AFRICA CENTER OF EXCELLENCE IN PHYTOCHEMICALS, TEXTILE AND RENEWABLE ENERGY (ACE II - PTRE)

Virtual International Conference on Phytochemistry, Textile & Renewable Energy for Sustainable Development

12th to 14th August 2020

Conference Theme:

Advancing Science, Technology and Innovation for Industrial Growth

Venue: **VIRTUAL CONFERENCE**

Host: **Moi University, Eldoret, Kenya**

CONFERENCE BOOK OF ABSTRACTS

August 2020

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BRIEF ABOUT MOI UNIVESITY

Moi University was established in 1984 by an Act of Parliament (Moi University Act, 1984) as the second public university in Kenya. This was on the recommendation of a Presidential Working Party, chaired by Prof. Collins B. Mackay, which had collected views from Kenyans about the desirability of the same. Courtesy of his deep and altruistic concern for and interest in the advancement of education at all levels in Kenya, not only as a professional teacher but as Kenya's Head of State, President Daniel Toroitich arap Moi pioneered the idea of a university in a rural setting. He, like most Kenyans, had good reasons for this. Among them was the need to decentralize higher education from Nairobi to other parts of the country. The former president felt time had come to create another university away from an urban environment. Not surprisingly Kenya's second university bears his name. That is a modest tribute to a great and deserving Kenyan. The University was, therefore established with an intention of making it a science, technology and development-oriented institution which would focus on problems of rural development in its training and research programmes. The first group of students, 83 in total, was admitted on October 1, 1984 through a transfer from the Department of Forestry of the University of Nairobi, which formed the initial one faculty in 1984. The University Act of 1984 was repealed and replaced by the Universities Act No. 42 of 2012, which is the one in current use. Under this Act, the Cabinet Secretary for Education, Science and Technology has considerable powers over the operations of both the public as well as private universities. The University is located in Kesses, 35 kilometers from Eldoret Town, and 310 kilometers Northwest of Nairobi, the capital city of Kenya. Moi University has expanded tremendously over the past decade and this can be attributed to the commitment of the entire Moi University fraternity, government investment, strategic partnerships, and the visionary leadership of the University Council and Management. These achievements are a testament of the resilience and fortitude of every faculty and staff member who enabled change at a pace and on a scale never experienced before in the country. Since 1984, the University has experienced phenomenal growth leading to the establishment of several constituent colleges across the country, many of which have since grown to fully fledged Universities namely Maseno University, Masinde Muliro University of Science and Technology, Maasai Mara University, University of Kabianga, University of Eldoret, Karatina University and Rongo University and Garissa University. Currently, the University has two constituent colleges namely Bomet University College in Bomet County and Alupe University College in Busia County. It has the following Schools, Education, Arts and Social Sciences, Business and Economics, Agriculture and Natural Resources, Information Sciences, Engineering, Medicine, Public Health, Nursing, Dentistry, Law, Tourism, Hospitality and Events Management, Sciences and Aerospace Studies. The University has the following Institutes: Institute of Postgraduate Studies, Confucius Institute and Institute of Open and Distance Learning. From 83 students in 1984, the University currently has a student population of 39,786 with a staff component of 3,000 being both academic and administrative. In addition, the University has satellite campuses: Nairobi campus, Mombasa campus, Eldoret West Campus and Annex Campus located about five kilometers from Eldoret Town. https://www.mu.ac.ke/.

Vision of Moi University

To be the university of choice in nurturing innovation and talent in science, technology and development.

Mission of Moi University

To preserve, create, and disseminate knowledge, conserve and develop scientific, technological and cultural heritage through quality teaching and research; to create conducive work and learning environment; and to work with stakeholders for the betterment of society.

Core Values of the University

1. Promotion and defense of intellectual and academic freedom, scholarship and relentless search for truth.
2. Fostering teamwork, innovation, networking, tolerance, and a culture of peace.
3. Embracing excellence, transparency & accountability.
4. Practicing professionalism, meritocracy, equality, integrity and social justice.
5. Maintaining self-respect, discipline, responsibility, institutional loyalty, national patriotism & international competitiveness.

BRIEF ON AFRICA CENTER OF EXCELLENCE IN PHYTOCHMICALS, TEXTILE AND RENEWABLE ENERGY (ACE II - PTRE)

The Africa Centre of Excellence in Phytochemicals, Textile and Renewable Energy (ACEII PTRE) at Moi University is one of the 24 centers under World Bank ACEII project. ACEII-PTRE was established at Moi University in the year 2016. The objective of the ACE II project is to strengthen selected Eastern and Southern Africa higher education institutions to deliver quality postgraduate education and build collaborative research capacity in the regional priority areas. The ACEs are expected to address specific development challenges and skills gaps facing the region through graduate training in Master's, PhD, and short-term courses and applied research in the form of partnerships and collaborations with other institutions and the private sector.

VISION

To be a Center of Excellence in Phytochemicals, Textile and Renewable Energy training, research, innovation and technology for enhancement of the industrial sector.

MISSION

To provide highly trained, skilled and empowered human capacity in Phytochemicals, Textile and Renewable Energy, with the potential to develop innovative products of high value and quality, offer services and solutions for the industrial sector.

OBJECTIVES OF PTRE

The Overall objective:

To advance technology development and innovation in Phytochemicals, Textile and Renewable energy through delivery of quality post-graduate training and collaborative research in the regional priority areas.

Specific objectives:

To strengthen:

1. Education capacity excellence in terms of quality postgraduate training
2. Research capacity excellence and outreach service in Phytochemicals, Textile and Renewable energy
3. Innovation and technology development in the industrial and manufacturing sectors
4. Sustainability of research and training through enhancement of facilities

BRIEF ABOUT SINO-AFRICA INTERNATIONAL FORUM ON TEXTILE AND APPAREL & SINO-AFRICA CULTURAL EXCHANGE FORUM (SAISTA)

SAISTA & SACEF are funded by the program of "20+20" Cooperation plan for Chinese and African Institutions of Higher Education, the first conference which was co-hosted by Moi University and Donghua University was held in 2015. Since then, the conference has been providing the platform for the communication in the field of textile and fashion design industry between China and Africa.

CONFUCIUS INSTITUTE AT MOI UNIVERSITY

Co-established by Moi University and Donghua University, China. Confucius Institute at Moi University has been promoting Chinese language and Culture among the students of Moi University and local citizens. More than 30 students from Moi University have pursued studies in China with Confucius Institute Scholarship. As the first Confucius Institute featuring textile and fashion design across the world, Confucius Institute at Moi University serves as a platform for promoting the collaboration and dialogues in the field of textile and fashion design between China and African.

CONFERENCE THEMES AND SESSIONS

Advancing Science, Technology and Innovation for Industrial Growth

ABSTRACTS FOR SYMPOSIUM SESSIONS:

Symposium 1: Photochemistry - Nano materials, Medicinal chemistry, Natural products, Phytoremediation, Food nutrition, Phyto-economics and phytochemical analysis

Symposium 2: Renewable energy: smart technologies for energy access; energy conversion; hybrid energy systems; energy systems modeling, optimizations and analysis; energy and environmental management; waste to energy; energy systems integration; energy storage, energy economics, policy and regulations.

Symposium 3: Progressive Textiles: Sustainable textile technologies, textile engineering, technical textiles and composites and textiles of the future.

Symposium 4: Transformative industrialization: Industrial engineering, manufacturing, sustainable production and consumption.

Symposium 5: Sustainable Technology and Innovations: Supporting Science and Social Innovations, Commercialization of Technology, Environment and Innovation for Growth, Policy, Ethics and Governance.

Symposium 6: Cross-cutting: Any other papers in Science, Technology, Engineering, Arts and Mathematics (STEAM)

ABSTRACTS FOR PHYTOCHEMISTRY THEME

PHY-001-20

Geochemical fractionation of heavy metals in chromated copper arsenate contaminated soils

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Abstract

In Uganda, hydroelectricity is transmitted through electric wires supported on wooden poles. The wood used are pre-treated with preservatives such as chromated copper arsenate (CCA) and creosote which are serious environmental pollutants. This study investigated the distribution and the geochemical fractionation of chromium (Cr), copper (Cu) and arsenic (As) in contaminated CCA soil from a wood factory in Wakiso district of Uganda. Six-step sequential extraction of Cr, Cu and As of 1.0 g of the CCA contaminated soils was done and the metalliferous content of the samples in each fraction were quantified by atomic absorption spectroscopy. The relative concentrations of Cr, Cu and As in the CCA contaminated soils were 365.8 ± 6.18, 109.72 ± 14.04 and 28.22 ± 3.8 mg kg-1 respectively. The mobility and bioavailability of the selected priority trace metals followed the chemical sequence Cu < Cr < As. Arsenic dominated in the water soluble, exchangeable and carbonate bound fractions followed by Cr and Cu. Amendment of the contaminated soils with 5, 10, 15, 20 and 25% sewage sludge biosolid increased soil pH from 6.77 to 6.35, 6.67 , 6.75 , 6.77 and 6.99 respectively. Thus, Cu and Cr in amended CCA soil were minimally available for plant uptake. Sewage sludge addition to soils contaminated with CCA heavy metals could remediate such soils for agricultural activities.

Keywords: heavy metals, Uganda, sewage sludge biosolid, sequential extraction.

PHY-002-20

Chemical composition and insecticidal activity of Pinus caribaea Morelet var. hondurensis needles against Sitophilus zeamais Motschulsky and Callosobruchus maculatus Fabricius

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Abstract

Plant allelochemicals from essential oils have recently received considerable attention in pharmaceutical, cosmetic and agricultural sectors due to their biodegradability and low toxicity. This study analyzed the chemical composition of essential oils of *Pinus caribaea* Morelet var. hondurensis needles. Thirty-nine (39) organic compounds were identified using gas chromatography/mass chromatography and gas chromatography, and the most abundant components were limonene (38.6%), α-pinene (27.6%), borneol (6.7%) and myrcene (3.5%). The chemical composition of the needles was dominated by monoterpene hydrocarbons (77.2%) followed by oxygenated monoterpenes (12.0%), sesquiterpene hydrocarbons (4.7%) and then lastly oxygenated sesquiterpenes (1.7%). In fumigant toxicity, 100% mortality was recorded at 10 µL/ml for bean weevils after 2 hours of exposure whereas the same concentration caused 100% mortality of maize weevils after 5 hours of exposure. In repellency bioassay using aliquots of acetonic essential oils, 100% repellence was recorded in bean weevils after 60 minutes of exposure while the highest concentration gave 100% repellence activity in maize weevils after 150 minutes. The essential oils showed higher insecticidal activity against bean weevils than maize weevils. Based on the results of this study, pine needles could be a suitable source of green insecticides for control of maize and bean weevils in stored food products.

PHY-003-20

Kenyan Antivenin Plants: Ethnobotany and Future Perspectives

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Abstract

Snake envenomation is one of the neglected tropical diseases which have left an intolerabl death toll and severe socio-economic losses in Kenya. In a continued effort to identify some antiophidic East African botanical species, this study generated ethnobotanical information on antivenin plants reported in Kenya, with a view to identify potential species which could be subjected to *in vitro* and clinical studies for possible development into antivenoms. Data retrieved through searches done in multidisciplinary databases indicated that 54 plant species belonging to 45 genera, distributed among 27 families are used for management of snakebites in Kenya. Most species belonged to family Asteraceae (11%), Malvaceae (11%), Fabaceae (9%), Annonaceae (6%), Combretaceae (6%) and Lamiaceae (6%). The main growth habit of the species is as herbs (35%), shrubs (33%) and trees (28%). Antivenin preparations are usually from leaves (48%), roots (26%) and stem bark (8%) through decoctions, infusions, powders and juices which are applied topically or administered orally. The most frequently encountered species were *Combretum collinum*, *Euclea divinorum*, *Fuerstia africana*, *Grewia fallax*, *Microglossa pyrifolia*, *Solanecio mannii* and *Solanum incanum*. Indigenous knowledge on medicinal antivenom therapy in Kenya is humongous, and therefore studies to isolate and evaluate the antivenom compounds in the claimed plants are required to enable their confident use in antivenom therapy alongside commercial antivenin sera.

PHY-004-20

Isolation, characterization and antioxidant activity of phenolic compounds from Ocimum gratissimum and Rosmarinus officinalis leaves

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Abstract

In this study, Ocimum gratissimum and Rosmarinus officinalis leaves were subjected to phytochemical screening and their antioxidant activities and total phenolic content evaluated. Extraction was done by maceration using n-hexane, dichloromethane, ethyl acetate and methanol in order of their increasing polarity. Results showed that methanol extracts had the highest total phenolic content of 476.8 ± 0.6928 µg/ml and 401 ± 6.466 µg/ml for R. officinalis and O. gratissimum respectively. Methanol extracts had the highest total phenolic content and on subjection to column chromatography, solid phase extraction and liquid chromatographymass spectrometry, 34 compounds were characterized in O. gratissimum extract while R. officinalis extract had 35 compounds. Gallic acid, rutin, catechin, quercetin, tannic acid, anustoline, ellargic acid and rosmarinic acid amongst other compounds were found to be common in both plant extracts. The total antioxidant activity of methanol extracts were 69.8% and 61.3% for R. officinalis and O. gratissimum leaves respectively.

Keywords: Polyphenols, Solid Phase Extraction, Traditional medicine, Uganda.

PHY-005-20

Evaluation of antioxidant and antibacterial activities, cytotoxicity of Acacia seyal Del bark extracts and isolated compounds.

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Abstract:

Water extract of *Acacia seyal* bark is used traditionally by the population in Djibouti for its anti-infectious activity. The evaluation of *in vitro* antibacterial, antioxidant activities and cytotoxicity as well as chemical characterization of *Acacia seyal* bark water and methanolic extracts were presented. The water extract has a toxicity against the MRC-5 cells at 256 µg/mL while the methanolic extract has a weak toxicity at the same concentration. The methanolic extract has a strong antioxidant activity with half maximal inhibitory concentration (IC_{50}) of 150 ± 2.2 µg / mL using 1-diphenyl-2-picrylhydrazyl (DPPH) and IC_{50} of 27 ± 1.3 µg / mL using 2,2'-azino-bis 3-ethylbenzthiazoline-6-sulphonic acid (ABTS) radical method. For ferric reducing/antioxidant power (FRAP) assay the result is 45.74 ± 5.96 µg Vitamin C Equivalent (VE) / g of dry weight (DW). This activity can be related to its high content of phenolic and flavonoids respectively 1927.1 mg gallic acid / 100 g (DW) and 30.9 mg quercetin / 100 g of DW. The precipitation of tannins from methanol crude extract decrease the minimum inhibitory concentration (MIC) from 64 µg/mL to 32 µg/mL against *Staphylococcus aureus* and *Corynebacterium urealyticum*. However, the antioxidant activity is higher before tannins precipitation than after (IC_{50} = 150 µg/mL for methanolic crude extract and 250 µg/mL after tannins precipitation determined by DPPH method. By matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS) analysis, the results showed that the condensed tannins consist of two types of catechin and gallocatechin-based oligomers. The fractionation led to the identification of three pure compounds: two flavanols catechin and epicatechin, one triterpene as lupeol and a mixture of three steroids and one fatty acid: campesterol, stigmasterol, clionasterol and oleamide.

Keywords: *Acacia seyal* bark, *in vitro* antibacterial properties, polyphenols, antioxidant activity, tannins, MALDI-TOF.

PHY-006-20

Effect of temperature and cooking time on total phenolic content, total flavonoid content and antioxidant activity of garlic

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Abstract

Objective: To investigate the effect of cooking temperature and time on the total phenolic content, total flavonoid content and antioxidant activity of aqueous and ethanolic extracts of garlic.

Results: The mean total phenolic content of fresh garlic were 301.29 ± 6.58 mg gallic acid equivalent per 100g (GAE/100g) and 637.91 ± 15.30 mg GAE/100g of plant material for the aqueous and ethanolic extracts respectively. The mean total flavonoid content was 109.68 ± 6.78 mg quercetin equivalent per 100 g (QE/100g) and 258.21 ± 12.37 QE/100 g for aqueous and ethanolic extracts respectively. Fourier transform infrared spectral data showed absorptions in the range for carboxylic acids, hydroxyl group, esters, and alcohols, confirming the presence of phenols and flavonoids in the extracts. Cooking temperature had a significant effect on total phenolic content and total flavonoid content while cooking time did not have a significant effect on the phytochemicals and antioxidant activity. In conclusion cooking enhances extraction of phytochemicals and increases the antioxidant activity of garlic. It is therefore recommended that garlic should be cooked at higher temperatures for optimum phytochemicals and antioxidant activity for more health benefits.

Keywords: *Allium sativum*, Fourier transform infrared spectroscopy, condiment, allicin, radical scavenging activity.

PHY-007-20

Biosynthesis of Zinc Oxide Nanoparticles Precursor for Development of Nanocomposite For Degrading Selected Organochlorines.

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Abstract

Water pollution due to organic contaminants has been a serious issue in developing countries because of acute toxicities and carcinogenic nature of these pollutants. Among various water treatment methods, adsorption is purported to be one of the best because it is cheap and easy to prepare and use. Initially, activated carbon was being used in water treatment to remove contaminants but it proved to be expensive and it did not also degrade these contaminants after adsorption. For this reason, zinc oxide nanoparticles are synthesized for a recommended use in the degradation of pesticides. The zinc oxide nanoparticles was synthesized using *Cissus quadrangularis* plant leaf extract. The surface analysis of the synthesized nanoparticle was analyzed using scanning electron microscope (SEM) and X -ray diffraction (XRD) crystallography.

Key Words: Water pollution, Organic contaminants, nanoparticle, Carcinogenic,

PHY-008-20

Identification of phenolic compounds in *Prosopis juliflora* by liquid chromatography electrospray ionization tandem mass spectrometry

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Abstract

A substantive study on the identification of phenolic compounds present in *Prosopis juliflora* was undertaken. *P. juliflora* is known to be highly adapted to dry lands because of its deep taproots which tolerate dry and waterlogged soils. However, because of its invasive nature, it has spread to undesirable areas like sea shores, arable lands and roads becoming a great menace. Towards its valorization, this study aimed at identifying the various phenolic compounds present in it. Study of phenolic compounds is necessary due to their potential health benefits like antioxidant, anti-inflammatory, anti-carcinogenic, antimicrobial, antihypertensive and cardioprotective. Plant samples were collected from three different geographical areas in Kenya; Baringo, Garissa and Turkana Counties. Its acetonic extracts were thereafter analyzed using a reversed-phase liquid chromatography coupled to electrospray ionization – tandem mass spectrometry. Identification of the compounds present was achieved by comparison of experimental retention times and UV-MS spectra to bibliographic data and standard compounds. Twenty chemical compounds were tentatively identified out of which fifteen were found either as flavonoid aglycones or some of their glycosylated forms. For the first time, a new compound believed to be a B-type proanthocyanidin of mesquitol was identified based on the MS/MS diagnostic ions that resulted from retro-diels-alder reaction, quinone methide cleavage and heterocyclic ring fission. The results illustrated a rich array of phenolic compounds present in *P. juliflora.*

Keywords: *Prosopis*; Flavonoids; Glucosides; Mesquitol

PHY-009-20

Comparison of the phytochemical composition of *Euclea divinorum* 1 Hern (Ebenaceae) leaves, tender stems and root bark 2

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Abstract

Euclea divinorum Hern (Ebenaceae) has a long history of folkloric use in the treatment of different diseases. However, there are few reports on the responsible phytochemicals in its tender stems, leaves and root bark. The aim of this study was to compare the phytochemicals in the hexane, dichloromethane and ethanolic extracts of *E. divinorum* leaves, tender stems and root bark. The plant materials were extracted serially by maceration with dichloromethane, hexane and finally ethanol. Alkaloids, phenols, saponins, flavonoids, steroids, cardiac glycosides, tannins, terpenes, and volatile oils were identified in qualitative screening of the extracts. UV Visible and FTIR spectroscopy indicated the presence of alcohols, phenols, alkanes, alkenes, alkynes, aldehydes, carboxylic acids, aromatics, nitro compounds and amines in the extracts. GC/MS identified and quantified 30 compounds in hexane and dichloromethane extracts. The major constituents were 3,4-Methylenedioxybenzylacetone, Eicosane, Tetratriacontane, Hexatriacontane, 9-Hexadecen-1-ol, 2-Hydroxy-2-methyl-8,8-diphenyl- octa-5,7-dien-3-one, 1,4-Naphthoquinone and Octacosanal. The compounds identified in the extracts supports the use of this plant in traditional medicine.

PHY-011-20

DYEING CHARACTERISTICS OF DIFFERENT SOLVENT EXTRACTS OF *Euclea divinorum* ON COTTON FABRIC

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Abstract

Most of the dyes used in the textile industry are of synthetic origin. Recently the use of natural dyes in dyeing has regained interest due to environmental hazards associated with synthetic dyes. Therefore there is need to introduce more natural dyes in order to satisfy the increasing demand. *Euclea divinorum* has been in use as a source of traditional medicine for tooth ache, chest pain, constipation, cancer, pneumonia and snake bite. For many years the root and stem of *E. divinorum* has been used traditionally by different communities to color the mouth and lips and as a dye but its potential as a source of natural dye for textile dyeing has not been exploited. This study investigated the effect of different solvent extracts on the dyeing characteristics of dyestuffs from Euclea divinorum plant on cotton fabric. Light, wash and rub fastness of the dyed cotton were tested using fad-o-meter, launder-o-meter and crock-o-meter, respectively. Colour coordinates, reflectance and color strength were determined using the reflectance spectrophotometer. The aqueous and methanolic extracts showed the highest color strengths followed by ethyl acetate extract. The wash, light and rub fastness values for aqueous and methanolic extracts were between 4 and 5 which is above the acceptable levels of 3. Quantitative phytochemical analysis indicated that methanolic extract had the highest content of phenols, tannins and flavonoids compared to the other solvent extracts.

Key words: *Euclea divinorum*, natural dye, colour strength, colour fastness, phytochemical

PHY-019-20

Phytochemical screening, Total Phenolic Content, Total Flavonoid Content and GC-MS evaluation of crude acetonic extracts of *Prosopis juliflora*

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Abstract

Commonly referred to as mathenge in Kenya, the Prosopis juliflora plant has been considered as a noxious weed within the boundaries of Kenya occupying vast ASAL lands, colonizing water bodies and affecting livestock by the blocking of their rumens, causing diarrhoea and in some cases leading to the loss of teeth eventually leading to death. Despite these disadvantages, the *P. juliflora* plant has been identified in several nations as a plant of great medicinal value being used for the treatment of eye problems, digestive problems, lung problems, sore throats among other ailments. This have mainly been extracted from the pods, leaves and bark. Acetonic extracts of the heartwood, have in recent research shown to be high in flavonoid content with mesquitol being an isolated compound of interest. This is because mesquitol, in comparison to the existing antioxidants such as catechin, probucol and alpha-tocopherol has been shown to have better antioxidant and radical scavenging properties potentials hence it can be useful for managing diseases such as cancer and diabetes. With the heartwood being significantly different from the other parts of the plant, limited research has been done on the phytochemicals present, their total flavonoid contents, total phenolic content and potential medicinal uses. Phytochemical screening of acetonic extracts showed the presence` of flavonoids, alkaloids, terpenoids, steroids, tannins and no saponins. The total flavonoid content was 33.7 ± 1.22 while the total phenolic content was 53.5 ± 2.6 GAE. GC-MS identified five compounds namely 2(4H)-Benzofuranone, 5,6,7,7a-tetrahydro-4,4,7a-trimethyl, 2(4H)-Benzofuranone, 5,6,7,7a-tetrahydro-4,4,7a-trimethyl-, (R)-, cyclopentanecarboxylic acid, 3-(3-fluorophenylcarbamoyl)-1,2,2-trimethyl, 6,6-Dimethyl-10-methylene-1-oxa-spiro[4.5]decane and 2-Pentanol, 2,4-dimethyl-

Keywords: Phytochemicals, medicinal properties, flavonoid

PHY-013-20

Evaluation of shading on tea (*Camellia sinensis* (L.) O. Kuntze) yield component and phenolics in aerated and unaerated products.

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Abstract

Tea (*Camellia sinensis* (L.) O. Kuntze) consumption has increased in recent years, due to the health benefits associated with its rich polyphenols. However, varying climatic conditions have pronounced effect on growth and development of the plant. The objective of this study was to evaluate the effects of shade adaptation on yield and quality parameters in aerated and unaerated products. This was investigated in one cultivar namely; TRFK 6/8, maintained under three different shading regimes (30, 60 and 90%) and unshaded regime as a negative control over three seasons of a year. Yield components included; shoot growth rate, shoot density and monthly seasonal yields. Biochemical parameters assessed included total; catechins, caffeine and polyphenols. Shoot growth rate, shoot density, monthly mean seasonal yields, catechin content and caffeine content were negatively affected while total polyphenol content was positively affected by increase in shading. Product diversification can be adopted in existing tea populations in production of unaerated tea under moderate shading (30 and 60%) during cold/wet season and production of high quality of aerated product during warm/hot seasons of the year while maintaining optimum yields.

Key words: Shoot growth, shoot density, seasonal yields, catechins, caffeine, polyphenols.

PHY-018-20

Phytochemical Screening, Total Phenolic and Flavonoid Content of *Senna didymobotrya*

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Abstract

Senna didymobotrya belongs to the plant family Caesalpiniaceae. It is a potential medicinal plant whose medicinal values have been explored widely by traditional practitioners. In Kenya, the Kipsigis community has been using this plant to control malaria as well as diarrhoea. The Pokot peel the bark, dry the stem and burn it into charcoal that they use to preserve milk, treat skin conditions of humans and livestock infections. The plant is also useful for the treatment of fungal and, bacterial infections, hypertension, haemorrhoides, sickle cell anaemia, a range of diseases affecting women such as inflammation of fallopian tubes, fibroids and backache, to stimulate lactation and to induce uterine contraction and abortion. Research has not been done to investigate effect of different extraction solvents on yield, total phenolic and flavonoid content of *Senna didymobotrya* plant roots. The aim of this study was to compare root extract yield of diethyl-ether, methanol and aqueous solvents; phytochemical screening; and total phenolic and flavonoid content of *Senna didymobotrya* plant roots. Extraction was done by soxhlet method. Phytochemical screening was done using Harborne (1973) method with slight modification. Total flavonoid content was determined by aluminium chloride colourimetric assay at 420 nm. Total phenolic content was determined by Folin-Ciocalteu at 760 nm using UV-VIS spectrophotometer. Extraction yield of diethyl ether, methanol, and distilled water were 3.72 g (7.44%), 4.97 g (9.94%), and 9.09 g (18.18%) respectively showing a significant difference ($p < 0.05$) in the yields obtained using the different solvents. Phytochemical screening showed positive for phenols, tannins, saponins, gladiac glycosides, anthraquinones, alkaloids, and flavonoids. Total flavonoid content was found to be 48.3 ± 1.5 (QEmg/g) and total phenol content was calculated as 34.5 ± 0.1 (GAEmg/g). Distilled water can be utilized as the best extraction solvent. Senna has high amount of flavonoid and phenolic content.

Keywords: Phytochemicals, Flavonoid, Phenolic, *Senna didymobotrya*

PHY-015-20

Bioefficay of *Chrysanthemum cinerariifolium* and *Allium sativum* oil extracts against *Sitophilus zeamias*

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Abstract
Post harvest grain loss due to insect pests remains a major challenge to most farmers in developing countries. The application of current synthetic chemicals in pest control has been limited due to toxicity, evolution of insect resistance and environmental degradation. A study was done to evaluate the ability of natural garlic oil extract to synergize pyrethrin against Sitophilus zeamias a significant postharvest cereal pest. The treatment solutions for bioassay tests were mixture of garlic oil extracted using hexane as solvent and pyrethrin. The experimental design used for bioassay was completely randomized design and the tests were done in triplicate. The pyrethrin with garlic oil were analysed for phytochemicals to confirm the presence of secondary metabolites like saponins and tannins linked to insecticidal activity. The treatment solutions used for bioassay were mixtures of pyrethrin with garlic oils in a ratio of 1:10 of varying concentrations. The highest concentration ratio of pyrethrin to garlic oil was 20 mg/ml: 200 mg/ml while the lowest was 14 mg/ml: 140 mg/ml. The mortality rates were determined at intervals of 24, 48 and 72 hours. There were significant changes in percentage mortality rates of the insects with increase in concentration of treatment solutions and exposure time. The result showed piperonyl butoxide as the most effective pyrethrin synergist with percentage mean mortality of 90% compared with garlic oil of comparable concentration which had 50%. The standard convectional insecticide used was 20 mg/ml actellic super dust recorded the highest mean of 93%. The non-synergized pyrethrum containing 20 mg/ml pyrethrin had a mean mortality rate of 29% which was less compared to some treatments with lower concentration of pyrethrin but synergized with garlic oil. The parameters used to evaluate the efficacy of test solution were mortality rates relative to concentrations of treatments and insect's exposure time. The findings from this study revealed that garlic oil can enhance the potency of pyrethrin against Sitophilus zeamias.

Keywords: Sitophilus zeamias, Phytochemicals, Treatments, Synergist,

PHY-016-20

OPTIMIZATION OF WATER-BASED DRILLING MUD USING LEAVES FROM *Veronia amygdalina*

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Abstract

Naturally occurring materials can be utilized to valuable means in the oil and gas production industry. This work aimed at optimizing water-based drilling mud by using leaves from *Veronia amygdalina* (*V. amygdalina*) plant. The plant material was collected within Port Harcourt, Nigeria and was prepared by drying and grinding into powder. The rheological properties of the mud were measured using Fann viscometer. Mud balance was used to obtain the mud weight while the pH was measured using pH meter. It was observed that the mud weight of formulated muds with *V. amygdalina* leaves was not affected. The pH of the control mud was highest (10.44) while the lowest pH was recorded by mud with 3% leave's extract. Obtained results indicate that the plastic viscosity (PV) of the mud with 2% *V. amygdalina* recorded the highest value of 38cP at 49°C while the control mud (without plant leaves), recorded the lowest PV of 22cP at 70°C. Yield point (YP) of the mud formulated with 3% plant material recorded high value of 61 1b/100ft2 and 11 1b/100ft2 was recorded by control mud. Mud with 4% mud sample recorded extremely high YP of 113-251 1b/100ft2 which are above the range of accepted yield point values. The gel strength of the mud indicated that at 10 seconds, gel strength of mud sample with 1% extract recorded the highest value of 3.51b/100ft2 at 50°C and lowest value of 1.2 1b/100ft2 sat 70°C. The 10-minute gel strength gave the highest value of 251b/100ft2 at 30°C for the plant having a 3% extract. The control mud sample gave the lowest of 10-minute gel strength at 49°C. The results shows that the *V. amygdalina* leaves significantly improved the rheological properties of the mud. It was also observed that the mud weight of formulated muds with *V. amygdalina* leaves was not affected. The mud with plant leaves reduced the filtration loss by 25%. These observations recommend the use of *V. amygdalina* leaves to improve the rheological properties of the drilling mud. Also, there is a need to carry out isolation and characterization of the active ingredients from *V. amygdalina* leaves to establish the compound (s) associated with its activity in drilling mud.

Keywords: *Veronia amygdalina*, rheology, drilling mud

PHY-017-20

Colourimetric Study of Natural Dye from *Beta vulgaris* Peels and Pomace on Cellulosic Substrate

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Abstract

The manufacturing and textile industrial usage of synthetic dyes is associated with carcinogenic, toxic, and allergic effects on humans and to our environment. Natural dyes have attracted attention globally because of their non-hazardous nature. *Beta vulgaris* (Beetroot) plant wastes such as peels and pomaces are unexploited resource. The present study involved solvent extraction of natural dye from *Beta vulgaris* peels and pomace, and apply on cellulosic fabrics with the use of natural mordants (alum and tannic acid) in comparison to metallic mordants (potassium dichromate, ferrous sulphate and copper sulphate) to improve the colour fastness of the cotton substrate and establish colour strength equivalence relating to a synthetic dye of the same hue. The three mordanting methods (pre-mordanting, simultaneous and post mordanting) were employed in all the mordants. Reactive dyeing using Reactive Orange HER was done for colour equivalence (ceq) comparison. Factors which affect extraction and dyeing namely temperature, M: L ratio, time and pH were considered in extraction and dyeing by employing Response Surface Methodology and central composite design for optimization. It was observed that extraction and dyeing parameters have significant effect on colour characteristics of dyed cotton fabric. Extraction of dye with optimized parameters resulted in moderate (30-40%) yield of natural dye from the plant proving to be better than conventional methods. The optimized extraction conditions were M:L ratio of 1:20 and time of 11 hours, while those of dyeing, that is, temperature, time and pH were 55^0 C, 75 minutes and pH 6 respectively. Colour fastness of dyed fabrics (light, washing, and rubbing and perspiration fastness) were determined and the fabrics exhibited very good to excellent score in the range of 4-5. The CIE L*, a*, b*, C* and hº values were studied by standard methods. The findings of this study are encouraging that the natural dye and natural mordants as potential alternatives to synthetic dyes and metallic mordants respectively.

Key words: *Beta vulgaris*, mordant, colour strength

PHY-018-20

Application of Response Surface Methodology for optimized adsorption of crystal violet dye from aqueous solution using *Eichhornia crassipes* biochar.

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Abstract

Pollution of environment as a result of presence of toxic dye effluents in water bodies is on the increase. The main purpose of this study was therefore to apply Response Surface Methodology (RSM) to optimize removal of crystal violet dye from an aqueous solution using *E. crassipes* biochar. The specific objectives were to develop a second order model for adsorption of crystal violet dye from an aqueous solution using *E. crassipes* and to determine optimal condition for temperature, adsorbent dose, initial dye concentration and agitation that will optimize adsorption of crystal violet dye. Central Composite Design (CCD) with a total of 28 experimental runs was used to estimate a second order response surface regression model. The amounts that were used during the experimental study in the Laboratory were: Agitation speed (X_1) ranging from of 125 rpm to 225 rpm, Temperature (X_2) ranging from 35 ºC to 55 ºC, Initial dye concentration (X_3) ranging from 0.75 mg/L to 1.75 mg/L and adsorbent dose (X_4) ranging from 0.03 g to 0.07 g. The experimental runs were utilized for the analysis of response surface designs using Minitab version 17. All linear factors and pure quadratic factors except the square of factor (X_4) were significant in the model. Only(X_2 X_4) interaction factors was significant. Maximum dye adsorption (at 92.82%) was obtained at agitation speed of 201.77 rpm, temperature of 51.57 °C, adsorbent dose of 0.0369 g and initial dye concentration of 1.75 mg/dm3. In conclusion, a second order model for adsorption of crystal violet dye was developed and the optimal conditions for maximum dye adsorption determined. RSM is recommended to be used to optimize conditions for removal of toxic dyes in textile manufacturing industries using *E. crassipes* biochar.

Key words: Optimization, adsorption, crystal violet, *E. crassipes*, biochar

PHY-019-20

Antacid effect of Leaf Extracts of *Bidens pilosa* Linn Varr Radiata.

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Abstract

Bidens pilosa Linn Varr Radiata is a medicinal plant used widely in folk medicine for its antiulcer activity. Methodology: *Bidens pilosa* Linn Varr Radiata leaves were assessed for the antacid activity. The preliminary chemical tests performed for the extracts showed the presence of tannins, phenols, steroids and absence of flavonoids. Then the extracts were evaluated for the antacid potencies by working on the parameters like determination of pH of the prepared extracts, neutralizing effects on artificial gastric acids using sodium bicarbonate and water as positive and negative standards respectively. Methanolic, dichloromethane, sodium bicarbonate and water extracts showed potent antacid activity.

Key words: Antacid activity, hydrochloric acid in the stomach, Non-Steroidal Anti-Inflammatory Drugs (NSAIDs), gastrointestinal tract.

ABSTRACTS FOR PROGRESSIVE TEXTILE THEME

PROG-001-20

Effects of Alkaline and Microwave Surface Modification on Calotropis Procera Bast Fibers for Development of Fiber-Reinforced Polylactic Acid Composite

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Abstract

Different natural occurring fibres have been widely used as reinforcement in thermoplastic or thermosetting polymer matrix. One of the major challenges of using them in polymer composites is incompatibility with some polymeric matrices. Physical and chemical treatments for surface modification have been used by researchers as a way of overcoming these challenges and improving the properties of natural fibres. However, the issues of environment and health are major concerns. Thus, the use of non-hazardous chemical and physical modification of natural fibres is becoming an attractive area of research. In this study, bast fibres of Calotropis plant were used. The stems of the plant were collected from the field in Baringo County, Kenya, done by cutting the stems from the *Calotropis* plant bushes and removing the leaves. The *Calotropis* bast fibres were then extracted manually using decortication method. The first samples of the fibres were treated using varied alkaline solution concentrations of sodium hydroxide for different duration of treatment time. The second samples were subjected to microwave treatment at various power levels for different duration of treatment time. The linear densities and tenacities of the treated and untreated fibers were then tested and analyzed. The fibers with optimum properties were then used with Polylactic acid (PLA) matrix to fabricate bio-composite materials. Both the samples treated in alkaline solution and those subjected to microwave showed significant increase in tensile properties (tenacity) when compared with the untreated samples. Moreover, both treated fibers samples showed significant decrease in fiber linear density. These changes ascertained the effect of microwave treatment and can be used as an eco-friendly alternative technique to alkaline fibre surface modification. Alkaline treatment at 5 w/v% alkaline solution for 1 hour and microwave irradiation with 231Watts of power for 4 minutes treatment period were the optimum for *Calotropis procera* bast fibers modification. The PLA/Calotropis Procera Bast Fibers (PLA/CPBF) composite tensile properties test were performed to authenticate the effect on the Mechanical/tensile properties and the results showed that both the alkaline solution treatment and the microwave energy irradiation improved the tensile strength and modulus of the composites. The results showed that the tensile strength of PLA/alkaline treated-CPBF and PLA/microwave treated-CPBF improved by 34.27% and 20.46% respectively, while the tensile modulus increased by 21.22% and 15.54% for the alkali treated fiber composites and microwave treated fiber composites respectively. Conversely, it was observed that prolonged and higher power radiation lead to decrease in mechanical properties.

Key words: Calotropis procera bast fibers, fiber properties, surface modification, composites.

PROG-002-20

Identification of Means of Alleviating Production Related Problems that Lead to Poor Quality in Garment Manufacture (A Case Study of Carousel Clothing Factory)

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Abstract

The qualitative aspect of production has been identified as having a strong influence on critical production issues such as productivity and cost of production. This is mainly because each manufacturer seeks to produce acceptable quality products using the most efficient and economic methods of production. For this goal to be met, process parameters and conditions affecting quality of output in clothing factories must therefore be properly balanced. The assembling of garments is the central process in clothing manufacture which determines the output of a clothing factory. Since output is measured both quantitatively and qualitatively, most of the quality defects of the finished products emanate from the sewing process, therefore the scope of the study focused on this department in Carousel clothing factory located in Bulawayo, Zimbabwe. This factory experienced quality problems which led to complaints from customers to an extent of rejection of orders, resulting in the company incurring significant amounts of external costs. This research was therefore meant to identify means of alleviating production related problems that lead to poor product quality. The techniques used were meant to provide an understanding of the current situation in the company in terms of all the variables that affect quality both directly and indirectly. A qualitative research approach was employed in the collection of data, which is characterized by the use of small samples not necessarily representative of the population. The study utilized primary data, collected using interviews, Discussions, and Observations. The data was analyzed qualitatively by interpretation of the findings with reference to what other academics and researchers have concluded, and it was established that the company is greatly affected by lack of monitoring and control of systems, coupled with poor communication. Continuous evaluation and auditing of the production system, preventive maintenance, and quality training of employees, emerged as the critical measures to remedy the situation.

Key words: Garment technology, Continuous improvement, Total quality management

PROG-004-20

Influence of Cotton Field Soil Cultured Bacteria on Cellulosic Substrate Properties

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Abstract

Most microbes are known to cause bio deterioration on textile materials. Textiles made from cellulosic fibres are generally more susceptible to bio deterioration than those of synthetic fibres. The inherent properties of cellulosic textile substrates provide room for the growth of micro-organisms. This is because their porous hydrophilic structure retains water, oxygen and nutrients, providing perfect environments for bacterial growth. Consequently, bacterial attack causes staining and poor performance of cellulosic textile substrates. The poor performance such as loss of strength or flexibility result from eventual rotting and breakdown of the fibres leading to physical changes which may cause the fabric to fail in use. On the contrary, a soil dwelling *bacillus* when cultured in presence of cellulosic substrate has been found to produce extracellular substances that tend to enhance the substrate's physical properties rather than cause bio deterioration. In this work, b*acillus* cultured from cotton field soil was used to study its effect on cotton fibres. Cotton fibres were treated with the bacteria broth at pre optimized conditions. Bacteria treated fibres were further washed with caustic solution. Strength, morphological and structural properties of the untreated, bacteria- treated and bacteria-caustic treated fibres were studied using HVI, SEM and FTIR respectively. HVI results showed 25.44% increase in the fibres strength. This was attributed to adherence of bacterial extracellular substances onto the cotton cellulose through hydrogen bonding that resulted into increased fibre stiffness as evidenced by the morphological and structural analysis results. A 16.74% drop in average strength of the bacteria-caustic treated fibre was recorded. These findings provide new insights in the treatment of cellulosic textile materials against microbial attacks and subsequent bio deterioration. Moreover, these cellulosic materials could offer increased service life.

Keywords: *Bacillus*, cotton field soil, cotton, extracellular substances, morphology, strength

PROG-005-20

A Study of Coir Fibre Length, Tensile Strength and Elongation as a Function of Water and Mechanical Extraction Methods (Case Study Kwale, Kilifi and Malindi in Kenya)

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Abstract

Coir fibre is a by-product of coconut processing and is obtained from the husks of *Cocos Nucifera* species of the palm tree. Normally its extraction is carried out by traditional, chemical and mechanical methods. In Kenya, mechanical and water methods have been used but the quality of fibres produced by these methods have not been established. Therefore, this study aimed at studying the effect of these extraction methods on the quality parameters of coir fibres collected from Kilifi, Kwale and Malindi. The fibres were collected randomly and sorted out according to three sizes, short, medium and large. Two sets of 22 husks from each size and from each zone were selected randomly and one set was subjected to mechanical extraction while the other set was subjected to a water retting process. The extracted fibres were subjected to length and tensile measurement following standard testing methods. Results obtained from the two methods were compared. Water extracted fibres from Kilifi had 11.8% greater length; Kwale had 4.2% greater length and from Malindi 1.8% greater length than those extracted through mechanical method. Fibre tensile strength extracted through mechanical method were superior to those extracted through water retting method by 26.15%, 70.11% and 36.93% for fibres collected in Kilifi, Kwale and Malindi regions, respectively. Water extracted fibres had better elongation properties compared with mechanically extracted fibres by 33.39%, 20.22% and 33.36% for fibres collected in Kilifi, Kwale and Malindi regions, respectively. From the determined properties, it is clear water extraction method is more suitable for coir fibre extraction for the production of nonwovens by needle punching method.

Keywords: coir fibre, water retting, mechanical extraction, fibre length, fibre strength, fibre elongation.

PROG-006-20

Thermal Properties of Sisal/Cattail Fiber Reinforced Polyester Hybrid Composites

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Abstract

Natural fibres have been a subject of intensive research in the recent past due to their eco-friendly and renewable nature in addition to other attractive advantages. The current study evaluated the thermal properties of sisal/cattail fibre reinforced polyester composites. The composites were fabricated by a hand lay-up technique at varying hybrid fibre weight fractions (5 to 25 wt.%) while maintaining a constant fibre blend ratio of 50/50. Composites were also prepared at constant fibre weight fraction of 20% while varying the fibre blend ratio between 0 to 100%. The thermal conductivity of the hybrid composites decreased by 2.93%, 23.4%, 4.31% and 20.39% for 5-10, 10-15, 15-20 and 20-25 wt% hybrid fibre loadings respectively. At a constant hybrid fibre weight fraction of 20%, thermal conductivity of the hybrid composites increased as the percentage of sisal fibres in the hybrid increased from 0-100%. Thus, the hybrid composites may be suitable for non-structural applications as ceiling boards, walls, room partitioning, door panels and electronic and food packaging. Further studies should investigate the wettability and flammability of the hybrid composites.

Keywords: *Agave sisalana*, hand lay-up technique, *Typha angustifolia*, thermal conductivity.

PROG-007-20

Dyeing of Cotton Fabric with Natural Dye from *Flavoparmelia Caperata*

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Abstract

Natural dyes are from natural origin while synthetic dyes are from organic molecules and are made up of chemical compounds that are harmful to human health due to their toxic nature. Textile industries have been using synthetic dyes in colouring fabrics over a long period of time. Recently, natural dyes gained interest over them due to health hazards associated with it . Degradation of synthetic dyes produces a lot of by-products that are associated with health hazards. Such hazardous compounds have so far not been found in by-products of natural dye degradation. *Flavoparmelia caperata* is a lichen species that has been evaluated for its anti-fungal, anti-bacterial, anti-inflamatory and cytotoxic effects. This study focuses on the application of dye from lichen extract on a cellulosic fabric with and without a mordant. The dye was extracted using boiling water method (BWM) and ammonia fermentation method (AFM) where both resulted in a brown coloured extract. Phytochemical screening confirmed the presence of flavonoids, fixed oils, anthraquinones, terpenoids, tannins, steroids and alkaloids. The dye was applied on a cotton fabric and assessed for colour fastness properties to wash, light and rub. The dyed fabrics were brown with extract from BWM and light purple from AFM without a mordant, on mordanting the purple colour darkened. The extract from AFM mordanted fabrics showed best results upon colour fastness tests to rubbing and washing while extracts from BWM displayed best results on light. Vinegar was used as a mordant. *Flavoparmelia caperata* is therefore a good source of phytochemicals and it has the potential of dyeing cotton fabrics.

Keywords: Natural dye, colour fastness, *Flavoparmelia caperata*

PROG-008-20

Optimization of Extraction Conditions of *Allium Burdickii* Natural Dye and Finger Print Assessment of Bioactive Compounds using Raman Spectroscopy

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Abstract

Natural dyes are a fundamental instrument in improving human health, and reducing environmental degradation. They are an important component in the climate system that play a key role in maintaining eco-balance hence averting adverts caused by the long term use of synthetic dyes. A key aspect in the application of natural dyes is establishing the extraction conditions of the respective dye used. The objective of this research was to determine the extraction conditions of *Allium Burdickii* bulb, and assess its bioactive compounds. Natural dyes were prepared using aqueous method, and the structural changes of the dye obtained after its application on cotton fabric. Four extractions conditions namely temperature (^{o}C), time (minutes), mass to liquor ratio (M/LR), and amount of plant powder (gms) was conventionally investigated. The vibrational assignments of the Raman modes obtained from the dyed fabrics were used as a fingerprint of the bioactive compounds present in the dye. The optimized conditions were extraction using 2gms at 40^{0}C for 60 minutes with a M/LR of 1:20. The Raman peaks obtained were (408, 528, 637, 687, 986, 1344, and 1536cm^{-1}), and the vibrational assignment of Raman peaks implied the presence of bioactive compounds namely flavonoids, quinones and phenols. This research has given insight on the extraction and application of natural dyes on cotton fabrics and determination of bioactive compounds using Raman Spectroscopy.

Keywords: *Allium Burdickii*, Extraction conditions, Bioactive compounds, Raman Spectroscopy

A Statistical Analysis of the Machine Parameters Affecting the Properties of 3D Printed Cotton/PLA Fabrics

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Abstract

3D printing has been used widely in different fields and has also found several functions in the textile and clothing industry. The technology offers opportunities to produce custom made and functional garments. The aim of this study was to determine the effect of machine parameters on the properties of woven cotton fabrics that have been combined with Polylactic Acid (PLA) through statistical techniques. A Fused Deposition Modelling (FDM) 3D printer was used for the deposition of PLA onto woven cotton fabric samples. The effect of printing speed, model height, extrusion temperature and fill density on tensile strength of the 3D printed fabrics before and after washing were studied using a central composite rotatable design and regression analysis. Tests were also done to determine the tensile strength of the fabric before 3D printing. The experimental data was used to develop regression models to predict the properties of the cotton/PLA structures. The model for tensile strength yielded a coefficient of determination (R^2) value of 0.94, a P value of less than 0.05 and an optimum tensile strength of 346.22 MPa. The results for tensile strength before and after washing showed that a negative correlation exists between tensile strength and printing speed and model height while a positive correlation exists between tensile strength and temperature. From the results of the study it was concluded that 3D printing parameters have an effect on the properties of the structures.

Keywords: Cotton, PLA, 3D Printing, Tensile Strength, Extrusion Temperature

ABSTRACTS FOR TRANSFORMATIVE INDUSTRIALISATION THEME

TRANS-001-20

Industrial Engineering and Operation Management in Ready-Made Garments Industry

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Abstract

The today competitive advantage of Ready-made garments (RMG) industry depends on the ability to improve the efficiency and effectiveness of resource utilization through proper adaptation of industrial engineering techniques. RMG industries have historically adopted less technological and process advancement. This is especially true for less developed regions like East African Community (EAC) although significant amounts of textile and apparel products are produced in these regions. In most RMG industries, industrial engineering techniques have not been given enough attention even though they need to compete globally and survive in this extremely competitive and dynamic business environment. Presently, only very few garment industries have comprehended the functions of industrial engineering department. One of the basal reasons for this shortage is that the garment industries suffer much from substantial inadequacy of information and literature on the practical application of industrial engineering techniques in garment manufacturing. In this paper, the application of industrial engineering tools; ABC classification, process mapping, fishbone diagram, time study, and brainstorming were demonstrated in a garment manufacturing factory. The empirical data obtained were utilized to determine the standard minute value (SMV) and prepare operation bulletin for trousers. The results from the present study are very useful to the garment industry for setting up a realistic production target, and measure production capability of trouser assembly line as well as improving its efficiency.

Keywords: Industrial Engineering, Time study, Garment industry, processing mapping, Standard minute value, Operation bulletin, Operation management, SAM

TRANS-002-20

Design, Fabrication and Testing of a Hand Driven Canola/Sunflower Seed Cold Press Machine

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Abstract

This project paper entails the design, fabrication and testing of a system of continuous mechanical cold pressing to extract oil from seeds of either canola or sunflower. The literature on the design of screw presses reveals that most of the knowledge related to the design and development of this type of equipment belongs to the holders of large manufacturers in industrial scale production systems. Thus, the approach to this design involved fabrication of a worm screw by winding a square bar in a helical manner on a circular shaft and then welding. The screw forces the seeds or nuts through the cylinder with gradually increasing pressure. This makes the design a practical, functional and inexpensive one to use to obtain oil and is highly recommended for small communities of farmers. It is simple in construction, easy to maintain and its operation does not need a highly qualified technical professionals for its use. In the detail design calculations section, geometrical dimensions, stress analysis and the material selection of the machine components are well analyzed.

Keywords: Design & fabrication, Canola, worm screw windings, Simulations, model calculations.

TRANS-003-20

Impact of Organizational Safety Climate on Productivity

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Abstract

This study focused on identifying if safety climate contribute on organizational productivity, assessing the factors for safety climate that affect firm productivity, examining the relationship between organizational safety climate and productivity and to identify the challenges facing safety management system of the organization. To meet the objective, a sample of 60 respondents responded on questionnaires and 3 respondents were interviewed. The Findings showed that good safety climate leads to higher production. From regression analysis, the R square value of 0.165 and the value of F (11) implied that the model possessed significant overall strength. Also from econometrics analysis, the factors for safety climate which were behavior safety, management strategies, administration control and safety programs are all significant, according the result from ordered probit regression model shows that Probability >chi2 =0.0000 that means a model is so good hence shows fitness of the model into explained variables for safety climate participation in firm productivity through their independent variables.

Keywords: Safety Climate, Productivity, Risk, Key Performance Indicator

TRANS-004-20

Antibacterial Efficacy of the Aqueous and Ethanolic Herbal Extracts from Datura Stramonium, Racinus Communis and Galinsoga Parviflora Plant Leaves

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Abstract

On earth, the plant kingdom is estimated to be having around 250,000-500,000 different species of which a small portion of around 10 percent can be of use in the food sector. There are higher possibilities that a bigger portion of more than 10% could be in existence for plant species with medicinal properties that are unexploited. This study, therefore, was focused on extracting dyes from *Datura Stramonium, Racinus Communis,* and *Galinsoga Perviflora* plant leaves using aqueous and ethanolic extraction methods under maceration process and thereafter investigated for their antibacterial activity using disc diffusion method. Five concentrations of each plant extract obtained using both (aqueous and ethanolic) extraction methods were considered in determining their Minimum Inhibition Concentrations (MIC) by serial dilutions of the original plant extracts. The results obtained from all the plant extracts showed growth inhibition of micro-organisms and a bigger zone of inhibition which ranged from 8 – 18 mm against both *Staphylococcus aureus* (ATCC 25923) and *Pseudomonas Aeruginosa* (ATCC 27853) bacterial strains was identified when using aqueous extracts as compared to Ethanolic extracts with inhibition zone ranging from 6 – 13 mm. The Minimum Inhibition Concentration (MIC) was found to be at 3mg/ml and 30mg/ml for aqueous and ethanolic extracts respectively. The controls (Water and Ethanol) used in the extraction process indeed did not influence the inhibition outcome since they had no activity detected as opposed to the Ciproflaxin and amikacin standard antibiotics which showed inhibition. It was then concluded that all the selected plants have antibacterial properties with aqueous extraction method showing the best results and the active principles obtained from them can be potential sources for the production of antibacterial drugs.

Keywords: Antibacterial activity, *pseudomonas aeruginosa*, *Staphylococcus aureus*, Aqueous and ethanolic extraction, medicinal plants

TRANS-006-20

The Use of Solar Evacuated Tubes as an Alternative Method of Drying

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Abstract

Drying is one of the traditional methods of food preservation having been practiced over the years. It is performed in various ways which include sun drying (natural sun) or forced convection (diesel heaters and solar evacuated tubes). The sun drying method takes long and can be affected by seasons thereby increasing the risk of spoilage of the food being dried. This may be avoided by using more efficient methods of drying that enable quick drying and can be used in all seasons. The aim of this study was to design and fabricate heating system using solar evacuated tubes to produce heat that could dry farm products. Fabrication was done using waste aluminium sheets collected from Rivatex East Africa Limited. Tests were then carried out to determine the amount of heat required for drying, the arrangement of the solar evacuated tubes housing and the quantity of air necessary for drying. Changes in temperature and relative humidity were also measured to determine the effectiveness of the dryer. and the arrangement of the solar tubes was parallel. The solar heat collector was able to heat the air from a temperature of 27.1 ℃ to 56.7 ℃, and relative humidity dropped from 52.4% to 36.5%. Results show that the designed solar dryer can be used as an alternative for natural sun drying. Future studies can consider testing the dryer with different foods like maize and vegetables.

Keywords: Solar evacuated tubes, Drying, Temperature, Relative Humidity, Food Preservation.

TRANS-007-20

Industrial Output in Uganda: Does Electricity Consumption Matter?

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Abstract

Existing studies indicate that access to electricity is associated with gainful economic benefits. This study examines the effect of electricity access on industrial output while holding other factors constant using data set from Uganda Investment Authority, Uganda Bureau of statistics, Electricity Regulatory Authority and World Bank enterprise report on workers' education, labour employed and electricity consumed on the industries (agro based). Using the vector error correction model, results of the study indicated that that education, electricity consumption and labour have along run causality on industrial output. Based on the research questions, the effect of electricity consumption on industrial output, the effect of educated workers on industrial output and how the labour employed influence industrial output. Furthermore, we find evidence that workers education and labour employed differentials correspond directly with industrial output differentials. Regulators must make efforts to increase affordable and reliable supply of industrial electricity as a facilitating condition through subsidies electricity tariffs. Moreover, results suggest that industrial led electricity consumption policies that can enhance industrial growth should be effected. Likewise, the results also suggest efforts to encourage agro based industries to employ more and well educated workers to increase the industrial output.

Keywords: Sustainable Electricity consumption, Industrial output, education and labour employed

TRANS-008-20

Numerical Modeling and Simulation of Femur Bone Reinforcement using Braided Structures

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Abstract:

There are several ways to repair human femur bone fracture; one of which is the oblique cut. Accurate surgical procedures to repair the fracture in these bones become vital in the regeneration of the bone structure to its original posture. The conventional techniques of fractured bone repair have been blamed for lack physical movements at early stages of bone repair. This paper studies the feasibility of using braided structures in reinforcing the fracture site of the femur bone. The study uses numerical methods to analysis the contribution of the braided structure in offering reinforcement to a fractured femur at the shaft region of the bone single stance configurations. This study further analyses the deformation criterion under stance loading in the bone without fracture (intact bone), with fracture and after reinforcement of the fracture with a tubular braided fabric. The evaluated results give an understanding of the potentially provided by a braided structure on fractured bone during single stance conditions. Further, the results are of significant importance in designing reinforcements for bone repair.

Keywords: femur, bone, fracture, braid, crack, diaphysis, FEM.

ABSTRACTS FOR SUSTAINABLE TECHNOLOGIES AND INNOVATIONS THEME

STI-001-20

An Innovative Ergonomic Design of Classroom Furniture Based on Anthropometric Measurements at Tertiary Institutions

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Abstract

It is necessary to consider anthropometric measurements as well as to follow ergonomic guidelines in designing any furniture in which people perform their regular activities. The purpose of this research was to fill the gap of not having enough anthropometric data of students in Uasin-Gishu, County, Kenya. Developing an anthropometric database on Kenyan students will help the local designer, manufacturers, and producers to create more efficient industrial applications and products for Kenyan students. A total of three hundred and eighty-two (382) students, from both genders and different levels from four selected tertiary institutions in Uasin-Gishu, County, Kenya, were involved in the survey. Their anthropometric measurements were taken and recorded with the help of anthropometric tools. Moreover, the research applied fundamental engineering principles of product design and was carried out in compliance with ISO 7250-1:2017 (Basic human body measurements for technological design part 1: Body measurement definitions and landmarks). The anthropometric measurements taken were stature, sitting height, sitting shoulder height, popliteal height, hip breadth, elbow rest height, buttock popliteal length, buttock knee length, thigh clearance, sitting eye height, shoulder breadth, knee height, body mass and forearm-fingertip length. The data obtained were analyzed using Minitab 17.0 statistical package to determine the average, standard deviation (St. Dev), minimum (min), maximum (max), 5th, 50th, and 95th percentiles. Comparing the dimensions of the existing furniture used by students in the four selected tertiary institutions with the anthropometric measurements obtained revealed that the existing furniture is not ergonomically suitable for the students. Using the results of the analysed anthropometric data, therefore, an innovative ergonomically suitable desktop-chair design was proposed which takes into consideration of the seat height, seat depth, seat width, backrest height, armrest, and desk height using engineering design software: SolidWorks, 2019 (design-tool). From the present research, it is hereby recommended that further researches should be carried out in other regions of the country to develop an adequate database of anthropometric measurements which can be used by furniture designers to come up with ergonomically designed school furniture.

Keywords*:* Ergonomic design; SolidWorks; Anthropometry; Classroom furniture; Tertiary institutions; Students.

STI-002-20

A Content Based Image Retrieval Model Using Color, Texture and Shape Features With K-Nearest Neighbor Algorithm for E-Commerce

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Abstract
In the last decade, E-Commerce websites have experienced high growth of large databases of images. This trend is expected to continue into the future. Retrieval and querying of these images in order to access the visual contents from large databases in efficient way is a challenge. Majority of E-Commerce websites use Text Based Image Retrieval (TBIR) where a user is required to input a keyword as a textual query which has many challenges including delay in generating descriptive texts when images are large, subjective annotation of images as well as content-sensitive result. Content Based Image Retrieval (CBIR) provides a solution for efficient retrieval of images from these huge image databases. Many research efforts have been directed to this area with color feature being the mostly used feature because of its ease of extraction. However, the effectiveness of the developed models is still low leading to unsatisfactory search results. This research proposes improvements of the effectiveness of CBIR models by integrating color, texture and shape features of an image with K-Nearest Neighbor (KNN) algorithm. To extract the color features of the images, color histogram was adopted. The texture feature was extracted by Local Binary Patterns (LBP) algorithm while canny edge detection algorithm was adopted to extract shape features. A similarity computing algorithm based on KNN algorithm was used to carry out the multistage similarity computation. Euclidean distance measure was used to calculate the similarity of images after fusion of the color, texture and shape features. The similarity value was used to carry out image retrieval. Document analysis and prototyping were adopted in this research as research instruments. The target population was 1000 images of Wang dataset where a sample size of 290 images was used. We randomly selected 29 images from each of the 10 classes of the database and experiments conducted. The developed model produced an average precision of 89.5%, an average recall of 17.9%. Compared to other work studied, the model performed better. The developed model contributes to the field of CBIR by improving the precision and recall values of retrieval results. The developed model can find useful application when embedded into ecommerce websites.

Keywords: CBIR, TBIR, E-Commerce, Precision, Recall, Features

ABSTRACTS FOR RENEWABLE ENERGY THEME

REN-001-20

Production of Biogas from Sized Cotton Yarn Wastes

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Abstract

Solid waste management is among the environmental challenges facing many industries in the world today. Biogas production is one of the most cost-efficient renewable energy technologies that use biodegradable wastes as feedstock. Furthermore, it is one of the methods for reducing greenhouse gas emission (GHG). Cotton Yarn Wastes (CYW) is among the biodegradable wastes that are commonly managed by dumping onto the open land or disposing in sanitary landfills where they undergo anaerobic composition. However, CYW could be used as substrate to generate energy in the form of biogas that can be utilized in other activities like powering textiles production. The aim of this study was to investigate the use of sized CYW as a substrate for biogas production. The experiment was carried out in reactors of two liter capacity. The substrates were characterized before and after digestion. Proximate analysis before digestion showed that total solids (TS), total volatile solids (TVS) and moisture content (MC) were 93.18%, 82.48%, and 6.82% respectively. Analysis of digested sludges showed that TS solids, TVS and MC were 21.61%, 23.61% and 78.38% respectively. The carbon to nitrogen (C/N) ratio of inoculum was 20.5, which is in the suitable range to keep the anaerobic digestion in a stable condition. However, the sized CYW had high carbon content; resulting in a C/N ratio of 42.5. The effect of TS concentration at different ratios of sized CYW on biogas volume produced was investigated. The reactors loading was differentiated using a mixture with concentration corresponding to R1 (1:1), R2 (1:1.5), R3 (1:2), R4 (1:2.5), R5 (1:3), R6 (1:3.5), R7 (1:4), R8 (1:5), R9 (1:6) and R10 (1:10) on TS content basis i.e 50%, 40%, 33%, 28%, 25%, 22%, 20%, 18%, 14% and 10% of solid content respectively. The biogas produced was measured on daily basis using the water displacement method. The average biogas productions were 6307, 6519, 6711, 7178, 4878, 3868, 3720, 3306, 1164 and 932 ml respectively after 36 days of digestion. The results indicated that biogas production increased with increase in TS content. The ratio that provided 28% of TS content had the highest biogas yield. The average reduced TVS at the end of digestion was 88.49%. The results of this test indicated that sized CYW is a suitable substrate for AD due to its high biodegradability. Therefore, the reactors should run at 28% TS, for maximum biogas generation.

Keywords: RIVATEX, total solids, textile waste, anaerobic digestion, moisture content.

REN-002-20

Optimization of Liquid Fuel from Microwave Pyrolysis of Used Tyres

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Abstract

Used tyres pose a threat to environment especially in developing countries since the current methods of disposal pollutes environment. Liquid from used tyres has the potential of being used as a source of fuel to replace petroleum diesel. Researches have been done to prove that pyrolysis technique can extract the useful liquid fuel from used tyres and solid residue can be used as carbon black. Microwave pyrolysis is an alternative valorization process which is efficient and environmental friendly. It is effective in producing Tyre Pyrolysis Oil that can be an alternative source of energy. Optimization experiment for microwave pyrolysis of used tyres was performed and Central Composite Design was used to optimize the variables. The variables considered for optimization were Microwave Power, Residence Time and Particle Size. The yield of liquid fuel was correlated as a Quadratic function of the reaction variables. Response surface and Contour plots for the correlation was plotted to indicate effects of operating variable and finally identify the points of optimal yield. Highest yield of 38.4 % (wt.) corresponded to a microwave power of 50 %, residence time of 17.5 minutes and a particle size of 25mm^2

Keywords: Microwave pyrolysis, Microwave Power, Used tyre, Tyre Pyrolysis Oil

REN-003-20

Renewable Energy Policy Implementation Drivers and Barriers in Uganda

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Abstract

The paper explores the Renewable Energy Policy Implementation Drivers and Barriers in Uganda. It develops an explanation of how the policy governance architecture serves to drive or impede policy implementation. An analytical approach was adopted as a preliminary test of theoretical constructs and supported by further empirical evidence. The paper examines case studies and various documents to draw out the drivers and barriers to the implementation of renewable energy policy in Uganda. The findings of our study are two-fold; i.e. the drivers and the barriers of REP implementation. The major drivers for renewable energy implementation in Uganda are; improving modern energy access rate, presence of legal and policy instruments and, disposition and bureaucratic structure. Whereas the barriers include high costs of investment, lack of human capacity and training development, weak regulations and enforcement. Based on the findings, the recommendations were made to address the major obstacles in the renewable energy industry with the view of informing policy review and development in Uganda. The paper generates a grounded set of concepts that have explanatory efficacy.

Keywords: Renewable energy policy (REP), Government of Uganda (G.O.U), Global Electricity Transfer Feed in Tariffs (GET FiTs), Renewable Energy Feed in Tariffs (REFiTs)

REN-004-20

Redox Potential advances of Quinone derivatives for energy storage applications

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Abstract

Natural quinone's electron transfer role is an important aspect in a number of areas like biochemistry, medicine and electrochemical redox reactions for energy storage applications. This electroactive nature of quinones has fronted them for energy storage and energy harvesting applications. Recent rechargeable energy storage systems which have been advanced are redox flow batteries (RFB), pseudocapacitors and Li-ion batteries are made up of reversible quinone redox couples. Quinone and its derivatives are preferred as redox active compounds used to fabricate rechargeable batteries due to their relative high energy density, fast charging rate, solubility in electrolytes, abundance and cyclic stability. This review paper puts in summary quinone's molecular structure, its electrochemical behavior, quinone redox predictions and the strides made in predicting its redox potential computationally. These recent advances in the functionalization of quinone hybrid materials based on their redox properties applications can provide solutions to the engineering of bio-inspired energy storage systems such as rechargeable batteries.

REN-005-20

EVALUATION OF LOWCOST BIOGAS PURIFICATION MATERIALS

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Abstract

Raw biogas contains 50-70% methane and impurities which comprise of 30-40% carbon dioxide, 5% moisture, 0.5% hydrogen sulphide and other trace compounds. Currently, especially in rural areas of developing countries such as Kenya, biogas is used in households without purification. This poses challenges such as corrosion of equipment and low biogas calorific value. In this study, we assess the various low cost adsorbents that have been recently employed for biogas purification. The materials evaluated include activated carbon from organic waste such as coconut shells, and iron oxide from lathe machine iron chips. The performance of these materials in biogas purification reported in various studies is evaluated. The findings indicate that these materials have great potential in biogas purification and can be readily applied in small scale systems. Such systems are expected to contribute significantly to increasing access to clean energy in rural areas.

Keywords: adsorption, biogas, energy, purification

REN-009-20

Evaluation of Kisumu County Clay Soil for Plastic Waste Pyrolysis

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Abstract

Plastics play a major role in our daily lives; the disposal and decomposition of plastics has been an issue because plastics do not degrade. Pyrolysis of plastic waste is able to produce high amount of liquid oil up to 80 wt.% at moderate temperature of 700 0C. The three major products that are produced during pyrolysis are oil, gas and char which are valuable for production industries. The activation energy of the process is lowered down by a catalyst which then speeds up the rate of reaction. The current study established the suitability of clay soil from Kisumu county as a catalyst in pyrolysis process. In this study the clay soil was characterized for its elemental composition. The raw material was collected from Kisumu county, at the river banks of Oren river near Oren market. Analysis was done using X-Ray Fluorescence Spectrophotometer (XRFS), XRD and Atomic Absorption Spectrometry (AAS). From the study it was established that clay from Kisumu county have the highest elements as Silica and alumina at 64.5% and 16.3% respectively. The other elements are Iron II oxide (9.3%), Potassium oxide (4.3%), Sodium Oxide (1.9%), Titanium Oxide (0.8%), Calcium Oxide (1.2%), Magnesium Oxide (0.6%) and Manganese Oxide (0.5%). Clays are constituents of minerals that are hydrous silicates of aluminium and/or magnesium, with significant amounts of iron, nickel, chromium and other cations in the crystalline structure as an isomorphic substitution. The peculiar crystalline structure of clay minerals generates a capacity of reversible exchange with organic or inorganic cations and metal-organic. The exchange of specific cations generates active centers in the clay minerals, making them catalysts, which can then be used for pyrolysis of plastics. In conclusion it was found that clay soil is suitable for use as a catalyst in pyrolysis of plastics. The catalyst reduces the optimum temperature required in plastic pyrolysis process.

Keywords: Kisumu county, clay soil, plastic waste, catalytic pyrolysis

REN-010-20

Economic Study Results of a 100 W Residential Solar PV System

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Abstract

Universal access to electricity is the current focus all over the world, especially in the developing countries where the majority of those without electricity live today. The SDG7 committed the world countries to work together and provide access to electricity to all by the year 2030. In response to this agenda, the Kenyan government has expanded the national grid supply across the country through the Rural Electrification Authority (REA), but the rate of connectivity in the rural regions is still very low despite the presence of the grid infrastructures. In addition, the Kenya government sought to increase access to electricity through solar energy in remote, low density and traditionally underserved counties through Kenya Off-Grid Solar Access Project (K-OSAP). However, integration of PV generators into the energy mix requires the right approach to design and operational planning due to fluctuation of their outputs. Sizing of an off-grid PV system is necessary at the planning stage to make it cost effective with regard to load demand and upfront cost. This paper is an economic study design of solar energy potential in Western Kenya Region using 100W installed off-grid PV system in a residential home as a case study. Results show that the investment will be recovered in 6.38 years and that levelized cost of energy of 3.5/kWh is attainable.

Keywords: Solar energy, Off-grid PV system, residential energy demand, Life cycle cost analysis.

REN-012-20

Experimental Investigation of Thermal Efficiency Enhancement of Improved Biomass Cookstoves for Domestic Cooking Applications

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Abstract

Biomass is the best and a wider area that has attracted world's attention to the production of energy in a renewable energy source. A large dependency on world energy sources is renewable energy. Improved Biomass cookstoves are recently developed devices for domestic cooking utilizing biomass as fuel through gasification. In Ethiopia, biomass is the most widely used source of energy for cooking and heating applications. This study attempted to enhance the thermal efficiency of domestic cookstoves. The developed model was tested by water boiling testing protocol (WBT) experimentally. Results showed that the stove had a thermal efficiency of 46.28%, with specific fuel consumption of 11.53 g/l and 43 minutes to 48 minutes of cooking time. The mathematical model was implemented and validated, and the experimental results showed that there was an improvement of the stove, as well as reduced fuel consumption and cooking time.

Keywords: cooking stoves, Ethiopia, biomass, thermal efficiency.

REN-006-20

Photovoltaic Off Grid Solar Home System Sizing Using the Charging Current and Total Energy Methods: A Comparison of the Two Sizing Methods

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Abstract
Kenya receives some good sunshine owing to its strategic location in the tropics. Solar energy, being environmentally friendly and an inexhaustible source of energy has the potential to change people's lives for the better, especially in the rural communities in Kenya. Solar energy is converted to useful electrical energy using solar panels exposed to the sun's radiation. The solar panels and other balance of system components are usually interconnected to provide this energy for powering loads. This connected system, popularly known as Solar Home System (SHS) is creating a lot of impact in the rural communities in Kenya. Although the system installation is key in the overall system performance, the system has to be well designed and sized as well for it to perform optimally. A number of commercially available sizing soft wares are complex and way beyond the average person in terms of cost. There are two main sizing methods: the charging current method, here in abbreviated as, CCM and the total energy method, abbreviated as, EOM which could be easier and more accessible to solar designers and installers. In this paper, we have presented a comparison of the two sizing methods to assess if there is any significant difference between the two methods. On applying both methods to an example, it has been found that they give the same sizing details of the components. Furthermore, the EOM, appears more appealing since it provides the total power rating of the system, the most commonly used and understood term in rating solar panels.

Keywords: Solar Home Systems, Solar energy, communities, sizing, method, off grid, charging current, total energy

REN-016-20

Microgrids as the Vehicle to Rural Development: The Case of Uganda

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Abstract

Captivated by the ever proliferating need to increase rural energy access with the purview of 26% by 2022 in Uganda, both the government and private sector investments have proved worthwhile in the development of decentralized generation (DG) for accelerated rural electrification. DG is aimed at increasing rural development by taking advantage of the locally available renewable energy (RE) resources for power generation while also minimizing country's dependency on imported fossil fuels in its effort to bring about more desirable development to rural areas for socio-economic inclusion. Due to the difficulty posed in extending the grid to rural and isolated areas, off- grid solutions like the mini grids (MGs) continue to foster this impetus based on their technological improvements and cost reductions since there underlie numerous rural productive uses of energy. With about thirteen MGs currently operational in the country, it is very optimistic that its benefits shall be outstripping considering the crucial role electricity plays in the transformation of rural communities. Numerous studies have revealed that rural electrification contributes to rural development with considerate efforts targeting confined communities, increasing load growth, coupled with the diversification and modernization of existing economic activities. This paper therefore highlights the development of MG in Uganda with specific emphasis on the different MG case studies and their corresponding implication on society as favored by the inherent policy environment while also summarizing the lessons learned from which horizontal technical knowledge transfer could be exploited. This could yield far reaching aspirations in regard to education, health, income status and poverty eradication.

Keywords: *Mini - grids, Uganda, renewable energy, rural development, rural electrification.*

REN-017-20

Production of Solketal, A Fuel Additive, Through Microwave Heating and Catalysis

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Abstract

Many efforts are being geared toward finding new sources of alternative energy to replace the currently used non-renewable fossil fuels. Among the renewable energy resources being looked into, biofuels are receiving intensive attention. The use of biofuels and fossil fuels lead to fuel gelling and chocking of nozzle as well as having an effect of corrosion on different parts of the engine. This can be mitigated by use of fuel additives.

Fuel additives are materials that improve the cleanliness of different parts of the engine (such as fuel injector, intake valve etc), promotes complete combustion of fuel, reduces fuel gelling and choking of nozzle as well as reduce corrosion impact on different parts of the engine. This in turn leads to improved engine performance, reduced emissions and reduced fuel consumption. Fuel additives can also reduce particulate emissions of diesel fuel and increase oxygen concentration.

Solketal, an oxygenate fuel additive, is one of the fuel additives used to improve engine and fuel performance. It is majorly produced from glycerol, a by-product obtained from the production of biodiesel. It helps to reduce the soot, reduce the particulate emission, improve the cold flow properties of liquid transportation fuels, reduce gum formation, improves the oxidation stability and enhances the octane number when added to gasoline. Solketal is also used as a versatile solvent and a plasticizer in the polymer industry and a solubilizing and suspending agent in pharmaceutical preparations, as surfactants, disinfectants, and flavouring agents, among others. Solketal is an excellent component for the formulation of gasoline, diesel, and biodiesel. The mixture of this compound in biofuels improves its properties, decreases viscosity, and helps to achieve the pre-established requirements for the flash point and oxidation stability of biodiesel. The reaction for solketal (isopropylidene glycerol or 2,2-dimethyl-1,3-dioxolan-4-yl methanol) production is facilitated mostly by major homogeneous and heterogeneous acid catalysts.

The purpose of this review paper is to investigate production of solketal through microwave heating and use of catalysis with an aim of finding an optimal production process of solketal from glycerol through reduced cost of production.

Keywords: Solketal, catalyst, microwave heating

REN-018-20

A time series analysis of modern socio-economic determinants for carbon emission levels in emerging Sub-Saharan economies; (Uganda, 1997-2014)

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Abstract
A time-series analysis of modern socio-economic determinants for carbon emission levels in emerging Sub-Saharan economies; (Uganda, 1997-2014). In this analysis, percapita carbon emission in Uganda is a nonlinear STIPAT function, influenced by real gross domestic product per capita, per capita fuel consumption, and implementation of open access trade protocols among its trading partners. The model is fitted using the ARDL model to achieve the OLS assumptions for non-stationary series. The findings indicate insignificant causality among variables in the short run. But the short-run analysis model was highly significant and with a high explanatory power of the independent variable. The Long-run ARDL analysis demonstrates convergence among variables, with a positive causality for real GDP per capita, Open trade protocol, but insignificant negative causality for per capita fuel consumption on percapita carbon emission levels. These findings will help developing economies to attain a long run Environment Kuznets curve nexus if adopted, by promotion and support for clean and smart energy innovation, and enacting green economic policies to achieve a significant opposite directional causality between per capita fuel consumption and percapita carbon emission levels. It is also clear that per capita carbon emissions levels and real GDP percapita highly co integrate therefore strategic mitigation decisions will be needed for developing countries to attain the ECK nexus.

Keywords: Carbon emission, Time Series Analysis

REN-019-20

A Review of Solar Adsorption Cooling with Focus on Using Composite Adsorbent to Improve System Performance

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Abstract

The focus on solar- based cooling systems is driven by the need for climate friendly technologies which are efficient and pollution free. Solar radiation within the tropics poses an opportunity for its exploitation in solar adsorption refrigeration systems. Environment friendly adsorption cooling systems are possible alternatives to conventional electricity-driven vapour compression refrigeration systems. The purpose of this paper is to review advancement in solar adsorption cooling systems in line with the proposed study to use a novel composite adsorbent consisting of steatite impregnated with charcoal, paired with methanol as adsorbate. The proposed system comprises an adsorption bed, condenser and an evaporator. The objective of this review is to understand the principal parameters which may affect performance of a solar adsorption refrigeration system such as adsorbent-adsorbate pair, system design and arrangement of the subsystems as well as assess possible improvement techniques and strategies for wide spread use of adsorption cooling systems.

Keywords: *Solar adsorption, Steatite, Adsorbent, Adsorbate, Refrigeration, Coefficient of Performance,*

REN-021-20

Electricity Consumption and Economic Growth in Uganda

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Abstract

This paper examines the causal relationship between electricity consumption and economic growth for Uganda over the period 2008-2018. Whereas electricity consumption is among the key drivers of Economic growth. Studies have conflicting results on the direction of causality and methodology. The hypothesis that explains causality between electricity consumption and economic growth follows the growth, conservation, feedback and neutral hypothesis. The study uses a Vector error correction Model within a multivariate data framework. The JohansenCo-integration test was carried out to ascertain if there exists a long run relationship between Electricity Consumption, Real Fixed Capital Formation, Labour Force and Real GDP. Quarterly data from both World Bank Statistics and Electricity Regulatory Authority (ERA) was used. The results from the Vector Error Correction model indicate bidirectional causality between electricity consumption and economic growth in both the short run and long run. Empirical findings lend support for the feedback hypothesis of the interdependent relationship between electricity consumption and economic growth in Uganda. The study recommends Ugandan authorities to expand electricity infrastructure to increase electricity production only and increase electricity consumption with a focus on efficient energy use to support economic growth.

Keywords: Electricity consumption, Vector Error Correction, Co-integration, Economic growth, Uganda.

REN-022-20

Purification and upgrade of biogas using biomass derived adsorbents: Review

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Abstract

Biogas contaminants which include carbon dioxide and hydrogen sulfide (H_2S) limit the application of biogas as engines fuel because they reduce energy content, cause corrosion and wear in machine parts. In addition, CO_2 is the main cause of global warming. Modern biogas purification and upgrading methods are very expensive and involve complex operational processes. The aim of this study is to review the applications of biomass materials in the purification and upgrading of biogas. Activated biomass material and biochar are adsorbents derived from biomass materials that can be applied in biogas cleaning. Biomass adsorbents are generated from biomass materials through physical and chemical treatment processes. The CO_2 adsorption capacity of activated carbon is dependent on the surface area and pore size of the adsorbent. Published data indicate that modification with KOH adsorbents improves CO_2 uptake. Moreover, biochar has high adsorption capacity of H_2S. The capture of CO_2 and H_2S by biomass adsorbent is by physisorption and chemisorption respectively. Therefore, increase in adsorption temperature decreases the adsorption capacity of CO_2 but increases that of H_2S using biomass adsorbents. The H_2S adsorption capacity of biochar is dependent on the alkalinity of the surface chemistry. In addition, impregnation of biomass adsorbents with agents like amine compounds or metal alkaline oxide can increase the adsorption capacity of H_2S. Comparative investigations of the process cost-effectiveness of using biomass adsorbents should be carried out to determine their suitability against established technologies in biogas upgrade applications.

Keywords: Biogas cleaning, Activated carbon, Biochar, Engine biofuel, Carbon dioxide adsorption, Biomass activation

REN-023-20

Evaluation of sugarcane vinasse and maize stalks waste for anaerobic digestion

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Abstract

Sugar cane vinasse and maize stalks wastes disposal have pose serious challenges to the environment. However, anaerobic digestion is an attractive treatment method for these wastes. The current study therefore established the suitability of theses wastes for anaerobic digestion. Specifically, the study aimed at characterizing the substrates and anaerobic digestion of the substrates. The raw materials were collected from Muhoroni Sugar Company and Uasin-Gishu county maize farms respectively. The pH, moisture content, chemical oxygen demand (COD), total solids (TS), total suspended solids (TSS), total dissolved solids (TDS), total organic carbon (TOC), nitrogen content and CN ratio were determined based on standard methods. Experiment setups were run depending on batch experiment. The study established that the pH, moisture content, COD, TS, TSS, TDS, TOC and nitrogen content for vinasse were 4.34, 93.91%, 71.28g/l, 7.05%, 6.04%, 1.01%, 0.96% and 0.456 g/l respectively. For the maize stalks, the pH, moisture content, TS, TSS, TDS, TOC, and nitrogen content were 7.52, 9.52%, 91.50%, 90.12%, 1.38%, 425g/l and10.4 g/l respectively. The cumulative biogas yield for sugarcane vinasse and maize stalks were 329ml and 385ml respectively. In conclusion, this study found that the characteristics of vinasse and maize stalks are suitable for biogas production.

Keywords: Vinasse, maize stalks, Co-digestion, anaerobic, COD, Nitrogen content, moisture content

REN-024-20

The Effects of Gross Domestic Product and Energy Consumption on Carbon Dioxide Emission in Uganda (1986-2018)

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Abstract

This paper investigates the effect of energy consumption and Gross Domestic Product (GDP) on carbon dioxide (CO2) emission for the period 1986 to 2018. The autoregressive distributed lag model was used to establish the long run relationship in the data from 1986-2018. The results indicate that GDP is a key determinant of CO2 emissions in the long run and GDP Granger cause CO2. The growth in GDP as the country strive to attain a middle income status is a precursor for future emission in Uganda. Thus, whereas growth in GDP is necessary for the welfare of the people, it should be sustainable for the posterity. The impact on energy consumption on the CO2 emission was found to be insignificant. This result suggests that there are other causal factors responsible CO2. Further research should investigate the impact of population activities on the environment as key factors for CO2 emission.

Keywords: CO2, GDP, Autoregressive Distributed Lags (ARDL)

REN-025-20

Role of Modified Coulomb Potential in Determining Stability of Isobars

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Abstract
The binding energy of an atomic nucleus is composed of a number of different forms of energy. The most important ones being the nuclear interaction energy and the Coulomb energy due to the Coulomb repulsion between the protons. Coulomb interaction is a long-range force whereas very small size protons are confined inside the nucleus whose size is also very small. Thus, the Coulomb potential inside the nucleus has to be modified. The recently proposed modified Coulomb potential model has been used to calculate the stability of some finite nuclei. According to the semiempirical mass formula (SEMF), nuclei with Z>90 are in general unstable. However, the last heavy stable nucleus is Bismuth with Z=83 and N=126. Thus, a few nuclei (rather isobars) with Z>90 are chosen to study the stability of the isobars. Calculations from this study show that the modified Coulomb potential model generates the most stable nuclei (Z_{STABLE}) for the isobars when $n > 21$. As the value of n increase, some occurrence of nuclear transformations that include alpha decay and beta decay, which the isobars undergo in order to gain stability are revealed. However, some unknown kind of radiations are predicted to be emitted when the value of n increases consecutively from $n = 1$ to $n = 5$. Therefore, it is recommended that, some further investigations on the unknown radiations can be carried out in order to describe the kind of nucleon interactions that take place as n increases at the initial stages of the nuclear decay.

Keywords: Binding energy, Coulomb potential, Isobars, Super heavy nuclei, nuclear model.

ABSTRACTS FOR SCIENCE, TECHNOLOGY, ENGINEERING, ARTS AND MATHEMATICS (STEAM) THEME

STEAM-001-20

Theoretical modeling of selected toxic molecular products from the thermal degradation of a selected light cigarrette brand

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Abstract

The pyrolysis of tobacco gives rise to a variety of toxic organic substances such as toluene, phenol, propanol and ethyl benzene. In this work, we simulate the pyrolysis of selected light cigarettes between the temperatures 373K and 1223 K under conditions that simulate a normal cigarette smoking process at 1 atmosphere in increments of 50 K. The minimum energies of these compounds and their corresponding radicals (toluenyl, phenoxyl, propanoxy and ethylbenzyl radicals) were computed using Gaussian 03 computational code with Molar Plesset second order Perturbation (MP2) level of theory and Hartree Fock theory. At 373 K, the minimum energy for phenol, propanol, toluene and ethyl benzene were 67.868 K cal mol^{-1}, 73.862 K cal mol^{-1}, 90.126 K cal mol^{-1} and 104.628 K cal mol^{-1} respectively. Ethylbenzene was the least stable of the all molecules while phenol was the most stable compound. A comparable development was observed as the temperature was increased from 373 K to 1223 K. Radical stabilization energies for these compounds were also calculated. The more stable a compound or a radical is, the more it persists in the environment substantially causing extensive biological and environmental impacts. Hyperchem with Quantitative Structural Activity Relationship (QSAR) technique was used to calculate the relative toxicities of ethyl benzene, phenol, propanol, and toluene, and their corresponding radicals. The toxicity values were 2.15, 0.57, 0.55 and 1.75 respectively while for the radicals it was 2.17, 1.99, 2.31 and 1.77 respectively. Additionally, theoretical nuclear magnetic resonance (NMR), infra-red (IR), and Raman spectra including HOMO-LUMO molecular orbitals of toluene, ethyl benzene, toluenyl, and ethylbenzyl radicals are presented.

Key words: Molecular orbitals, MP2, pyrolysis, theoretical, thermolysis, tobacco.

STEAM-002-20

Africa's need for a Technological Approach to Monitor Pollutions from Mining Activities

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Abstract

Africa host the largest mineral industry in the world and mineral exploration and production form a significant part of our economy. Most of these mining countries operate with unregulated environmental impact and societal stewardship. Mining activities have serious effect on the environment and human health. The impact of mining operations in Africa touches on the principal elements of the environment (i.e., land, water and air) affecting the implementation of the SDGs (2, 3, 6, 13, 14 and 15). Large tracts of land for farming activities have been used for mining operations depriving communities of their source of livelihood leading to massive deforestation. Sporadic cyanide and other trace metals contamination of water bodies by large scale surface mining operations, and mercury contaminations from small-scale and illegal mining activities are common pollution sources. Air quality is severely degraded by miners, by putting large quantity of dust into the atmosphere. This research seeks to analyze the impact of mining activities on the environment by considering two different mining sites from Ghana, Kenya and Tanzania by employing the services of the dataset from the NASA Giovanni System. We have used time series analysis of $PM_{2.5}$ from the NASA Giovanni System that spans years before and during the mining activities at our study sites to determine the pollution levels and the health issues involved. The results obtained showed that there was a significant increase in pollution level over time at all the mining sites. Tanzania's Geita goldmine recorded its highest $PM_{2.5}$ value of 0.0019kg m-2 in 1998. Karebe gold mine in Kenya experienced 58% $PM_{2.5}$ increment from 2007 to 2016. There was 250% increase in $PM_{2.5}$ from the location of Tarkwa Goldfields in Ghana from 1993 to 2008. This work will propose an Internet of Things (IoT) based solution to help the environmental protection agencies effectively monitor the Pollution level from mining activities.

Keywords: Air Quality, Mining, Pollution, $PM_{2.5}$, Internet of things

STEAM-003-20

Optimization and Enhancement of Rwanda Power System Protection in Cascade Outages

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Abstract

Power blackouts in Rwanda severely affected most of western and northern Rwanda in 2018 and 2019. Most of the times, long duration power blackout occur due to loss and overloading of distribution transformers and 110kv transmission lines, absence of control mechanisms such as the static and dynamic reactive power controls for stabilizing power grids, transmission congestion that leads to the malfunction of distance and auto reclosing relays. This project studies the causes and mechanism of power system long duration blackouts and develops new methods and new tools to help detect, prevent and mitigate the long duration blackout. Two operational elucidations such as a balanced state control system and an optimal overcurrent and autorecloser relay settings model for operational HV substation relay coordination have been proposed. A balanced state control system can help detect and prevent the possible long duration blackout at its initial slow steady state progress stage. The approaches, such as Load Frequency Control of Automatic control strategy has been proposed and developed. The overcurrent relay setting models for operative substation relay coordination will be used to optimize the power system protection, and it is required to calculate the working time coordination of incoming and feeders Over Current Relay (OCR) based on relay characteristics to a given time setting multiplier (TSM) using different equations of overcurrent relay (standard inverse, very inverse and extremely inverse) for determination of relay parameters and pick up current (Iset) of each relay so that the overall operating time of the primary relays is minimized properly. MATLAB/Simulink software was used for simulations.

Key Words: Load Frequency, Power Blackouts

STEAM-004-20

Bayesian Inference for Simple and Generalized Linear Models: Comparing INLA and McMC Techniques

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Abstract

Markov chain Monte Carlo (McMC) is a traditional technique used in Bayesian inference. Lately, Integrated Nested Laplace Approximations (INLA) has gained popularity as another technique for Bayesian inference. This paper compares the performance of these techniques in terms of accuracy, time and computational burden in simple and generalized linear models.

In comparison to McMC, INLA was computationally efficient in Bayesian inference, producing almost similar estimates for the fixed parameters of the simple and generalized linear models. Though the random effects of the generalized linear models were not considered in this paper, the estimate for that of the simple linear model was determined. It was found out that the estimates by the two techniques were closely identical. Again, INLA took a shorter time in approximating parameters than McMC while McMC was realized to be more computationally intensive than INLA. The default settings of INLA were maintained and adopted for the McMC simulations.

Keywords: Bayesian Inference; McMC; INLA; Simple Linear Model; Generalized Linear Model.

STEAM-005-20

Determination of precursors of acrylamide formation in roasted maize

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Abstract

Acrylamide is a contaminant generated through cooking processes as a result of Maillard reactions catalyzed by presence of reducing sugars and free amino acids present in food compounds. This chemical reaction occurs when food are roasted, fried or baked under elevated temperatures above 120℃ and in low moisture conditions. Acrylamide has been considered a probable human carcinogen since it was found to cause tumors in rodents. In this analysis raw maize were purchased from local market and roasted under simulated laboratory conditions. Extraction of acrylamide was done using a modified method by extracting using water under refluxing conditions and defatting using hexane and derivatized with potassium bromate ($KBrO_3$) and potassium bromide (KBr), liquid –liquid extraction with ethyl acetate-hexane (4:1) was done. The final analyte (2-bromopropenamide, 2-BPA) was analyzed by gas chromatography –Flame Ionization Detector). Other parameters analyzed were moisture content and presence of reducing sugars (fructose and glucose). The raw maize samples were light coloured. Browning of samples was achieved after roasting had been done. Acrylamide amount was below LOD (20 µg/kg) and LOQ (60 µg/kg) which was consistent with maize based data reported from studies done by researchers in other countries.

Keywords: Acrylamide, glucose, fructose, GC-FID

STEAM-007-20

Computational Modelling of Selected cannabinoid derivatives from thermal degradation of Cannabis sativa

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Abstract

Cannabis sativa, like tobacco plant, is a complex biomass material comprising of a range of molecular compounds that excite immediate psychoactive behavioural impacts on individuals during smoking. It consists of over 400 chemicals with at least 61 cannabinoids. When smoked, cross pyrosynthetic reactions occur, giving rise to over 2000 chemical compounds which may be inhaled into the respiratory airway causing deleterious biological damage. Evidently, smoked *cannabis sativa* produces more tar bearing significant more concentrations of Carcinogenic compounds that are well-established precursors of lung cancer, cancers of the upper aero digestive tract in addition to mental problems of psychotic nature and negative brain development amongst teenagers. Exposure to second hand marijuana smoke leads to acute vascular endothelium dysfunction. Accordingly this input seeks to describe the mechanistic degradation of selected marijuana cannabinoids that contribute to marijuana pharmacological effects including □-9-tetrahydrocannabinol (d-9-THC) and Cannabidiol (CBD) which have received limited consideration in literature. Additionally, the thermal and electronic properties of these compounds are investigated from a quantum mechanics level of theory using the density functional theory (DFT) coupled to 6-31+G basis set. A simulation of biomass pyrolysis was designed under conditions representative of actual human smoking regime in the temperature range 300-800 ºC at typical temperature increments of 50 ºC at 1 atmosphere at a residence time of 2 s. Gaussian 09 and HyperChem computational platforms have been employed in this work followed by a comprehensive discussion on the clinical consequences of these compounds. Nonetheless, the mechanistic degradation channel for cannabinoid compounds in the light of smoking is reported in this study.

Key words: cannabinoids, psychoactive, smoking, DFT, Quantum level of theory

STEAM-009-20

Substitutional Sulphur Doped 2D-MoS2: Quantum mechanical study

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Abstract

2D-MoS2 is a direct band gap of 1.83824 eV semiconductor. It follows that replacement doping of the S atoms has a great effect on the material's structural and electronic properties, in-terms of the surface, the magnitude of the band gap energy and the location of the Fermi energy level. Here, *ab initio* density functional theory (DFT) approach is used to investigate the impacts of substituting S with four distinguished elements: O, Cl, P, and Se. O and Se have the same valence electrons with S but with smaller and bigger atomic radii as compared to S atom. Cl have one more valence electron than S does and is thus n-type dopant, while P is p-type dopant, possessing one less valence electron than S has. One type of substitutional structure is considered for individual dopant species. The O doped structure is obtained to be the most balance configuration out of all the other dopant species. The electronic structure investigation showed that O and Cl dopants improve conductivity of 2D-MoS2 by reducing band gap from 1.83824 eV to 0.22824 eV and 1.1192eV respectively with O converting the material to be a conductor. On the other hand, P and Se increases the band gap to 2.52416 eV and 2.94117 eV respectively thus, converting 2D-MoS2 into an insulator. Finally, it is noted that *ab initio* calculations can give some valuable insight into atomic structure of the decorated material. Understanding properties of substitutional S doped 2D-MoS2 can pave way for its successful application into various solid state devices.

Keywords: *ab initio* DFT, doping, saturation, insulator, conductor

ABSTRACTS FOR CROSS CUTTING THEME

CROSS-001-20

A Survey of Engineers' and Engineering Students' Ethical Awareness and Conduct

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Abstract

The engineering industry is known for low ethical performance, and professional ethics instruction in Kenyan engineering faculties is commonly conducted by examining case studies in light of the code of ethics and conduct for engineers. Although the tenets of a code of ethics may leave a lasting impression, students generally gain their professional identity from relatives, colleagues, and practicing engineers. Their engineering professional ethics tend to be mostly an extension of their personal ethics. Instruction on ethics during training generally serves only to reinforce students' inclination to act ethically and encourages them to act on these beliefs. In this study, a survey on engineering ethics was conducted (n = 164) to examine the personal ethical perceptions of engineering students (n = 120, consisting of n = 79 for 1st year and n = 41 for 5th year) and practicing engineers (n = 44). The survey consisted of 16 acts that challenged respondents by examining their personal ethical beliefs in light of the professional ethics requirements of the EBK code. The survey measured how respondents perceive their own ethical beliefs and how they perceive the ethical beliefs and actions of their peers. After familiarization with the EBK code, respondents were also invited to comment regarding their beliefs regarding adherence to the code. Results indicate that, although generally, engineers and engineering students sampled agreed that the acts listed were unethical, several items raised concern. In particular, the item concerning "continuous professional development" was rated as one of the least unethical behaviors. This result points strongly to the need to further reinforce the need for relevant lifelong learning for engineers both during training and practice. Also, results indicated that there is evidence of self-versus-other disparity. For six unethical acts for students and four acts for engineers, in the surveyed list, the means of data for self and colleague perceptions were statistically significantly different at the alpha level of 0.05. When the act was perceived as more unethical, both engineers and students tended to rate themselves more ethical compared to their peers. Action research through mentorship is recommended as part of the solution to addressing ethical issues in engineering practice.

Keywords: identity, ethics, engineering practice, perceptions, student, professional, development

CROSS-002-20

Smart Refuse Collection Bin

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Abstract

Cleanliness is next to Godliness they say, but without proper and conscious effort to be clean, it might only be a mare saying. With the rise of industries and increase in population, filth is the first thing we encounter at our doorsteps when we step out. To deal with this situation, we need a paradigm shift that will enable us to use garbage bins. In this project, an IOT -Based Garbage Bin Monitoring System is designed. This system monitors the garbage bins and informs the managing companies about the level of waste collected in the garbage bins using web page to show the graphical view of the garbage bins and highlights the garbage bins in real time. For this the system uses ultrasonic sensors placed at the brim of the bins to detect the garbage level from the top of the bin to the bottom of the bin and compare it with the garbage bin's depth to calculate the distance. This system makes use of AVR family microcontroller, LCD screen to display the status of the level of garbage collected in the bins, Wi-Fi modem for sending data and a buzzer, to call for attention when the level of waste in the bin crosses the set limit.

Keywords: IOT, Ultrasonic sensors, Microcontroller, LCD Screen and Wi-Fi

CROSS-003-20

Assessment of Ni toxicity to fungi and bacteria in oil tainted soils in Greater Port Harcourt Area, Nigeria

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Abstract

Intensified urbanization and industrialization are rapidly triggering the release of pollutants to the environment. This study aimed to determine the extent of soil contamination with Nickel (Ni) and its impact on the levels of Ni tolerance by fungi and bacteria in soils of Greater Port Harcourt Area, Nigeria. The effect of the Ni on fungi and bacterial populations in soils tainted with petroleum was determined. Colony forming units per gram of soil (CFUs/g) were determined by culturing in media through standard procedures. Nickel was added into culture media in concentrations of 10, 25, 50, 75, 100 and 150 ppm for both fungi and bacteria. The total CFUs/g of soil were enumerated after a culture period of 7 days at 28°C and LC50 was determined using probit and regression analysis. One Way ANOVA was used to evaluate the difference between the LC50 between the study and control sites. Pearson's correlation was used to determine the relationship between the LC50 values and the values of metal concentration and TPH. The mean values of Ni were 1.38±0.23 in industrial area, 1.41±0.36 ppm in agricultural area and 1.02±0.64 in urban area. The mean values of Total Petroleum Hydrocarbon (TPH) were 4,405.46 ppm in industrial area, 55.65 ppm in agricultural area and 1,304.53 ppm in urban area. Nickel's (Ni's) peak concentration indicating growth of both the fungi and the bacteria was 150 ppm. There was significant difference ($p \leq 0.000$) in mean levels of LC50 of fungi between the study sites. There was no significant correlation between the concentration of TPH in soil and LC50 of fungi ($r = -0.169$) and bacteria ($r = 0.042$). In conclusion, TPH influenced the levels of fungi and bacteria tolerance to Ni in soils. Moreover, it was observed that LC50 can be a reliable method for monitoring chemically resistant microorganisms directly in the environment to improve the use of microorganisms for the bioremediation of oil contaminated soils and in monitoring of antibiotic resistant microorganisms in natural ecosystems.

Key words: Nickel, Tolerance, Toxicity, Bacteria, Fungi, LC50,

CROSS-004-20

Studies on Medicinal Potentials of *Hannoa undulata* Essential Oil

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Abstract

Hannoa undulata is a woody tree and shrub that belong to the family of Simaroubaceae. It is a perennial plant distributed in tropical and subtropical region of Africa. The plant is known for its medicinal value and the potency according to tradomedicine practitioners is very tremendous. The plant is acclaimed to be use in treatment of verse array of ailments viz: cancer, leprosy, tuberculosis, insanity, dementia, viral infection and prevention of abscesses in children among others. Due to the acclaimed therapeutic uses of the plant, this study was aimed at determining the possible bioactive components of leaves and barks of *H. undulata* using GC-MS analysis. The fresh leaves and bark stems of *H. undulata* were obtained from the plant and shade dried at room temperature. The dried leaves and bark stems were minced into fine powder. The bioactive combinations were done by GC-MS. The mass spectrum of the compounds found in the essential oils were matched with the National Institute of Standards and Technology (NIST) library Nine and twentyone phytocompounds were identified in the methanol leaf and bark stem extracts of the plant respectively. The major chemical constituents of the leaf include; 3,3-dimethoxyprop-1-en-1-ylium (4.77%), 5-methyl-1,3-oxazolidin-2-one (6.23%), furan-2-carboxylic acid (8.16%), ethyl palmitate (8.89%), 9,12,15-octadecatrien-1-ol (12.44%), hexadecanoic acid (17.86%), 7, 10,13-octadecatrien-1-ol (36.89%) while that of the bark are hexadec-14-en-1-ylium (6.69%), oleic acid (9-octadecenoic acid) (8.17%), hexadec-15-en-1-ylium (9.12%), di-n-octyl phthalate (16.14%), 3-(hydroxy {2-[(2-methylpropoxy) carbonyl] phenyl} methoxy)-2-methylprop-1-ylium (16.51%), The presence of these compounds in the plant extract may be conscientious for the pharmacological properties of *H. undulata* and thus recommended as plant of phytopharmaceutical importance.

Keywords: *Hannoa undulata*, phytochemistry, ethnopharmaceuticals, natural products

CROSS-005-20

Research ethics and scientific innovations nexus: Unpacking the essentials

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Abstract

Research on scientific technologies and innovations are critical in providing solutions to societal challenges. Sustainable development policy decisions must be informed by sound scientific research that adheres to ethical values and practice. The quality of research, innovations and consequent technologies arising therein should be within acceptable integrity standards. This implies that ethical lapses in research and innovation development can harm those involved in as research participants in the research process, researchers, the general public and the environment. It also compromises the application of knowledge and innovations arising therein. Besides this, deliberate, dangerous and negligent deviations can, not only compromise research and innovations integrity but can greatly damage the institutional image. It is therefore vital for researchers to conduct research with integrity and sustain a research environment that fosters veracity. Furthermore, for scientific research, innovations and scholarships to endure, it must be founded on objectivity, clarity, reproducibility and utility. This article emphasises on ethics as an integral part of research on scientific technologies and innovations. It reflects on what ethical research and innovation entails and the integrity expected from researchers. It discusses importance of complying with ethical requirements with emphasis on informed consent, where human participants are involved. Ethical review by an accredited committee is one way of mitigating the occurrence of research misconduct. For innovations, one of the key integrity issues is the intellectual property rights. In this paper, we discuss ethical issues in the research and innovation lifecycle. There is no doubt that the quest for new knowledge and innovations is unstoppable as society continues to face new challenges. Nonetheless, if advances in science, technology and innovations are to create meaningful contribution to communities, then ethical considerations are inevitable.

Key words: Ethical clearance; Good research practices; Informed consent; Intellectual property rights; Research misconduct; Scientific integrity; Subsidiarity

CROSS-006-20

A survey on the impact of Covid-19 on businesses in Uasin Gishu County Kenya

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Abstract
Following the announcement of COVID-19 pandemic by the World Health Organization (WHO), a wide range of measures and guidelines have been issued by Government of Kenya through the Ministry of Health (MOH). Citizens are being reminded through various communication channels to adhere to MOH containment measures which include social distancing, testing and isolation of the persons likely being infected. This report is based on a survey of businesses in Uasin Gishu County conducted to provide the status of the impact of the COVID-19 pandemic on their operations. The report brings out how the coronavirus pandemic has already affected businesses and suggestions from the business owners on how the situation could be mitigated. KNCCI as a business membership organization includes members from all the sectors of the economy in the county and has more than 700 members in Uasin Gishu Chapter. The findings show that more than 29% of the businesses had already closed down and most of the others are operating at less than 50% at the time of this study. It was also established that 80% of the businesses had already sent about 1,400 employees on leave, most of them without pay. This report provides useful information for both the Local and National Governments and other stakeholders in coming up with mitigation measures.

Key Words: Covid-19, Mitigation Measures, Local and National Governments.

CROSS-008-20

Analysis of low carbon electrification in Kenya using an integrated capability assessment framework

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Abstract

Renewable electrification, particularly improved and sustained access to cleaner electricity, remains central in virtually every major developmental agenda in the world today. In this regard Kenya has set a target of achieving universal electricity access by the year 2030. Reflecting on Kenya's ambitious goal and considering the trends in the country's electricity access over the last decade, the goal of this paper is to analyze renewable electrification processes in Kenya with respect to renewable energy project activities against the inherent capabilities. The research was carried out between 2018 and 2019 by means of an in-depth structured survey on capabilities in solar, wind, small hydro, biogas and geothermal energy projects in Kenya. Specifically, the paper seeks to investigate the nexus within and across the low carbon business/project activities and the development of capabilities. In addition, the paper also investigates the interactions and necessary capabilities for further advancement. The unit of analysis in the survey was renewable energy business firms and energy projects in Kenya. The analysis is based on primary data collected through interviews of senior management and technical personnel in sixty-one business firms and projects. The survey data was aggregated and processed using python software. The results from this study show that there is a near uniform involvement of all the respondents in the project life cycle activities. In addition, the results reveal that the low carbon firms and projects in Kenya have high financial and strategic management capabilities with the predominant capabilities being the capability to create new organizational structures, capability to develop and implement strategic plan; capability to deploy integrated financial systems and capability to make strategic decisions, implement and integrate the organization activities. Conversely, the capability to identify, assess, negotiate and finalise terms of the necessary financing as well as the capability to plan, monitor and control research and development activities was found to be the most deficient capabilities. Concerning design and engineering, the most predominant capabilities were the capability to undertake process/product improvements and the capability to duplicate internally acquired technologies. On the other hand, the most deficient capabilities were the capability to identify, assess, negotiate and finalize the terms of the technology to be acquired as well as the capability to adapt both internally and externally acquired technologies. With respect to project implementation, the capability to undertake quality assurance, inspection and inventory control was the most predominant capability for most of the respondents. Conversely, the most deficient capabilities were with respect to supporting project feasibility studies, utilization and control of conversion technologies as well as in erection and commissioning of equipment thus leading to almost complete dependence on external agents for the implementation of low carbon energy projects. The results further show that there were predominantly high capabilities with respect to all the servicing and maintenance capability dimensions evaluated. However there was low to moderate capability in supplementary capabilities. Specifically the most deficient supplementary capability was in the acquisition of technology and raw materials (support facilities, spare parts & consumables; identify, assess, negotiate & finalize the term). The main conclusions from this study imply that the studied firms possess diverse management, strategic and technological capabilities hence they possess divergent generic knowledge-intensive ability to jointly mobilize different scientific and technical resources that can enable them to successfully implement competitive strategy and create value in the

low carbon energy environment. However, the deficient capabilities will largely remain a key bottleneck unless they are addressed appropriately. This research has clarified and unpacked the role of capabilities on the deployment of renewable electrification solutions in Kenya. The results from this research have pertinent ramifications on the renewable electrification landscape in Kenya and will inform the actors and interventions geared towards enhancing renewable electrification in Kenya.

Key Words: Low carbon electrification, Integrated Capabilities.

CROSS-009-20

Responsible Consumption and Production for Wholistic Transformation of Universities: Innovating in Scholarly Governance, Methods, and Identities for Broad-scale Sustainability Impact in Industry and Society

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Abstract

Of the 17 UN *Sustainable Development Goals* (SDGs) adopted as global goals from 2015 to 2030, Sustainable Development Goal #12 on *Responsible Consumption and Production* has been described by some as the "heart" of the Goals: our production systems are central to meeting our human needs and aspirations along with important dimensions of human wellbeing (SDGs #1-5); they shape and organize our economic practices, our choice of material inputs, and their efficient and effective long term sustainable use (SDGs #6-11); they also ensure whether or not we live within the carrying capacity of our natural ecosystems and whether these systems are healthy and resilient (SDGs #13-15). Yet in addition to these social, economic, and environmental sustainability goals, SDG 12 is central at a deeper *cultural* level. It enables (and is enabled by) peace, justice and strong institutions (SDG 16) and motivates new productive partnerships between a variety of organizations at all geographic scales (SDG 17 on "Partnerships for the Goals"). This paper explores the cultural dimensions of SDG 12 through its potential for a whole institution approach on university campuses. In particular, its role in reshaping university governance and scholarly identities (particularly around the concept of sustainable livelihoods and political dimensions as discussed by Ian Scoones (2015)), understandings of scholarly impact, and greater inclusivity of our disciplinary specializations (through living laboratories and development of transformative technologies) are explored. The University of Regina in Saskatchewan, Canada, is then used as a case study to illustrate these cultural dimensions in the recent development of its strategic plan and living laboratories on campus. Finally, implications of such a whole institution shift in university culture for other sectors are highlighted.

Keywords: sustainable consumption and production, sustainable development goal 12, sustainable livelihoods, cultural sustainability, whole-institution approach, whole-university approach, university governance, living laboratories

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