks delineated an adverse potential non-carcinogenic health risk with target hazard indices greater than one in all the studied groundwater. The health hazard quotient result identified cadmium and arsenic as the dominant contributing metals to the hazard quotient in the study areas' groundwater. Results of the hazard quotient also classified the children with a higher vulnerability rate to potential risks arising from heavy metal intake through contaminated groundwater consumption compared to the adults.

Conclusion: The results obtained in this study will serve as a guide and sensitization tool to the inhabitants and governmental bodies in understanding the pollution degree of the area's groundwater and the flow efficiency of its aquifer sequence.

Keywords: Lorenz-plot, hydraulic, physicochemical, non-carcinogenic, stratigraphic



Investigation of Proinflammatory Genes Expression in STZ-Induced Diabetic Rats Treated with Extract of *Hibiscus rosa-sinensis* Flower

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Background: Diabetes mellitus, a metabolic disorder of carbohydrates and fat, which results from the deficiency of insulin secretion or varying degree of insulin resistance, is a major public health problem and has become a global menace. This study investigated the expression of proinflammatory genes in STZ-induced diabetic rat model, treated with *Hibiscus rosa-sinensis* flower extract.

Methodology: Diabetes was induced by intraperitoneal injection of streptozotocin (65 mg/kg). Diabetic rats were divided into 6 groups which includes the diabetic control, another group treated with 100 mg/kg of sildenafil citrate and 4 other groups treated with varying concentrations of aqueous extract of *Hibiscus rosa-sinensis* flower (50, 100, 200 and 1000 mg/kg). Another group was administered only water throughout the experiment as normal control. Treatment was administered for 21 days. The mRNA expression of the pro-inflammatory cytokines (IL-6, IL-1 β and TNF- α) in the pancreas, kidney, liver and brain of the experimental animals were investigated using RT-PCR. The fasting blood sugar and body weight of the experimental animals was also monitored throughout the experiment.

Results: Oral administration of *Hibiscus rosa-sinensis* flower extract (100, 200 and 1000 mg/kg) to STZ-induced diabetic rats significantly ($p < 0.05$) down-regulated the pancreatic mRNA expression

of IL-6, IL-1 β and TNF- α when compared with the diabetic control group. 200 and 1000 mg/kg of the extract down-regulated ($p<0.05$) the mRNA expression of TNF- α and IL-6 in the kidney when compared with the diabetic and normal control groups. 100, 200 and 1000 mg/kg of the extract significantly up-regulated ($p<0.05$) the mRNA expression of IL-6 in the liver when compared with the diabetic and normal control groups. 200 and 1000 mg/kg of extract significantly down-regulated the mRNA expression of TNF- α in the brain of diabetic rats. In addition, the oral administration of *Hibiscus rosa-sinensis* flower extract (50, 100, 200 and 1000 mg/kg) significantly ($p<0.05$) reduced the fasting blood sugar and increased the body weight of experimental animals.

Conclusion: Observation drawn from this study suggests that *Hibiscus rosa-sinensis* flower extract possess antidiabetic potential and can suppress the JAK/STAT pathway thereby regulating the mRNA expression of the proinflammatory cytokines.

Keywords: *Hibiscus rosa-sinensis* flower, diabetes mellitus, gene expression, JAK/STAT pathway, proinflammatory cytokines

Kogi African Medicinal Plants Healthcare Information System: A Data Mining Approach

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Background: In recent times, the use of medicinal plants as an alternative or supplement for curatives for healthcare problems cannot be overemphasized. Although Nigeria has, all it takes to produce and market herbal supplements, the country still depends on imported products; this may not be farfetched from the limited ethno-botanical knowledge of indigenous medicinal plants of our richly endowed green vegetation. One of the major strategic goals of the World Health Organization identified that a key priority for the Member States is the strategic gathering, analysis, and synthesis of data on Traditional & Contemporary Medicine (T&CM) use and the development of a national research agenda. The advent of the recent economic downturn and untold hardship in Nigeria has made conventional orthodox medicine inaccessible and hence forced 47.7% of the Nigerian population living below the poverty line to seek alternatives in managing health conditions; the need to seek available alternatives to ameliorate the high cost of family medical bills using herbs initiated this research.

Methodology: A hundred and fourteen (114) medicinal plants species belonging to 58 plant families were compiled and authenticated by a plant biologist. The corresponding names of the plants in the three major local languages of Kogi State, their common names, parts of the plants used for medicinal purposes, sample pictures and their medicinal uses were compiled in a repository database. An association rule-mining algorithm (Apriori algorithm) was adapted to implement the classification of diseases and linking them with corresponding medicinal plant(s) that can cure them.

The model was further deployed into a web based application (KAMPHIS - Kogi African Medicinal Plants Healthcare Information System) built using these tools - HTML, CSS and JavaScript for the frontend design, Python programming language for the backend, and MySQL for the database.

Results: The developed model classified the frequently associated ailments to the medicinal plants. The model was used to implement a web-based application called- KAMPHIS, where a user has the privilege to view and access information on all the possible medicinal plants that can cure a particular ailment existing in the compiled repository using the local medicinal plant name or ailment to query the database. Other accessible information are botanical names, common names, pictures, and the part of the medicinal plants to be used.

Conclusion: With the effective use of KAMPHIS, healthcare professionals, individuals, and researchers using the indigenous names of the plants for the production of indigenous drugs and herbs that have higher efficacy, could extract more information that is valuable from the medicinal plants' database for better decision-making.

Keywords: medicinal plants, ailments, Apriori algorithm, association rule mining, KAMPHIS

Lycopene Attenuates Nicotine-Induced Nephrotoxicity in Female Wistar Rats

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Background: Exposure to nicotine, either via active or passive smoking is strongly shown to augment kidney failure in various animal models. In this study, we investigated the effect of nicotine-induced nephrotoxicity in the female Wistar rat model.

Methodology: Thirty (30) female Wistar rats were grouped into 5 different groups. Group 1 rats were given 10ml/kg body weight of distilled water. Group 2 received corn oil volume of approximately 2ml/kg body weight. Group 3 received 1mg/kg body weight of nicotine throughout the whole course of the experiment. Group 4 received 10mg/kg body weight of Lycopene dissolved in corn oil for 14 days and 1mg/kg body weight of nicotine for another 14 days. Group 5 received 1mg/kg body weight of nicotine daily for 14 days and 10mg/kg body weight of Lycopene dissolved in corn oil for another 14 days.

Results: Upon completion of treatment, body weight and food intake was observed for changes as well as kidney injury markers. Administration of nicotine alone for 28 days resulted in significant renal impairment shown by marked increase in plasma creatinine, BUN and decrease in uric acid, total protein and albumin. Pretreatment with Lycopene and Co-administration Lycopene with

nicotine however attenuates these changes by decreasing serum creatinine, BUN, uric acid, total protein and albumin.

Conclusion: This study suggests that treatment of animals with Lycopene provides nephroprotective effects against nicotine-induced nephrotoxicity.

Keywords: lycopene, nicotine, renal dysfunction, nephrotoxicity, rat



n-Hexane Sub-fraction of *Uvaria chamae* (p. Beau.) Roots Halted Chlorpromazine-Induced Hyperprolactinemic Female Wistar Rats

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Phytomedicine, Toxicology, Reproductive and Developmental Biochemistry Research

Background: This study investigated the effects of administration of fractions of *Uvaria chamae* roots in chlorpromazine (CPZ)-induced hyperprolactinemia in female rats.

Methodology: A total of one hundred and ten female rats (208.15 ± 9.46 g) were assigned into 7 groups. Animals in Group I received 0.5 ml of 5% dimethyl sulfoxide (DMSO) only while the 7 days CPZ-treated female rats (to induce hyperprolactinemia) in groups II, III, IV, V, VI and VII received 5% DMSO, 2.5 mg/kg body weight of bromocriptine (reference drug), 2.83 mg/kg body weight of n-hexane sub-fraction A, B, C and D respectively for 28 days.

Results: Administration of CPZ increased ($p < 0.05$) the levels of prolactin, testosterone, serotonin, thyroid stimulating hormone (TSH), adrenocorticotrophic hormone (ACTH), tyrosine hydroxylase (TH), monoamine oxidase (MAO) and interleukin 1 β (IL-1 β) and reduced ($p < 0.05$) the levels of progesterone, estradiol, follicle stimulating hormone (FSH), luteinizing hormone (LH), triiodothyronine (T_3), tetraiodothyroxine (T_4), oxytocin, growth hormone (GH), dopamine and dopamine D2 receptor (DD2R). In contrast, n-hexane sub-fraction A (n-HSFA), B (n-HSFB), C (n-HSFC) and D (n-HSFD) significantly ($p < 0.05$) reduced the CPZ-treatment related increases in the levels of prolactin, testosterone, serotonin, TSH, ACTH, TH, MAO, IL-1 β and increased the levels of CPZ-treatment related reduction in the progesterone, estradiol, FSH, LH, dopamine, T_3 , T_4 , oxytocin, GH, dopamine and DD2R. The n-HSFC and n-HSFD exhibited the most profound effects on the levels of prolactin, progesterone, FSH, LH, estradiol and dopamine when compared with the DMSO naive control and bromocriptine-treated control female rats. The high-performance liquid chromatographic analysis fingerprint of the most active sub-fractions revealed the presence of uvarinol, chamuvaritin, armepavine, corydine, chamanen, quercetin, linalool, germacrene D, limonene, terpinene in n-HSFC with an addition of 1_8 cineole in n-HSFD. The CPZ-induced remarkable increase in the lobular pattern distinct lumina in the alveoli, characterised by partly defined double layered epithelium in the female mammary gland. Administration of n-HSFC and D restored the tubulo-alveoli female pattern to a well-defined cuboidal branching terminal duct with lobular units and little alveoli budding off the duct which is characterized by scant basophilic non vacuolated epithelium in female rats.

Conclusion: The study concluded that n-HSFD of *Uvaria chamae* root exhibited the most anti-hyperprolactinemic activity in female rats. The study recommended that n-HSFD be explored for clinical trials towards the formulation of drug leads for the management of hyperprolactinemia.

Keywords: Annonaceae, anti-hyperprolactinemia, *Uvaria chamae*



Perinatal Exposure to Cigarette Smoke Can Alter Reproductive Indices and the Antioxidant Defence System in the Sex Organs of Male Offspring in Wistar Rat Model

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Background: Cigarette smoke exposure during pregnancy into infancy affects human growth and development in early life and adulthood. The testes and accessory male reproductive organs are highly susceptible to oxidative damage and endocrine disruption from stress caused by exposure to environmental influences. Therefore, this study aimed to investigate the effects of exposure to cigarette smoke on reproductive indices, androgen function, and the antioxidant defence system in the testes and accessory sex organs of male pups using a perinatal whole-body exposure protocol in the Wistar rat model.

Methodology: Pregnant Wistar rats were exposed to normal air (control) or smoke from two Rothmans cigarettes (nicotine <1mg, tar <8mg) in a whole body exposure chamber twice daily for six weeks from gestational day 1 to weaning (postnatal day [PND] 21). Male offspring were evaluated on anogenital distance, body weight, and morphometry from PND 1 to 48. On PND 49, the pups' anogenital distance, penile length, increase in body weight and final weights were recorded. All male pups were euthanised, and blood samples were withdrawn and processed for serum testosterone assays. The testes and epididymis were collected and weighed. Biochemical evaluations on oxido-inflammatory markers (Superoxide Dismutase, Catalase, Reduced Glutathione, and Lipid Peroxidation) and testicular function markers (Glucose-6-Phosphate Dehydrogenase, Alkaline Phosphatase, Acid Phosphatase, and Lactate Dehydrogenase) were performed. All data collected were analysed statistically with a level of significance taken at 5%.

Results: The male offspring from dams exposed to cigarette smoke during pregnancy and into early infancy had physical malformations and abnormal growth patterns, reduced penile lengths, impaired testosterone, antioxidant enzymes, and spermatogenic enzyme activity, and increased lipid peroxidation in the tissues of the testes and epididymis.

Conclusion: These findings imply that exposure to cigarette smoke during gestation and early infancy can disrupt the antioxidant defence system and impair the reproductive capacity of the testes and accessory sex organs of male pups in the first filial generation. These insights provide further information on the adverse effects of exposure to environmental tobacco smoke on early-life growth and development, general health and well-being, and overall quality of life.

Keywords: cigarette smoke, reproductive development, testis, testosterone, oxidative stress



Pharmacological Evaluation of *Musanga cecropioides* Extracts for Anti-Diarrhoeal Activity in Mice

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Background: Diarrhoea is a common gastrointestinal disorder causing significant morbidity and mortality, particularly in children. This study aimed to evaluate the anti-diarrhoeal potential of *Musanga cecropioides*, a traditional medicinal plant.

Methodology: Castor oil-induced diarrhoea and enteropooling models were employed in albino mice to assess the effects of aqueous and methanol extracts of *M. cecropioides* leaves and roots, as well as crude root sap. The animals were treated with various doses of the extracts, loperamide (a standard drug), and normal saline as controls. The number of diarrhoeal faeces and the volume of intestinal content were measured and used to calculate the percentage inhibition of diarrhoea and enteropooling, respectively.

Results: Results demonstrated that all extracts significantly inhibited castor oil-induced diarrhoea compared to the control group. The highest percentage inhibition of diarrhoea was observed with the methanol leaf extract at 50 mg/kg (71.11%) and the methanol root extract at 50 mg/kg (88.89%). In the enteropooling model, all treatments led to a significant reduction in the volume of intestinal content compared to the control group. Notably, the aqueous root extract at 200 mg/kg (87.59%) and methanol root extract at 50 and 200 mg/kg (78.10% for both doses) showed significant inhibition of enteropooling. Furthermore, the crude root sap at 0.5 and 2 ml/kg demonstrated substantial inhibition of enteropooling (70.80%).

Conclusion: These findings indicate the potential of *M. cecropioides* extracts as effective anti-diarrhoeal agents supporting the traditional use of *M. cecropioides* in the management of diarrhoea and highlighting its potential for the development of new anti-diarrhoeal therapies.

Keywords: diarrhoea, *Musanga cecropioides*, anti-diarrhoeal activity, castor oil-induced diarrhoea, traditional medicine



Public Health Risks and Biomarkers in Laboratory Mice Exposed to Air Emissions at High-Density Traffic Sites in Ojota, Lagos, Nigeria

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Traffic air pollution, arising from diverse human activities and primarily fueled by fossil fuel combustion, poses a global health threat, and demands urgent comprehensive strategies for mitigation. Therefore, the aim of this research is to investigate the effects of emissions in high-density traffic in Ojota, Lagos. In a 90-day study, 60 laboratory mice (30 exposed to high-density traffic air emissions in Ojota, and 30 in a clean-air environment at the Zoology laboratory, University of Lagos) were housed in specially designed cages with sex-segregated sections. Oxidative stress, hepatic histological and behavioural indices were assessed during the study period. After a 30-day period of exposure, the following results were recorded: antioxidant assays revealed an elevated superoxide dismutase (SOD) (421.7 min/mg) in traffic-exposed mice compared to the control mice (328.65 min/mg); hepatic histological biomarkers in traffic-exposed mice shows distended vessel in the aveoli wall and many red blood stain and range of mild and severe vascular congestion with edema in the lung, contrasting with normal histological features in the control group. Groups of mice exposed to traffic air emission exhibited heightened aggression and 13.3% mortality (3 males and 1 female) was recorded after 45 days, compared to stable behavior observed in mice exposed to control site. The short term (24 h) air quality index for PM_{2.5} at the traffic site was 35.2 µg/m³ which exceeded the WHO guideline of 15µg/m³. Noise levels recorded ranged from 78.1 to 92 decibels, surpassing the National Environmental Standards and Regulations Enforcement Agency's limit of 65 decibels for outdoor commercial environments. Biomarker experiments unveiled respiratory health effects of traffic air emissions, emphasizing the need for further studies on chronic impacts, especially on the brain and liver. This study is crucial for policymakers, the result is aligned towards meeting the 3rd, 11th, and 13th sustainable development goals, which are: good health and wellbeing, sustainable cities and communities, and climate action, respectively.



Serological Evidence of Tick-borne Relapsing Fever in Nigeria: A Preliminary Report

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Background: Relapsing fever is a recurrent febrile disease caused by several species of the spirochete *Borrelia* and transmitted by lice or ticks. In various regions of the world, several species

of *Borrelia* have been recognized as endemic, with variation in their enzootic cycles and having the capability of infecting humans mainly as accidental dead-end hosts. In the past, louse-borne relapsing fever had always kept tick-borne relapsing fever from sight and was more famous and epidemiologically relevant in view of its epidemic occurrence. In the West African sub region, tick-borne relapsing fever accounts for about 13% of febrile illnesses and in the endemic regions of East Africa, it constitutes great mortality among children. Over the last decades, documented cases were almost exclusively restricted to the Horn of Africa and louse-borne relapsing fever was increasingly considered a disappearing, neglected tropical disease (NTD). However, the disease has recently re-emerged as non-malaria febrile illness among East African migrants arriving from Somalia, Eritrea and Ethiopia to Europe. Moreover, diagnosis remains a challenge and there are no available serological tests for *Borrelia spp.* The present study was aimed at determining the incidence and/or prevalence of relapsing fever in Sokoto, Nigeria using an ELISA kit developed at the Institute of Medical Microbiology and Infection Control, Goethe University. The kit targets antibodies produced against the *Borrelia* complement inhibition via C4BP domain (CihC), which is common to all *Borrelia spp.*

Methodology: An initial descriptive, cross-sectional study was conducted in Sokoto State, Nigeria using samples of patients with fever of unknown origin, who had been treated for other infectious diseases including malaria and typhoid fever without improvement. Ethical clearance was given by the State Ministry of Health and Teaching Hospital, and samples were collected from across secondary and tertiary hospitals in the state. A total of 70 blood samples were collected and plasma were used to run the ELISA assay targeting *Borrelia spp.* IgM and IgG.

Results: Out of the 70 samples, 16 (22.86%) were positive, 17 (24.29%) were borderline, while 37 (52.86%) were negative for IgM. Similarly, 4 (5.71%) were positive, 3 (4.29%) were borderline, while 63 (90%) were negative for IgG.

Conclusion: The results showing a whopping 28.57% positivity for IgM or IgG suggest that relapsing fever caused by *Borrelia spp.* is one of the causes of fever in Sokoto State, Nigeria and possibly other states in Nigeria. This is an ongoing study, and the final results may even show a higher prevalence especially considering that some of the borderline cases (28.58%) may also be positive. Thus, there is the need for clinicians to actively consider screening for *Borrelia spp.* when working up patients with recurrent fever. Our results could potentially revolutionize the management of infectious disease in the country.

Keywords: *Borrelia*, CihC, ELISA, fever



Toxicological Assessment of Chromatographic Fraction Obtained from Aqueous Extract of *Acacia nilotica* Seedpod in Experimental Rats

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Background: Traditional medicine is extensively utilized throughout the world to treat an array of maladies. Evaluation of toxicity in traditional herbal treatments is often overlooked.

Methodology: The toxicological effect of the chromatographic fraction B of *Acacia nilotica* on serum biochemical parameters in rats was investigated. The aqueous extract of *Acacia nilotica* was subjected to solvent partition using hexane, butanol and ethylacetate. The n-butanol fraction was subsequently subjected to column chromatography. Column fraction B was administered to rats in graded doses of 5mg/kg, 10mg/kg and 15mg/kg bw orally for twenty-eight days.

Results: The Packed cell volume (PCV), hemoglobin (Hb), red blood cell (RBC) and white blood cell (WBC) levels were not significantly ($p > 0.05$) different at all same dose levels when compared with the control group. Serum total protein, globulin, total and conjugated bilirubin, urea, creatinine and uric acid levels of group administered the highest dose were significantly reduced ($P < 0.05$) when compared to the control group. However, at concentration of 5mg/kg bw and 10mg/kg bw of the administered extract there was no significant ($P > 0.05$) changes in total protein, albumin and globulin levels, suggesting no major adverse effects on protein metabolism or liver function. Activity of liver aminotransferases are significantly increased ($P < 0.05$) at the highest dose level (15 mg/kg bw). The activity of kidney alkaline phosphatase was significantly reduced ($P < 0.05$) at the highest dose level.

Conclusion: The toxicological assessment suggests that administration of Fraction B of *Acacia nilotica* pod should be with caution, as higher dose may cause mild alteration in kidney and liver function.

Keywords: *Acacia nilotica*, chromatography, solvent partition toxicity

Type 2 Diabetes: Evaluating the Effects of Claramine on Insulin- mediated Glucose Regulation in Hepatoma (HepG 2) Cell Line

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Diabetes is a chronic, metabolic disease characterized by elevated levels of blood glucose (or blood sugar), which leads over time to serious damage to the heart, blood vessels, eyes, kidneys and nerves. The most common is type 2 diabetes, usually in adults, which occurs when the body becomes resistant to insulin or doesn't make enough insulin. Protein tyrosine phosphatases (PTPs) are critical antagonist of insulin receptor (IR) signalling. Their inhibition with pharmacological inhibitory agents can play the role of insulin thus facilitating the uptake of glucose and the inhibition of

lipolysis. Elevated PTPIB activity underlies insulin resistance in type 2 diabetes. Several experiments have shown that PTPIB is implicated in glucose regulation obesity and type-2 diabetes. Claramine is a novel synthetic chemical agent which possess selective inhibitory activity against PTPIB. This research was aimed at unveiling the effects of claramine on insulin-mediated glucose regulation in Hepatoma (HepG2) cell lines. Research materials including Hep G2 cell line, T-75 flasks, Eppendorf tubes, 96-well plates, Bradford reagent test kit, cell culture media (Dulbecco's Modified Eagle Medium) (DMEM) and all reagents for buffer preparation was purchased. First experiment was conducted to test the viability of the HepG 2 cell lines using standard procedure. Second round of experiment was conducted to culture the HepG 2 cells at 37°C. The cells were divided into 6 wells plates and allowed to adhere for 24 hours. After adherence, the cells were treated with high glucose and different concentrations of insulin and claramine. The determination of glucose utilisation by the cells was done with multiscan-FC spectrophotometer at 540nm and the amount of glucose utilised by the cell was calculated and use for protein normalisation. Combination of 50nm of insulin with various concentrations of claramine showed trend in the uptake of glucose by Hep2 cells with highest uptake at 2.0um of claramine. However, with 100nm insulin there was relative little and irregular variation in glucose uptake by HepG 2 cells with different concentrations of claramine. Also, glucose utilisation with respect to joint variation of insulin and claramine concentrations showed increase uptake at 50nm insulin and 1um claramine. Hepatoma cell lines can be used to investigate the glucose uptake and glucose metabolism in hepatocyte. claramine is a first class highly selective inhibitor of protein tyrosine phosphatase IB (PTPIB). It is therefore eminent that inhibitors of PTPIB plays important role as efficient therapeutic target for type-II diabetes and obesity by increasing insulin and leptin sensitivity.

Keywords: diabetes, insulin, PTPs, claramine, hepatoma cell line, metabolic disease



Ulcer Control Revolution: Acetovanillone from *Balanites aegyptiaca* Triumphs over Omeprazole in Virtual Experiments

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Background: Peptic ulcers are prevalent gastrointestinal disorders characterised by mucosal erosion and inflammation, often associated with *Helicobacter pylori* infection or prolonged use of nonsteroidal anti-inflammatory drugs (NSAIDs). Omeprazole, a proton pump inhibitor, is widely used as a standard treatment for peptic ulcers. However, concerns regarding its long-term use and potential side effects have prompted the exploration of alternative therapeutic options. In recent years, researchers have sought alternative therapies with fewer side effects, and the natural compound acetovanillone, derived from *Balanites aegyptiaca*, has emerged as a promising

candidate. This study investigates acetovanillone, a compound identified from the n-butanol extract of *Balanites aegyptiaca*, as a potential antiulcer agent, comparing its efficacy to omeprazole through in silico experimental studies.

Methodology: Acetovanillone was identified through GC-MS analysis of the n-butanol fraction of *Balanites aegyptiaca* stem bark aqueous extract. Molecular docking of the compound against three target proteins namely M₃ Muscarinic acetylcholine receptor (MAR), gastric proton pump (GPP) and pig gastric H, K-ATPase (PGHKA) was performed using Schrödinger Suite 2020-3 software. The pharmacokinetics and drug-likeness properties of this compound were assessed by using the SwissADME server. The ProTox-II online server was utilized in predicting the carcinogenicity, cytotoxicity, hepatotoxicity, immunotoxicity, mutagenicity, acute toxicity class and LD₅₀ of the compound. Molecular dynamic simulations and bioinformatics analysis were employed to assess the binding affinity and interaction of acetovanillone with ulcer targets.

Results: Results from the *in-silico* experiments revealed that acetovanillone exhibited a remarkable binding affinity to the targeted proteins, MAR and PGHKA potentially inhibiting acid secretion, a primary mechanism underlying ulcer formation, better than omeprazole suggesting that it could be promising in the development of a new antiulcer agent. Acetovanillone had hydrogen bonds with amino acids SER 151 and ASN 507 with MAR, CYS 813 and ASP 137 with GPP and LEU 811 with PGHKA. In molecular dynamic simulations, acetovanillone revealed good stability in the active site of the protein since significant conformational changes were not evident. Furthermore, it displayed a favourable safety profile of LD₅₀ of 9000 mg/kg as against omeprazole with LD₅₀ of 1000 mg/kg, and bioavailability characteristics, suggesting its potential as a promising antiulcer agent. It had no predicted toxicity, unlike omeprazole which was predicted to possess immunotoxicity potential.

Conclusion: While these in silico findings are compelling, further research involving in vivo experiments and clinical trials is essential to validate acetovanillone's therapeutic potential and safety profile. Nevertheless, this study serves as a critical stepping-stone in advancing our understanding of acetovanillone's role in ulcer management. In conclusion, acetovanillone derived from *Balanites aegyptiaca* extract presents a captivating prospect in the realm of ulcer management. Through in silico analysis, this natural compound has demonstrated superior binding affinities to key ulcer-associated targets when compared to omeprazole.

Keywords: acetovanillone, molecular docking, *Balanites aegyptiaca*, muscarinic acetylcholine receptor, ADMET studies



Undiagnosed and Unreported Human African Trypanosomiasis Cases in Non-HAT Focus: A Cryptic Threat to HAT/NTD Elimination

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Background: Human African trypanosomiasis (HAT) is one of the neglected tropical diseases targeted for elimination (interruption of transmission/zero cases) by 2030. The gambiense form (gHAT) accounts for >93% of global HAT cases and presents a chronic disease in West and Central Africa. It is characterized by low parasitemia and neurologic symptoms (hence the name “sleeping sickness”), with parasites crossing the blood–brain barrier and invading the central nervous system. The disease is often fatal without early diagnosis and prompt treatment, but recognizable symptoms may appear several months/years after infection. The number of reported cases has declined globally since the last epidemic (by 97%). In Nigeria, only one case (which was diagnosed in the UK) has been reported in the last decade. However, several studies suggest that silent human infections and animal carriers in/around HAT-endemic foci exist in Nigeria, and these could act as reservoirs of infection.

Methodology: To investigate if genetic exchange/hybridization between human-infective and animal-infective trypanosomes that could lead to disease re-emergence was ongoing in the field, we carried out a preliminary survey of patients attending a primary healthcare facility in Southeast Nigeria. Blood samples were collected from the hospital diagnostic laboratory and tested using various serologic and molecular diagnostic assays such as ELISA, CATT, IFAT, (q)PCR and sanger sequencing.

Results: The results showed a surprisingly high prevalence of HAT (4.3% of sampled population) in that location. This finding is surprising on two counts: 1. The sampled location was not previously considered a Human African Trypanosomiasis focus in Nigeria. 2. WHO has not recorded any HAT cases being reported from Nigeria in the last ten years (except for one case diagnosed in the UK in 2016). This raises a lot of concern about the true prevalence of HAT in Nigeria.

Conclusion: In addition to the obvious lack of surveillance, we realized that one of the greatest challenges for HAT elimination efforts/target in Nigeria is the lack of appropriate/adequate diagnostic tools and capacity to support indigenous surveillance and case detection. There is currently no laboratory capable of confirming HAT diagnosis in Nigeria, hence many suspected cases remain unconfirmed and unreported. Also, existing HAT diagnostic tools and tests are grossly inefficient and unavailable in the low-resource and low-prevalence settings in the endemic areas in Nigeria. Hence, developing improved diagnostic tools and building capacity for indigenous testing/confirmation are critical for adequate HAT surveillance and the achievement of the 2030 elimination target.

Keywords: gambiense HAT, African trypanosomiasis, sleeping sickness, neglected tropical diseases, HAT diagnosis



Vancomycin and Methicillin-resistant *Staphylococcus aureus* from Clinical and Food Samples: Guardians of Resistance and Virulence?

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Background: *Staphylococcus aureus* is a commonly isolated species and generally hosted in the nasal cavity of the healthy populace with no apparent clinical indication regardless of public health interventions to curb its spread. It is highly virulent and versatile, implicated in a wide range of severe nosocomial and community-acquired infections, and has also been reported to easily acquire simultaneous resistance to numerous antibiotics and encode several resistance and virulence determinants. The present study aimed to assess the occurrence of Vancomycin-resistant *S. aureus* (VRSA) and Methicillin-resistant *S. aureus* (MRSA), and also detect the possible presence of the associated resistance genes (*vanA*, *vanB*, *VanCI*, *mecA*, *mecC*, and *femA*) as well as virulence determinants *pvl*, *hlg*, and *spa* genes in recovered isolates from clinical and ready to eat (RTE) food sources in Osogbo, Southwest Nigeria.

Methodology: In total, 465 samples comprising clinical and RTE food samples were analyzed. Recovered isolates were characterized by conventional and molecular microbiological techniques. Phenotypic screening for resistance to vancomycin was done with the agar screening method and methicillin resistance via the disc diffusion method. Isolates positive for the above phenotypic screenings were confirmed as *S. aureus* via detection of the *nuc* gene. The molecular detection of resistance genes *vanA*, *vanB*, *VanCI*, *femA*, *mecA*, and *mecC* and virulence genes *luk-PV*, *hlg*, and Staphylococcal protein A (*spa*) gene was done by PCR using specific primers.

Results: Altogether, 138 (29.7%) VRSA and 59 (12.7%) MRSA strains were recovered phenotypically, and all were confirmed to possess the *nuc* gene. The highest proportion of VRSA was from meat pie fillings (46.0%), while the least proportion was from skin swabs (18.0%). For the MRSA, the trend in proportion was meat-pie fillings > donkunnu sauce > skin swabs and coleslaw mix. Only 3 (2.2%) isolates had *van* genes— 1 for *vanA* and 2 isolates for *vanB*, none had *vanCI* gene. For methicillin resistance genes, 114 (82.6%), 7 (5.1%), and 6 (4.3%) isolates had the *femA*, *mecA*, and *mecC* genes respectively. The *spa* gene was recovered in 77 isolates across all sample types, while only 8 isolates had the *pvl* gene. Overall, 83.3% (115/138) isolates carried either vancomycin or methicillin resistance genes, with co-detection observed in 13 of the 115 (11.3%); 55.8% (77/138) isolates carried virulence genes, with dual or multiple carriages observed in 15 of the 77 (19.5%); while co-detection of both virulence and resistance genes were observed in 73 (52.9%) isolates.

Conclusion: The present study shows the high incidence of VRSA strains with virulent traits in clinical and RTE food samples and underscores the urgent need to moderate this trend, particularly in the clinical and food processing settings. The results obtained are quite worrisome and portends an imminent threat to public health. These data can be useful for epidemiological and surveillance

purposes and help to keep track of the changing dynamics of these strains regarding virulence and resistance to antibiotics. These results may enhance clinicians' expertise to better control illnesses in which these organisms may be implicated and lower possible sequelae.

Keywords: VRSA, MRSA, virulence, *spa*, *femA*



SUB-THEME 3: SMART AGRICULTURE AND FOOD SECURITY

Characterization of Wild Lactic Acid Bacteria for Industrial Applications

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Background: Lactic acid bacteria (LAB) are the main bacteria used as raw materials in both the food (for the production of several dairy products such as yoghurt, cheese and lactic acid amongst others), and pharmaceutical industries (for drugs and cosmetics). The LAB strains include the genera of *Lactobacillus* and *Streptococcus*. Most often than not, this basic raw material is mostly imported consequently having its share of strain on the foreign exchange of the country despite the array of indigenous products yet to be fully harnessed in this clime.

Methodology: This study was therefore designed to characterize, identify, screen and develop some wild LAB strains for industrial applications. A total of eighty (80) wild strains were isolated, from *nunu* (a locally fermented dairy milk product) using basic microbiological procedures such as morphological/phenotypic, gram staining, and other biochemical tests. All the isolates were tested for various functional and technological capabilities in order to determine their suitability and adaptability viz-a-viz acidification, curd formation and aroma production abilities. After forty-eight (48) hours of incubation at 42°C, 23 isolates were selected for further functional tests and analysis.

Results: Out of the twenty-three (23) isolates obtained, five (5) had high acidification rates, excellent acetaldehyde production ability as well as being bile and acid tolerant. Two (2) strains out of these namely: *Lactobacillus casei* LM32 and *Streptococcus thermophilus* LM08 had additionally high exopolysaccharide production ability and correspondingly produced yoghurt with very low residual content.

Conclusions: Local milk products are excellent reservoir of LAB strains for use as starter cultures for yoghurt production. This study successfully isolated, screened and identified lactic acid bacteria from *nunu* using a series of evidence-based protocols. Two (2) promising isolates exhibited excellent criteria to be used as starter cultures for yoghurt production which were identified as *Lactobacillus casei* LM32 and *Streptococcus thermophilus* LM08. Based on the remarkable characteristics obtained from these two species, they were selected for optimization and therefore proposed for large scale utilization as starter cultures in the dairy industries.

Keywords: LAB, *nunu*, indigenous, acidification, strain

Cypermethrin Exposure Impacts Biochemical Parameters and the Metabolism of Liver Enzymes in African Catfish (*Clarias gariepinus*, Burchell 1822)

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Background: Pesticides present in aquatic settings pose a threat to aquatic species as well as to people who rely on the ecosystem. The effect of Cypermethrin on some biochemical parameters of the widely consumed African catfish, *Clarias gariepinus*, was evaluated.

Methodology: Healthy juvenile *Clarias gariepinus* (average weight and length, 198.42±5.4g and 28±1.23 cm) were procured from a farm and acclimatized for 14 days prior to exposure to sub-lethal concentrations of Cypermethrin. The water was changed once every two days. Six fish each in groups A–E with replicates were exposed to 0.00, 1.25, 2.5, 3.75, and 5.0 ml/L of toxicant, respectively, for 96 hours. Water quality parameters were monitored. Blood was drawn from the caudal circulation, separated into plasma by centrifugation, and then the plasma's biochemistry was determined spectrophotometrically using Randox kits.

Results: The water's obtained physicochemical parameter values fell within the ranges necessary for freshwater fish viability. Group E had the highest total protein, albumin, and cholesterol values (10.40.36g/dl, 4.270.40g/dl, and 228.68mg/dl, respectively), while Group A without any toxicant had the lowest values (6.702.04g/dl, 2.001.32 g/dl, and 193.67g/dl, respectively). The experimental fish showed a dose-dependent rise in serum aspartate transaminase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP) with an increase in the quantity of the toxicant ($P < 0.05$).

Conclusion: Fish with elevated transaminase levels typically have liver cells that are deteriorating or destroyed. An increase in the pesticide concentration in any body of water could cause abnormal biochemical dysfunction in the health and general condition of the fish.

Keywords: cypermethrin, cholesterol, *Clarias gariepinus*, liver enzymes, total plasma protein



Determination of Aflatoxin in Maize Flour Sold at Wudil Market, Kano State, Nigeria

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Background: Aflatoxin is a toxic and carcinogenic secondary metabolite produced by some species of *Aspergillus* and other fungi on food crops and feed. The versatility of these fungi to different factors determines the infestation and colonization of the substrate. Aflatoxin can be found in maize flour and other food stuffs.

Methodology: A total of ten (10) samples were obtained for analysis from different locations in Wudil market, Kano state, Nigeria.

Results: The analysis in mold isolation and aflatoxin was carried out to isolate the major aflatoxigenic fungi and identify the type of aflatoxin present in the samples. Detection of aflatoxin was done using thin layer chromatography (TLC). Fungi were isolated on Sabroad dextrose agar by standard dilution plate method and the maize is in powdered form. Five fungal species were isolated

and identified as *Aspergillus flavus*, *Aspergillus niger*, *Aspergillus fumigatus*, *Aspergillus terreus* and *Penicillium*. Percentage occurrence of fungal species range from 11.4 to 22.9% in which the *Aspergillus flavus* are the most dominant species in the samples.

Conclusion: Aflatoxin was detected in some of the samples. Microbiological standards on agricultural products should be put in place for the safety of consumers.

Keywords: determination, aflatoxin, maize flour



Effects of Treated Greywater and its Potential for Irrigation and Reuse for Sustainable Food Security in Nigeria

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Background: Greywater (GW) reuse is emerging as an integral part of water demand management, promoting the preservation of high-quality fresh water and reducing both environmental pollution and its overall importance for irrigation purposes. Greywater is defined as wastewater generated from domestic activities such as dishwashing, laundry, and bathing. GW represents the largest potential source of water savings in domestic residences, accounting for as much as 50–80% of the total water use. However, as a result of the increase in periods of drought, exacerbated in part by climate change and deforestation, as well as the changes in water consumption patterns, unconventional technologies for the conservation of this resource are gaining support.

Methodology: A filtration tank composed of a slow sand filter followed by a sawdust-activated carbon filter was constructed, and pH, COD, BOD, and surfactants were determined. Scanning electron microscopy was also employed for surface morphology.

Results: The efficiency of the filtration tank was determined by comparing the water quality before and after the filtration process. The results showed that the filtration tank was effective in removing pollutants from the water. The permeability of the sand was $2.7 \times 10^{10} \text{ m}^2$, while the sawdust-activated carbon was $1.8 \times 10^9 \text{ m}^2$. The scanning electron microscopy (SEM) analysis showed that sawdust-activated carbon has more irregular geometric shapes than sand, which has a more rounded shape. The sawdust-activated carbon has pores that provide a greater surface roughness, unlike sand grains, which appear more uniform without the roughness.

Conclusion: The efficiency of the systems was very good with regard to the pH, COD, BOD, and surfactants. The maximum efficiency values were high, indicating the potential of the systems and demonstrating that if they are optimized, the filters may achieve higher average efficiencies. The combination of sand and sawdust-activated carbon contributed to the improvement of the water quality, making it suitable for irrigation and encouraging sustainable food security in Nigeria.

Keywords: Greywater, sawdust activated carbon, water treatment, pH



Environmental Condition and Food Security: A Case of Fish Growth Pattern and Water Condition in Osinmo Reservoir, Osun State, Nigeria

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Background: Anthropogenic activities are the major dictators of environmental conditions; in terms of water quality, weather patterns and sustenance of biodiversity. Fish is a major protein source in riverine communities and their sustenance is dictated by the quality of water. Principally, the rate of industrialization and urbanization notwithstanding climatic issues and fishing practices has increased the nature and form of wastes generated on land which meanders into aquatic systems thereby affecting fish species. In lieu of this, there is need to assess the present condition of fish species by investigating their growth pattern, the water quality, and environmental activities towards achieving food security in terms of achieving zero hunger, good health and well-being, sustenance of life under water and life on land as elaborated by the United Nations Sustainable Development Goals 2, 3, 14 and 15 respectively.

Methodology: The reservoir was purposely partitioned based on identified anthropogenic activities and sampling was done from each partition. Water was measured for surface temperature, dissolved oxygen, pH, ammonia, nitrite and nitrates using appropriate kits. Monofilament gill net of mesh sizes of 40mm – 45mm were used for fish sampling and their morphometric measurements such as length and weight were taken. Linear regression analysis a $P < 0.05$ was used to observe the relationship between the length and weight of fish species, and the condition factor was calculated.

Results: The mean value measured for temperature ($26.00 \pm 0.24^{\circ}\text{C}$), dissolved oxygen ($3.16 \pm 0.01\text{mg/L}$), pH (6.9 ± 0.16), Nitrate ($3.51 \pm 0.31\text{mg/L}$) were within the recommended range while Nitrite ($0.22 \pm 0.00\text{mg/L}$) and Ammonia ($0.25 \pm 0.01\text{mg/L}$) were high and above the recommended limits. The nitrite and nitrates in the three partitions were high. All the five species identified – *Coptodon zilli*, *Oreochromis niloticus*, *Hydrocynus forskahlii*, *Parachanna obscura*, and *Mormyrus rume* exhibited a positive length weight relationship and negative allometric growth pattern of because their b-values were less than 3. Similarly, the condition values were greater than 1 which indicated good condition of fish species.

Conclusion: Despite the increased concentration of ammonia and nitrite, the fish exhibited good growth conditions. This may be attributed to the extensive surface area and volume of water which is constantly exposed to aeration. The reservoir therefore has the great potential to support rich aquatic community and fishery production. It is also essential that the water quality of the reservoir should be maintained, and human activities around the catchment which was predominantly agriculture should be improved by adopting climate smart activities.

Keywords: anthropogenic activities, fish sustenance, fish food production, weather factors, climate smart



Growth Performance and Yield of the Edible White Rot Fungus (*Pleurotus ostreatus*) on Different Agro-Waste Materials

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Background: *Pleurotus ostreatus* (Oyster mushroom) is an edible mushroom species commercially produced and sold in markets in Asia, America, Europe and Africa. In Africa, the fungus is often observed in the wild growing around the African breadfruit (*Treculia africana*) and attacking dead wood resulting to varying degrees of white rot. Oyster mushrooms have gained appreciable popularity in Nigerian markets for their exceptional flavor and other nutritional potentials. This study was carried out to evaluate the growth and yield performance of *Pleurotus ostreatus* spawn on different organic substrates in Lafia, Nasarawa State, Nigeria.

Methodology: Fifty grams each of four different substrates namely; corncobs, rice straw, sugarcane bagasse and sawdust sourced locally from farmlands and processing sites, were amended with 2% calcium carbonate and calcium sulphide and sterilized using three sterilization methods namely; hot water, steam, and lime. Five grams of *P. ostreatus* spawn were inoculated unto treated substrates, incubated in the dark for 16 days and in light for 19 days at 25° C for the commencement of pinhead and fruit body formations respectively. Growth and yield parameters such as days to full colonization, days to pinhead formation and days to fruit body formation were recorded. Cap diameter and fresh weight of mature mushrooms were also measured for a total count of four flushes.

Results: *P. ostreatus* spawn grown on sugarcane bagasse recorded the highest mean cap diameter (4.69 cm), highest mean fresh weight (34.68 g), highest biological efficiency (69.37%) and highest production rate (2.83 g per day). Spawn grown on rice straw recorded the least number of days to full substrate colonization (11.00). Spawn grown on corn cobs recorded the least mean number of days to pin head (18.75) and fruiting body formations (20.25). There were no significant differences ($P \leq 0.05$) among the evaluated substrates with respect to growth and yield performance of *P. ostreatus*. Substrates sterilized with hot water supported the highest mean cap diameter (5.64 cm), highest biological efficiency (87.04%) and highest production rate (3.43 g per day) of *P. ostreatus*. Significant differences ($P \leq 0.05$) were observed in cap diameter, fresh weight, biological efficiency, and production rates among the evaluated sterilization methods.

Conclusion: Hot water sterilization of sugarcane bagasse showed great potential for the promotion of oyster mushroom growth, and could be adopted for enhanced yield of oyster mushrooms, especially among indigent farming communities in Nigeria and beyond.

Keywords: Agro wastes, growth, *Pleurotus ostreatus*, sterilization methods, yield



Interactive Effects of Reduced pH and Increased Salinity on Paraquat Toxicity in *Clarias gariepinus*

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Background: Freshwater ecosystems worldwide face multiple stressors including change in pH and salinity as a result of climate change and pollution. This study investigated the interactive effects of reduced pH (5.0) and increased salinity (6ppt) in concert with paraquat dichloride on the toxicity and hatching success of *Clarias gariepinus* (the African sharptooth catfish) juveniles and embryos for 96 hours and 26 hours post-fertilization respectively.

Methodology: Ten (10) *C. gariepinus* were allocated into five groups of paraquat concentrations in triplicates exposed to different stressors at varying concentrations. Paraquat dichloride alone (0, 20, 40, 60, 80 and 100mg/L); pH and Paraquat (0, 120, 180, 240, 300 and 360 mg/L); salinity and Paraquat (0, 120, 180, 240, 300 and 360 mg/L) and pH, salinity and Paraquat (0, 240, 300, 360, 400, 460 mg/L). Fifty (50) fertilized embryos were exposed to 1/10th LC₅₀ environmentally realistic concentrations of the paraquat in triplicates for the various treatments. Hatching success was determined as the percentage of the embryos that emerged completely from the chorion in the different treatments after 26hours post-fertilization.

Results: The 96h LC₅₀ values of the test media against *C. gariepinus* juveniles were 49.0 mg/L, 266.6 mg/L, 209.0 mg/L and 331.8 mg/L paraquat dichloride alone, pH and paraquat, salinity and paraquat and pH and salinity and paraquat respectively. Paraquat exposed to juvenile *C. gariepinus* was 5.4x, 4.2x and 6.8x more toxic acting alone compared to the combination with pH, salinity as well as pH and Salinity respectively. Percentage hatching success of embryos were 82.666, 25.333, 21.333, 11.333 and 14.666 control, paraquat alone, pH and paraquat, salinity and paraquat as well as pH, salinity and paraquat respectively.

Conclusion: Paraquat use on farmlands closer to water bodies should be discouraged because run-offs of this herbicide into water bodies could alter the ecosystem composition and eventually lead to the mortality of economically important aquatic species. More studies on the interaction of other multiple stressors in combination should be given more attention, especially the mechanisms of reactions causing the observed changes in both field and laboratory studies. The knowledge from this study can be used as a basis for further research in the field of ecotoxicology, interactive effects of multiple stressors and for policy making.

Keywords: toxicity, pH, salinity, paraquat, *Clarias gariepinus*



Isolation and Molecular Identification of Growth Promoting Potential Bacteria from Cowpea (*Vigna Unguiculata*) for the Production of Biofertilizer

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Plant growth promoting rhizobacteria (PGPR) are bacteria that inhabit the rhizosphere of plants and promote plant development through nutrient cycling, generation of growth hormones and defense against plant diseases to improve soil fertility and plant development. Biofertilizers are fertilizers made from living organisms. This study aims to determine the improvement of plant growth and nutrient efficiency through the application of PGPR as effective fertilizers in order to eradicate the adverse effect of chemical fertilizer on plant and environment. In this study, bacteria were isolated and characterized from soil collected from the rhizosphere and root nodules of cowpea plant (*Vigna unguiculata*). The bacteria were isolated using standard microbiological techniques and identified using molecular methods, including 16S rRNA gene sequencing. Single strains of each bacterium were mass produced and a carrier (activated charcoal) was prepared for the production of the biofertilizer. The biofertilizer was produced by mixing single pure culture of isolate with sterile charcoal under aseptic condition; the biofertilizers were packaged in zip-lock bags and stored in -40°C freezer. The efficacy of the single and mixed bacteria strains of the biofertilizer was studied on growth of *Amaranthus hybridus* (smooth pigweed) plants in green house experiments. The isolated bacteria belonged to the genera, *Bacillus subtilis*, *Enterobacter sp* and *Acetobacter ghanensis*, all isolates were positive for their ability to fix atmospheric nitrogen, solubilize phosphate, ammonium production and catalase test. However, they were unable to fix hydrogen cyanide and the mixed bacteria strains biofertilizer was more effective on the growth of *Amanrathus* plant. All the bacteria isolates were effective as plant growth promoting bacteria.



Isolation and Molecular Identification of Phosphate Solubilizing Fungi from Rhizosphere Soil of Okro Plant and its Effect on the Growth of Okro

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Background: Phosphate solubilizing fungi (PSF) play an important role in the cycling of nutrients in soils, particularly phosphorus, which is often limiting in African soils. Through their ability to solubilize phosphate, PSF can improve soil fertility, increase nutrient uptake by plants, and enhance crop productivity. The aim of this research project was to isolate and identify potential phosphate solubilizing fungi from soil samples collected from the rhizosphere soil of okro (*Abelmoschus esculentus*) plant for the development of environmentally friendly biofertilizers.

Methodology: Phosphate solubilizing fungi were isolated from the rhizosphere soil of okro plants and screened for their ability to solubilize tricalcium phosphate (TCP) using pikovskaya agar. The phosphate solubilization index (PSI) of the isolates were determined. The isolated strains were subjected to molecular identification using techniques namely DNA extraction, amplification of the

internal transcribed spacer (ITS) region and DNA sequencing. The PSF strains were used to produce phosphate solubilizing biofertilizers and the effectiveness of the biofertilizers were tested on okro plant growth in a pot experiment for 8 weeks in a greenhouse.

Results: Two phosphate solubilizing fungi strains were successfully isolated from the rhizosphere soil of okro plant with PSI values of 2.27 and 2.52. The two PSF isolates were molecularly identified as *Aspergillus niger* and *Talaromyces purpureogenus*, respectively. The two phosphate-solubilizing biofertilizers made showed okro plant growth support and increase in yield outperforming the control group with no fertilizer treatment.

Conclusion: This excellent PSI property of *Aspergillus niger* and *Talaromyces purpureogenus* suggests that they have a great individual potential for agricultural utilization as an environmentally friendly biofertilizer. The application of PSF biofertilizers can enhance the growth and yield of okro plants, offering potential benefits for sustainable agriculture and food security.

Keywords: phosphate solubilizing fungi, biofertilizers, okro plant, sustainable agriculture

Isolation, Modification and Characterization of Starch from African Star Apple Seed Nut

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Background: Food processing generates a large number of by-products or waste such as seeds, peels, pulp, and fibrous materials. These by-products contribute to food insecurity, and when not discarded properly, they result in environmental pollution. However, these discarded wastes or by-products are important sources of starch, fibre, and phenolic compounds and can be utilized when processed as food or industrial raw material. This, however, is dependent on the physiochemical and functional properties of the products obtained from the food by-products.

Methodology: Starch was isolated from African star apple starch and was subjected to modification processes by microwave heat treatment, acetic acid, and microwave-acetic acid (dual). Both the native and modified African star apple starches were examined and analyzed for functional group identification, thermal properties, as well as colour attributes via FTIR, Differential scanning calorimetry (DSC), and Colorimeter.

Result: Significantly, modification influenced the functional properties of the African star apple starch. The modified and dual-modified process improved the gel consistency, water absorption capacity, solubility, and swelling capacity of the starch. The colour attributes compared with native and modified starch showed that acetic acid modified starch (AS) had the highest in L (lightness), followed by Native starch (NS), and also WI (white index) and FCI (flour colour index) significantly increased in acetic acid-modified starch. Dual-modified microwave-acetic acid starch, MAS significantly has the lowest L and WI. The thermal attributes such as enthalpy of gelatinization and

gelatinization temperature range of native African star apple starch are mostly increased by the acetic acid modification processes (AS).

Conclusion: In conclusion, physical and most especially chemical modifications of African star apple starch produced a starch that can be applied and used as functional food preparations and ingredients, hence mitigating food insecurity.

Keywords: African star apple, starch modification, food insecurity



Molecularly Profiling Yam Rot Pathogenic Fungi from North Central Nigeria

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Background: Edible varieties of yam (*Dioscorea* spp) are the most important food crops in West Africa, East Africa, the Caribbean, South America, India and Southeast Asia. Yam rot caused by fungal pathogen has been of great concern to farmers. The study was aimed at identifying eco-friendly *Trichoderma* species through phylogenetic method from yam tuber and evaluating their biocontrol potential. The objectives of the study were as follows - identification of microorganisms associated with rot of yam tubers, determination of the biocontrol activity of *Trichoderma* on rot causing fungi, and molecular identification of the *Trichoderma* species with biocontrol potential.

Methodology: A total of thirty samples of both healthy and unhealthy yam tuber were collected from farms in Jos, Plateau State and Demsa, Adamawa State. Samples were transported aseptically to the laboratory for microbial analysis. The samples were cultured according to the standard microbiological procedures; antagonistic response was carried out by dual culture essay method. Molecular profiling by; ITS Regions Sequencing, PCR Amplification and BLASTN.

Results: The fungi isolated and identified as pathogen were *Trichophyton* spp, *Aspergillus niger*, *Penicillium echinalutum*, *Penicillium citrinum*, and *Aspergillus flavus* while the isolated biological control agent was identified as *Trichoderma* strains, *Trichoderma yunnanense* (OP800836.1). The inhibitory effect of the biological antagonist *T. yunnanense* showed that it reduced the growth of *Trichophyton* spp by 45.5 %, *A. niger* by 75.8 %, *Penicillium echinalutum* by 84.6 %, *Penicillium citrinum* by 80 % and *A. flavus* by 66.6 %.

Conclusion: This study revealed the potential of bio control potential of the identified strains of *Trichoderma*, *Trichoderma yunnanense* (OP800836.1) against common pathogenic fungi which cause spoilage of yam in North-central Nigeria and other regions of the world. It is important that *Trichoderma* sp. biological control agent be commercially developed in Nigeria and sub-Saharan Africa, this will make it easily available to low-income farmers.

Keywords: *Trichoderma yunnanense*, biocontrol, pathogenic fungi, biopesticide, post-harvest



Potential of Castor Seed (*Ricinus communis*) Powder-Formulated Feed in the Fertility Control of Wildly Caught Female African Giant Rats (*Cricetomys gambianus*)

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Managing rodent pest species using synthetic rodenticides to achieve lethality has been considered an unsustainable management strategy because of their attendant shortcomings such as bait shyness, secondary poisoning etc. An alternative ecofriendly option needs to be developed and one of such is the use of plant materials with the potential of reducing the reproduction of rodent pest species. The present study evaluates the potential of Castor seed (*Ricinus communis*) powder-formulated feed in the fertility control of wildly caught female African giant rats (*Cricetomys gambianus*) (a notable rodent pest). Four different concentrations of experimental feeds were formulated by mixing Castor seed powder with Commercial rat feed in the ratio 1:12, 1:6, 1:1 while only Commercial rat feed served as control. Twenty (20) wildly caught female African giant rats were randomly allocated into four groups (with 5 animals/group), acclimatized for 4 weeks and fed with appropriate experimental feed for 60 days with water provided *ad libitum*. Blood samples were collected at 20 days intervals for serum biochemistry analysis - reproductive hormone which include Follicle Stimulating Hormone (FSH), Luteinising Hormone (LH), Prolactin (PRL), Progesterone (PROG), and Estrogen (ESTR); and cellular enzymes which include Aspartate Aminotransferase (AST), Alanine Aminotransferase (ALT), and Alkaline Phosphatase (ALP). The results showed progressive decrease in the hormone level with time in all the experimental groups. There was significant reduction in the reproductive hormones in all the experimental groups compared with the control ($p < 0.05$). No significant difference was recorded in the mean feed intake (%) among the groups ($p > 0.05$). The mean body weight among the groups showed no significant difference ($p > 0.05$). Conclusively, the Castor seed powder has the potential of reducing the reproductive ability of the female African giant rats and therefore can be recommended to the farmers for use.

Rapid Screening Methods for Identification of Resistant Maize Inbreds to Fungal Foliar Pathogens

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Background: Maize (*Zea mays* L.) is an important cereal and a source of nutrition for more than 50% of the world's population. Despite the numerous benefits and potential of the crop, maize is susceptible to various biotic stresses that limits its maximum yield potential. Host plant resistance (HPR) has been adjudged the best option among the various options for disease management. However, identification of sources of resistance among maize genotypes maximizes the efficiency of HPR. The present study evaluated the effectiveness of the rapid laboratory assay; the detached

leaf assay (DLA) in comparison with screenhouse experiment for identification of disease-resistant maize genotypes.

Methodology: Ten each of extra-early maturing (EEM) and early maturing (EM) maize inbreds were screened for resistance to three isolates each of *Bipolaris maydis* (SLB 01, SLB 02 and SLB 03) and *Exserohilum turcicum* (NGIK-16-5, NGIK-16-12, and NGIB16-13), respectively. The isolates were obtained from the International Institute of Tropical Agriculture (IITA) Ibadan, Nigeria. The screenhouse experiment was laid out in a restricted randomized complete block design (based on the pathogen isolates) with two replications. Disease severity was measured using a scale of 1 to 9 at weekly interval after inoculation. The most virulent pathogens, SLB 02 and NGIB-16-13 from screenhouse evaluation were identified and used to inoculate four-weeks-old EM and EEM maize leaves using the DLA in a completely randomized design in three replications. The leaves were inspected for 10 days at 2-day intervals for symptom manifestation and rated for disease severity using a scale of 1-5. The collected data was subjected to ANOVA and significant means were separated using the Fisher's LSD at 0.05 level of probability.

Results: Results from the DLA and screenhouse experiments were compared and found to be similar. TZEEI 179, TZEEI 8, TZEEI 20 were identified as *B. maydis* resistant inbreds while TZEI 56, TZEI 60, TZEI 128, and TZEI 128 were found to be *E. turcicum* resistant genotypes using both methods.

Conclusion: The DLA is an efficient technique for identification of disease-resistant EM and EEM genotypes, and could facilitate rapid development of disease-resistant maize hybrids and open pollinated varieties. The adoption of the disease-resistant genotypes would reduce crop losses, increased farmer's income and ensure food security.

Keywords: disease resistance screening, detached leaf assay, breeding, food security, fungi

Seasonal Variation and Growth Conditions Influence Seed Germination of Ebolo (*Crassocephalum crepidioides* and *Crassocephalum rubens*) Vegetables

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Background: *Crassocephalum crepidioides* and *C. rubens* are underutilized, traditional leafy vegetables native to tropical Africa but grow throughout tropical and sub-tropical regions of the world. They belong to the plant family Asteraceae and are annuals that grow rapidly and thrive well in marginal conditions. *C. crepidioides* and *C. rubens* are highly nutritious and are used as leafy vegetables and medicinal plants in Sub-Saharan Africa and Asia. Despite their importance as a nutritious food source, *Crassocephalum* species are not regularly cultivated but are primarily harvested from the wild. One of the problems limiting the cultivation of these plants is a high degree of seed dormancy, which poses a major difficulty for farmers who sow the seeds. Therefore, the

effects of the growth conditions and seasonal variation on seed germination of *C. crepidioides* and *C. rubens* were assessed to improve the seed germination capacity of the crops.

Methodology: *Crassocephalum crepidioides* and *C. rubens* seeds were grown in the greenhouse at two different seasons of the year. Seeds were harvested during the 2018/19 winter and 2020 summer periods. Both seed batches were subjected to germination tests using two different growth media: filter paper and half-strength Murashige and Skoog (1/2 MS) medium. The seeds were incubated at different temperature regimes (21°C and 25°C), light intensities (30 $\mu\text{mol}/\text{m}^2\text{s}$, 80 $\mu\text{mol}/\text{m}^2\text{s}$), in the dark and long-day photoperiod (16 hours of light/ 8 hours of darkness).

Results: Both *Crassocephalum crepidioides* and *C. rubens* exhibited a high degree of seed dormancy in the dark. However, light promoted the germination of both species with stronger effects on *C. rubens* seeds. Increase in temperature enhanced seed germination in both species. In addition, germination medium had a significant influence on seed germination of both *C. rubens* and *C. crepidioides*. Germination was faster for both *C. crepidioides* and *C. rubens* when seeds were germinated on filter paper as compared to 1/2 MS. However, low light intensity increased the speed of seed germination of both species on 1/2 MS. *C. rubens* seeds were predominantly dormant during the winter compared to those harvested during the summer. Contrarily, *C. crepidioides* seeds harvested during the summer period were more dormant than those harvested during the winter period.

Conclusion: *C. crepidioides* exhibited higher levels of seed dormancy and required light and temperature to break out of dormancy. Filter paper improved seed germination of both species while seasonal variation influenced the dormancy level in *C. crepidioides* and *C. rubens*.

Keywords: dormancy, Ebolo, germination, underutilized crops

Smart Irrigation System, A Strategy for Climate Change Mitigation and Enhanced Smallholder Farming Efficiency: The Elizade University Experience

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Climate change is a change in the average weather patterns on a long-term basis. The effects of climate change include natural disasters such as extreme temperatures, floods, melting of the glaciers, and irregular rainfall patterns to mention a few. The irregularity in rainfall patterns has greatly affected agriculture thereby creating a state of emergency in regard to food security. In this research, a solar-powered smart irrigation system is developed to assist farmers in sub-Saharan Africa in their efforts to adapt to the challenges of irregular rainfall patterns due to climate change. The strategy adopted in providing a holistic solution to the highlighted challenges in this research starts with an assessment of climate change awareness in Ilara-Mokin, and Akure metropolis, Ondo State, Nigeria through physical and online surveys. Others include awareness creation about climate

change and the concept of smart irrigation through seminars and practical demonstrations of smart irrigation in four secondary schools, the development of electronic tools for farmers to aid the practice of smart irrigation, and the implementation of a smart irrigation system using the developed tools on a solar-powered smart farm in Elizade University campus, Ilara-Mokin, Ondo State, Nigeria. Results of climate change awareness attributed schools and the Internet as their major sources of information with 55% in both cases. 47.3% of the respondents identified Radio and Television as their sources of information while 40.5% attributed it to social media with the majority of respondents (83%) asserting that all stakeholders should take responsibility for mitigating climate change effects. These stakeholders include the government, citizens, and multinational companies involved in oil exploration. Awareness and demonstrations of smart irrigation systems carried out in four selected secondary schools using a mobile laboratory-scale smart irrigation system revealed that students are able to understand new concepts better when it is demonstrated and this goes a long way in achieving learning objectives faster. Results of the implementation of a smart irrigation system on our pilot (smart farm) in Elizade University campus for a period of three months reveal that farmer is able to start and stop the irrigation process from remote locations (Akure) in real-time over the internet using a user-friendly mobile application on his mobile phone. From this mobile application, he is also able to monitor environmental parameters on his farm such as soil moisture content, temperature, and humidity of the farm. The use of solar energy for powering sensors, actuators such as water pumps, solenoid valves, and the control unit reduces the carbon footprint and makes the developed system environmentally friendly. Solar energy also makes the developed system suitable for installation in rural areas with inadequate or no electricity. Possible applications include greenhouse farming, open-field farming, golf courses, and horticultural gardens to mention a few.

Keywords: smart irrigation system, climate change, solar energy, sensors, actuators



SUB-THEME 4: EMERGING TECHNOLOGIES FOR SUSTAINABLE ENERGY PRODUCTION AND USAGE

Carbon Alchemy in Lagos: Transforming Carbon Emissions into Sustainability

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The city of Lagos, Nigeria, stands as a vibrant metropolis, but with its rapid urbanization, comes along environmental challenges, notably the scarcity of green spaces and an alarming deficit in tree cover. Against this backdrop, this research investigates a transformative approach to environmental sustainability through the lens of carbon capture and utilization. In a city characterized by limited greenery, innovative technologies are explored for capturing and converting carbon emissions into valuable products, including biofuels and construction materials, contributing to a more sustainable and greener Lagos. Carbon capture and utilization (CCU) represents a pivotal strategy in the fight against climate change and the reduction of greenhouse gas emissions. In Lagos, the lack of substantial tree cover, traditionally, essential for carbon sequestration, accentuates the importance of alternative CCU technologies. This research delves into pioneering methods and technologies that harness carbon emissions from various sources, including industrial processes, transportation, and energy generation, to create sustainable solutions for the city. The development of CCU technologies in Lagos focuses on the capture and conversion of carbon dioxide (CO₂), a major greenhouse gas, into valuable products. This includes exploring advanced techniques such as direct air capture, where specialized systems remove CO₂ directly from the atmosphere. Additionally, the research investigates the use of biological processes, such as algae-based systems, to capture and convert CO₂ into biofuels and other high-value organic products. Furthermore, the research explores the potential to repurpose captured carbon emissions into construction materials, like carbon-neutral concrete. This innovative approach aligns with Lagos' urban development needs while also addressing the imperative of sustainability and climate resilience. The recycled carbon-based materials can find application in infrastructure projects, contributing to the reduction of carbon footprints associated with traditional construction materials. This research's significance for Lagos lies in its potential to combat climate change, improve air quality, and advance urban sustainability in a city marked by its distinctive urban challenges. The adoption of CCU technologies offers a unique pathway to bridge the gap in tree cover while simultaneously addressing the imperative of carbon emissions reduction. Moreover, the research underscores the prospect of job creation, economic diversification, and environmental stewardship in Lagos through the utilization of CCU solutions. In conclusion, the exploration of carbon capture and utilization technologies in Lagos is emblematic of a forward-looking, sustainable city's aspiration. By developing innovative strategies for capturing and repurposing carbon emissions into valuable products, Lagos can significantly contribute to its ecological health, economic prosperity, and long-term sustainability. This research serves as an essential step toward a greener and more resilient Lagos, setting an example for urban centers worldwide facing similar challenges.

Keywords: carbon capture, greenery, climate change

Production of Bioethanol from Sorghum Stalk Grown in Kaura Namoda, Zamfara State, Nigeria

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Background: Sorghum (*Sorghum bicolor*), also known as great millet, durra, jowai, jowar, or milo is a grass species cultivated for its grain, which is used for food for humans, animal feed, and ethanol production. Sorghum originated in Africa, and is now cultivated widely in tropical and sub-tropical regions. Sorghum is the world's fifth-most important cereal crop after rice, wheat, maize, and barley, with 59.34 million metric tons of global production in 2018. *S. bicolor* is typically an annual crop, but some cultivars are perennial. It grows in clumps that may reach over 4m high. The grain is small, ranging from 2 to 4mm in diameter. Sweet sorghum is a sorghum cultivar that is primarily grown for forage syrup production and ethanol; it is taller than those grown for grain. The leading producers of *S. bicolor* in 2011 were Nigeria (12.6%). Mexico (11.2%), and the United States (10.0%). Sorghum grows in a wide range of temperatures, high altitudes and toxic soils.

Methodology: The sorghum stalk was obtained from the farm area around Kaura Namoda. The sorghum stalk was thoroughly washed with water, and was allowed to dry for three days. It was pounded into fine material using mortar and pestle. The fine material was sealed in a poly bag then transported to school laboratory for further process as required. 40g of the sorghum stalk was weighted and added to a conical flask containing 500 ml distilled water. H_2SO_4 was prepared and was added to the mixture, the mixture was emptied into a round bottom flask of 100 ml. The content was stirred vigorously and later subjected to heating at 120 °C for 120mins. It was removed and allowed to cool. After that it was thoroughly washed using running tap to wash out acid. Litmus paper (blue) was used to test the absence of acid. The sample was allowed to dry under room temperature for 24 hrs in preparation for alkali treatment. This was preceded by spectrophotometric test to determine the glucose level. NaOH (1 M) was prepared and added 500ml distilled water in a conical flask. The dried sample was also added to the mixture and stirred before it was poured into round bottom flask. This was also subjected to heating at 120 °C for 1 hr. It was removed and was allowed to cool. The sample was thoroughly washed with a running tap water to wash out the base. Litmus paper (red) was used to test alkalinity. It was filtered and was allowed to dry under room temperature. After this, spectrophotometric test was carried out to determine glucose level.

Results:

Table I: Concentration of glucose after acid and alkaline treatment

Treatment	Glucose Concentration (mg/dl)
Acid	14.61±0.3
Alkali	23.10±0.01

Table I shows the results obtained from ethanol production using *sorghum stalk* as raw material. It has been reported by earlier researchers that pre-treating biomass with both acid and alkaline enhances the ethanol yield (Goshadrou *et al.*, 2011). In their findings, the yield of hydrolysis of native bagasse effectively improved after sodium hydroxide and concentrated sulphuric acid

pretreatments. This is attributable to a corresponding increase in the concentration of reducing sugar content of the bagasse. Similar result was obtained in the present work as shown. Result obtained from hydrolysis and fermentation of the reducible sugar to ethanol is shown in Table II. A high yield of ethanol was recorded as a result of the moderately high concentration of glucose generated from the pretreatment activity. An ethanol yield of 84% was obtained, indicative of the fact that the biomass raw material used in this research is a promising alternative source of bioethanol. Ethanol fermentation from crude enzymes hydrolyzed sorghum stalk was analyzed in the present research and results were given in Fig-1. The reducing sugar content was recorded maximum after 60 hours. Problems associated with the hydrolysis process need more improvements in order to reduce the operating cost for an ethanol-producing plant that uses wood waste as feedstock. Furthermore, large amounts of exogenous enzymes are required. The findings of the present work corroborate findings of earlier researchers. It has been established from the present work that biomass from locally grown cereals could be useful as second-generation bioethanol precursors.

Conclusion: The present study demonstrated that sorghum stalk is promising after natural energy crop for bioethanol production that can make large contribution to the economic enhancement of our community if properly harnessed; also it will contribute to the global greenhouse revolution. This crop has a short period of growth and it is an almost all-season crop.

Keywords: production, bioethanol, sorghum stalk, Kaura Namoda, Zamfara State, Nigeria

Ultra-white Barium Sulphate on Silver Substrate for Sub-ambient Radiative Cooling Under Direct Solar Irradiance

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Background: The spontaneous thermodynamic process of radiative cooling, which releases excess heat from earthly objects into space without requiring additional energy is gaining serious attention globally. At present, spectrum selectivity has posed a stringent constraint to achieving diurnal radiative cooling. This experiment aims to determine whether radiation cooling is feasible in Nigeria's humid and hot environments.

Methodology: This work experimentally demonstrates a dual-layer emitter comprising Barium Sulphate and silver substrate for efficient radiative cooling below ambient temperature throughout the day. The cooler was tested in under Owerri climatic conditions, both during the day and at night, and the temperature differentials between the ambient air and the radiative cooler were recorded. The photonic cooler has an excellent reflectivity of 98%, allowing it to reflect light from the visible to the near-infrared spectrum with near-black emittance in the mid-infrared.

Results: The experimental results during the test periods showed that the passive radiative cooler provided a satisfactory cooling effect with an average temperature reduction of about 5°C from the ambient air temperature under direct sunlight. A potential cooling power density of about 120W/m²

was obtained. The results also revealed that climatic conditions affected the performance of the cooler.

Conclusion: This research demonstrates that it would be possible to enhance the performance of the current passive radiative coolers used for space conditioning, and also that passive radiative cooling is a viable alternative to efficient space cooling in Nigeria's hot climate.

Keywords: photonic emitter, metamaterial, space cooling, sub-ambient cooling, passive cooling



SUB-THEME 5: SMART CITIES AND EMERGING TECHNOLOGIES

Employability of Students in Lagos State-owned Tertiary Institutions: Technology and Job Readiness Skills Options

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There has been noticeable increase in the rate of unemployment in the country coupled with increase in complaints by stakeholders about the quality of graduates of tertiary institutions on their inability to secure or retain jobs. This situation has worsened as a result of the COVID-19 pandemic which struck the entire world in 2019; but the pandemic has also revealed the benefits of technology at building smart cities and ensuring the development of economies. Despite the huge advantage of technology, it appears Africa especially Nigeria is yet to fully tap the benefits of technology in order to reduce unemployment and compete favourably with other great economies of the world. This study therefore intends to fill that gap by probing whether technology and job readiness skills significantly relate to employability of students in Lagos State-owned tertiary institutions. The study used the descriptive survey research design with a population of 6984 final year students while the sample was 378 participants determined using Taro Yemane formular and selected using the multistage sampling approach. A self-designed questionnaire was administered, and data collected was analysed using Pearson Product-Moment Correlation statistics and result showed that technology significantly offers employment opportunities and that job readiness skills significantly relate to employability. In conclusion, practical technology classes should be introduced in schools at all levels, job relevant skills of students should be adequately developed in order to make them employable or create employment and drive growth and development in the country.

Keywords: technology, employability, job readiness, team building

Reinforcing the Smart Cities with New Residential Housing Schemes: The Imperative of Needs Assessment for Community Development Education Planning

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Background: Cities are known to have started from what now constitute the central business districts. As city centres get saturated, new residential areas start to emerge. Apart from individual efforts and property developers' activities (which are private), governmental agencies, most especially the local government authority, open up unbuilt landed areas and create housing schemes, usually with the surname of the chairman incumbent as the label. It is imperative to stress that the

new housing schemes so created would eventually graduate from sub-urban or urban periphery areas into another set of city hubs which new privately developed residential housing schemes would surround. In order for the newly created government schemes to prepare to catch up with existing urban areas, and also serve as a hub for adjoining residential quarters, technology must be engaged to provide necessary life-supporting elements for the residents. It would however be an over-assumption that stakeholders in urban housing and infrastructural development know what to do to develop emerging urban hubs into an integrated smart city, to the point that they would have to put things in proper shape and in order of priority without making undue mistakes. There is therefore an imperative of need-assessment of what would make new residential housing schemes evolve in the tone of a smart city, from the perspectives of the community development education planners.

Methodology: This essay, beyond empiricism, is guided by the opinion of Sleezer (2014) that effective planning and action require accurate and up-to-date information about the needs of a community; and that a needs assessment frames the problems or opportunities and builds relationships with the people and groups who have a stake in the issue. It provides the foundation for planning and action to improve development and performance. This is with the view to theoretically explaining what constitute the modern-day development indices that residents of housing schemes must enjoy as a necessity; examining the possible impact that the government and the residents themselves could make, to turn new residential housing schemes into smart areas of the city in a reflective thinking approach. All these are with the view to determining what could actually constitute the development needs of housing schemes, about which the community educational planner advocates in support of the smart city.

Results: The essay projects that existing theories and conceptual sources may be supportive of the fact that while the government may have responsibility assignments for the development of emerging residential areas in the spirit of evolving an undented smart city, the residents who enjoy the products of government responsibilities may not be left without a self-development assignment.

Conclusion: The essay projects to possibly conclude that there are many needs of the urban housing schemes that would need to be met, about which community development educational planner should regularly advocate, in order to comply with the demands of the smart city of the future.

Keywords: reinforcing the smart cities, residential housing schemes, needs assessment, community development education planning



Levitation Based Smart Resort

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Background: This study considered the possibility of creating or building a smart resort based on levitation. Levitation connotes floating or hovering upward and we need a way of employing it in smart resort design. With a magnetic force one could make something to float. Levitation is

accomplished by providing an upward force that counteract the pull of gravity, plus a small force for stability of the system. This paper addressed the application of levitation (science) in building a smart resort.

Methodology: The study looks at systems or key technologies needed in levitation and how these could be utilized in creating a smart resort. The scientific principles involved were investigated, operational challenges and the system consideration and deployment were also investigated. The main systems studied were high temperature superconductor and rear earth magnetic systems, cryogenic systems, stabilizing systems and support systems.

Results: We observed that these systems have the capabilities that could be exploited to create a levitation-based resort. These resorts, if achieved, will house levitating artistic artifacts.

Conclusion: We conclude that in the near future (probably five or ten years from now), smart resorts based on levitation will become a reality. This kind of resorts are tourist attraction targets for boosting a nation's economy.

Keywords: levitation, smart-city, superconductor physics, levitrons, economic development



SUB-THEME 6: EMERGING TECHNOLOGIES IN EMERGENCY PREPAREDNESS AND RESPONSE

Assessment of Contamination of Aquifer in Niger- Delta Region (Warri and Portharcourt)

Edward Monday Ossai¹, Nureni Oladimeji Falade¹, Abraham Olufemi Asuku¹, Titilola Tawakalit Falese¹, Ekundayo Temitope Ola¹, Olatunde Akindole¹, Adewole.Micheal Gbadebo²

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Background: Human beings have been exposed to heavy metal toxicity for an immeasurable amount of time. Heavy metals are abundant in our drinking water, air and soil due to our increased use of these modern consumerism materials to cosmetics, fuel sources to agents of destruction etc. The Niger Delta, located in the southern Nigeria is widely considered to be of global economic significance of its vast mineral deposits especially oil and gas. Heavy metal concentrations of hand dug wells and boreholes from four locations within Warri and eight from Port-Harcourt metropolis were studied. About twenty- four (24) water samples hand-dug well water samples were analyzed.

Methodology: Twenty-four (24) water samples in total were collected from hand – dug wells from 4 different locations in Warri and 8 locations in Port-Harcourt on 2 different occasions. The samples were analyzed for the following physicochemical parameters such as temperature, pH value, total dissolved solid and conductivity within 24 hours of sampling using standard methods. The metal cations were determined using the A.A.S method; hardness, chloride and bicarbonate concentrations were determined using titrimetric method. Sulphate was determined by spectrophotometric method, while nitrate was determined as nitrogen content using the Kjeldhal method.

Results: From the obtained results, most physicochemical parameters were found to be within the WHO acceptable limits for drinking water in all sample location. Rumagbo and Udu have the highest (108.5 and 288.55 mg/L) while Elewere and Iyare lowest (36.08 and 36.05 mg/L) concentrations of HCO_3^- respectively. The highest concentration of SO_4^{2-} was recorded in Waterline and Efuru (72.00 and 82.75 mg/L). Cl^- (91.5 and 107.25 mg/L) and NO_3^- (0.05 and 0.06 mg/L) have their highest concentrations observed at Eligolo and NPA respectively. The highest concentration for F^- (6.85 and 5.70 mg/L) was obtained in Rumuola and Udu respectively. Mn, Cd, Fe and Pb ions concentration were found to be highest in water samples from Eligolo and Udu respectively, as ion concentration (0.75 and 0.77 mg/L) was found to be highest in Rumuola and Udu respectively, lowest in Elewere and Iyare (0.38 and 0.46 mg/L) respectively.

Conclusion: All reported concentrations were above the WHO limits of heavy metals concentrations in drinking water. The results obtained from this study suggest a significant risk to the population given the toxicity of these metals and the fact that for many, hand dug wells are the only sources of their water supply in this environment.

Keywords: heavy metals, toxicity, hand dug well



Cybercrimes and Cyber security in Nigeria: A Comprehensive Study

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Cyber-crime is related to use of internet to commit crime. Internet is not on its own, it is a combination of computers, telecommunication gadgets and information and communication technology facilities including both software and hardware of different kinds. Crime of this nature is always difficult to track because of the diverse nature of the internet. Various information about cybercrime was tapped from the National Bureau of Statistics and the Nigerian Communications Commission, and reports show that cybercrimes is growing at a geometric rate. Google form was used to design the questionnaire for 20 questions. Students were asked to send it through their personal e-mails and whatsapp groups. 100 questionnaires were sent out via whatsapp and emails, 67 responded after one month; this represents 67%. Each question was analyzed independently in term of percentages and results was shown in graphical forms.

Keywords: cybercrimes, google form, information communication technology



Geospatial Analysis of Building Collapse in an African City: Lessons and Implications for Public Health and Sustainable Development

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Building collapse is a growing problem in African cities. This study analyzed the spatial distribution of building collapse incidents in Lagos metropolis, Nigeria and investigated the factors that contribute to building collapse using geographic information systems (GIS). The data source for the study was with the aid of primary and secondary sources. A purposive sampling method was used to select the study subjects for the quantitative survey. In total, 429 questionnaires were administered across the 17 local government areas of the Lagos metropolis. One of the findings shows that the private sector is the most affected by building collapse. The Z-score of -4.209904 and p-value of 0.000026 indicates a cluster pattern for locations of collapsed buildings which is statistically significant at the conventional threshold of $p < 0.05$. This suggests that the spatial distribution of the collapsed buildings in Lagos metropolis is not due to chance alone. 69.3% of the respondents indicated that the effect of building collapse is very high on human lives as compared to properties. The study recommends that regulatory agencies should implement stricter enforcement measures, provide training and education for building owners, and develop best practices with industry associations to improve building monitoring and compliance.

Keywords: building collapse, GIS, public health, urban development, sustainability, African city



Laboratory Efficacy of Essential Oils of *Ocimum gratissimum* and *Mesosphaerum suaveolens* Against *Culex quinquefasciatus* and Adulticidal Trials using Humidifier Technology

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Background: Plant-based intervention is one of the active approaches to controlling mosquitoes, a vector of malaria and many arthropod-borne viruses in Sub-Sahara Africa. We designed an experiment that tested the validity of two essential oils of proven insecticidal plants on *Culex quinquefasciatus* mosquitoes. Larvicidal, pupicidal and adulticidal efficacy was done using essential oils of scent leave (*Ocimum gratissimum*) and pignut leave (*Mesosphaerum suaveolens*).

Methodology: Third instar larvae and pupae of *Culex quinquefasciatus* for the experiment were collected from natural breeding sites using 350ml deep ladles and scooping spoons. The essential oils were measured, 1ml and 0.5ml into 100ml, 250ml and 500ml of water to form 0.01%, 0.001%, 0.002% 0.004% and 0.005% respectively. Twenty third instar larvae and pupae were introduced into vials containing the various concentrations in triplicates. Readings of mortality were recorded from 10, 15, 20, 30, 40, 50, and 60 minutes adhering strictly to the WHO standard protocols. Highest concentrations, 0.01% (1ml:100ml) and 0.005% (0.5ml:100ml), were tried on adult mosquitoes in 300 cm squared cage using ready-to-use humidifier technology.

Results: Mean mortality was higher in larvae exposed to *O. gratissimum* compared to other concentrations. Adult mosquitoes exposed to 0.005% of both plant oils were highest. Pupicidal activities of scent leave oil was higher than pignut oil. Larvicidal efficacy of 0.01% pignut oil equates adulticidal efficacy of 0.01%. The differences between the mean mortality of mosquitoes were significant ($p < 0.05$). Lethal Concentration (LC_{50} and LC_{95}) of scent leave and pignut oil exposed to larvae were 0.011 and 0.021%, and 0.024 and 0.042% respectively. Similarly, for pupicidal exposure, LC_{50} and LC_{95} were 0.019 and 0.041%, and 0.041 and 0.072% respectively.

Conclusion: Scent leave oil was more efficacious. Anticipated efforts should be geared towards emulsifying and synergizing them with other plant oils for complete adult mortality.

Keywords: *Culex quinquefasciatus*, humidifier, laboratory efficacy, pignut leaf, scent leaf



Appendix

Conference Agenda

Time	Activity
DAY ONE: TUESDAY 23rd JANUARY, 2024	
8:00am	Arrival and Registration
Opening Session <i>Session Chair: Ekanem Braide FAS – President, NAS</i>	
9:00am	Welcome/Introduction of Special Guests <i>Oladoyin Odubanjo – Executive Secretary, NAS</i>
9:05am	Opening Remarks <i>Ekanem Braide FAS - President, NAS</i>
9:15am	Goodwill Messages • Aminu Iya Abass – <i>Chairman, Senate Committee on Science and Technology</i> • Ifedayo Adetifa – <i>Director General, Nigeria Centre for Disease Control (NCDC)</i> • Folasade Ogunsola FAS – <i>Vice Chancellor, University of Lagos</i> • Sola Akinrinade FNAL – <i>President, Nigerian Academy of Letters (NAL)</i>
9:30am	Keynote Address: Transdisciplinary Research as Catalyst for Nigeria's Sustainable Development <i>Neta Hanien – Vice President, Programs and Partnerships, Innov8 Hub</i>
Sub-theme 1: Artificial Intelligence and other Emerging Technologies for Nigeria's Development <i>Session Chair: Abubakar Sambo FAS – Vice President, NAS/Chair, Conference Committee</i>	
10:00am	Lead Presentation: Artificial Intelligence and other Emerging Technologies for Nigeria's Development <i>Kashifu Abdullahi – Director General, National Technology Development Agency (NITDA)</i>
10:20am	Oral Presentation 1: Deep Learning for Breast Cancer Detection Using Ultrasonographic Images <i>Oluwatobi Odubela – Department of Biomedical Engineering, University of Lagos</i>
10:35am	Oral Presentation 2: Development of Face Spoofing Attack Detection Attack Detection Using Deep Convolutional Neural Network to Help Business Owners Detect Fraud <i>Temitayo Balogun –Department of Information Systems, Federal University of Technology, Akure</i>
10:50am	Oral Presentation 3: AI-Enhanced Fault Detection and Protection in Solar Mini-Grids for Sustainable Energy Production <i>Bello Muhammad – Center for Renewable Energy Research, Bayero University, Kano</i>
11:05am	Discussion
11:25am	Tea Break/Poster Session/Exhibitions
Sub-theme 2: Transdisciplinary Research for Healthcare in Nigeria <i>Session Chair: Ifedayo Adetifa – Director General, NCDC</i>	
12:25pm	Lead Presentation: Transdisciplinary Research for Healthcare in Nigeria <i>Akinyinka Omigbodun FAS – Department of Obstetrics & Gynaecology, College of Medicine, University of Ibadan</i>

12:45pm	Oral Presentation 1: Anticancer Effect of a Copper (II) Complex with Vanillin 3-ethyl-thiosemicarbazone Ligand in Triple-negative Breast Cancer <i>Ifeoluwa Oyeyemi – Department of Biological Sciences, University of Medical Sciences, Ondo, Nigeria</i>
1:00pm	Oral Presentation 2: Development of a Recombinant DNA Vaccine Candidate for the Prevention of Lassa Fever <i>Mustapha Imam – Centre for Advanced Medical Research and Training, Usmanu Danfodiyo University, Sokoto</i>
1:15pm	Oral Presentation 3: COVID-19 Deaths and Vaccination in Nigeria <i>Emmanuel Okoro – Department of Medicine and Behavioural Sciences, University of Ilorin Teaching Hospital</i>
1:30pm	Discussion
LUNCH BREAK (1:50pm - 2:50pm)	
Sub-theme 3: Smart Agriculture and Food Security <i>Session Chair: Jonathan Babalola FAS – Public Affairs Secretary, NAS/Vice Chancellor Bowen University</i>	
2:50pm	Lead Presentation: Smart Agriculture and Food Security <i>Michael Abberton – Director, R4D West Africa, International Institute of Tropical Agriculture (IITA) Ibadan.</i>
3:10pm	Oral Presentation 1: A Smart Biofilm from African Star Apple Seed Starch and Its Application as a Real-time Freshness Indicator <i>Babatunde Olawoye – Department of Food Science and Technology, First Technical University, Ibadan</i>
3:25pm	Oral Presentation 2: Duplication and Evolution of Cytochrome P450 (CYPS) in Rice Diterpenoid Biosynthesis <i>Jamiu Ahmad - Roy J. Carver Department of Biochemistry, Biophysics and Molecular Biology, Iowa State University, United States of America</i>
3:40pm	Oral Presentation 3: Heavy Metal and Polycyclic Aromatic Hydrocarbons (PAH) Accumulation in Chrysichthys Nigrodigitatus Obtained from Ogun River: Human Health Implication <i>Peter Adegbola – Department of Biochemistry and Forensic Science, First Technical University, Ibadan</i>
3:55pm	Discussion
Sub-theme 4: Emerging Technologies for Sustainable Energy Production and Usage <i>Session Chair: Professor Chidi Akujor FAS – Academic Secretary (Physical Sciences), NAS</i>	
4:15pm	Lead Presentation: Emerging Technologies for Sustainable Energy Production and Usage <i>Femi Oye – CEO, Green Energy and Biofuels (GEB)/Co-Founder, SMEFUNDS</i>
4:35pm	Oral Presentation 1: Effective Utilization of an Agro By-Product as Substrate for Biomass Energy <i>Femi Oyeniyi – Department of Agricultural Technology, Ekiti State Polytechnic</i>
4:50pm	Oral Presentation 2: Exhaust Energy Analysis and Design of a Turbo-Driven Mechanism for Automotive Air Conditioning Application <i>Godswill Nwaji – Department of Mechanical Engineering, Federal University of Technology, Owerri</i>

5:05pm	Oral Presentation 3: Addressing Industrial Energy Needs in Lagos with Small Modular Reactors (SMRs) <i>Abubakar Aliyu – Centre for Renewable Energy and Sustainability Transition, Bayero University, Kano</i>
5:20pm	Discussion
5:40pm	Closing Remarks / End of Day One <i>Chidi Akujor FAS</i>
5:45pm	Poster Session/Networking
DAY TWO: WEDNESDAY 24TH JANUARY, 2024	
8:00am	Arrival and Registration
Opening Session <i>Session Chair: Oluwole Familoni FAS – Treasurer, NAS</i>	
9:00am	Welcome Remarks <i>Oluwole Familoni FAS</i>
9:05am	One-minute Flash Poster Presentations • Onuah Okocha - <i>Federal College of Education, Eha-Amufu, Enugu State, Nigeria</i> • Ijeoma Uzoma – <i>University of Nigeria, Nsukka</i> • Oladimeji Babatunde - <i>Crown-Hill University, Ilorin</i> • Chinenye Ugwah-Oguejiofor – <i>Usman Danfodiyo University, Sokoto</i> • Confidence Kpakol – <i>University of Lagos, Lagos</i> • Onyinyechi Akomah-Abadaike – <i>University of Port Harcourt, Port Harcourt</i> • Emmanuel Anyanwu - <i>Federal University of Technology, Owerri</i> • Hassan Bamidele – <i>Federal Polytechnic Kaura Namoda, Zamfara</i> • Oladejo Adewale - <i>Lagos State University of Education, Lagos</i> • Emmanuel Igwe - <i>University of Nigeria, Nsukka</i> • Victor Enwemiwe - <i>Department of Animal and Environmental Biology, Delta State University, Abraka</i> • Abiodun Areola - <i>Department of Geography, University of Ibadan, Ibadan</i>
Sub-theme 5: Smart Cities and Emerging Technologies <i>Session Chair: Kehinde Ladipo FAS – Chair, NAS Resource Mobilization Committee</i>	
9:30am	Lead Presentation: Smart Cities and Emerging Technologies <i>Stella Chiemeké – Vice Chancellor, University of Delta Agbor</i>
9:50am	Oral Presentation 1: Cloud-Based Vehicular AD – HOC Network and Traffic Control Strategy for Sustainable Development in Nigeria <i>Abasiama Akpan – Department of Computer Science, Federal University of Technology, Ikot Abasi, Akwa-Ibom</i>
10:05am	Oral Presentation 2: Design and Performance Analysis of an Energy Efficient Building in Owerri, Nigeria <i>Godswill Nwaji - Department of Mechanical Engineering, Federal University of Technology, Owerri</i>
10:20am	Oral Presentation 3: Smart Cities vs. The Heatwave: IoT-Driven Strategies to Beat the Urban Heat in Lokoja <i>John Odiba – Biochemistry Department, Salem University, Lokoja</i>
10:35am	Discussion

10:55am	Tea Break/Poster Session/Exhibitions
Sub-theme 6: Emerging Technologies in Emergency Preparedness and Response <i>Session Chair: Olatunde Farombi FAS – Academic Secretary (Biological Sciences), NAS</i>	
12:25pm	Lead Presentation: Emerging Technologies in Emergency Preparedness and Response <i>Mustapha Habib Ahmed – Director General, National Emergency Management Agency</i>
12:45pm	Oral Presentation 1: Preparation and Characterization of Novel Mixed Nano-metal Oxides Compositied with Activated Kaolinitic Clay (CeO₂/TiO₂/AKC) for Photodegradation of Rhodamine B <i>Samsudeen Azeez – Department of Chemistry and Industrial Chemistry, Faculty of Pure and Applied Sciences, Kwara State University, Malete</i>
1:00pm	Oral Presentation 2: Molecular Identification of Endosymbiotic Microbial Populatons Associated with Mosquitoes from Breeding Sites in Osogbo, Nigeria <i>Omotayo Oyedara – Department of Microbiology, Osun State University, Osogbo</i>
1:15pm	Oral Presentation 3: A Framework for Enhancing Emergency Response Systems with Artificial Intelligence and Predictive Analytics <i>Omokhagbo Imafidor – Research and Policy Department, Africa PPP Advisory Services, Nigeria</i>
1:30pm	Discussion
Closing Session <i>Session Chair: Adenike Oladiji FAS – Representative, Biological Sciences, NAS/Vice-Chancellor, Federal University of Technology, Akure</i>	
1:50pm	Presentation of the Professor Alex Acholonu FAS Prize for Best Oral and Best Poster Presentations • Best Oral Presenter • Best Poster Presenter
2:00pm	Vote of thanks <i>Abubakar Sambo FAS</i>
2:05pm	Closing remarks <i>Ekanem Braide FAS</i>
Lunch (2.10-3.10 pm)	

List of Abstracts (Oral Presentations)

S/N	Abstract Title	Page Number
1.	A Framework for Enhancing Emergency Response Systems with Artificial Intelligence and Predictive Analytics	33
2.	A Smart Biofilm from African Star Apple Seed Starch and its Application as a Real-time Freshness Indicator	24
3.	Addressing Industrial Energy Needs in Lagos with Small Modular Reactors (SMRs)	27
4.	AI-Enhanced Fault Detection and Protection in Solar Mini-Grids for Sustainable Energy Production	18
5.	Anticancer Effect of a Copper (II) Complex with Vanillin 3-ethyl-thiosemicarbazone Ligand in Triple-negative Breast Cancer	21
6.	Cloud – Based Vehicular AD – HOC Network and Traffic Control Strategy for Sustainable Development in Nigeria	30
7.	COVID-19 Deaths and Vaccination in Nigeria	21
8.	Deep Learning for Breast Cancer Detection using Ultrasonographic Images	19
9.	Design and Performance Analysis of an Energy Efficient Building in Owerri, Nigeria	31
10.	Development of a Recombinant DNA Vaccine Candidate for the Prevention of Lassa Fever	22
11.	Development of Face Spoofing Attack Detection Using Deep Convolutional Neural Network to Help Business Owners Detect Fraud	20
12.	Duplication and Evolution of CYPs in Rice Diterpenoid Biosynthesis	24
13.	Effective Utilization of an Agro By-Product as Substrate for Biomass Energy	27
14.	Exhaust Energy Analysis and Design of a Turbo-Driven Mechanism for Automotive Air Conditioning Application	28
15.	Heavy Metal and Polycyclic Aromatic Hydrocarbons (PAHs) Accumulation in <i>Chrysichthys nigrodigitatus</i> obtained from Ogun River: Human Health Implication	25
16.	Molecular Identification of Endosymbiotic Microbial Populations Associated with Mosquitoes from Breeding Sites in Osogbo, Nigeria	34
17.	Preparation and Characterization of Novel Mixed Nano-metal Oxides Compositised with Activated Kaolinitic Clay (CeO ₂ /TiO ₂ /AKC) for Photodegradation of Rhodamine B	35
18.	Smart Cities vs. The Heatwave: IoT-Driven Strategies to Beat the Urban Heat in Lokoja	31

List of Abstracts (Poster Presentations)

S/N	Abstract Title	Page Number
1.	6-Gingerol Rich – Fraction of <i>Zingiber officinale</i> Prevented Cerebral Cortex and Cerebellar Dysfunction Caused by Mercury chloride in Male Wistar Rats: Behavioural, Biochemical and Immunohistochemical Studies	44
2.	Applying Emerging Technologies of Internet of Things in the Conduct of Teaching Practice among College of Education Students: A Study in Plateau State	38
3.	Assessment of Contamination of Aquifer in Niger- Delta Region (Warri and Portharcourt)	91
4.	Assessment of the Baseline Requirements of Active Pharmaceutical Ingredients (APIs) among Nigerian Pharmaceutical R&D and Manufacturing Companies	45
5.	Benefits and Challenges of Utilizing Chat-GPT and Gamma.App in Teaching, Learning and Assessment of 21 st Century Colleges of Education Vocational Students	39
6.	<i>Buchholzia coriacea</i> Seed Attenuates Scopolamine-Induced Memory Impairment in Mice by Down-Regulating Oxidative Stress	45
7.	Carbon Alchemy in Lagos: Transforming Carbon Emissions into Sustainability	84
8.	Characterization of Wild Lactic Acid Bacteria for Industrial Applications	71
9.	Computational Study on <i>Securidaca longipedunculata</i> Secondary Metabolites Modulation of the GABA-A Receptor Benzodiazepine Active Site	46
10.	Creating Agricultural Training Video/Audio Content to Improve Quality Impact for Farmers and Other Stakeholders	40
11.	Cybercrimes and Cyber security in Nigeria: A Comprehensive Study	92
12.	Cypermethrin Exposure Impacts Biochemical Parameters and the Metabolism of Liver Enzymes in African Catfish (<i>Clarias gariepinus</i> , Burchell 1822)	71
13.	Determination of Aflatoxin in Maize Flour Sold at Wudil Market, Kano State, Nigeria	72
14.	Development of Antigen-Based Multiplex Immunodiagnosics for Two Predominant <i>Schistosoma</i> Parasites in Sub-Saharan Africa	47
15.	Effects of Treated Greywater and its Potential for Irrigation and Reuse for Sustainable Food Security in Nigeria	73
16.	Employability of Students in Lagos State-owned Tertiary Institutions: Technology and Job Readiness Skills Options	88

17.	Environmental Condition and Food Security: A Case of Fish Growth Pattern and Water Condition in Osinmo Reservoir, Osun State, Nigeria	74
18.	Establishing a “Plug and Play” Vaccine Platform for Emerging Infectious Diseases in Nigeria: A Recombinant COVID-19 DNA Vaccine as a Prototype	48
19.	Evaluation of Antidepressant and Antioxidant Activities of Ethanolic Leaf Extract of Fig Tree (<i>Ficus capensis</i> thunb.) in Wistar Rats	49
20.	Evaluation of the Biochemical Effect of Aqueous Leaves Extract of <i>Basella alba</i> on Wistar Rats Fed with Bouillon Cubes	50
21.	Explainable Artificial Intelligence (XAI) for Smart and Sustainable Healthcare Delivery in Nigeria	41
22.	Exploring Anti-Malarial Efficacy: A Bioactivity-Guided Study on Solvent Fractions from <i>Combretum glutinosum</i> Root Extract in <i>Plasmodium berghei</i> -Infected Mice	51
23.	Extract of Teak Leaf (<i>Tectona Grandis</i>): An Alternative Broad Spectrum Antibiotic Product to Selected Over-The-Counter Antibiotic Drugs	52
24.	Geospatial Analysis of Building Collapse in an African City: Lessons and Implications for Public Health and Sustainable Development	92
25.	Growth Performance and Yield of the Edible White Rot Fungus (<i>Pleurotus ostreatus</i>) on Different Agro-Waste Materials	75
26.	Heavy Metals Evaluation and Median Lethal Dose of the Methanol Leaves Extracts of <i>Moringa oleifera</i> Lam. (Moringaceae) and <i>Carica papaya</i> L. (Caricaceae)	53
27.	Illuminating the Epidemiologic Triad of Human African Trypanosomiasis in Selected Hamlets, Oyo State, Nigeria: One Health Approach	54
28.	Inhibitory Effect of Methanol Extract of <i>Annona muricata</i> Flower on Postprandial Glucose Concentration in Diabetic Rats and its <i>In-vitro</i> and <i>In-silico</i> Mechanistic Properties	55
29.	Interactive Effects of Reduced pH and Increased Salinity on Paraquat Toxicity in <i>Clarias gariepinus</i>	76
30.	Investigating Hydrokinetic Properties for Aquifer Zonation Applying Indexed-Based Models	56
31.	Investigation of Proinflammatory Genes Expression in STZ-Induced Diabetic Rats Treated with Extract of <i>Hibiscus rosa-sinensis</i> Flower	57
32.	Isolation and Molecular Identification of Growth Promoting Potential Bacteria from Cowpea (<i>Vigna Unguiculata</i>) for the Production of Biofertilizer	77
33.	Isolation and Molecular Identification of Phosphate Solubilizing Fungi from Rhizosphere Soil of Okro Plant and its Effect on the Growth of Okro	77
34.	Isolation, Modification and Characterization of Starch from African Star Apple Seed Nut	78

35.	Kogi African Medicinal Plants Healthcare Information System: A Data Mining Approach	58
36.	Laboratory Efficacy of Essential Oils of <i>Ocimum gratissimum</i> and <i>Mesospaerum suaveolens</i> Against <i>Culex quinquefasciatus</i> and Adulticidal Trials using Humidifier Technology	93
37.	Levitation Based Smart Resort	89
38.	Lycopene Attenuates Nicotine-Induced Nephrotoxicity in Female Wistar Rats	59
39.	Molecularly Profiling Yam Rot Pathogenic Fungi from North Central Nigeria	79
40.	n-Hexane Sub-fraction of <i>Uvaria chamae</i> (p. Beau.) Roots Halted Chlorpromazine-Induced Hyperprolactinemic Female Wistar Rats	60
41.	Okun Handwritten Character Recognition Model	41
42.	Perinatal Exposure to Cigarette Smoke Can Alter Reproductive Indices and the Antioxidant Defence System in the Sex Organs of Male Offspring in Wistar Rat Model	62
43.	Pharmacological Evaluation of <i>Musanga cecropioides</i> Extracts for Anti-Diarrhoeal Activity in Mice	63
44.	Potential of Castor Seed (<i>Ricinus communis</i>) Powder-Formulated Feed in the Fertility Control of Wildly Caught Female African Giant Rats (<i>Cricetomys gambianus</i>)	80
45.	Production of Bioethanol from Sorghum Stalk Grown in Kaura Namoda, Zamfara State, Nigeria	85
46.	Public Health Risks and Biomarkers in Laboratory Mice Exposed to Air Emissions at High-Density Traffic Sites in Ojota, Lagos, Nigeria	62
47.	Rapid Screening Methods for Identification of Resistant Maize Inbreds to Fungal Foliar Pathogens	80
48.	Reinforcing the Smart Cities with New Residential Housing Schemes: The Imperative of Needs Assessment for Community Development Education Planning	89
49.	Seasonal Variation and Growth Conditions Influence Seed Germination of Ebolo (<i>Crassocephalum crepidioides</i> and <i>Crassocephalum rubens</i>) Vegetables	81
50.	Sequence Analysis for SNP Detection and Phylogenetic Reconstruction of SARS-Cov-2 Isolated from Nigerian COVID-19 Case	42
51.	Serological Evidence of Tick-borne Relapsing Fever in Nigeria: A Preliminary Report	63
52.	Smart Irrigation System, A Strategy for Climate Change Mitigation and Enhanced Smallholder Farming Efficiency: The Elizade University Experience	82

53.	Toxicological Assessment of Chromatographic Fraction Obtained from Aqueous Extract of <i>Acacia nilotica</i> Seedpod in Experimental Rats	65
54.	Type 2 Diabetes: Evaluating the Effects of Claramine on Insulin- mediated Glucose Regulation in Hepatoma (HepG 2) Cell Line	65
55.	Ulcer Control Revolution: Acetovanillone from <i>Balanites aegyptiaca</i> Triumphs over Omeprazole in Virtual Experiments	66
56.	Ultra-white Barium Sulphate on Silver Substrate for Sub-ambient Radiative Cooling Under Direct Solar Irradiance	86
57.	Undiagnosed and Unreported Human African Trypanosomiasis Cases in Non-HAT Focus: A Cryptic Threat to HAT/NTD Elimination	67
58.	Vancomycin and Methicillin-resistant <i>Staphylococcus aureus</i> from Clinical and Food Samples: Guardians of Resistance and Virulence?	69



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