



AFRICA-*ai*- JAPAN Project:

African Union - *african innovation* - JKUAT AND PAUSTI Network Project

Towards Enhancement of JKUAT-PAUSTI Research and Innovation Capacity

Abstracts of Scientific Publications: April 2020 to February 2022

April 2022

Preface

The AFRICA-*ai*-JAPAN Project phase II, is five-year extension of the Project Phase I, an initiative of JICA-JKUAT collaboration to enhance the University's capacity for supporting PAUSTI, which started in April 2014.

The Project operates through four sub taskforces which include: (1) the Integrated Prototyping Innovation and Innovation Centre (iPIC) which has the key objective of the employment of modern technologies in developing African indigenous knowledge into products and services that enhance science, engineering and technology education. The iPIC thematic areas are environment and infrastructure solutions, sustainable transport vehicles and systems, agricultural and industrial machinery and processes; (2) the Innovation Centre for Bio-resources (iCB) which has the objective to apply modern technologies to enhance the utilization of endogenous bio-resources to alleviate food and nutrition insecurity, and support climate change mitigation. The iCB thematic areas are Bio-diversity and conservation, Animal Health and Production, Bio-resource and Waste Management; (3) the Innovation Centre for Molecular Biology and Biotechnology (iCMoB) with an objective to foster understanding the molecular basis of biological activity in organisms to enhance the development of innovative solutions to meet human needs. Its thematic areas are Drug and Disease Control, Biodiversity and Conservation, Food Security and Value addition; and (4) the Innovation Centre for Computing and Technological Solutions (iCCATS), which has the objective of the application of open data and analytics in enhancing research and its dissemination. The iCCATS subtaskforce has started with development of a centralized computer centre which would act as the central backbone serving the entire university with all the ICT requirements. The AFRICA-*ai*-JAPAN project works to deliver a number of outputs as described in the Project Design Matrix document.

The first output includes strengthening the human capacity of JKUAT through long term (PhD and MSc) and Short term (Technical, education trips) trainings for JKUAT staff and students. It also extends to creation of a favourable environment for research through provision of state of art equipment for research, and repair and maintenance of existing infrastructure and equipment. It is foreseen that the outcome of this, will be a stable foundation for JKUAT to deliver on its PAUSTI mandate and to drive Scientific and Technological Innovations (STI) in Africa.

The second output is strengthening research in STI by providing funding support for new research and innovation projects undertaken by both postgraduate students and academic staff of JKUAT/PAUSTI. It is anticipated that this will open the door for more multidisciplinary research projects in the areas of agriculture, engineering, health and ICT, among others. The projects will be aligned to the national development agenda (Vision 2030 and the Big Four) as well as Sustainable Development Goals of the United Nations.

The third output is development of a close academia-industry linkage necessary for sustainable technology transfer and commercialization of research and innovation outputs. The activities

relating to this output include hosting of seminars on topical issues covering the thematic areas of the project. The topics covered include concepts on innovation, building of innovation culture, role of science, technology and innovation as drivers of African transformation and development, the emergence of FabLab concept in Africa and its contribution to development, experiences and challenges in the manufacturing research arena, and the importance of continuous monitoring and evaluation of the project progress. It is anticipated that for JKUAT to remain relevant to societal needs, it needs to work closely with industry in providing scientific and technological solutions to existing problems.

The fourth output is the formation of global partnership to strengthen research collaborations with teaching and research institutions worldwide. These activities will enable JKUAT to contribute to African institutions' capacity development and solving common problems. Further, they will share developmental experience with ASEAN institutions and challenge them towards more development with Japanese, European and other developed countries.

As direct result of the research and innovation environment created and arising from the activities of the AFRICA-ai-JAPAN project phase II, many publications in peer reviewed journals were published over the period of **April 2020 to February 2022**. A highlight of the abstracts obtained in the last 2 years segregated by the sub-taskforce category, the year published and the publication serial number is provided in the subsequent section. A total of **146 publications** were documented and their distribution per year is provided in Table 1.

Table 1. Summary of abstracts from AFRICA-ai-JAPAN taskforce members and JKUAT staff

Year	Task force
2020 (From April to December)	27
2021 (From January to December)	114
2022 (upto end of February)	5
Total	146

Yours Sincerely,

AFRICA-ai-JAPAN Project Director

Prof. Victoria Wambui Ngumi, PhD., EBS

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Acknowledgement

The Project appreciates the authors of the various **abstracts** from JKUAT within the period 2020 to 2022 who willingly shared their outputs with the compiling team. This is considered a good gesture for building the spirit of documentation which is critical in pelting JKUAT high in university ranking. The Project further expects JKUAT researchers to keep publishing in high impact factor journals and share their peer review journal publications with JKUAT library for consolidated archiving.

It is also a reminder that the genesis of the the first edition of the book of **abstracts** 2014-2019 for all peer review journal publication papers stemmed from the urge of providing evidence for the outcomes of the implementation of AFRICA-*ai*-JAPAN Projects. This additional third publication (2020-2022) confirms that the seed which was planted in 2018 is still growing. It is this conviction which led the Project to initiate work on collection of all peer review journal publications.

Lastly, special thanks are given to the JKUAT Management Team for providing a favorable environment towards implementation of AFRICA-*ai*-JAPAN Project Phase II. We treasure every single minute dedicated towards supporting the Project. Let's keep working together towards realization of the university vision through transforming the research and innovation culture of the university. It is our desire, and through their support, to keep documenting and showcasing the growth in Scientific and Technological Innovations within the University.

JICA Chief Advisor at JKUAT,
Prof. Hiroshi Koaze

AFRICA-ai JAPAN Project Chairman
Prof. Daniel Ndaka Sila

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Introduction

A summary of the abstract from the various sub-taskforce members is as indicated below for each of the teams that form the AFRICA-ai-JAPAN project.

A. Summary of abstracts from iPIC

Year	iPIC
2021	27
Total	27

B. Summary of abstracts from iCB

Year	iCB
2020	27
2021	43
2022	1
Total	124

C. Summary of abstracts from iCMoB

Year	iCMoB
2021	29
2022	4
Total	33

D. Summary of abstracts from iCCATS

Year	iCCATS
2021	15
Total	15

1.0. Compilation of Abstracts from AFRICA-ai-JAPAN Project Taskforce

1.1. Compilation of Abstracts from iCB Sub Taskforce: April 2020 to February 2022

iCB 2022-01:

Antinutrient to Mineral Molar Ratios of Raw Common Beans and their Rapid Prediction using Near-Infrared Spectroscopy

Wafula, E. N., Onduso, M., Wainaina, I. N., Buvé, C., Kinyanjui, P. K., Githiri, S. M., Saeys W., Sila D. N. & Hendrickx, M. 2022. *Food Chemistry*, 368, 130773

Abstract

The presence of antinutrients in common beans negatively affects mineral bioavailability. Therefore, this study aimed to predict the antinutrient to mineral molar ratios (proximity-indicators of in vitro mineral bioavailability) of a wide range of raw bean types, using near-infrared (NIR) spectroscopy. Iron, zinc, phytate and tannin concentrations and, antinutrient to mineral molar ratios were determined. Next, model calibration using NIR spectra from milled beans was performed. This entailed wavelength selection, pre-processing and partial least squares regression. Bean type had a significant effect on tannin content. The average values of phytate to iron (Phy:Fe), phytate to zinc (Phy:Zn), tannins to iron (Tan:Fe) and phytate and tannins to iron (Phy + Tan:Fe) MRs were 27.6, 61.7, 16.0 and 43.6, respectively. With determination coefficients for test set prediction above 75%, the PLS-R models for Phy:Zn, Tan:Fe and Phy + Tan:Fe molar ratios are useful for screening purposes.

Key Words: Common beans, Near-infrared spectroscopy, Antinutrients, Minerals, Molar ratios

iCB 2021-01

Prediction of Cooking Times of Freshly Harvested Common Beans and their Susceptibility to Develop the Hard-To-Cook Defect using Near Infrared Spectroscopy

Elizabeth N. Wafula, Irene N. Wainaina, Carolien Buvé, Peter K. Kinyanjui, Wouter Saeys, Daniel N. Sila and Marc E.G. Hendrickx., 2021. *Journal of Food engineering*, 10495.

Abstract

The cooking time of common beans is influenced by genotype and storage conditions. This study aimed to use near-infrared (NIR) spectra of milled, freshly harvested (fresh) beans to predict their cooking times and their susceptibility to develop the storage-induced, hard-to-cook (HTC) defect. The physical characteristics of bean accessions, from two different seasons, were evaluated. The cooking times and susceptibility to HTC (determined by aging under standard adverse conditions) of the aforesaid beans were correlated to NIR spectra to develop calibrations using variable selection and partial least squares regression. The beans exhibited diverse physical characteristics, cooking times and susceptibility to HTC. The models predicting cooking times of fresh beans sufficiently overcame genotype and seasonal differences ($R^2_P=0.73$, RMSEP=4 minutes). The susceptibility of fresh beans to HTC was also successfully predicted ($R^2_{CV}=0.8$, RSECV=64%). NIR spectroscopy has high potential to rapidly identify beans with short cooking times and low susceptibility to HTC at harvest.

Key Words: near-Infrared spectroscopy, susceptibility, hard-to-cook, common beans, aging, cooking times

iCB 2021- 02

Smallholder Farmers' Practices and African Indigenous Vegetables Affect Soil Microbial Biodiversity and Enzyme Activities in Lake Naivasha Basin, Kenya

Taskin, E., Misci, C., Bandini, F., Fiorini, A., Pacini, N., Obiero, C., Sila, D.N., Tabaglio, V. and Puglisi, E. 2021. *Biology*, 10(1), 44

Abstract

Smallholder farmers in Sub-Saharan Africa (SSA) are food insecure. Underexploited African indigenous vegetables (AIVs) are consumed locally without being considered a primary source of food and income. However, AIVs hold great potential for the future challenges of food security and climate change. We investigated the effects of different cropping systems and inclusion of AIVs in farming on the soil biodiversity and fertility status of smallholder farmers in Naivasha, Kenya. Compared to mainstream farming approaches, soil microorganisms under AIV cultivations differed significantly. Tillage, fertilization, soil amendments, and traditional homemade plant protection were singled out as the most important factors. The soil alteration index based on enzyme activity offered a reliable way to determine the alteration status for the first time in SSA. These findings could be useful for farmers to integrate AIVs with correct sustainable practices for a sustainable future and may contribute to the mitigation of food insecurity. Loss of soil biodiversity and fertility in Sub-Saharan Africa (SSA) may put the food security of smallholder farmers in peril. Food systems in SSA are seeing the rise of African indigenous vegetables (AIVs) that are underexploited but locally consumed without being considered a primary source of food and income. Here we present a field study, a first of its kind, in which we investigated the effects of different cropping systems and inclusion of AIVs in the farming approach on bacterial and fungal biodiversity and community structures, enzymatic activity, and the alteration status of soils of the smallholder farmers in Kenya. When compared to mainstream farming approaches, the composition and biodiversity of bacteria and fungi under AIV cultivations was significantly different. Tillage had a significant impact only on the fungal communities. Fertilization and soil amendments caused shifts in microbial communities towards specialized degraders and revealed the introduction of specific microorganisms from amendments. Traditional homemade plant protection products did not cause any disturbance to either of soil bacteria or fungi. The soil alteration index based on enzyme activity successfully differentiated the alteration status for the first time in SSA. These findings could be useful for farmers to integrate AIVs with correct sustainable practices for a sustainable future.

Key Words: soil biodiversity, soil bacteria, soil fungi, family farming, NGS, HTS, sustainable agriculture, farming practices, microbial diversity, soil enzymes, soil fertility, SSA

iCB 2021- 03

Compliance of Maize Meal to Food Safety and Food Fortification Standards at Market Level in Kenya

Mwai, J.M., Oketch, F.A., Sila, D.N., Kiage, B.N., Abuga, D., Kamathi, J.M., Njogu, C., Okoth, J., Kahenya, P., Masanta, G. and Lawrence, L. 2021. *Journal of Agriculture, Science and Technology*, 20(3)

Abstract

Maize meal samples (597) were obtained from local markets outlets in 10 Counties which were purposively selected based on the high number of millers and high consumption of maize meal. The

collected samples were sorted by brands and duplicates identified using batch numbers. Randomly selected samples of diverse brands per county, which were representative of the analytical lot, were homogenized using a blender before drawing the analytical sample. A total of 312 analytical samples were prepared. Samples were analyzed for aflatoxin using Elisa, vitamins A and B complex using HPLC and minerals using AAS. Overall, 14.4% of the maize samples had total aflatoxin levels above the safety threshold of 10ppb, with some samples having very high levels (>100ppb). Kiambu County had the highest (29.8%) number of samples with aflatoxin content above the maximum threshold. Overall compliance to maize fortification standard was at 28.0%. Kwale County had the highest compliance to fortification standards at 38.9% while Kisumu County had the lowest (20.8%). Compared with earlier surveillance done by the Ministry of Health in 2017, there was an improvement in compliance to fortification standards from 16.0% to 28.0%. Aflatoxin was detected across the 10 counties as an indication of food safety concerns. Compliance with food fortification standards is still low despite all the efforts put by both government and its partners. There is a need for concerted efforts to understand the main causes of the low compliance levels to develop targeted strategies for mitigation.

Key Words: Aflatoxin, Compliance, Food fortification, Maize Meal, Standards

iCB 2021- 04

Assessment of Variation in Agronomical Traits among Herbicide Tolerant M3 and M4 Maize Lines

Kariuki, J.K., Wesonga, J.M. and Mwangi, G.S. 2021. *Cutting-edge Research in Agricultural Sciences* Vol. 10, 34-57.

Abstract

The purpose of this study was to assess variation in agronomical traits among 39 herbicide tolerant M3 and 37 M4 maize lines during March to July 2015 and September 2015 to January 2016 respectively. A randomised complete block in triplicates was used in the experiment. The informations were collected. on plant height, ear diameter, hundred seed weight, ear length, grains row⁻¹ and ear⁻¹, total ears plant⁻¹, yield plant⁻¹, ear height and herbicide tolerance. The information were examined using Genstat 16th edition at 5% level of significance. The outcomes revealed significant ($p < 0.05$) variations among M3 and M4 for all traits except rows ear⁻¹ and total ears plant⁻¹. The highest yielding M3 and M4 lines were 520-58 and 520-38_3 recording 116.2 g plant⁻¹ and 151.1 g plant⁻¹ respectively but yields were lower than check varieties (165.3 g) and (183.5 g) respectively. The most herbicide tolerant M3 and M4 line were 513-12 and 520-38_3 taking 25 days and 28.5 days to ultimate death respectively. Grain yield plant⁻¹ correlated significantly and positively with most traits in M3 while the positive and significant correlation with 100 seed weight, grains row⁻¹ and total ears plant⁻¹ in M4. In addition, tolerance days showed negative and highly significant correlations with plant height and ear height. Herbicide tolerance was negatively and significantly correlated with grain yield plant⁻¹. Overall, the findings suggested that induced mutation could be a useful source of variation for plant breeding.

Key Words: Agronomical characterization, correlation, maize, mutation breeding, variations, Zea mays L

iCB 2021-05

COP26 Futures We Want-Kenya Country Profile

Mogo, E.R., Wesonga, J.M., Gichuyia, L.N. and Shuckburgh, E. 2021.

Abstract

This country profile for Kenya has been developed with the input from in-country academic experts, including Prof John M. Wesonga (Jomo Kenyatta University of Agriculture and Technology) and Dr Linda Nkatha Gichuyia (University of Nairobi), in the context of the BEIS COP26 Futures We Want project. It provides a review of the available evidence on the risks, solutions and opportunities for Kenya and Kenyan society to contribute towards a global transition to a net zero future that is inclusive, resilient and desirable by all.

The purpose of this draft country profile was to provide an evidence base to inform the production of Net Zero Future visions. A consolidated version of the material contained here was used as a stimulus for in-country workshops and creative translational approaches that will develop a plausible vision for each country. This document provides a selection of relevant evidence for the sectors and themes identified through the scoping exercise.

iCB 2021-06

Variability of In-Situ Plant Species Effects on Microclimatic Modification in Urban Open Spaces of Nairobi, Kenya

Onyango, S.A., Mukundi, J.B., Ochieng'Adimo, A., Wesonga, J.M. and Sodoudi, S. 2021. *Current Urban Studies*, 9(01), p.126.

Abstract

Plant species play a key role in microclimate regulation especially in cities where Urban Heat Island (UHI) effects are mostly felt. This study aimed at determining the impact that different tree species have on microclimatic parameters in urban open spaces of Nairobi and the degree to which they reduce UHI implications and improve Thermal Comfort (TC) of inhabitants. Two sites representing two Local Climate Zones (LCZ) were selected for sampling namely; LCZ B: Central Park (Site 1), and LCZ 4: Taifa road (Site 2). Four mature and isolated in-situ plant species with varied tree architecture were chosen for measurements of climatic variables done at 1.1 m above the ground, at the trunk base, 5 m horizontally away from the plant and open in the sun with no trees (control). Leaf area index (LAI) and Physiological Equivalent Temperature (PET) were measured under the trees. In both sites, *Terminalia mantaly* species with a spreading canopy form provided the best cooling effect with a PET reduction of 9.6°C and 9.3°C in Site 1 and Site 2, respectively. *Tipuana tipu* (round canopy form) was the second best with 9.2°C and 8.2°C, followed by *Cassia spectabilis* (vase canopy form) with 8.5°C and 7.6°C, and lastly *Podocarpus falcatus* (pyramidal canopy form) with 7.9°C and 6.4°C. Air temperatures in Site 1 (Park) were 2.3°C, 1.3°C and 1.0°C lower compared to those in Site 2 (Street) at 1 pm, 6 pm and 8 am, respectively. A strong negative correlation (S1; $r = -0.96$, S2; $r = -0.8$) was obtained between LAI and PET for both sites. This showed that plants with higher canopy densities reduced temperature more, which in turn helps improve human TC.

Key Words: Local Climate Zones (LCZ), Physiological Equivalent Temperature (PET), Tree Architecture, Leaf Area Index (LAI), Thermal Comfort (TC), Urban Heat Island (UHI)

iCB 2021-07**Effect of Moisture Stress on the Development of False Codling Moth *Thaumatotibia leucotreta* (Lepidoptera: Tortricidae) on Two Tomato Varieties**

Patrick, E.M., Koomen, I., Ndlela, S. and Wesonga, J.M. 2021. *Neotropical Entomology*, 50(5), 828-834.

Abstract

False codling moth *Thaumatotibia leucotreta* (Meyrick) is a pest native to sub-Saharan Africa infesting over 100 plant species including tomato. Its survival and performance are influenced by changes in precipitation and stress-related biochemical changes in the host plant. Water availability for agricultural production continues to decline due to climate change affecting drought-sensitive crops like tomatoes. Little is known on host plant–insect interactions of *T. leucotreta* and tomato as influenced by moisture stress. Hence, our study tested the impact of different water holding capacities (WHC) (40%, 50%, 60%, 70%, and 90%) of plant growing media on the growth of Anna F1 and Yaye tomato varieties and the infestation rate and development of *T. leucotreta* on the two varieties. WHC significantly influenced the growth of Anna F1 and Yaye tomato varieties. WHC significantly affected stem girth of Anna F1 variety and leaf length, leaf width, stem girth, and plant height of the Yaye variety. For Yaye variety, *T. leucotreta* laid a significantly high number of eggs when grown at 70% WHC and had the highest pupation when grown at 60% WHC. The development of *T. leucotreta* as observed on wing growth was highest at 40% and 50% WHC for both Anna F1 variety and Yaye variety. Our study shows that the infestation of tomato by *T. leucotreta* is likely to be high when grown in water-scarce media. The results are useful for predicting possible future *T. leucotreta* trends with increasing water scarcity due to climate change and in designing pest management programmes.

Key Words: Climate change, Drought, Plant host interactions, Global warming, Emerging pests

iCB 2021-08**Chemical Composition and Bioactivity of *Lantana camara* L. Essential Oils from diverse Climatic Zones of Kenya against Leaf Miner (*Tuta absoluta* Meyrick)**

Liambila, R.N., Wesonga, J.M., Ngamau, C.N. and Waudu, W. 2021. *African Journal of Agricultural Research*, 17(9), 1198-1208.

Abstract

In recent years, essential oils (EOs) as alternatives to synthetic pesticides in managing pests have been assessed. The use of bioinsecticide in pest management is encouraged in agroecology for a sustainable agricultural system. Essential oils of *Lantana camara* L. leaves from different climatic zones of Kenya were extracted by steam distillation and analyzed through GC-MS to identify the compounds. The contact toxicity and repellent activity of EOs against the invasive tomato pest, *Tuta absoluta*, were tested. The toxicological assays were performed following the leaf-dip bioassay protocol, while the repellency activity was performed using the repellent response method for phytophagous pests and the data analyzed using the ANOVA test. It was found that *L. camara* EO has a good insecticidal activity with higher mortality (89%) on the 2nd instar larvae with a higher dosage (0.01 µl/µl). The repellence test also showed a higher average repellence (93.44%) effect

with a higher dosage (0.01 $\mu\text{l}/\mu\text{l}$) of the EOs. According to these results, the EO of *L. camara* may well be a sustainable, eco-friendly alternative for synthetic insecticide in the *T. absoluta* management program.

Key Words: Bioinsecticide; essential oil, integrated pest management, invasive species, secondary metabolites

iCB 2021-09

Push-pull Strategy Combined with Net Houses for Controlling Cowpea Insect Pests and Enhancing Crop Yields

Diabate, S., Martin, T., Murungi, L.K., Fiaboe, K.K., Wesonga, J., Kimani, J.M. and Deletre, E. 2021. *Crop Protection*, 141, 105480.

Abstract

Net houses can be used in tropical environments to protect crops such as cowpea against large insect pests, thereby avoiding pesticide treatments while sustainably mitigating the effects of climate change. We investigated a push-pull strategy to prevent small insect pest outbreaks in a net house. The push component consisted of two stimulus plants, i.e. *Cymbopogon citratus* and *Tagetes minuta*, and the pull stimuli consisted of visual cues from blue and yellow sticky traps. Field experiments were set up in central Kenya and conducted during a rainy and a dry season, involving an open field control treatment, and three management treatments consisting of (1) an open field push-pull treatment, (2) a net house treatment and (3) a combined net house + push-pull treatment. *Trialeurodes vaporariorum* infestations were lower in the net house and net house + push-pull treatments than in the two open field treatments during the dry period or in the control treatment during the rainy period. *Aphis craccivora* infestations were higher in the net house and net house + push-pull treatments than in the control and open field push-pull treatments during the dry period, while no differences were observed among treatments during the rainy period. *Megalurothrips sjostedti* infestations did not vary among treatments in both periods. Among the larger insect pests, *Clavigralla tomentosicollis* infestations were lower in the net house and net house + push-pull treatments than in the open field treatments during the dry period, while *Maruca vitrata* infestations were lower in the net house treatment than in the control. During the rainy period, *C. tomentosicollis* infestations were higher in the net house + push-pull treatment than in the net house treatment, whereas *M. vitrata* infestations did not vary among treatments. Compared to the control, *Empoasca* sp. infestations were lower in the net house and net house + push-pull treatments in both periods, and in the open field push-pull treatment in the rainy period. Cowpea pod and grain yield and quality were higher in the net house and net house + push-pull treatments than in the control irrespective of the period. Although the treatments 1 reduced some of the pests, the net house and net house + push-pull treatments were effective in protecting cowpeas against most of the pests while improving pod yields in both periods.

Key Words: Net house, Integrated pest management, Push-pull, Sticky traps, Insect pests.

iCB 2021-10

Forest-based Livelihood Choices and their Determinants in Western Kenya

Yego, P., Mbeche, R., Ateka, J. and Majiwa, E. 2021. *Forest Science and Technology*, 17(1), 23-31.

Abstract

Forest extraction is an important livelihood activity for millions of low-income households in rural areas of developing countries. Understanding the choices households make to extract forest products can help formulate strategies for preventing livelihood strains associated with forest degradation. This article evaluates the nature, extent and determinants of forest extraction among rural households in western Kenya. Data were obtained from a survey of 924 randomly selected households in the Mt. Elgon area in western Kenya. The level of forest extraction was measured as the aggregate value of products extracted, while a Double Hurdle model was applied to assess the factors influencing forest extraction. The results show that the choice to engage in forest-based livelihood was generally higher among households with lower asset value, membership in forest user associations, and headed by males. The results further show that although the majority of households' engaging in forest-based livelihood were of the lowest wealth category, households in the middle wealth category were found to extract higher value products. Institutional characteristics, including access to agricultural markets, credit, extension, and membership to forest user groups, increased the likelihood of households' extracting higher value products. Overall, the results show that in addition to asset endowment, other contextual factors, such as access to markets, agricultural extension, and membership to farmer groups defined whether a household extracted forest products for survival or accumulation.

Key Words: Livelihoods, forest extraction, rural households, double hurdle model, Kenya

iCB 2021-11

Understanding Forest Users' Participation in Participatory Forest Management (PFM): Insights from Mt. Elgon Forest Ecosystem, Kenya

Mbeche, R., Ateka, J., Herrmann, R. and Grote, U. 2021. *Forest Policy and Economics*, 129, 102507.

Abstract

Participation of local communities in forest management decision-making has been promoted as a mechanism of improving livelihoods and forest conditions, yet the level of participation in many programs remains low. Using data from a cross-sectional survey of 924 forest-dependent households in Western Kenya, we examine the factors that support or constrain forest dependent people's participation in a Participatory Forest Management (PFM) program. We run a probit model to assess households' choice to join PFM and then compute a Participation Index (PI) for forest users' participation across different stages of the PFM program – planning, implementation and Monitoring and Evaluation (M&E). The determinants of participation are then analyzed using the fractional regression approach. Results show that over half (52%) of the respondents participated in PFM. While vulnerability to shocks, being in a farmers' group, a household's access to the forest within the previous 12 months and access to extension were associated with the likelihood of

participating in PFM, the influence of the household head's age and education, access to credit and food insecurity had a negative influence. Our results reveal PIs of 41%, 49%, and 42% at the planning, implementation, and M&E stages respectively, indicating a moderate participation level. The fractional regression model shows that transaction costs associated with access to markets, gender (being male), household expenditure and expected forest benefits positively influence household participation in PFM, while the opportunity costs associated with off-farm income, distance to the forest and lack of extension have a negative influence on participation. These results point to the need to take the household context (gender, education, household expenditure and vulnerability) into consideration during planning and implementation of the forestry programs. The implication is that forest authorities should identify and implement mechanisms to enhance benefits from forests but also reduce costs of participation, especially for women.

Key Words: Forest decentralization policy, Household participation, PFM, Community forest associations, Fractional regression model

iCB 2021-12

Determinants of Forest Dependent Household's Participation in Payment for Ecosystem Services: Evidence from Plantation Establishment Livelihood Improvement Scheme (PELIS) in Kenya

Waruingi, E., Mbeche, R. and Ateka, J. 2021. *Global Ecology and Conservation*, 26, e01514.

Abstract

Payment for ecosystem service (PES) programs are increasingly being promoted as suitable mechanisms for addressing degradation of forest resources in developing countries. While interest in PES has grown over the last decade, empirical research on factors influencing household involvement in PES remains limited. This paper analyses factors influencing household participation in a forestry PES scheme in Kenya. Drawing on a cross sectional survey of 919 households in Mt Elgon, Kenya, we estimate a household participation index (PI) in the Plantation Establishment Livelihood Improvement Scheme (PELIS) program based on involvement in nine key program activities. We then run a Heckpoisson model to determine factors that affect household participation in the PES program. The results show that while the level of participation was medium (with nearly 50% of eligible households participating), involvement was higher among the wealthier and male headed households. The intensity of participation across PELIS activities was above average (reflected in a participation index of 5.3 out of a maximum nine). The key factors associated with participation were access to forest benefits (products and share of PELIS income) and having a positive attitude towards environmental conservation. The access to different forms of household capitals was found to have varying influence on participation, depending on household socioeconomic context. While ownership of livestock had a positive influence on participation, the effect of farm size and off-farm income was negative. Equally, the level of expected crop harvests had a negative influence on participation suggesting presence of incentive incompatibility among some benefits. Our findings have three important implications. First, the low level of participation among the women and poor, and resultant disproportionate distribution of benefits suggests the need for mechanisms to reduce program costs and other barriers that limit participation of the poor and marginalized groups. Second, the varying influence of household capitals point to the importance

of taking into consideration gender and other socio economic contexts when designing and implementing PES programs. Lastly, considering that PELIS can only enroll a limited number of participants, PES programs may need to expand the range of incentives in order to accommodate more beneficiaries.

Key Words: Incentive based conservation, Sustainable forest use, Rural livelihoods, Ecological outcomes, Heckpoisson model

iCB 2021-13

Preferences and Willingness to Pay for Yogurt Product Attributes Among Urban Consumers in Kenya

Ateka, J.M., Mbeche, R., Obebo, F. and Sila, D. 2021. *Journal of International Food & Agribusiness Marketing*, 1-23

Abstract

This paper assesses the preferences of yogurt attributes among urban consumers in Nairobi, Kenya. Data were collected through a survey of 190 urban consumers and analyzed using descriptive statistics and willingness to accept (WTA) regression models. The results show that preference for flavored yogurt was much stronger with fewer consumers (39%) willing to forgo the attribute compared to micronutrient fortification (45%), probiotic (46%), and real fruit yogurt (53%). The results also show that willingness to accept price reductions in order to forgo a preferred attribute was higher for nutrition compared to sensory attributes (such as taste and appearance). The findings indicate that in the face of numerous yogurt brands in the market, there is a need for targeted messaging on the nutritional value of yogurts. The paper uncovers the tradeoffs in preferences between sensory and nutritional attributes, a contribution that has received limited attention in the literature.

Key Words: Consumer preferences, nutrition, ordered probit, willingness to accept, yogurt

iCB 2021-14

Participatory forestry improves mangrove forest management in Kenya.

Kairu, A., Kotut, K., Mbeche, R. and Kairo, J. 2021. *International Forestry Review*, 23(1), 41-54.

Abstract

Participatory forestry has been recognized as a tool for improving tropical forest management. The current study assessed the impacts of participatory forest management (PFM) on the structure and regeneration of a mangrove forest at Gazi Bay, Kenya. Data were collected along belt transects perpendicular to the waterline in both co-managed and state-managed mangrove forests. Basal area and standing density were significantly higher in the co-managed mangrove forests (16 m²/ha and 4 341 tree/ha) as compared to the state forests (eastern block 10.3 m²/ha and 2 673 trees/ha; western block 6.2 m²/ha and 2 436 trees/ha). There were significantly higher ($p = 0.0068$) densities of merchantable poles in community-managed as compared to state-managed forests. Natural regeneration patterns in community-managed and state-managed forests were deemed adequate to support the recovery of both forests. The results demonstrate that community participation

contributes to improved management of mangrove forests and is in agreement with the principles of sustainable forest management.

Key Words: Gazi Bay, mangroves, natural regeneration, participatory forestry, stand biomass

iCB 2021- 15

Purchasing Behaviour and Relational Contract Decisions of Retailers in Grasshopper Value Chains in Uganda

Donkor, E., Mbeche, R. and Mithöfer, D. 2021.

Abstract

Agrifood marketing in sub-Saharan Africa is associated with high inefficiencies, which emanate from high transaction costs, poor coordination and asymmetric information. These challenges lead to high food prices and limited accessibility to consumers. Formal contracts could address these challenges, but they are largely non-existent in the traditional agrifood marketing. Studies addressing the agrifood marketing challenges have focused mainly on farmers and consumers. However, the mid-stream actors who bridge the gap between farmers and consumers are ignored in scientific and policy debates. The paper therefore analyses the purchasing behaviour and relational contract decision of retailers using a primary data set from 500 grasshopper retailers in Central Uganda. We find that most retailers prefer to purchase non-value added grasshoppers from wholesalers. Consistent with the theory of relational contract, trust and close relationship reinforce relational contract between retailers and suppliers. We find a significant positive relationship between demand for grasshopper products and relational contract

Key Words: Purchasing behaviour, grasshopper value chain, retailers, relational contract, transaction cost theory, buyer-seller model

iCB 2021-16

Assessment of Technical Efficiency of Smallholder Coffee Farming Enterprises in Muranga, Kenya

Kamau, V., Ateka, J., Mbeche, R. and Kavoi, M.M., 2021. *Journal of Agriculture, Science and Technology*, 18(1) 12-23

Abstract

The Kenyan coffee industry is a major contributor to Kenya's economy. The industry is a top foreign exchange earner coming fourth after tourism, tea and horticulture. The sector directly and indirectly supports over 6 million people, making it one of the leading sources of livelihood in the country. Despite the immense contribution, the production of coffee in Kenya has declined significantly over the past decades – associated with inefficiencies – resulting in increased poverty in coffee-dependent communities. This paper explores the determinants of technical efficiency in Murang'a County; a leading coffee producing region in Kenya. The analysis of the data followed a two-step approach following Helfand and Levine (2004). In the first step, technical efficiency measures were calculated using the non-parametric data envelopment analysis (DEA) model. In the second step, the estimated technical efficiency scores were regressed on a set of explanatory variables which included farm

size, household characteristics and various indicators for institutional arrangements and adoption of technology. Results showed that the average technical efficiency was low at 54%. The findings show that farm size, coffee variety, access to credit, farmers' age and household size are critical determinants of technical efficiency in coffee farming. It is therefore concluded that adoption of improved varieties especially by youthful farmers and increased access to credit facilities which help farmers to purchase market inputs for coffee enterprise would increase TE and ultimately coffee productivity.

Key Words: Coffee production, technical efficiency, non-parametric approach, DEA

iCB 2021- 17

Determinants of Protected Tomato Production Technologies among Smallholder Peri-urban Producers in Kiambu, Kenya

Ateka, J.M., Mbeche, R.M. and Muendo, K.M., 2021. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, 122(1) 43-52

Abstract

Climate variability and the rise in incidences of pests and diseases continue to undermine production of high value vegetables among smallholder farmers in sub-Saharan Africa. In order to respond to these challenges, protected farming technologies (PFT) (such as greenhouses) which modify the plant environment and therefore aid in avoiding the harmful effects of climatic factors have been promoted. Greenhouses protect the crops against high solar radiation and heavy rainfall that have the potential of destroying vulnerable crops like tomatoes. Consequently, PFT is associated with better yields and farm incomes. However, the adoption of PFT among smallholder farmers, not least in Kenya is low. Drawing on the Agricultural Household Model (AHM) theoretic framework, this paper assessed the determinants of adoption of PFT among smallholder tomato farmers in Kenya. Tomato is the second most important horticultural vegetable crop in Kenya after potatoes in terms of production volumes and value. Data for the study were collected from a cross sectional multistage random survey of 104 tomato farming households and analysed using maximum likelihood probit model. The probit results revealed that the age of a farmer, educational level, household size, total household income and access to credit positively influenced the likelihood of PFT adoption. The likelihood of adoption was negatively related to distance to input markets and access to the county government extension services. Overall, the results of this study suggest that an integrated promotional strategy that accounts for household heterogeneities and focuses on institutional arrangements that support the accumulation of human and financial capital would enhance PFT adoption.

Key Words: Protected farming, greenhouses, adoption, agricultural household model, probit maximum likelihood

iCB 2021- 18

The Influence of Privatised Agricultural Extension on Downward Accountability to Smallholder Tea Farmers

Mbeche, R.M., Mose, G.N. and Ateka, J.M. 2021. *The Journal of Agricultural Education and Extension*, 1-22.

Abstract

Purpose. To assess the extent to which privatised extension service, which is premised to be demand-driven, delivers downward accountability to smallholder farmers who are both owners and users of agricultural services.

Design/methodology/approach. The research collected data through focus group discussions with smallholder tea farmers and key informant interviews after which the information were corroborated with semi-structured interviews with 104 smallholder farmers.

Findings. Our findings show that KTDA (Kenya Tea Development Agency) extension service has in recent years embraced methodologies that allow two-way information exchange and farmers' involvement in planning, implementing and evaluation of extension programmes. While this transition has provided opportunities for increased accountability and empowerment of smallholder farmers, downward accountability is limited by among others; presence of multiple accountabilities, a heavy top-down governance structure, higher incentives for upward accountability, limited resourcing of extension delivery, excessive workload and unrealistic targets on the part of extension staff and weak extension–research–farmer linkages.

Practical implications. The findings of this study may be used by policymakers, extension practitioners and organisations delivering extension services to improve downward accountability and quality of advisory services

Theoretical implications. The paper contributes to the debate on outcomes of privatisation on extension provision using the accountability lens in an area dominated by perceptions on costs and payment for the services.

Originality/value. The literature on downward accountability on privatised extension services is lacking. The paper also extends the framework for assessing the performance of pluralistic extension services to develop and apply a framework for assessing downward accountability in privatised extension.

Key Words: Privatised extension, downward accountability, smallholder farmers, tea, KTDA, Kenya

iCB 2021-20

Metagenomics Survey Unravels Diversity of Biogas Microbiomes with Potential to Enhance Productivity in Kenya

Muturi, S.M., Muthui, L.W., Njogu, P.M., Onguso, J.M.A., Wachira, F.N., Opiyo, S.O. and Pelle, R. 2021. *PloS one*, 16(1), e0244755.

Abstract

The obstacle to optimal utilization of biogas technology is poor understanding of biogas microbiomes diversities over a wide geographical coverage. We performed random shotgun sequencing on twelve environmental samples. Randomized complete block design was utilized to assign the twelve treatments to four blocks, within eastern and central regions of Kenya. We obtained 42 million paired-end reads that were annotated against sixteen reference databases using two ENVO ontologies, prior to β -diversity studies. We identified 37 phyla, 65 classes and 132 orders. *Bacteria* dominated and comprised 28 phyla, 42 classes and 92 orders, conveying substrate's

versatility in the treatments. Though, *Fungi* and *Archaea* comprised 5 phyla, the *Fungi* were richer; suggesting the importance of hydrolysis and fermentation in biogas production. High β -diversity within the taxa was largely linked to communities' metabolic capabilities. *Clostridiales* and *Bacteroidales*, the most prevalent guilds, metabolize organic macromolecules. The identified *Cytophagales*, *Alteromonadales*, *Flavobacteriales*, *Fusobacteriales*, *Deferribacterales*, *Elusimicrobiales*, *Chlamydiales*, *Synergistales* to mention but few, also catabolize macromolecules into smaller substrates to conserve energy. Furthermore, δ -*Proteobacteria*, *Gloeobacteria* and *Clostridia* affiliates syntrophically regulate P_{H_2} and reduce metal to provide reducing equivalents. *Methanomicrobiales* and other *Methanomicrobia* species were the most prevalence *Archaea*, converting formate, $CO_{2(g)}$, acetate and methylated substrates into $CH_{4(g)}$. *Thermococci*, *Thermoplasmata* and *Thermoprotei* were among the sulfur and other metal reducing *Archaea* that contributed to redox balancing and other metabolism within treatments. Eukaryotes, mainly fungi were the least abundant guild, comprising largely *Ascomycota* and *Basidiomycota* species. *Chytridiomycetes*, *Blastocladiomycetes* and *Mortierellomycetes* were among the rare species, suggesting their metabolic and substrates limitations. Generally, we observed that environmental and treatment perturbations influenced communities' abundance, β -diversity and reactor performance largely through stochastic effect. Understanding diversity of biogas microbiomes over wide environmental variables and its' productivity provided insights into better management strategies that ameliorate biochemical limitations to effective biogas production.

Key Words: Complete genome sequence, central carbohydrate-metabolism, propionate-degrading bacterium, SP-NOV, GEN. NOV., *Methanogenic archaea*, anaerobic-digestion, *Escherichia-coli*, *Fusobacterium-varium*, molecular phylogeny

iCB 2021-21

Current Methods of Enhancing Bacterial Bioremediation of Pesticide Residues in Agricultural Farmlands

Anode, S. and Onguso, J. 2021. In: Panpatte D.G., Jhala Y.K. (eds) *Microbial Rejuvenation of Polluted Environment. Microorganisms for Sustainability*, vol 26. Springer, Singapore. https://doi.org/10.1007/978-981-15-7455-9_7

Abstract

The accumulation of recalcitrant xenobiotic compounds is due to continuous efflux from population and agricultural and industrial inputs that have created a serious impact on the pristine nature of our aquatic and terrestrial environment. Apart from this, these compounds are mostly carcinogenic, posing health hazards which persist over a long period of time. Metabolic pathways and specific operon systems have been found in diverse but limited groups of microbes that are responsible for the transformation of xenobiotic compounds. Distinct catabolic genes are either present on mobile genetic elements, such as transposons and plasmids, or the chromosome itself that facilitates horizontal gene transfer and enhances the rapid microbial transformation of toxic xenobiotic chemical compounds. Both natural and anthropogenic activities result in the accumulation of wide ranges of toxic xenobiotic compounds in the environment, causing a global concern. Bacteria, fungi, and actinomycetes are the main transformers and pesticide degraders. They generally biotransform pesticides and other xenobiotics by introducing minor chemical structural changes to the molecule, rendering them nontoxic. Several bacterial genera are adapted to grow in pesticide contaminated

soils. These microorganisms have enzymes involved in the hydrolysis of P-O, P-F, P-S, C-Cl, P-C, and other chemical bonds, which are found in a wide variety of chemical pesticides. Most of the genes responsible for catabolic degradation are located on the chromosomes, but in a few cases, these genes are found in plasmids or transposons. The recent advances in metagenomics and whole genome sequencing have opened up new avenues for searching the novel pollutant degradative genes and their regulatory elements from both culturable and nonculturable microorganisms from the environment. Microorganisms respond differently to various kinds of stresses and gain fitness in the polluted environment. This process can be accelerated by applying genetic engineering techniques. The recombinant DNA and other molecular biological techniques have enabled amplification; disruption, and/or modification of the targeted genes that encode the enzymes in the metabolic pathways; minimization of pathway bottlenecks; enhancement of redox and energy generation; and recruiting heterologous genes to give new characteristics.

Key Words: Accelerated biodegradation, Bacterial bioremediation, Recalcitrant compounds, Xenobiotic pesticides, Lake Naivasha

iCB 2021-22

Baobab (*Adansonia digitata* L.) Population Structure across different Agro-ecological Zones in Coastal and lower Eastern Kenya

Orina, J., Mukundi, J.B., Adimo, A.O., Rimberia, F.K., Omondi, M.A., Gebauer, J. and Kehlenbeck, K. 2021. *Forests, Trees and Livelihoods*, 30(1), 13-27

Abstract

Baobab (*Adansonia digitata* L.) is a multipurpose wild fruit tree of sub-Saharan Africa with unknown population demographic stability. This study assessed the baobab population structure in two main growing regions of Kenya where thirty-five plots (0.5 × 3 km each) were set in two transects, along road C107 in the coastal region and B9 in the lower Eastern Kenya, covering different agro-ecological zones (AEZs). For all baobabs within a plot, position, height and diameter at breast height (DBH) were recorded, stem densities calculated and DBH size-class distribution (SCD) curves developed. In total, 599 and 1351 baobab trees were recorded in the 14 and 21 plots in the Coastal and lower Eastern regions, respectively with densities of 0.285 (±0.07 S.E.) and 0.429 (±0.07 S.E.) stems/ha, respectively. The rather dry AEZ “Lower Midland 5” had a significantly higher density of mature ($p = .047$) and total trees ($p = .028$) than the other zones. However, at regional level (coast versus eastern), there were no significant differences in the densities of juvenile, mature or total baobab trees. Negative SCD slopes obtained in the two regions indicated more trees in the smaller size classes and hence good recruitment. The results indicated stable populations in general, but local communities should be encouraged to maintain existing trees and promote the establishment of young baobabs.

Key Words: *Adansonia digitata* L., agro-ecological zone, diameter at breast height, population stability, recruitment, size-class distribution, stem densities

iCB 2021- 23

Growth and Biochemical Response of Nile Tilapia (*Oreochromis niloticus*) to Spirulina (*Arthrospira platensis*) Enhanced Aquaponic System

Siringi, J.O., Turoop, L. and Njonge, F., 2021. *Aquaculture*, 544, 737134.

Abstract

Experiments were conducted to examine growth performance and biochemical response of Nile tilapia (*Oreochromis niloticus*) to spirulina (*Arthrospira platensis*) enhanced aquaponic system. Fingerlings of *O. niloticus*, with an average initial weight and total length (TL) of 3.90 ± 0.015 g and 64.04 ± 0.18 mm (Mean \pm SD) respectively were randomly distributed into four treatments and replicated four times. The treatments were four diets containing 0, 4.0, 8.0 and 12.0 g spirulina/kg of the basal diet of 30.4% Crude Protein (CP). The effect of spirulina enhanced aquaponic system on growth, feed utilization, haematological parameters and whole-body composition of *O. niloticus* was determined. A one-way analysis of variance (ANOVA) was used to determine the treatment effect and whenever the effects of the treatments were significant ($p \leq 0.05$) means were compared using Turkey's test. Polynomial Contrasts were further used to determine the linear, quadratic and cubic effects of spirulina levels on *O. niloticus*.

Polynomial contrasts analysis showed that the cubic trend for final total weight (FTW), gain in weight, final total length (FTL), specific growth rate (SGR), feed conversion ratio (FCR) and protein efficiency (PE) were significantly ($p < 0.05$) increased by inclusion of 8 g of spirulina/kg in the fish diet. The final crude protein (FCP), lipid (FL) and ash (FA) were significantly higher ($p < 0.05$) at 8 g of spirulina/kg. The contrasts analysis showed significant ($p < 0.05$) linear increment for final blood glucose (FBG), final red blood cells (FRBC), final white blood cells (IWBC) and final hematocrit (IH) content of *O. niloticus*. The results of the present study indicate the potential of the use of spirulina in promoting growth, feed utilization, and haematological parameters of *O. niloticus*.

Key Words: Aquaponic, Spirulina, *Oreochromis niloticus*, Haematological parameters

iCB 2021-24

Current Occurrence and Management Options for Bacterial Wilt Caused by *Ralstonia solanacearum* in African Nightshade Kenya

Njau, N., Turoop, L. and Mwangi, K.L.M. 2021. *Asian Journal of Management Sciences & Education* 10(1), 51-66

Abstract

Ralstonia solanacearum is responsible for bacterial wilt epidemics in a wide range of cultivated crops including solanaceae, bananas, and geraniums among others. The pathogen has the ability to thrive in wide temperature ranges enabling a wide geographical distribution but tends to be aggressive in warm and humid regions. Climatic conditions in Sub-saharan Africa are optimal for the pathogen multiplication. *R. solanacearum* is capable of surviving for long periods in soil, crop residues and irrigation water owing to its great metabolic adaptability. Indigenous vegetables form an important component in people's diets. African nightshades are solanaceous crops and are among the most popular indigenous vegetables. Their production is threatened by the devastating bacterial wilt pathogen *R. solanacearum*. Nightshades are important in food security and are a rich source of vitamins, micronutrients and roughage. Initially the vegetable was consumed by the rural poor but its popularity has risen due to its multiple health benefits. They also possess phytochemicals such

as antioxidants, one of the body's defense compound against diseases. African nightshades are vital in curbing hidden hunger especially among vulnerable communities. A survey was done in selected areas in Kenya to determine the current status of the pathogen in African Nightshade farms. *R. solanacearum* affecting African nightshades was confirmed in various parts Western, Central and Rift valley regions. Several management options have been used including use of chemicals as fumigants and amendments, solarization, biological control with the aim of reducing the population. However, no single control method has been completely successful. The aim of this paper is to give insights to the current status of bacterial wilt and the current management options against bacterial wilt in African Nightshades in Kenya.

Key Words: *Ralstonia solanacearum*, African Nightshade, Management

iCB 2021-25

Regulatory Influences of Methyl Jasmonate and Calcium Chloride on Chilling Injury of Banana Fruit during Cold Storage and Ripening

Elbagoury, M.M., Turoop, L., Runo, S. and Sila, D.N. 2021. *Food Science & Nutrition*, 9(2), 929-942

Abstract

Fruit quality is preserved through cold storage, but climacteric fruits are prone to chilling injury (CI) which limits their shelf life and marketability. Two postharvest treatments, 1 mM methyl jasmonate (MeJA) and 4% (wt/vol) calcium chloride (Ca^{2+}), were separately used to investigate their influences on chilling injury (CI) incidence and fruit quality in unpacked banana cultivar "Grand Nain" during cold storage and subsequent ripening. Banana fruits were dipped for 2 min in aqueous emulsions containing 1% Tween-80—used here as a surfactant with untreated fruits being used as control. Fruits were stored at 10 ± 2 or optimal $14 \pm 2^\circ\text{C}$ temperature and relative humidity 85%–90% for a 20-day cold storage period and then removed from cold storage at 5, 10, 15, and 20 days followed by ripening at $22 \pm 2^\circ\text{C}$. Treatments with MeJA or Ca^{2+} significantly reduced CI in banana fruit during cold storage and subsequent ripening temperature. Untreated controls exhibited increased CI, weight loss, and decreased hue angle, as well as firmness. In contrast, the aforementioned changes were considerably delayed after treatments with MeJA or Ca^{2+} . Application of MeJA or Ca^{2+} also increased total phenolic compound contents and maintenance of total antioxidant activity throughout cold storage and during ripening periods as compare to that of the control. These findings indicate that coating bananas with 1 mM MeJA or 4% (wt/vol) Ca^{2+} can improve the postharvest quality and shelf life of fruits, and it can ameliorate chilling injury during cold storage and at ripening temperature.

Key Words: antioxidant activity, chilling injury, firmness, phenolic compounds, storage temperatures

iCB 2021-26

Socio-economic Determinants of Production and Consumption of African Indigenous Vegetables in Kakuma Refugee Camp and Kakuma Town, Kenya

Kahara, S., Turoop, L. and Majiwa, E. 2021. *Scientific Research Journal* 9(6), 11-33

Abstract

African Indigenous Vegetables remain important in the food system due to their relative importance in providing nutritious food for the rural and urban population. AIVs contain high micronutrients such as carotene, iron, calcium, magnesium and vitamins important for proper body functioning hence contributing to food security and nutrition especially in resource-poor households. AIVs have low input requirements and can adapt to many agro-ecological zones. Despite their importance, the production and consumption of AIVs are progressively declining in Kenya. Further, AIVs remain less exploited, especially in the arid and semi-arid areas. It is on this backdrop that this study assessed the socio-economic determinants of production and utilization of AIVs in the Kakuma refugee camp and its environs. Using a descriptive survey design, the study collected data from 172 farmers from Kakuma Refugee Camp and Kakuma Town. Both descriptive and inferential statistical analyses were used to obtain frequencies, mean, chi-square test and a linear regression model to assess socio-economic determinants of production and consumption of AIVs. The results indicated that the main AIVs produced and consumed in Kakuma town and refugee camp were Amaranths, Cowpea and Jute mallow. The country of origin, marital status and age of the household head significantly influenced the production of AIVs. Further, land ownership, communal farming and awareness creation by self-help groups and preferences of AIVs to exotic vegetables had a significant relationship with the production and consumption of AIVs. Income generation was a motivating factor for producing AIVs. Since age and the country of origin influenced the production and consumption of AIVs, the study recommends that there is a need for people to adopt a culture of producing and consuming more AIVs to promote production of AIVs.

Key Words: African Indigenous Vegetables (AIVs), production, consumption, Kakuma

iCB 2021-27

Physico-chemical Properties of Kernel from Coconut (*Cocos nucifera* L.) Varieties grown at the Kenyan Coast

Adoyo, G.O., Sila, D.N. and Onyango, A.N. 2021. African Journal of Food Science, 15(8), 313-321

Abstract

The coconut tree (*Cocos nucifera*) is widely referred as the “tree of life” for its important role in the livelihoods of 10 million persons from over 90 countries globally. In Kenya, the coconut sub-sector is valued at KES 25 billion, yet only 65% is utilised, which is partly contributed by insufficient knowledge of the coconut’s physico-chemical features and investment in the sector. Physico-chemical analysis of four coconut varieties’ kernel grown in two counties (Kilifi and Kwale) of Kenya was carried out. Based on the de-husked coconut fruit, coconut kernel was the highest component (46.58 - 48.70%) in comparison to shell (25.93±0.72% - 28.46±0.29%) and water (23.75±1.07% - 27.11±1.49%) across the varieties. The colour of the coconut kernel was marked by generally high L* values (85.34 - 93.35) and low a* (0.51 - 0.81) and b* (1.53 - 2.20) values among the varieties confirming the milky- white colouration of the kernel. All the varieties contained high crude fat (35.01±1.0 - 38.28±1.09%) content. Fatty acid analysis profile revealed that lauric acid (45.91- 50.72%) was the predominant fatty acid. Most of the oil extract was saturated (91%) but comprising of middle chain fatty acids. This indicates stability for storage and suitability for use in ketogenic diets.

Key Words: coconut kernel, coconut variety, colour, proximate analysis, fatty acid profile.

iCB 2021-28

Effect of Temperature, Storage Containers and Improved Hygiene on Microbial Safety and Chemical Quality of Traditional Meat Products

Dabasso, B.G., Makokha, A.O., Onyango, A.N., Mathara, J.M. and Badake, Q.D. 2021. *European Journal of Agriculture and Food Sciences*, 3(4), 71-77.

Abstract

Preservation of meat and meat products is important due to its short shelf life and perishability. The pastoralists of Northern Kenya processed and preserved traditional meat products for consumption. The traditional meat products are relished food both for nutritional and cultural heritage among the Borana pastoralists. The study was carried out to assess the microbial safety and chemical quality of traditional meat products. The samples were collected immediately after processing and transported in a cool box to the food laboratory for microbial analysis and determination of changes related to lipid oxidation during storage for seven weeks at ambient temperature and at refrigerated temperature (5 °C). Microbiological quality of the samples was assessed by Total Viable Count (TVC), *Escherichia coli* count, *Staphylococcus aureus* count and yeast and mold count. Result showed that *Staphylococcus aureus*, yeasts and molds were detected in the products and there was increase of *Staphylococcus aureus* count from (1.44 log₁₀ CFU/g) to (2.28 log₁₀ CFU/g) during storage at ambient temperature for seven weeks. Samples stored at refrigerated 5°C showed less counts of microbial load. The peroxide value, acid value and thiobarbituric acid levels were below the value associated with meat spoilage during the expected shelf life. Reduction of moisture during drying of traditional meat products and cooking of meat at high temperature contributed towards reduction of microbial load. However, poor handling and post contamination may lead to poor microbial quality of traditional meat products.

Key Words: meat products, microbial, quality, safety, traditional

iCB 2021-29

Does Lysine Drive the Conversion of Fatty Acid Hydroperoxides to Aldehydes and Alkyl-furans?

Wanjala, G.W., Onyango, A.N., Abuga, D., Onyango, C. and Makayoto, M., 2021. *Scientific African*, 12, e00797

Abstract

During the oxidation of lipids in food or *in vivo*, fatty acids are initially converted to hydroperoxides, which undergo decomposition to various secondary decomposition products, including aldehydes and alkyl-furans. Aldehydes and alkyl-furans reduce the sensory quality of food by contributing to rancidity, and aldehydes reduce nutritional value by reacting with some essential nutrients such as lysine and thiamine. *In vivo*, reactions of aldehyde with proteins and DNA contribute to the pathogenesis of physiological disorders. Conversion of fatty acid hydroperoxides to aldehydes is generally believed to involve free radical reactions. However, it was recently hypothesized that lysine can catalyze the non-radical conversion of hydroperoxides to aldehydes. Thus the aim of the present study was to determine such lysine-catalysed conversion of linoleic acid hydroperoxides to aldehydic products. Linoleic acid hydroperoxides were prepared by the photosensitized oxidation

of linoleic acid. The mixture of hydroperoxides was reacted with lysine, in the presence of a radical scavenger, and the organic fraction analysed by gas chromatography-mass spectrometry (GC-MS). Hexanal was detected as a major aldehydic product. The alkylfuran, 2-pentylfuran was also surprisingly detected under these conditions, and a pathway for its lysine-catalysed formation via the highly cytotoxic aldehyde, 4-hydroxy-2-nonenal proposed. The results of this study imply that, in the prevention of lipid oxidation-associated food deterioration and development of physiological disorders, more attention should be paid to pathways not involving free radical reactions, and which cannot be prevented by radical scavenging antioxidants.

Key Words: Lipid oxidation, Bioactive aldehydes, Dioxetane, Singlet oxygen

iCB 2021-30

Analysis of β -amylase Gene ($Amy\beta$) Variation reveals Allele Association with Low Enzyme Activity and Increased Firmness in Cooked Sweetpotato (*Ipomoea batatas*) from East Africa

Banda, L., Kyallo, M., Entfellner, J.B.D., Moyo, M., Swanckaert, J., Mwanga, R.O., Onyango, A., Magiri, E., Gemenet, D.C., Yao, N. and Pelle, R., 2021. *Journal of Agriculture and Food Research*, 4, 100121

Abstract

β -amylase is a thermostable enzyme that hydrolyses starch during cooking of sweetpotato (*Ipomoea batatas*) storage roots, thereby influencing eating quality. Its activity is known to vary amongst genotypes but the genetic diversity of the beta-amylase gene ($Amy\beta$) is not well studied. $Amy\beta$ has a highly conserved region between exon V and VI, forming part of the enzyme's active site. To determine the gene diversity, a 2.3 kb fragment, including the conserved region of the $Amy\beta$ gene was sequenced from 25 sweetpotato genotypes. The effect of sequence variation on gene expression, enzyme activity, and firmness in cooked roots was determined. Six genotypes carrying several SNPs within exon V, linked with an AT or ATGATA insertion in intron V were unique and clustered together. The genotypes also shared an A336E substitution in the amino acid sequence, eight residues upstream of a substrate-binding Thr344. The genotypes carrying this allele exhibited low gene expression and low enzyme activity. Enzyme activity was negatively correlated with firmness ($R = -0.42$) in cooked roots. This is the first report of such an allele, associated with low enzyme activity. These results suggest that genetic variation within the $AmyB$ locus can be utilized to develop markers for firmness in sweetpotato breeding.

Key Words: Beta-amylase, Nucleotide variation, Sweetpotato, Orange-fleshed, Texture, Optimal cooking time

iCB 2021-31

Lipid Peroxidation as a Link between Unhealthy Diets and the Metabolic Syndrome

Onyango, A.N. 2021. IntechOpen, DOI: 10.5772/intechopen.98183

Abstract

Unhealthy diets, such as those high in saturated fat and sugar accelerate the development of non-communicable diseases. The metabolic syndrome is a conglomeration of disorders such as abdominal obesity, hypertension, impaired glucose regulation and dyslipidemia, which increases

the risk for diabetes and cardiovascular disease. The prevalence of the metabolic syndrome is increasing globally, and dietary interventions may help to reverse this trend. A good understanding of its pathophysiological mechanisms is needed for the proper design of such interventions. This chapter discusses how lipid peroxidation is associated with the development of this syndrome, mainly through the formation of bioactive aldehydes, such as 4-hydroxy-2-nonenal, malondialdehyde, acrolein and glyoxal, which modify biomolecules to induce cellular dysfunction, including the enhancement of oxidative stress and inflammatory signaling. It gives a current understanding of the mechanisms of formation of these aldehydes and how dietary components such as saturated fatty acids promote oxidative stress, leading to lipid oxidation. It also outlines mechanisms, apart from free radical scavenging and singlet oxygen quenching, by which various dietary constituents prevent oxidative stress and lipid oxidation in vivo.

Key Words: Oxidative stress, lipid peroxidation, insulin resistance, metabolic syndrome

iCB 2021-32

Application of Wedge Fracture Test for Texture Analysis in Boiled Sweetpotato (*Ipomoea batatas*)

Banda, L., Moyo, M., Nakitto, M., Swanckaert, J., Onyango, A., Magiri, E., McDougall, G., Ducreux, L., Taylor, M. and Muzhingi, T., 2021. *African Journal of Food Science*, 15(4), 145-151.

Abstract

Several instrumental texture analysis methods have been developed for use in sweetpotato. However, there are very few reports on the use of the wedge fracture test. The purpose of the study was to develop a texture analysis method using a wedge fracture and evaluate its performance against compression test in assessing sweetpotato varieties with different cooking times. The optimal cooking time (OCT) of five sweetpotato varieties was determined by boiling 2.5 cm³ cubes until soft. Samples for texture analysis were prepared under four conditions: 85°C for 10 and 15 min; and 95°C for 5 and 10 min. Peak positive force (firmness) and total work done (toughness) were determined using the wedge fracture texture analysis. The correlation between the OCT and texture measurements was evaluated, and samples incubated at 85°C for 15 min had the highest correlation with OCT ($R^2 = 0.725$). Using this heat treatment, texture measurements from the wedge fracture were compared to those obtained from a compression test. The wedge fracture test gave significant discrimination of sweetpotato varieties ($p \leq 0.05$) while the compression test did not. The wedge fracture test is thus recommended for determining the instrumental firmness of boiled sweetpotato varieties with different cooking times.

Key Words: Texture, wedge fracture test, orange-fleshed sweetpotato, optimal cooking time

iCB 2021-33

From Farm to Fork: Crickets as Alternative Source of Protein, Minerals, and Vitamins

Murugu, D.K., Onyango, A.N., Ndiritu, A.K., Osuga, I.M., Xavier, C., Nakimbugwe, D. and Tanga, C.M. 2021. *Frontiers in Nutrition*, 505.

Abstract

Globally, there is growing interest to integrate cricket-based ingredients (flour) into food products to combat food and nutrition insecurity. However, there is lack of information on in-depth nutrient profile of the two cricket species (*Scapsipedus icipe* and *Gryllus bimaculatus*), which are the most widely consumed in Africa. Here we determined the nutrient composition of two cricket species and compared them with published records of key animal and plant sources. Our results revealed that the crude protein contents of *S. icipe* and *G. bimaculatus* were similar (56.8 and 56.9%, respectively) and comparable to those of animal protein sources. Both cricket species had balanced amino acid profiles that are superior to that of animal and plant sources, except for histidine and cysteine. The protein digestibility of *S. icipe* and *G. bimaculatus* ranged between 80 and 88%, which is comparable to that of common plant foods but slightly lower than that of animal proteins. The iron, Zinc, and potassium contents were considerably higher in both cricket species compared to that of plant and animal sources. The calcium contents of both crickets (*S. icipe* and *G. bimaculatus*) was superior to that of plant and animal origin except for kidney beans and eggs, respectively. Riboflavin, thiamine, and folic acid concentrations of *S. icipe* and *G. bimaculatus* were superior to that of the conventional sources. Vitamin A levels were significantly higher in *S. icipe* compared to *G. bimaculatus*. This implies that *S. icipe* and *G. bimaculatus* can adequately contribute to our daily required nutrient intake. Thus, integrating cricket flours into ready-to-eat food products would address some of the most pressing nutritional deficiency challenges that many developing countries have to grapple with, particularly high risk to serious health problems such as anemia, poor pregnancy outcomes, hypertension, increased risk of morbidity and mortality, stunted growth and impaired physical and cognitive development. We conclude that edible crickets present unique opportunities for improving food and nutritional insecurity status of both resource-poor and Western populations.

Key Words: edible crickets, *Scapsipedus icipe*, *Gryllus bimaculatus*, nutrient quality, recommended nutrient intake, human food

iCB 2021-34

Nutrients Content and Antioxidant Potential of Selected Traditional Vegetables Grown in Malawi

Issa, J.Y., Onyango, A., Makokha, A. and Okoth, J. 2021. *Journal of Agricultural Studies*, 9(2), 406-420

Abstract

Vegetables provide nutrients, especially minerals and vitamins, and non-nutrient phytochemicals with health benefits. Iron, zinc and vitamin A deficiencies are common in most developing countries yet traditional vegetables that can provide these nutrients grow wild in most areas. This study evaluated the nutrient contents, phytochemicals and the 2,2-diphenyl-1-picryl hydrazyl (DPPH) radical scavenging activities of five traditional leafy vegetables grown in Malawi, namely *Amaranth hybridus* (*Amaranth* ssp.), *Moringa oleifera* (Drum stick), *Bidens pilosa* (Black jack), *Corchorus oltorius* (Jute mallow) and *Ipomea batatas* (Sweet potato) leaves. Results from the present study show that beta-carotene ranged from 829.68 $\hat{\mu}$ g/100g to 5,791.64 $\hat{\mu}$ g/100g and *Moringa oleifera* had the highest concentration. Vitamin C content ranged from 7.93 mg/100g to 35.81 mg/100g and

Ipomea batatas leaves had the highest concentration. Zinc concentrations ranged from 4.42 mg/100g to 10.59 mg/100g. Iron content ranged from 37.22 mg/100g to 48.21 mg/100g. Total phenolics content (TPC) ranged from 0.98 g/100g to 3.89 g/100g with *Bidens pilosa* leaves having the highest TPC (3.89 $\hat{\pm}$ 0.23 g/100g). *Moringa oleifera* and *Bidens pilosa* leaves had significantly higher (P<0.05) total flavonoids content (TFC) compared to the other vegetables. Total carotenoids content (TCC) ranged from 1,708.68 $\hat{\mu}$ g/100g to 15,041.59 $\hat{\mu}$ g/100g. Tannins content ranged from 42.94 mg/100g to 77.16 mg/100g. DPPH radical scavenging activities of the vegetable leaves were in the order of *Bidens pilosa* > *Corchorus olitorius* > *Moringa oleifera* > *Ipomea batatas* > *Amaranth hybridus*. The 50% inhibitory concentration (IC₅₀) values of these vegetables ranged from 12.5 $\hat{\mu}$ g/mL to 125 $\hat{\mu}$ g/mL. Lower IC₅₀ values indicate higher radical scavenging activity. The results suggested that the traditional vegetables under the study can significantly contribute to improved human nutrition and have potential to reduce diseases related to oxidative stress.

Key Words: DPPH radical scavenging activity, nutritional profiles, phytochemicals, vegetables

iCB 2021-35

Quality and Sensory Properties of Instant Fried Noodles made with Soybean and Carrot Pomace Flour

Chepkosgei, T.M. and Orina, I. 2021. *African Journal of Food Science*, 15(3), 92-99.

Abstract

Wheat flour commonly used in making noodles is rich in starch but poor in protein and fiber. Wheat flour substituted with soybean and carrot pomace flours were used to produce instant fried noodles. Soybean is high in protein while carrot pomace is rich in dietary fiber. The aim of this study was to evaluate the effect of substituting wheat flour with soybean and carrot pomace flour on the physicochemical, cooking and sensory properties of instant fried noodles. Four flour blends in ratios of 100:0:0, 80:15:5, 70:20:10, 60:25:15 wheat, soybean and carrot pomace flour respectively were prepared. The results indicated a significant difference (P<0.05) in protein and crude fiber content of the noodles made from the flour blends. The cooking loss and water absorption increased with increase in the amount of substituted soybean and carrot pomace flour. There was no significant difference in the tensile strength among noodles. However, breaking length of the noodles decreased with increase in replacement of soybean and carrot pomace flour. The noodles decreased in brightness with increased carrot pomace substitution. Noodles made from 80% wheat flour, 15% soybean flour and 5% carrot pomace were the most preferred by the sensory panelist. Incorporation of soybean flour and carrot pomace flour improved the nutritional quality and sensory attributes of the instant fried noodles.

Key Words: Instant fried noodles, carrot pomace flour, soybean flour.

iCB 2021-36

Physico-Chemical Properties of Selected Irish Potato Varieties Grown in Kenya

Gikundi, E.N., Sila, D.N., Orina, I.N. and Buzera, A.K. 2021. *African Journal of Food Science*, 15(1), 10-19.

Abstract

Potatoes have attracted great interest as a feasible solution to food insecurity and climate change in Kenya. Many varieties have been developed but their nutritional value and suitability for domestic and industrial use are not sufficiently studied. A comparative study of physical attributes (tuber weight, size, shape, eye depth and number, specific gravity, colour) and nutrient composition (proximate, minerals, vitamins, and simple sugars) of three varieties (Unica, Shangi and Dutch robjin) were evaluated using standard methods. Shangi and Unica had lengths above 50 mm recommended for French fry processing, but had deep eyes (1.54-2.98 mm). Unica had a red skin colour while Shangi was yellow. Both varieties had yellow coloured flesh. The specific gravity of the varieties ranged from 1.08-1.12. Shangi and Unica were suitable for processing based on their physical attributes except for eye-depths. Dutch robjin had the highest content of protein (1.76%), carbohydrates (20.43%), total ash (1.10%), crude fibre (1.11%), iron (0.87 mg/100 g), thiamine (0.036 mg/100 g), niacin (0.93 mg/100 g), pyridoxine (1.92 mg/100 g) and folic acid (34.62 µg/100 g). Unica had the highest zinc (0.41 mg/100 g) and calcium (8.51 mg/100 g) contents. Reducing sugar content across the three varieties was within recommended range for processing (97.75-107.53 mg/100 g). There was a significant ($p<0.05$) varietal difference in most of the nutrient components. Dutch Robjin showed the best nutritional quality.

Key Words: Potato quality, *Solanum tuberosum* L., physical characteristics, nutrient content, food composition.

iCB 2021-37

Porcine Cell Line for Virus Production

Jordan, I., Sandig, V., Horn, D. and John, K. 2021. US Patent 11,060,069

Abstract

The present invention relates to a continuous porcine cell line that is capable of proliferating in medium free of animal - derived components. Further, the present invention relates to a method for producing a virus using said cell line and a virus obtainable by said method. Furthermore, the present invention relates to a method for accumulating a virus from an environmental sample using said cell line and a virus obtainable by said method.

iCB 2021-38

Schistosoma mansoni and Soil Transmitted Helminths in Olive Baboons and Potential Zoonosis

Fredrick, M., Danson, M., John, K., Stanislaus, K., David, N., Maina, N., Michael, G., Suleiman, M. and Mercy, A. 2021. *Veterinary Medicine and Science*, 2021(7), 2026–2031

Abstract

Zoonotic pathogens are among the most important causes of ill health all over the world. The presence of these pathogens in free ranging baboons may have significant implications for humans. In Kenya, the encroachment of wildlife habitats has led to increased interaction between humans and wildlife especially non-human primates. The current study therefore aimed at investigating any possible zoonotic gastrointestinal helminths of olive baboons (*Papio anubis*) at the human–wildlife

interface in two park borders and a ranch in Kenya, namely, Tsavo West National Park, Tana River Primate Reserve and Mutara Ranch, Laikipia, Kenya. One hundred and forty-seven baboons were used in the study. They were trapped in the wild, sampled for stool marked and then released back to the wild. Gastrointestinal (GIT) helminths identified were *Strongyloides*, *Oesophagostomum*, *Enterobius* spp and *Trichuris Trichiura* from all the three sites while *Schistosoma mansoni* was only detected from Tsavo baboons and with very low incidence (2.1%). The prevalence of these parasites varied among the sites but significant difference in prevalence was only noted in *Strongyloides* and *Oesophagostomum* ($p < 0.05$) among the three sites. This therefore implies that even with control measures instituted on the human population, baboons will always be a source of zoonotic GIT helminths especially *S. mansoni* even if the incidence are low. There is need to put in place measures aiming to reduce their interactions with humans and also try to control these infections in the baboons.

Key Words: baboon, Schistosomiasis, Zoonoses

iCB 2021- 39

Occurrence of Beta-Lactamases Genes in Beta-Lactam Resistant Bacteria Isolated from Milk of Goats with Sub-Clinical Mastitis in Thika Sub-County, Kenya

Okoko, I.M., Kagira, J., Kiboi, D. and Maina, N. 2021. *World*, 11(1), 37-44.

Abstract

For decades, beta-lactam antibiotics have played a critical role in the control of mastitis in animals. However, the emergence of beta-lactam-resistant bacteria poses a challenge to both human and veterinary medicine. In this regard, bacterial isolates from milk samples collected from dairy goats with sub-clinical mastitis from Thika Sub-county, Kenya, were used in the current study to interrogate the occurrence of beta-lactamases genes in bacterial isolates (*Klebsiella pneumoniae*, *Staphylococcus aureus*, and *Acinetobacter* spp., and Coagulase-negative *Staphylococci*) with known phenotypic resistance profiles to penicillin G, cephalexin, cefoxitin, and cefotaxime. Four target genes, bla_{TEM}, bla_{SHV}, bla_{CTX}, bla_{OXA}, and bla_{KPC} were amplified using a polymerase chain reaction, and compared with *Escherichia coli* American Type Culture Collection 35218 and non-standard *Klebsiella pneumonia* positive controls. Out of the 46 samples, 44 samples (95.7%) harbored bla_{TEM} with two samples of the 44 bacterial isolates, also possessing the bla_{SHV} gene. Only one isolate of *Klebsiella pneumonia* and *Acinetobacter* spp had a combination of bla_{TEM} and bla_{SHV}. None of the bacteria had bla_{CTX}, bla_{OXA}, and bla_{KPC} genes. The data indicated that sub-clinical mastitis in dairy goats in Thika Sub-county is associated with the bacteria carrying beta-lactamases genes, suggesting that the use of beta-lactam antibiotics for the treatment of sub-clinical mastitis may result in the treatment failure and potential transfer of the infectious bacteria to humans and other animals. The current study recommends the use of an alternative class of antibiotics for the management of beta-lactam-resistant bacteria.

Key Words: Bacteria, Beta-lactam resistance, Beta-lactamases, Sub-clinical mastitis

iCB 2021-40

Apparent Digestibility and Gut Integrity of Chicken Fed a Diet Supplemented with African Safou (*Dacryodes edulis*)

Tangomo, A.N., Gicheha, M.G., Kagira, J.M. and Tiambo, C.K. 2021. *International Journal of Poultry Science*, 20: 13-26. DOI: 10.3923/ijps.2021.13.26

Abstract

Background and Objective: In the present study, which is the second in a series of three publications on a project aimed at evaluating the efficacy and safety of utilizing African Safou (*Dacryodes edulis*) in poultry feeds as an additive, the goal was to determine the apparent digestibility and gut integrity of chicken fed a diet supplemented with *Dacryodes edulis* parts. The first paper explored the impact of the plant parts on growth traits, ceca microbiota and blood parameters in dual-purpose indigenous chicken. **Materials and Methods:** In the current study, a total of 288 male dual-purpose indigenous chicken were fed six experimental diets. The diets differed in terms of the *D. edulis* part that was included plus its inclusion level. Data on the growth performance of the chicken fed the experimental diets were compared to chicken fed a positive (T+) and a negative (T-) control diet. The chickens were fed the diets for a period of 14 weeks. The apparent digestibility variability of various nutrients and gut morphometric variables were measured using standard methods. Data were collected and analyzed. **Results:** All the experimental diets improved the apparent digestibility of metabolizable energy (AME), dry matter (DM), fat, crude protein (CP), crude fiber (CF) and calcium. Conversely, the values for zinc, magnesium and phosphorus were negative. The AME, DM content and fat digestibility differed significantly between and among treatment diets. The gut morphometric variables were not significantly different across the treatment groups. **Conclusion:** The findings obtained in this study showed that parts of *D. edulis* plant positively impacted the apparent digestibility of the feed.

iCB 2021-41

Landscape Genomics and Selection Signatures of Local Adaptation of Eritrean Indigenous Cattle along Environmental Gradients

Goitom, S., Gicheha, M.G., Njonge, F.K. and Kiplangat, N. 2021. *Tropical Animal Health and Production*, 53(423), 1-8. <https://doi.org/10.1007/s11250-021-02837-6>

Abstract

Most parts of Eritrea are classified as arid and semi-arid land (ASALs) which are characterised by dryness, high ambient temperatures and low precipitation. The country has three different environmental landscapes: highland, Western lowland and Eastern lowland agro-ecological zones (AEZs). The geophysical and biophysical characteristics of the AEZs vary. Indigenous cattle which are mainly kept in extensive production system have to cope with the adverse climatic conditions of these AEZs. They have to adapt to the harsh climate, poor feed quality and endemic diseases and parasites and reproduction challenges in the AEZs. The underlying genetic basis of the indigenous cattle adaption to the specific AEZs in Eritrea is limited. In this study, it is hypothesized that the indigenous cattle have evolved and developed unique adaptive characteristics because of being reared in specific ecological landscapes. This was tested using the landscape genomics and analysis of selection signatures to ascertain the genetic basis of their adaptability to the nutritional and

environmental constraints that characterise the AEZ conditions. The study was carried out in three different environmental landscapes: highland, Eastern lowland and Western lowland AEZs. Blood samples were collected from a total of 188 indigenous cattle populations sampled from the three AEZs. DNA was extracted and genotyped using the genotype by sequencing (GBS) method. Analysis revealed the existence of medium to high genetic diversity between and within the indigenous cattle populations. Scanning of selection signatures revealed genomic regions under positive selection. The regions harboured genes (IFNAR2, CASR, AHSR, ATP1B3, AIRE, ROBO2, SCHIP1 and PARS2) of importance for facial morphology, locomotion, mineral homeostasis, immune system and skeletal and muscle system development. Findings pointed out the influence of AEZ landscapes on the genetic differentiation of indigenous cattle appearances probably due to selection driven by diverse climatic and biophysical conditions. The differentiation is orientated towards adaptive characteristics.

Key Words: Adaptive, Geographical barriers, Isolation by distance, Single-nucleotide polymorphisms

iCB 2021-42

The Effects of Heat Stress on Production, Reproduction, Health in Chicken and its Dietary Amelioration

Gicheha, M.G. 2021. In *Advances in Poultry Nutrition Research*, 189-203, IntechOpen. DOI: <http://dx.doi.org/10.5772/intechopen.97284>

Abstract

Farm profitability is the key driver of most livestock enterprises. The productivity and profitability are driven by genetic potential of the animals and the ability to express the superiority in the production environment. In an ideal situation, an animal should produce maximally as dictated by the genetic potential. It is noteworthy that the environment in which an animal lives in impacts on its ability to expose its genetic potential. Studies have shown that it is rarely feasible to provide animals with ideal conditions to express their full genetic potential. The environment in which animals are reared is characterised by many factors that interact in ways that result in different performance even in animals of similar genetic makeup. For instance, thermal environment is critical in poultry production as it affects both the production and reproduction in different ways. The thermal environment affects chicken differently depending on the stage of growth or production phase. This environment has been impacted by the climate change and subsequent increase in climatic variability resulting in thermal challenges in naturally produced chicken thus altering production and reproduction. This implies that there is need to consider thermal resource in the routine poultry management practices. This would result to design of poultry production systems responsive to the thermal environments more so in the light of climate change and the subsequent increase in climatic variability. This chapter explores the impact of heat stress on chicken production, reproduction, health and its dietary amelioration.

Key Words: Heat stress, Chicken, Production, Reproduction, Health

iCB 2021- 43

Breeding Dairy Goats for Disease Resistance is Profitable in Smallholder Production Systems

Amayi, A.A., Okeno, T.O., Gicheha, M.G. and Kahi, A.K. 2021. *Small Ruminant Research*, 197, 106337.

Abstract

We tested hypothesis that inclusion of the disease resistance indicator traits in a dairy goats' breeding goal would result to increased profitability of smallholder farmers. Deterministic simulation was used to compare responses for breeding schemes without (Scheme I) and with (Schemes II, III and IV) disease resistance in the breeding goal. Faecal egg count (FEC) and somatic cell score (SCS) were used as the indicator traits for helminthosis and mastitis in goats, respectively. We also investigated the effect of risk aversion among the smallholder farmers on response to selection. The breeding structure consisted of a two-tier closed nucleus system, with recording and genetic evaluations being undertaken in the nucleus. Breeding schemes differed on the number of traits in the selection criteria and number of records used to estimate breeding values. In Scheme I, traits in the breeding goal included milk yield (MY), live weight (LW), average daily gain (ADG), doe mature weight (DMW), number of kids weaned (NKW) and survival rate (SR). Scheme II was similar to Scheme I, but included records of FEC and SCS measured immediately after weaning and during early lactation, respectively. Scheme III was similar to II, but with additional information on SCS recorded at mid-lactation, while Scheme IV was similar to III with more SCS information recorded in late-lactation. Our findings indicate that schemes that included disease resistance indicator traits in the selection criteria (Schemes II, III and IV) were 28, 24 and 19%, respectively superior in profitability to Scheme I. Profitability for Scheme II was 3.5 and 7.6% higher than for Schemes III and IV, respectively. The response to selection was maximized when the nucleus consisted of 4–5% of the does' effective population size and 20% of them were phenotyped for SCS. High risk aversion tended to result in low profits. This suggests that use of economic values obtained using low risk aversion models could overestimate the economic worth of a breeding program especially in smallholder production systems where farmers are risk averse.

Key Words: Breeding schemes, Disease resistance, Risk aversion, Dairy goats, Smallholder systems

iCB 2021-44

Can Black Soldier Fly *Desmodium intortum* Larvae-Based Diets Enhance the Performance of Cobb500 Broiler Chickens and Smallholder Farmers' Profit in Kenya?

Mutisya, M.M., Agbodzavu, M.K., Kinyuru, J.N., Tanga, C.M., Gicheha, M., Hailu, G., Salifu, D., Khan, Z. and Niassy, S. 2021. *Poultry Science*, 100(2), 420-430.

Abstract

This study aimed to evaluate the performance of broiler chickens fed on 3 black soldier fly larvae (BSFL) (*Hermetia illucens*) and Greenleaf desmodium (*Desmodium intortum*)-based meals. We evaluated growth performance, carcass quality, and profitability under various commercial pathways (doorstep, retail, whole, and assorted). *Desmodium* and BSFL powders were formulated into 3 ratios: T1 25:75, T2 50:50, and T3 75:25. A commercial feed was used as a control. One hundred and twenty mixed-sex 1-day-old broiler chicks (Cobb) were reared in pens for 42 d in a completely randomized design. The chickens were weighed weekly to monitor their growth rate.

After the 42-day rearing period, they were slaughtered for carcass quality evaluation and recording of the weights of internal organs. During the initial growth phase (7–21 d), significant effects of fish meal replacement were found on the chickens' average weight ($P < 0.001$), average daily body weight gain ($P < 0.001$), average daily feed intake ($P < 0.001$), and feed conversion ratio ($P < 0.001$). However, during the second phase (21–42 d), no significant effect of the replacement was detected except on average daily feed intake ($P = 0.003$). No significant differences were found in terms of the relative weights of internal organs. It was found that *Desmodium*-BSFL-based feeds were more profitable than the control feed, and the assorted and retail modes of sale generated more revenue compared to when the chickens were sold at doorstep and on whole-chicken basis. The return on investment was higher for a push-pull adopter compared to a non-adopter. The study found that a BSFL-*Desmodium* mixture can be a valuable replacement for the protein component in conventional feed and would provide a new impetus for the adoption of push-pull.

Key Words: feed, insect, push-pull, smallholder-farmer

iCB 2021- 45

Behavioral Response of the Greenhouse Whitefly (*Trialeurodes vaporariorum*) to Plant Volatiles of *Ocimum basilicum* and *Tagetes minuta*

Matu, F.K., Murungi, L.K., Mohamed, S. and Deletre, E., 2021. *Chemoecology*, 31(1), 47-62. <https://doi.org/10.1007/s00049-020-00327-z>

Abstract

The use of chemical pesticides as a main pest control strategy has been highly criticised due to environmental pollution and negative effects on natural enemies of pests. In modern farming, it is essential to implement integrated pest management approaches that seek to control insect pests without causing environmental damage, e.g. the use of companion plants. Basil and Mexican marigold are often used as companion plants to attract greenhouse whiteflies, hence reducing damage to solanaceous crops, but the mechanism and role of volatile cues in crop protection strategies are unknown. This study found that both flowering basil and marigold were preferred to tomato by the greenhouse whitefly (*Trialeurodes vaporariorum*) in Y-tube olfactometer bioassays. PCA revealed that some volatiles were more correlated to one stage than to another. The dominant volatile constituents of Mexican marigold are limonene, dihydrotagetone, (Z)- β -ocimene, α -pinene, (Z)-3-hexenyl acetate, and those from basil are linalool, 1,8-cineole, eugenol and β -elemene. Among these dominant compounds, 1,8-cineole and (Z)-3-hexenyl acetate elicited strong attraction in greenhouse whitefly at 0.01%, whereas (Z)- β -ocimene and linalool elicited strong repellence at 0.1% and 1% dosages. This suggested that the basil flowering stage attraction is due to 1,8-cineole. These volatiles demonstrated potential as lures or bio-repellents and could be used in a “push–pull” semiochemical approach for greenhouse whitefly management.

Key Words: Basil, Mexican marigold, Volatiles, Y-tube olfactometer

iCB 2020-01

Characterisation of Productivity and Diseases Affecting Dairy Goats in Smallholder Systems of Greater Thika Region, Kenya

Kagucia, A.W., Kagira, J., Maina, N., Karanja, S.M. and Njunge, F.K. 2020. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, 121(2), pp.243-249.

Abstract

The current cross-sectional study aimed at characterising the productivity and diseases affecting dairy goats kept by smallholder farmers in three sub-counties in Thika Region, Kenya. Standard questionnaires were administered to 240 farmers through face-to-face interviews and the outputs were analysed using descriptive and inferential statistics. The farmers mainly kept crosses of Toggenburg (45.9 %), Kenyan Alpine (29.5 %) and Saanen (17.4 %) dairy goats. The average dairy goat flock size was 4.5 (range 1–23) and 77.5 % of the goats were kept for production of milk for domestic consumption. The average milk production per goat per day was 1.26 litres (range 0.5 to 3.5 litres) and was significantly ($p < 0:05$) associated with sub-county of origin, main occupation of the owner, breed, and lactation stages. Goats were mainly fed on napier grass, maize stovers, natural grass and hay; and these feeds did not influence ($p > 0:05$) the milk production levels. The farmers identified helminthosis (84.6 %), pneumonia (32.9 %), coccidiosis (25.8 %) and mastitis (25 %), as the most prevalent goat diseases. In conclusion, the study showed that dairy goat farming in greater Thika Region was characterised by low-input with an objective of provision of milk for home consumption. The observed challenges of low milk productivity and diseases should be addressed by the local extension workers through training on improved husbandry, nutrition and health management of the dairy goats.

Key Words: Dairy goats, milk production, feed, diseases, small ruminants

iCB 2020-02

Effect of Low Tannin Sorghum Based Feeds on Broiler Meat Nutritional Quality

Ochieng, B.A., Owino, W.O., Kinyuru, J.N., Mburu, J.N. and Gicheha, M.G. 2020. *Journal of Agriculture and Food Research*, 2, 100078.

Abstract

This study determined the meat quality characteristics of different parts of a broiler carcass obtained from chicken fed on diets formulated using either maize (*Zea mays*) or sorghum (*Sorghum bicolor*) as the source of energy. Six diets that differed on the sorghum/maize replacement levels (0%, 20%, 40%, 60%, 80% and 100%) were fed to 120-day old broiler. The chicken meat was harvested after 8 weeks and meat from different parts of the carcasses were analysed for fatty acid profile, cholesterol, vitamins A and E content. Levels of 36.37%–80.32% of saturated fatty acids were detected in different cuts. The polyunsaturated fatty acids ranged at 12.36%–29.13% while the monounsaturated fatty acids accounted for 1.46%–4.84% for all the experimental diets. The highest levels of long chain unsaturated fatty acids (18.68%–22.87%) were detected in the thigh muscle meat of chicken fed on a 0% sorghum diet. Conversely, diet that had a 100% sorghum had undetectable level of unsaturated fatty acids. The highest cholesterol content of 30.61 mg/100g was detected in the thigh muscles of chicken with 100% sorghum inclusion. The vitamin E content in the thigh meat of chicken subjected to diets high on maize content were significantly higher

($P \leq 0.01$) than those fed on high sorghum diets. Meat from chicken fed on high low tannin sorghum meals had significantly lower ($P \leq 0.01$) cholesterol content of 8.63 to 3.44 mg/100g compared to 20.10 mg/100g from diets high on maize. The present study shows that partial substitution of maize with low tannin sorghum can improve the nutritional value of broiler meat.

Key Words: Fatty acid, Cholesterol, Vitamin E, Vitamin A

iCB 2020-03

A Review on the Present Advances on Studies of Toxoplasmosis in Eastern Africa

Mose, J.M, Kagira, J.M., Kamau, D.M., Maina, N.W., Ngotho, M. and Karanja, S.M. 2020. *BioMed Research International*, 7135268, DOI: 10.1155/2020/713526

Abstract

Toxoplasmosis is a zoonotic infection caused by the protozoan parasite, *Toxoplasma gondii*. It was discovered over 100 years ago and is credited as the most successful parasitic organism worldwide, able to infect and multiply in all warm blooded animals including an estimated 2.3 billion people. Toxoplasmosis is asymptomatic in immunocompetent individuals. Infection in the developing fetus and immunocompromised individuals can cause severe clinical disease. Toxoplasmosis is also a major cause of reproductive failure in livestock. The economic impact of toxoplasmosis is believed to be substantial. Factors associated with toxoplasmosis infection have been defined. Eastern Africa region is a high-risk area mainly due to the close association of humans and livestock as well as sociocultural practices, poor environmental hygiene, and poverty. The present paper provides a narrative review of published data on toxoplasmosis in Eastern Africa.

Key Words: Gondii Antibodies, Congenital Toxoplasmosis, Addis-Ababa, Infection, Seroprevalence, Seroepidemiology, Prevalence, Animals, Kenya, Identification.

iCB 2020-04

Food Safety Knowledge and Practices of Street Food Vendors in Selected Locations within Kiambu County, Kenya

Mwove, J., Imathiu, S., Orina, I. and Karanja, P. 2020. *African Journal of Food Science* 14(6), 174-185

Abstract

The safety of street foods remains a public health concern especially in developing countries like Kenya where foodborne illnesses associated with these foods have often been reported. This study determined the food hygiene and safety knowledge and practices of 345 street food vendors (SFVs) in selected locations within Kiambu County, Kenya. Data collection was accomplished through face-to-face interviews using structured questionnaires and extensive observation using an assessment tool for observation of personal hygiene and food handling practices of SFVs and the condition of the vending environment. The results indicated that the majority of the SFVs were male (63.2%) with 38.1% of them having attained secondary school education. About 93% of the SFVs had not received any formal training on food hygiene and safety. Majority of SFVs handled food with bare hands (96.8%) or handled money while serving food without washing hands (86.1%). Few

also practiced preservation with 78.3% storing foodstuff that required refrigeration at ambient temperatures while 22.3% stored leftovers without any form of preservation and sold them the following day. Whereas public health officers' visits were found to significantly ($P < 0.0001$) motivate SFVs to obtain a food handler's medical certificate, only about 27% had obtained it. These findings suggest that street vended foods sold in this study area may pose a significant potential hazard to public health due to the poor hygiene and handling practices reported.

Key Words: Street vended food, food safety, food hygiene, public health, street food legislation.

iCB 2020-05

Multinomial Logistic Regression Analysis of Factors Influencing Food Safety, Hygiene Awareness and Practices among Street Food Vendors in Kiambu County, Kenya.

Mwove, J. Imathiu, S. Orina, I. Karanja, P. 2020. *Current Research in Nutrition and Food Science Journal*, 8(3), 988-1000. DOI: <http://dx.doi.org/10.12944/CRNFSJ.8.3.26>

Abstract

Street food vending is a very popular and unique part of the informal sector, particularly in developing countries. However, the safety of street vended foods is a major public health concern since poor food safety and hygiene knowledge and practices are often reported among street food vendors (SFVs). The objective of this study was to identify the factors influencing food safety, hygiene awareness and practices (FSHAP) among SFVs in Kiambu County, Kenya. Structured questionnaires and an observation checklist were administered to randomly selected 345 SFVs. Results showed that good food safety and hygiene awareness scores were significantly (P less than 0.05) influenced by education level, food hygiene and safety training, mobility of SFVs, public health inspection, and the category of SFVs. Public health inspection was the only factor that significantly (P less than 0.05) influenced all FSHAP score categories. Mobile vendors were 1.86 and 2.20 times more likely to have poor working conditions and poor food handling practices scores compared to those who were not mobile, respectively. Training and education level significantly (P less than 0.01 and P less than 0.05, respectively) increased food safety and hygiene awareness score whereas the duration of time in street food vending significantly (P less than 0.05) improved food handling practice score. Public health inspection of SFVs was found to be the most effective way of improving FSHAP among SFVs. The study recommends regular inspections of SFVs by public health officials to enhance compliance with food hygiene and safety standards and regulations governing the street food sector as well as scheduled training on food safety and hygiene targeting all categories of street food vendors.

Key Words: Food Hygien; Food Safety; Logistic Regression; Public Health Inspection; Street Food Vendors

iCB 2020-06

Agricultural Climate Atlas for Kajiado and Kiambu Counties, Kenya

Matsaba, E.O., van Selm, M., Wesonga, J.M., Goosen, H., Coninx, I. and Koomen, I. 2020. *Handbook of Climate Change Management: Research, Leadership, Transformation*, 1-21.

Abstract

Crop production in Kenya takes place mostly under rain-fed conditions, with weather fluctuations having a high impact on productivity. Significant changes in the climate are expected between now and the end of the century, while many smallholder farmers are ill-equipped to cope with climate-related risks. These challenges are exacerbated by the fact that agricultural investment decisions and policy aspects for systemic adaptation require long-term planning. Therefore, there is a need to know what kind of climate change to expect. A climate atlas was developed as an interactive and user-oriented tool to provide a first insight into the projected impact of climate change on the agricultural sector in Kajiado and Kiambu Counties in Kenya. The information is provided on a web-based platform and is easy to access by farmers, farmer organizations, agri-food businesses, policymakers, and investors for climate decisions and planning. The information results from downscaling global climate change models to the Kenyan context, combined with the local agricultural sector's vulnerability information. Via graphs and interactive maps, projected climate impacts are presented. The climate atlas also comprises an expert tool that allows exploration of climate impacts for a tailored situation to evaluate particular crops and/or varieties' suitability in a specific location. The climate atlas is critical for starting a dialogue on the climate challenges that affect the two counties. Results can be translated into investment portfolios for climate-proofing agribusinesses and accelerating investments due to the potential to mitigate climate-related risks.

Key Words: Adaptation, Agriculture, Climate atlas, Climate change, Expert tool, Storylines

iCB 2020-08

Climate-resilient Horticulture for Sustainable County Development in Kenya

Patrick, E.M., Koge, J., Zwarts, E., Wesonga, J.M., Atela, J.O., Tonui, C., Kilelu, C., Goosen, H., Coninx, I. and Koomen, I. 2020. Wageningen Centre for Development Innovation, Wageningen University & Research. Report WCDI-20-107/3R Research Report 010. Wageningen.

Abstract

Climate change presents one of the greatest challenges to the productivity and sustainable growth of the agricultural sector in Kenya due to extreme events such as droughts and floods as well as changes in temperature. Horticultural crops are particularly sensitive to climate change because of their high water demand and strict temperature requirements. Increased or decreased rainfall and increased temperature result in drought or flooding, lack of water for irrigation, and pests and diseases epidemic can affect the suitability of areas for growing horticultural crops. Understanding the impacts of climate for a given crop under specific conditions is key to supporting further development of the horticulture sector. While horticulture is a priority economic subsector in many counties, it is not known how the counties position themselves with regard to dealing with climate change threats in the sector. A review of the literature shows how climate change significantly affects the performance of horticultural crops across a variety of climatic zones and that counties need to be better prepared to address these effects. Horticulture covers myriad crops (including fruits and vegetables), which are affected by climate change in different ways. Seasonal patterns, both for temperature as well as (onset of) rainfall are changing. Temperature thresholds for specific crops are being exceeded, while some areas are now more favourable for growing certain crops where previously temperatures were too low. Suboptimal temperatures affect both the yield and quality of produce. The horticulture sector has also experienced incidences of pests, such as *Tuta absoluta* on

tomato; climate change is a confounding factor to the spread and establishment of these pests. Agriculture which is highly affected by climate change is devolved to counties; as such, policies relevant to it are expected to be implemented at county level. An analysis of the County Integrated Development Plans showed that horticulture is a high-value subsector that plays a major role in generating revenue for county development. Most counties have prioritized horticulture and made substantial investments. Climate change is acknowledged as a threat to different sectors, but there is only scant analysis of the factors causing it, effects it will have and proposed responses to it. Farmers and crop officers from Kiambu and Kajiado counties are aware of climate change and its effects on horticulture. However, understanding of the relationship between cause and effect and of possible mitigating actions is weak. We observed that at all levels, in the field as well as at county level, preparedness for climate change is low and government support to the farmers is also limited. Due attention and informed decision-making based on, for example the Kenya Climate Atlas that is currently being developed, is required.

iCB 2020-09

Seed Security for Vegetatively Propagated Orphaned Crops and its Implication for Household Food Security in Rural Kenya: A Case of Sweet Potato (*Ipomea batatas*)

Mwangi, C.W., Ateka, J., Mbeche, R. and Ateka, E. 2020. *Journal of Agriculture and Food Research*, 2, 100087.

Abstract

In the context of climate change and its effects, production and consumption of orphaned crops such as sweet potato has been promoted as alternative food diets in sub-Saharan Africa (SSA). However, sustainable production of these crops is hampered by poor access to seed. This paper assesses seed security among smallholder sweet potato producers in Kenya and its implications on household food security. Data for the paper were collected through a survey of 383 sweet potato producing households in Kirinyaga and Homabay Counties of Kenya. Seed security was measured through an adaptation and modification of the FAO's seed security framework based on four parameters – availability, accessibility, varietal suitability and seed quality. We measured food security using the Food Insecurity Experience Scale (FIES). Data were analysed using descriptive statistics and poisson regression models. Results show that our respondents experienced mild seed insecurity with a score of 4.8 out of a possible maximum score of 12. Results further show that seed security positively and significantly influenced food security and seed access is the most critical element influencing food security. The regression results also show that wealth index, distance to the market, income and education level positively and significantly influence household food security. Our findings underscore the importance of promoting seed security for orphaned crops, especially among the low-income households as a mechanism for improving household and by implication national food and nutrition security.

Key Words: Climate change, Orphan crops, Sweet potato, Seed security, Food security, Poisson regression

iCB 2020-10

Seedling Survival Levels under Plantation Establishment for Livelihood Improvement Scheme and Implications for Conservation of Mt. Elgon Natural Forest Ecosystem, Kenya

Masaba, P.W. Hitimana, J., Mbeche, R. and Matonyei, T. 2020. *Journal of Forestry* 7(3)

Abstract

Plantation Establishment for Livelihood Improvement Scheme (PELIS) is an incentive system anchored in the Kenya's Forest Management and Conservation Act of 2016. It allows local communities to use forestlands for food crop production while supporting forest establishment phase. Mixed tree-crop farming may benefit or harm planted trees. Forest plantations are being established using PELIS to protect Mt Elgon natural forest as a critical conservation area in East Africa. We assessed the success of this afforestation system, using tree seedling survival as an indicator in three Stations around Mt Elgon: Saboti, Kimothon and Kaberwa. The main plantation tree species are three exotics: *Cupressus lusitanica*, *Pinus patula*, and *Eucalyptus grandis*. Data on tree survival counts were collected in stands aged 1, 2 and 3 years; across 750 plots (0.04 ha each) and all species types. Field observations and structured interviews revealed PELIS-related causes of seedling mortality. Student's t and ANOVA tests were carried out to ascertain observed differences. Forest stocking level is below standard (< 75%) for each species and age class. The non-adherence to guidelines is the root-cause of failed forest establishment. PELIS will serve its intended purpose of supporting sustainable participatory forest management if actors follow guidelines and monitoring systems are in place.

Key Words: Seedling survival rate, PFM, CFA, PELIS management, stocking status.

iCB 2020-11

A more Responsive, Multi-pronged Strategy is needed to Strengthen HIV Healthcare for Men who have Sex with Men in a Decentralized Health System: Qualitative Insights of a Case Study in the Kenyan Coast

Van der Elst, E.M., Mudza, R., Onguso, J.M., Kiriika, L., Kombo, B., Jahangir, N., Graham, S.M., Operario, D. and Sanders, E.J. 2020. *Journal of the International AIDS Society*, 23(S6):e25597

Abstract

Introduction: HIV healthcare services for men who have sex with men (MSM) in Kenya have not been openly provided because of persistent stigma and lack of healthcare capacity within Kenya's decentralized health sector. Building on an evaluation of a developed online MSM sensitivity training programme offered to East and South African healthcare providers, this study assessed views and responses to strengthen HIV healthcare services for MSM in Kenya.

Methods: The study was conducted between January and July 2017 in Kilifi County, coastal Kenya. Seventeen policymakers participated in an in-depth interview and 59 stakeholders, who were purposively selected from three key groups (i.e. healthcare providers, implementing partners and members of MSM-led community-based organizations) took part in eight focus group discussions. Discussions aimed to understand gaps in service provision to MSM from different perspectives, to identify potential misconceptions, and to explore opportunities to improve MSM HIV healthcare services. Interviews and focus group discussions were recorded, transcribed verbatim and analysed using Braun and Clarke's thematic analysis.

Results: Participants' responses revealed that all key groups navigated diverse challenges related to MSM HIV health services. Specific challenges included priority-setting by county government staff; preparedness of leadership and management on MSM HIV issues at the facility level; data reporting at the implementation level and advocacy for MSM health equity. Strong power inequities were observed between policy leadership, healthcare providers and MSM, with MSM feeling blamed for their sexual orientation. MSM agency, as expressed in their actions to access HIV services, was significantly constrained by county context, but can potentially be improved by political will, professional support and a human rights approach.

Conclusions: To strengthen HIV healthcare for MSM within a decentralized Kenyan health system, a more responsive, multipronged strategy adaptable and relevant to MSM's healthcare needs is required. Continued engagement with policy leadership, collaboration with health facilities, and partnerships with different community stakeholders are critical to improve HIV healthcare services for MSM.

Key Words: HIV healthcare services; MSM; Kenya; decentralization; health equity

iCB 2020-12

Heterosis and Combining ability for Storage Root, Flesh Color, Virus Disease Resistance and Vine Weight in Sweet Potato [*Ipomoea batatas* (L.) Lam.]

Ba, A., Gemenet, D.C., Onguso, J., Diouf, D., Mendes, T., Sali, R.T., Mwanga, R.O. and Kitavi, M. 2020. *African Journal of Agricultural Research*, 15(2), 187-202.

Abstract

This study was done to determine the mid-parent heterosis, the general (GCA) and specific (SCA) combining abilities of storage root yield, sweet potato virus resistance (SPVD), flesh color and vine weight of candidate sweet potato clones. Sixteen selected genotypes from two gene pools were crossed in an 8B×8A cross having 64 families. Trials were conducted with 1,896 offsprings and 16 parents during two seasons at the National Crops Resources Research Institute in Uganda (NaCRRI) using a Westcott design (only checks were replicated). Significant differences in performance were noted among families for all traits in both seasons ($P \leq 0.001$). Magabali×NK259L and Resisto×Naspot 7 were the best crosses for improving total storage root while Naspot 5×Naspot 7 stood out as the best cross for flesh color. The ratio of general combining ability to specific combining ability (GCA/SCA) for storage root, flesh color and SPVD ranged from 0.55 to 0.79, implying that additive gene effects were more important than non-additive gene effects for these traits. For vine weight, non-additive gene effects tended to be predominant. A susceptible parent Magabali and a moderately susceptible parent Naspot 1 had the most resistant progenies. This suggests that SPVD resistant alleles could be homozygous recessive, which may be confirmed in further studies. Correlation studies between traits were almost all significant except for flesh color and storage root yield. There was a positive and significant correlation ($P \leq 0.001$) between flesh color and SPVD resistance, with orange roots being the most resistant to SPVD. This important finding can help breeders to come up with orange-fleshed sweet potatoes that are highly resistant to virus diseases.

Key Words: Sweet potato combining ability, heterosis, genetic effect, storage root, sweet potato virus resistance (SVDP), flesh color, vine weight.

iCB 2020-13

Antioviposition and Reduction of *Callosobruchus chinensis* Pic. 1902 (Coleoptera: Bruchidae) Emergence on *Phaseolus vulgaris* by *Dioscorea sansibarensis* Powder and its Chemical Composition

Mauti, G.O., Kasigwa, P.F., Munissi, J.J. and Onguso, J.M. 2020. *Psyche: A Journal of Entomology*, 2020.

Abstract

Callosobruchus chinensis causes damage to the *Phaseolus vulgaris* seeds. Traditionally, *Dioscorea sansibarensis* serves as a medicinal plant. Naturally, *D. sansibarensis* has toxins that protect against herbivores and the surrounding invasive plants in its natural habitat. Phytochemical analysis by thin-layer chromatography (TLC) and laboratory experiments was carried out to determine the activity of *D. sansibarensis* leaves, bulbils, and yams powders on antioviposition and inhibition of the F₁ emergence of *C. chinensis*. Bioassay data were subjected to nonparametric (Kolmogorov–Smirnov) statistical analysis and a generalized linear model at $P \leq 0.05$. Statistically, the powders had an antioviposition activity of 34.3% ($R^2 = 0.343$). A recommendable activity on antioviposition was displayed by the yams powder; treatment by 0.8 g of yams powder had a Wald Chi-Square value of 1.291, $P = 0.26$. Inhibition of F₁ emergence was significantly attained by the yams powder; the treatment by 0.6 g of yams powder had a Wald Chi-Square value of 7.72, $P = 0.01$. Statistically, the bulbils powder displayed low antioviposition and inhibition of F₁ emergence. Observations on the TLC exposed compounds with similar *R_f* values; saponin with an *R_f* value of 0.72 was portrayed in the leaves, bulbils, and yams. A terpenoid and a flavonoid with *R_f* values of 0.37 and 0.71, respectively, were observed in bulbils and yams but absent in leaves. A terpenoid with an *R_f* value of 0.49 was visualized in leaves and bulbils but not in the yams powder. The study concluded that the *D. sansibarensis* yams and leaves powders are viable for application by the farmers in the protection of stored legumes against attack by *C. chinensis*. However, there may be other diverse interests in other storage insects and other methods of phytochemical analysis that have not been investigated.

iCB 2020-14

Comparative Growth and Dry Matter Accumulation in Selected Tree Species in Response to Quarry Dust Media Amendments

Ayusa, J.K., Mukundi, J.B. and Ochieng'Adimo, A. 2020. *Journal of Horticulture and Forestry*, 12(4), 122-129

Abstract

Field and laboratory trials were conducted to assess the effect of quarry dust amendments media on plant growth (biomass) of various selected tree species for re-vegetation purposes of post quarry sites in Ndurugu, Kiambu-Kenya. A randomized complete block design experiment was piloted with two-month-old nursery established seedlings of four tree species (*Acacia abyssinica*, *Casuarina equisetifolia*, *Eucalyptus grandis* and *Schinus molle*) planted in four different media treatments. The media treatments were quarry dust (QD), and quarry dust amendments of a combination of quarry dust with red soil (QD+RS), with manure (QD+MN), and with forest soil (QD+FS), in a ratio of 2:1. Destructive sampling was done in three phases after the third, sixth, and

ninth months of transplanting. Measurements for tree height, fresh and dry weights were done bi-weekly in the field and laboratory. Analysis of variance (ANOVA) was conducted, and results showed a substantial difference in time-species interaction on belowground, aboveground biomass, and root shoot ratio, at $p \leq 0.05$. Generally, the results obtained from the research study point out that quarry dust-manure combination has the prospective to influence the growth of the plant species favorably. The medium can be recommended for the re-vegetation process in post quarry sites in Ndarugu, Kenya.

Key Words: Elite trees, quarry dust, plant biomass, re-vegetation, root shoot ratio.

iCB 2020-15

Farmers' Knowledge, Attitudes and Practices (KAP) on Production of African Indigenous Vegetables in Kenya

Ntawuruhunga, D., Affognon, H.D., Fiaboe, K.K., Abukutsa-Onyango, M.O., Turoop, L. and Muriithi, B.W. 2020. *International Journal of Tropical Insect Science*, 40(2), 337-349

Abstract

Local knowledge, attitudes, and practices (KAP) regarding African Indigenous Vegetables (AIVs) among local growers are required to design effective vegetable productivity-enhancing interventions. However, limited studies have been conducted in Kenya to assess the knowledge, attitudes, and practices on production performance of AIVs. A survey was conducted among 600 AIV growers in Busia, Nyamira and Machakos Counties of Kenya to assess the knowledge, attitudes and practices regarding AIVs and their contribution on output/yield. Primary data were collected using a semi-structured questionnaire supplemented with key informant interviews. Results showed significant knowledge and positive attitude of farmers regarding AIVs, but insignificant use of improved farming practices. The study used a binary logistic regression to identify the variables that are associated with yield increase in AIVs production. It was established that by employing a 5% criterion of statistical significance, ploughing tools, land proportion allotted to the cultivation of AIVs, and water irrigation in AIVs farming significantly influenced the output/yield. Whereas the agro-ecological zones, gender of the farmer, and the fact of being trained in AIVs farming were statistically significant at 10%. On the other hand, farmers' KAP was not statistically significant. An important implication of this result is that farmers' personal characteristics need to be taken into consideration when planning developmental programmes for them. We encourage further intervention studies to be done to complement these findings in order to enable effective methods of interventions to boost production of AIVs.

Key Words: Agro-ecological zone, Smallholder, KAP, Yield, Binomial logit regression, Kenya

iCB 2020-16

Can African Indigenous Vegetables Contribute to Nutrition Security? A Policy Perspective

N Laibuni, T Losenge, W Bokelmann, 2020. *International Journal of Food and Agricultural Economics*, 8 (2) 111-124

Abstract

Kenya is classified as a food-deficit country. Approximately 20 percent of the population does not attain the minimum dietary requirements to sustain a healthy and productive life, according to the National Bureau of Statistics. African Indigenous Vegetables (AIVs) contain beneficial micro-nutrients and are critical for achieving nutrition security. This study used cross-sectional household survey data to test the plausibility of enhancing food access in the context of nutrition security, on the one hand, and the contribution of the AIVs to nutrition security, on the other hand. The results show that, the consumption of AIVs is not widely acknowledged or documented. Households spend up to 15 times less money on AIVs when compared with exotic vegetables this is partly attributed to the perceptions that shape their tastes and preference. At a macrolevel, the lack of consistent data makes the promotion of the importance of these vegetables to the policy makers a mundane task since it is difficult to demonstrate and authenticate the nutritional benefits that have been accrued by the consumption of these vegetables.

Key Words: African Indigenous Vegetables; Food security; Nutrition security; Plausibility Analysis

iCB 2020-17

Demystifying the Contribution of African Indigenous Vegetables to Nutrition-Sensitive Value Chains in Kenya

Laibuni, N.M., Losenge, T. and Bokelmann, W. 2020. *Journal of Agricultural Science*, 12(8), 82-91

Abstract

African Indigenous Vegetables (AIVs) are widely consumed in Kenya as part of everyday meals. They provide the much-needed micro-nutrients which are critical for combating micronutrient deficiencies (“hidden hunger”). The study describes the socio-economic characteristics of households in rural and peri-urban areas in Kenya and appraises the contribution of AIVs to household food access. The results show that there are spatial variations in the consumption of AIVs. Households living in rural areas have a wider variety of vegetables and consume their own production for an estimated ten months in a year; at the same time, purchase vegetables for between 6-7 months. Their peri-urban counterparts have less variety, consume their own produce for 11 months in the year and purchase for 8-9 months. Household income plays a critical role in enabling participation in food markets, Households living in rural areas earn significantly less on average from their land, their annual salary and net profits compared to their peri-urban colleagues. At least 40 per cent of households living in rural areas compared to an estimated 20 per cent in peri-urban areas grade their vegetables. In contrast, 50 per cent of all households wash their vegetables before consumption. In conclusion, households’ living in rural areas are net buyers of food, indicating that interventions to ensure increased consumption of AIVs must be accompanied by broad-based livelihood improvements to ensure that benefits accrue. Also, there is a need to underscore the importance of extension services as knowledge brokers.

Key Words: household vegetable consumption, African Indigenous Vegetables, hidden hunger, nutrition security

iCB 2020-18

Effects and Persistence of Endophytic *Beauveria bassiana* in Tomato Varieties on Mite Density *Tetranychus evansi* in the Screenhouse

Omukoko, C.A., Maniania, N.K., Wekesa, V.W. and Turoop, L. 2020. In: Niassy S., Ekesi S., Migiro L., Otieno W. (eds) *Sustainable Management of Invasive Pests in Africa. Sustainability in Plant and Crop Protection*, vol 14. Springer, Cham. https://doi.org/10.1007/978-3-030-41083-4_22

Abstract

The tomato red spider mite (RSM), *Tetranychus evansi* Baker and Pritchard, is an important exotic pest in the production of tomatoes and other solanaceous plants in Africa. Isolates of *Beauveria bassiana* ICIPE 273, ICIPE 279, ICIPE 283, ICIPE 10, and ICIPE 35 were previously tested for their endophytic activity in tomato in a screenhouse assay. ICIPE 35 was able to colonise leaves, stems and roots of the tomato varieties Cal J, Kilele and Anna F1, whereas the other four isolates were undetectable in all plant parts of the varieties tested, thus confirming no colonisation. Colonisation was assessed after every two-week period by plating the various plant parts on selective media. Persistence was examined by comparing colonisation from week 2, 4 and 6, since there was no colonisation detected after this time, for all the tested tomato varieties. There were no significant differences in levels of colonisation in the various parts of tomato varieties, i.e. stem ($F = 1.7$, $DF = 2$, $P = 0.186$), roots ($F = 2.0$, $DF = 2$, $P = 0.127$), and leaves ($F = 0.28$, $DF = 2$, $P = 0.752$). The density of *T. evansi* was lower in endophyte-colonised plants than the controls. In conclusion, this study revealed that *B. bassiana* can colonise and persist in the tested tomato varieties for a period of 6 weeks in the screenhouse and reduce adult RSM populations.

Key Words: Endophytes, *Solanum lycopersicum*, Fungal Entomopathogens, Spider mites

iCB 2020-19

Effect of Fortification with Snail Meat Powder on Physicochemical Properties and Shelf-life of Sorghum-wheat Buns

Agengo, F.B., Onyango, A.N., Serrem, C.A. and Okoth, J. 2020. *Current Nutrition & Food Science*, 16(5), 749-756. DOI 10.2174/1573401315666190719162012

Abstract

Background: Formulation of composite flours from wheat and non-wheat flours has been proposed as the most desirable way to improve the nutritional quality in diets, promote food security and lower the cost of baked products.

Objective: This study evaluated the effect of fortification with snail meat powder on physicochemical properties and shelf-life of sorghum-wheat buns.

Methods: Buns were prepared by replacing a part of sorghum-wheat flour with 5, 10, 15, 20, and 25% of snail meat powder. Physical properties including volume, density, baking loss, yield, weight, hardness and colour, the proximate analyses including moisture, crude protein, crude fat, crude fibre and ash and mineral composition of iron, zinc, calcium, magnesium and copper were analyzed for the buns. In vitro protein digestibility was determined by pepsin digestion. Plate count agar and potato dextrose agar were respectively used for enumeration of bacterial and fungal flora in the buns during storage. Shelf-life determination was based on the number of days before the production of off flavours and fungal infestation.

Results: Compositing sorghum-wheat flour with snail meat powder progressively improved the density, baking loss, yield, weight and texture of the buns. Protein, fat, ash, energy, iron, zinc, calcium, magnesium and copper contents were also increased. Fortification of buns at 5% and 25% with SMP improved in vitro protein digestibility by 16% and 22%, respectively. Maximum bacterial count in buns was below the International Microbiological Standard recommended units for dry and ready to eat foods of 10(3) cfu/g.

Conclusion: Buns composited with snail meat powder showed a considerable potential to be used as protein rich foods in preventing protein energy malnutrition among young children.

Key Words: Buns, digestibility, nutrient imbalance, protein energy malnutrition, protein rich foods, snail meat powder, sorghum-wheat.

iCB 2020-20

Mechanisms of the Regulation and Dysregulation of Glucagon Secretion

Arnold N. Onyango, *Oxidative Medicine and Cellular Longevity*, vol. 2020, Article ID 3089139, 9 pages, 2020. <https://doi.org/10.1155/2020/3089139>

Abstract

Glucagon, a hormone secreted by pancreatic alpha cells, contributes to the maintenance of normal blood glucose concentration by inducing hepatic glucose production in response to declining blood glucose. However, glucagon hypersecretion contributes to the pathogenesis of type 2 diabetes. Moreover, diabetes is associated with relative glucagon undersecretion at low blood glucose and oversecretion at normal and high blood glucose. The mechanisms of such alpha cell dysfunctions are not well understood. This article reviews the genesis of alpha cell dysfunctions during the pathogenesis of type 2 diabetes and after the onset of type 1 and type 2 diabetes. It unravels a signaling pathway that contributes to glucose- or hydrogen peroxide-induced glucagon secretion, whose overstimulation contributes to glucagon dysregulation, partly through oxidative stress and reduced ATP synthesis. The signaling pathway involves phosphatidylinositol-3-kinase, protein kinase B, protein kinase C delta, non-receptor tyrosine kinase Src, and phospholipase C gamma-1. This knowledge will be useful in the design of new antidiabetic agents or regimens.

Key Words: Pancreatic Alpha Cells, Kinase-C-Delta, Oxygen Species Production, Stress-Induced Apoptosis, Insulin-Receptor, Beta-Cells, Cardiovascular-Disease, Glucose-Metabolism, Oxidative Stress, NADPH Oxidase

iCB 2020-21

Effect of a Nutrition Education Programme on the Metabolic Syndrome in Type 2 Diabetes Mellitus Patients at a Level 5 Hospital in Kenya: “A Randomized Controlled Trial”

Thuita, A.W., Kiage, B.N., Onyango, A.N. and Makokha A.O. 2020. *BMC Nutrition*, 6(30). <https://doi.org/10.1186/s40795-020-00355-6>

Abstract

Background: Type 2 diabetes mellitus (T2D), is a life-threatening condition of global public health concern. It worsens in the presence of the metabolic syndrome (MetS), a complex disorder

characterized by co-occurrence of at least three of such factors as hypertension, obesity, dyslipidemia and insulin resistance. However, lifestyle interventions reduce the risk of both MetS and T2D, and nutrition education can empower individuals on the appropriate, lifestyle changes. The aim of the current study was to evaluate the effect of a nutrition education programme, with and without inclusion of peer to peer support, on MetS in T2D patients.

Methods: This was a randomized controlled trial with two intervention groups and one control. One of the intervention groups involved a nutrition education programme with peer-to-peer support (NEP); the other involved only the education program, while the control received standard care. Each group had 51 participants. The nutrition education programme was conducted for 2 h per week for 8 weeks. In addition, the NEP had weekly peer-to-peer interactions for 8 weeks. All groups had follow-up sessions for 6 months. Data on MetS risk factors as well as food intake patterns and physical activity levels were taken at baseline and at different time points during the study. Analysis of Co-variance and regression were used in the analysis.

Results: The MetS prevalence improved in the NEP (90 to 52%) and NE (86 to 69%), while it worsened in C (88 to 91%). There was improvement in the mean values of the anthropometric parameters in the NEP and NE which worsened in the control group. There was a general improvement in mean values of blood lipids, fasting blood glucose and HbA1c in all the groups, with NEP showing the greatest improvements, followed by NE, except for triglycerides and HDL where the control group had better improvement than the NE. Changes in the anthropometric and metabolic indicators mirrored the changes in food intake patterns and physical activity, where the greatest improvements occurred in the NEP.

Conclusions: Nutrition education with inclusion of peer to peer support was of clinical benefit in improving metabolic outcomes and reducing MetS in T2DM patients. Trial registration: The study has been registered retrospectively by Pan African Clinical Trial Registry; Registration No: PACTR201910518676391.

Key Words: Metabolic syndrome, Type 2 diabetes mellitus and cardiovascular risk

iCB 2020-22

Empowering Women through Probiotic Fermented Food in East Africa

Reid, G., Sybesma, W., Matovu, W., Onyango, A., Westerik, N. and Kort, R. 2020. *Journal of Global Health* 10 (1). doi: 10.7189/jogh.10.010330

Abstract

The application of probiotic fermented food has the potential to reach millions of people. For example, twenty Early Childhood Development Centres in Kenya now use the sachets to produce fermented maize-millet-soybean porridge; and there are fifty thousand of these serving three million children. This project has shown how ‘western’ science and local ingenuity can impact vulnerable populations in rural East Africa. It has the potential to improve a number of important health and economic markers in regions challenged by poverty, infectious diseases, malnutrition and unemployment. As yet, the introduction of such a microbiome food-based initiative has not been assessed to see if and how it effects disease prevalence, morbidity and mortality. The premise exists for it to do so, especially through the women who have risen to the challenge of producing these foods, and those along the value chain who have witnessed greater revenue generation without

denying the poorest members of society access to the products. Others agree that gendered empowerment can help prevent HIV spread. By doing this through a practical, affordable and community-wide initiative using different food sources, we believe that this model can be transferable across the globe.

iCB 2021-23

Efficacy of Compositing with Snail Meat Powder on Protein Nutritional Quality of Sorghum–Wheat Buns using a Rat Bioassay

Agengo, F.B., Onyango, A.N., Serrem, C.A., and Okoth, J. 2020. *Journal of the Science of Food and Agriculture* 100 (7), 2963-2970

Abstract

Background: Protein energy malnutrition (PEM) is an important health burden in most developing countries mainly in sub-Saharan Africa, where it contributes to high rates of child morbidity and mortality. This study evaluated the efficacy of compositing with snail meat powder (SMP) on protein nutritional quality of sorghum–wheat buns using a rat bioassay. Nine diets –seven isonitrogenous diets, based on six variations of buns and a reference diet made using skimmed milk powder, in addition to the basal diet meant to estimate the endogenous nitrogen excretion and a 16% protein rehabilitation diet – were fed to male weanling albino rats. Protein efficiency ratio (PER), and food efficiency ratio (FER), net protein retention ratio (NPRR), apparent protein digestibility (APD), and true protein digestibility (TPD), protein digestibility corrected amino acid score (PDCAAS), and digestible indispensable amino acid score (DIAAS) indices of protein quality were determined.

Results: Fortification with SMP significantly ($P < 0.05$) enhanced PER from 0.21% to 2.70%, FER from 0.02% to 0.27%, APD from 81.17% to 88.28%, and TPD from 87.48% to 95.38%. PDCAAS and DIAAS increased from 45% to 78% and 44% to 69% respectively in unfortified buns to buns fortified with 25% SMP.

Conclusion: Complementary diets fortified with SMP promote growth and rehabilitate emaciated rats, whereas unfortified diet did not support weight gain. Thus, supplementation of buns with SMP might enhance a faster recovery in children affected by PEM.

Key Words: malnutrition; fortification; protein; digestibility; growth

iCB 2020-24

Lysine Reacts with Cholesterol Hydroperoxide to form Secosterol Aldehydes and Lysine-Secosterol Aldehyde Adducts

Wanjala, G.W., Onyango, A.N., Abuga, D.R., Muchuna, J.K., Onyango, C. and Makayoto, M. 2020. *Journal of Chemistry*, vol. 2020, Article ID 5862645, 8 pages, 2020.

<https://doi.org/10.1155/2020/5862645>

Abstract

Two cholesterol secosterol aldehydes, namely, 3β -hydroxy-5-oxo-5,6-secocholestan-6-al (secosterol A) and its aldolization product 3β -hydroxy-5 β -hydroxy-B-norcholestane-6 β -carboxyaldehyde (secosterol B), are highly bioactive compounds which have been detected in human tissues and potentially contribute to the development of physiological dysfunctions such as

atherosclerosis, Alzheimer's disease, diabetes, and cancer. They were originally considered to be exclusive products of cholesterol ozonolysis and thus to be evidence for endogenous ozone formation. However, it was recently postulated that primary amines such as lysine may catalyse their formation from cholesterol-5 α -hydroperoxide (Ch-5 α -OOH), the main product of the oxidation of cholesterol with singlet oxygen. This involves cyclization of Ch-5 α -OOH to an unstable dioxetane intermediate, which decomposes to form secosterol aldehydes with triplet carbonyl groups, whose return to the singlet state is at least partly coupled to the conversion of triplet molecular oxygen to singlet oxygen. Here, we subjected cholesterol to photosensitized oxidation, which predominantly produces Ch-5 α -OOH and minor amounts of the 6 α - and 6 β -hydroperoxides, exposed the hydroperoxide mixture to lysine in the presence of the antioxidant 2,6-ditertiary-butyl-4-hydroxytoluene (BHT), and analysed the reaction mixture by liquid chromatography-electrospray ionization-mass spectrometry. Consistent with the postulated lysine-catalysed formation of secosterol aldehydes, we detected formation of the latter and several types of their lysine adducts, including carbinolamines, Schiff's bases, and amide-type adducts. We propose that the amide type adducts, which are major biomarkers of lipid oxidation, are mainly formed by singlet oxygen-mediated oxidation of the carbinolamine adducts.

iCB 2020-25

Evaluation of Five Essential Oils by Gas Chromatography-Mass Spectrometry and their Effect on Fungal Growth Inhibition and Sensory Acceptability of Soymilk

Niyibituronsa, M., Onyango, A.N., Gaidashova, S., Imathiu, S., Ming, Z., Ruinan, Y., Weiqi, Z., XiuPin, W., Qi, Z. Zhaowei, Z. & Peiwu, L. 2020. *Journal of Food Research*, 9(2), 36-47.

Abstract

Essential oils are widely used in the food industry as natural food preservatives to extend product shelf life and as flavoring agents. However, not much has been done on their use in soymilk. The aim of the study is to determine the compounds of five essential oils by GC-MS and their effect on fungal growth inhibition and sensory acceptability of soymilk. The components of the essential oils of five spices, namely citronella, basil, cinnamon, eucalyptus and mint were analysed by gas chromatography-mass spectrometry (GC-MS). The minimum inhibitory concentration (MIC) of the essential oils was tested on the fungus *Aspergillus flavus* 3.4408 on PDA (agar dilution method). Sensory evaluation of soymilk flavored with the essential oils of citronella, basil and mint at different concentrations was done by ten member panelists using a 9-point hedonic scale. The main compound for basil was eugenol 83.26%. Cinnamon contained cinnamaldehyde (97.3%). The main compounds in citronella (*Cymbopogon nardus*) were limonene (38.51%), citronellal (30.29%). Eucalyptus (*Eucalyptus globulus*) essential oil mainly contained eucalyptol/cineole (76.70%), and Mint (*Mentha arvensis*): Menthol 42.72%, Menthone 25.72%. The MICs of citronella, basil, cinnamon, eucalyptus and mint were 5-10 μ l/ml, 0.5-1 μ l/ml, \leq 0.1 μ l/ml, \gg 10 μ l/ml and 10-20 μ l/ml, respectively. Thus, cinnamon was the most effective in inhibiting fungal growth, while eucalyptus was the least effective. These essential oils improved the soymilk flavor. Mint was the most preferred flavor, followed by citronella and basil. Thus, essential oils especially mint and citronella can be used for improving acceptability of soymilk at low concentration.

Key Words: basil, CFU, citronella, cinnamon, eucalyptus, mint, sensory attributes, soybean

iCB 2020-26

Proximate Composition and Mineral Contents of Farmed and Wild Fish in Kenya

Raymond, J.K., Onyango, A.N. & Onyango, C.A. 2020. *Journal of Food Research*, 9(3), 53-62

Abstract

The Kenyan government is promoting fish farming to boost fish supply and reduce rural poverty and malnutrition. This study was carried out to determine the differences between the chemical composition of wild and farmed fish particularly Nile tilapia (*Oreochromis niloticus*) and African Catfish (*Claris gariepinus*) species. Wild fish were obtained from City market Nairobi, while farmed fish were obtained from selected ponds in Sagana and Kamulu (Kenya). Proximate composition, mineral and heavy metal content of the fish were determined using standard methods of analysis. Farmed fish contained significantly higher moisture content than the wild fish. Protein content in wild fish ranged from 21.9 – 22.1 % compared to 16.0 – 19.2 % in farmed fish. Fat content in wild fish ranged from 3.0 – 3.8 % compared to 1.9 – 4.8 % in farmed fish and ash from 1.8 – 2.1 % in wild compared to 1.1 – 1.5 % in farmed fish. The concentration of minerals in wild fish ranged from 2.8 – 3.0 mg/100g of iron, 5.5 – 5.6 mg/100g zinc, and 39.9 – 43.8 mg/100g calcium compared to the lower values of 1.9 – 2.4 mg/100g of iron, 28.2 – 37.0 mg/100g calcium and 4.3 – 5.0 mg/100g zinc in farmed fish respectively. Unfortunately, the wild fish was found to contain significantly higher concentrations of heavy metals as compared to the farmed fish ($P < 0.05$). From the results, it was evident that wild fish were nutritionally superior to the farmed fish but, they also contained significantly higher levels of toxic heavy metals.

Key Words: wild fish, farmed fish, proximate composition, fatty acids, tilapia, catfish

iCB 2020-27

Effect of Boiling and Wet Frying on Nutritional and Antinutrients Content of Traditional Vegetables Commonly Consumed in Malawi

Issa, J.Y. Onyango, A., Makokha, A.O. and Okoth, J. 2020. *Journal of Food Research*, 9 (1), 19-33

Abstract

This study was carried out to evaluate the effects of boiling and wet frying on nutritional and antinutrients content of *Amaranth hybridus*, *Moringa oleifera*, *Bidens pilosa* (black jack), *Corchorus olitorius* (Jute mallow) and *Ipomea batatas* (sweet potato) leaves. The edible portions of the vegetables were either boiled or wet fried for ten minutes then dried alongside the raw vegetables under the shade. Crude fats, minerals, vitamins and antinutrients were determined in the dried materials. Wet frying increased the oil content of the vegetables by a range of 15.49% to 28.40 % and was hence associated with lower % ash and mineral contents. Wet frying significantly reduced ($P \leq 0.05$) beta-carotene in all the vegetables except in jute mallow. Boiling had no significant effect on beta-carotene in most of the vegetables. Boiling significantly reduced ($P \leq 0.05$) ascorbic acid in all the vegetables while wet frying preserved ascorbic acid in all the vegetables. Both boiling and wet frying significantly reduced ($P \leq 0.05$) oxalates in all the vegetables except in black jack. Both boiling and wet frying significantly ($P \leq 0.05$) reduced the concentration of phytates in most of the vegetables. However, boiling was more effective in reducing the amount of phytates. Boiling reduced higher concentrations of tannins in all the vegetables as compared to wet frying. Boiling was associated with better retention of minerals and beta-carotene, and greater reduction of

antinutrients in most of the vegetables. Wet frying was more advantageous in retaining vitamin C. The different species showed differences in retention of various minerals and vitamins.

Key Words: Vitamins, minerals, anti-nutrients, boiling, wet frying, traditional vegetables, Malawi

1.2. Compilation of Abstracts from iCMoB Subtaskforce

iCMoB 2022-01

Probiotic Properties of Lactic Acid Bacteria Isolated from “Tchoukou” Traditional Milk Cheeses Produced in Selected Region of Niger Ibrahima Doumbouya,

Kevin Mbogo Omolo, Willis Owino (2022). *International Journal of Food Sciences* 2789-7680 (online) Vol. 5, Issue 1, No. 1, pp 1 – 15

Abstract

Purpose: The current study's aim is to evaluate the probiotic potential of lactic acid bacteria strains isolated from traditional "Tchoukou" milk cheeses produced in a selected region of Niger. **Methodology:** Nine Samples were collected in selected regions of Niger (Tahoua, Maradi, and Zinder). Probiotic properties of isolated LAB were identified based on their acid tolerance, bile salt tolerance, auto-aggregation ability, simulated stomach and duodenum passage, simulated gastric juice survivability and their antimicrobial activities.

Findings: A total of eighteen strains were analysed in vitro for acid tolerance, bile tolerance, survival under simulated gastro-intestinal tract conditions and antimicrobial activity against index organisms. The results indicated that all seventeen strains exhibited a high viability after twenty-four hours of incubation at pH 2.5 and pH 3, but a decreased viability at pH 2.0 in which only eight strains were able to survive, strain C13 failed to grow at the three different pH. In this study, the isolates generally survived better after exposure to 0.3% bile salt. Also were able to survive exposure to simulated stomach and duodenum passage (SSDP) for three hours ranging from (89%-100%). All strains were able to survive under simulated gastric juice at different pH (2, 2.5 and 3). for auto-aggregation Only fifteen isolates showed the best auto-aggregation abilities ranging from (15-83%) and the other two had less auto-aggregation ability (2-11%). The isolates showed diverse antimicrobial activity against the index organisms. Among the isolates, only three (C1, C2 and C9) could not inhibit any of the selected pathogens. **Unique contribution to theory, practice and policy:** This study was conducted to characterize the probiotic properties of LAB isolate which could serve as a potential source for industries and commercial applications.

Keywords: Tchoukou, Probiotics, Lactic acid bacteria, Antimicrobial

iCMoB 2022-02

A New Collaborative Network for Bacteriophage Research in Africa. Version.

Noutin Michodigni,, Ritah Nakayinga, Angela Makumi, Josephine Kimani, Ivy Mutai, Christy Dapuliga, Belayneh Getachew, Jerrold Agbankpè, Jesca Nakavuma, Atunga Nyachieo, Nnaemeka Emmanuel Nnadi (2022) *The Africa Phage Forum.: Received: 21 January 2022 / Approved: 24 January 2022 / Online: 24 January 2022 (11:14:10 CET)*

Abstract

The problem of antimicrobial resistance has created a new need for alternative/ complementary treatments. To this end, bacteriophages offer an exciting prospect, as they can infect and kill specific bacteria without harming the host. This survey aimed to evaluate the state of applied phage research in Africa, among the members of the Africa phage Forum (APF). This was a cross-sectional survey whereby a google form was created for the members of the Africa Phage forum to fill so as to access the stage of phage research in Africa. Data was collected between June and July 2021 using a structured questionnaire form. A total of 65 out of a total of 101 forum members completed the questionnaire. The survey indicated that a majority 68% of phage researchers in Africa were at the training stages of their career. Some available participants were limited (8%). Most of the members identified funding, lack of skill set, near absence of adequate laboratory infrastructure as major hurdles for phage research. Despite these challenges, 73.3% of APF members work with the ESKAPE group with the majority of its members carrying out research in Phage in Biocontrol (80%), whereas others perform research related to human phage therapy (60%). However, it appeared this research has not yet reached the stage of commercialization. Overall, Phage research is in its infancy in Africa. Key challenges included poor laboratory infrastructure, lack of capacity building in the phage field, and lack of local awareness on the significance of phages for policymakers and governments. APF could, therefore, play a role in creating phage awareness in Africa; mobilizing resources; enhancing networks and collaborations amongst APF members and beyond, especially with more experienced phage mentors in the Western countries, to greatly reduce the gap in knowledge and enhance phage research in Africa.

iCMoB 2022-03

Development of an Inhibition Enzyme-Linked Immunosorbent Assay (ELISA) Prototype for Detecting Cytotoxic Three-Finger Toxins (3FTxs) in African Spitting Cobra Venoms

Ernest Z. Manson, Kyama C. Mutinda, Joseph K. Gikunju 2, Aleksandra Bocian, Konrad K. Hus, Vladimír Petrilla, Jaroslav Legáth and James H. Kimotho (2022). *Molecules* 2022, 27(3), 888; <https://doi.org/10.3390/molecules27030888>

Abstract

The administration of toxin-specific therapy in snake envenoming is predicated on improved diagnostic techniques capable of detecting specific venom toxins. Various serological tests have been used in detecting snakebite envenoming. Comparatively, enzyme-linked immunosorbent assay (ELISA) has been shown to offer a wider practical application. We report an inhibition ELISA for detecting three-finger toxin (3FTx) proteins in venoms of African spitting cobras. The optimized assay detected 3FTxs in *N. ashei* (including other *Naja* sp.) venoms, spiked samples, and venom-challenged mice samples. In venoms of *Naja* sp., the assay showed inhibition, implying the detection of 3FTxs, but showed little or no inhibition in non-*Naja* sp. In mice-spiked samples, one-way ANOVA results showed that the observed inhibition was not statistically significant between spiked samples and negative control (p-value = 0.164). Similarly, the observed differences in inhibition between venom-challenged and negative control samples were not statistically significant (p-value = 0.9109). At an LOD of 0.01 µg/mL, the assay was able to confirm the presence of 3FTxs in the samples. Our results show a proof of concept for the use of an inhibition ELISA model as a tool for detecting 3FTxs in the venoms of African spitting cobra snakes.

iCMoB 2022-04

Development of Loop-Mediated Isothermal Amplification Combined with Lateral Flow Dipstick Assay for a Rapid and Sensitive Detection of Cystic Echinococcosis in Livestock in Kenya.

Nasser Arreh Badoul, John Kagira, Florence Ng'ong'a, and Hunduma Dinka (2022).

Hindawi Journal of Tropical Medicine Volume 2022, Article ID 4928009, 9 pages
<https://doi.org/10.1155/2022/4928009>

Abstract

Cystic echinococcosis is a zoonotic disease caused by the metacestode stage of *Echinococcus granulosus* and occurs worldwide, causing considerable economic losses and public health problems. (e currently available methods for the diagnosis of animal hydatidosis are time-consuming and require well-equipped laboratories which make them incompatible with testing in resource-poor settings. (is study developed and evaluated a rapid, more sensitive, and specific loop-mediated isothermal amplification combined with a lateral flow dipstick assay for the rapid and sensitive detection of cystic echinococcosis. Results. In this study, a specific primer set and FITC-labeled probe targeting the conserved region of the NADH-1 gene were designed. (eLAMP reaction was performed at 60°C for 40 minutes, and the amplification products were successfully visualized by LFD strips. (e analytical sensitivity of LAMP-LFD was determined using 10-fold serial dilutions of *E. granulosus* DNA. (e minimal concentration detected was 10 fg/μl, and no cross-reactivity was observed with DNA extracted from *Taenia solium*, *Taenia saginata*, and *Fasciola hepatica*. (e ability of the developed LAMP-LFD assay to detect cystic echinococcosis was further evaluated with 62 cyst samples from slaughtered cattle in Juja Abattoir, Kiambu County, Kenya. (e LAMP-LFD was able to detect 59/62 (95.2%, 95% CI 0.87–0.98) as positive samples of *E. granulosus* compared to 53/62 (85.5%, 95% CI 0.75–0.92) by nested PCR assay. Conclusion. Our results indicated that the developed LAMP-LFD technique was more sensitive than the nested PCR assay, rapid, and easy to perform with a simple visual detection of products. (erefore, it could be an important point-of-care diagnostic tool for cystic echinococcosis.

iCMoB 2021-01

Genetic detection and phylogenetic relationship of *Babesia* species infecting domestic dogs from select regions in Kenya Scientific African.

Ismail Thoya Ngoka, Kevin Mbogo, Martina Kyallo, David biero Oduori, Roger Pelle (2021).
Volume 14, November 2021. <https://doi.org/10.1016/j.sciaf.2021.e01010>.

Abstract

The genus *Babesia* has more than 100 species that are transmitted by ticks with some being zoonotic. They can infect humans, livestock, and wildlife. Although canine babesiosis occurs locally, published studies on the species involved are limited. *Babesia* parasites cause severe disease in dogs which can be fatal. Drawbacks of the current control methods necessitate vaccine development. The study objective was to identify the *Babesia* species infecting dogs from three Kenyan counties; Nairobi, Mombasa, Nakuru and determine their phylogenetic relationship. This will enable improved control and rule out zoonotic potential. The study period was October 2018 to November 2019. The study design was descriptive and sampling opportunistic. One hundred and forty-three

dogs were sampled. From whole blood, total DNA was extracted using the TanBead extractor followed by PCR amplification targeting *Babesia* 18S rRNA. Positive samples were purified and sequenced using the Sanger Dideoxy method. CLC Genomics Workbench, GenBank™ and BLASTn™ on NCBI were used for sequence processing and analysis. Geneious prime™ was used for multiple sequence alignment and phylogenetic analysis. The overall prevalence of *Babesia canis* was 9.0% (95% CI: 4.37–13.81). Two out of 13 positive samples (2/13) were identified as *Babesia canis vogeli*, with a prevalence of 1.4% (95% CI: 1.38 - 14.2, $n = 143$) while 11/13 were identified as *Babesia canis rossi*, with a prevalence of 7.69% (95% CI: 3.3 -12, $n = 143$). The *Babesia rossi* sequences identified were closely related to sequences from black-backed jackals, while the *Babesia vogeli* ones were related to sequences from a pet cat in China. *Babesia rossi* which causes severe canine babesiosis was identified in 84.6% of the positive samples, immediate and aggressive clinical intervention is necessary. The possible sylvatic cycle of *Babesia rossi* and low levels of infections by *Babesia vogeli* should inform pertinent control measures.

iCMoB 2021-02

Barriers to Diabetes Self-Management in Primary Care Settings – Patient Perspectives: Phenomenological Design.

Sherry Oluchina, Simon Karanja, Amos Mbugua (2021)

Abstracts

Background: Type 1 diabetes mellitus (T1DM) is an autoimmune disease with a strong genetic component. Type 1 diabetes mellitus is characterized by destruction of pancreatic β -cells, culminating in absolute insulin deficiency. A person with T1DM needs to follow a structured self-management plan including insulin use, blood glucose monitoring, physical activity and a healthy diet.

Objective: To explore perceived barriers of diabetes self-management among adolescents with T1DM attending Thika Level 5 Hospital and Kiambu Level 5 Hospital diabetic clinics
Design: Phenomenological study design
Setting(s): Thika Level 5 Hospital and Kiambu Level 5 Hospital diabetic clinics in Kiambu County, Kenya.
Participants: A total of 96 adolescents aged 10 to 19 years with T1DM will be included in the study, 48 in the intervention arm and 48 in the control arm.

Methods: Stratified random sampling was used to select adolescents aged 10 to 19 years with T1DM in the study areas. Qualitative data was collected through use of Focus Group Discussions. Content analysis was done for the qualitative data. Ethical clearance was sought from JKUAT Institutional Ethics Review Committee.

Results: Six major themes were identified as perceived barriers for diabetes self-management. These were low perception of susceptibility and severity of illness; dynamic and chronic nature of diabetes; inadequate knowledge and skills on T1DM self-management; lack of motivation to perform T1DM self-management; unavailability of resources and financial burden; and social exclusion and feelings of embarrassment.

Conclusions: Programmatic recommendation suggested was self-help support groups to be introduced to provide counseling in diabetes self-management practices and emotional support to adolescents with type 1 diabetes mellitus

iCMoB 2021-03

Distribution patterns of drug resistance *Mycobacterium tuberculosis* among HIV negative and positive tuberculosis patients in Western Kenya

Martin O. Ogwang, Mabel Imbuga, Caroline Ngugi, Lucy Mutharia, Gabriel Magoma & Lamec Diero (2021) *BMC Infectious Diseases* volume 21, Article number: 1175 (2021)

Abstract

Globally anti-tuberculosis drug resistance is one of the major challenges affecting control and prevention of tuberculosis. Kenya is ranked among 30 high burden TB countries globally. However, there is scanty information on second line antituberculosis drug resistance among tuberculosis patients. Therefore, this study aimed at determining *Mycobacterium tuberculosis* drug resistant strain distribution pattern in 10 counties of Western Kenya among HIV positive and negative patients.

iCMoB 2021-04

Prevalence of Bacteremia among the HIV and Non HIV Infected Patients Visiting Alupe Sub Hospital, Alupe Division of Teso South Sub-County, Busia County, Kenya between 2017 and 2019.

Anne N. Mutsami, Caroline Ngugi, John Kiiru (2021)

Open Journal of Medical Microbiology Vol.11 No.03 (2021), Article ID:112120,18 pages
[10.4236/ojmm.2021.113016](https://doi.org/10.4236/ojmm.2021.113016)

Abstract

Background: Bacteremia is the presence of viable bacteria in circulating blood. This is common in HIV patients, leading to a significant public health problem worldwide. It is concomitant with upraising cases of antibiotic resistance that results in high morbidity rates leading to increased hospital visits and high mortality rates. Gram-negative bacteria which produce extended-spectrum β -lactamase (ESBL) are becoming more common and pathogenic in this group of people. Genes responsible for resistance are well-known to spread among various microorganisms. By employing a case-control study design, this study determined prevalence of bacteremia in *Salmonella ssp*, *Klebsiella ssp*, and *Escherichia coli* in HIV positive and HIV negative patients attending Alupe subcounty hospital. Methods: A total of 113 HIV positive and 133 HIV negative patients were sampled purposively grounded on Lameshow sample size determination formula. Consent was sought from the study participants followed by questionnaire administration. Blood (10 ml) was collected from each enrolled patient and later subjected to full haemogram (1 ml), Salmonella Antigen test (1 ml) and general bacterial isolation (8 ml). Results: HIV positive patients experienced significantly different bacterial diseases infection from those who were HIV negative ($\chi^2 = 27.684$, $P = 0.024$). In the current study, total prevalence of *Salmonella ssp*. among HIV positive and HIV negative patients was 11.1%, *Klebsiella ssp.*, 18.52%, *Staphylococcus ssp.*, 48.15%, *Shigella ssp* 7.4% while that of *Brucella ssp.*, *Neisseria gonorrhoea*, *Aeromonas carviae* and *Plesomonas shigelloids* each was 3.7%. *Escherichia coli* was not isolated from any of the blood samples collected from the study participants. Results were made available to policy makers for use in coming up with cognizant measures of prevention of bacteremia, hence a healthy society.

iCMoB 2021-05

Dermaseptin B2's Anti-Proliferative Activity and down Regulation of Anti-Proliferative, Angiogenic and Metastatic Genes in Rhabdomyosarcoma RD Cells *in Vitro*.

Ahmed A. Abdille, Josephine Kimani, Fred Wamunyokoli, Wallace Bulimo, Yahaya Gavamukulya, Esther N. Maina (2021). *Advances in Bioscience and Biotechnology* > Vol.12 No.10, October 2021

Abstract

Background: Rhabdomyosarcoma (RMS) is the most prevalent soft tissue sarcoma in children, representing approximately 50% of pediatric sarcomas and can develop in any part of the body though more frequently at the extremities.

Aim: Evaluating the *in vitro* anti-proliferative activity of Dermaseptin B2 on Rhabdomyosarcoma RD (CCL-136TM) cells and its effect on the expression of *MYC*, *FGFR1*, *NOTCH1*, and *CXCR7* genes involve in processes including proliferation, angiogenesis and metastasis.

Methods: RD cells were grown in Dulbecco's Modified Eagle's Medium supplemented with 10% Fetal Bovine Serum. Exponentially growing cells were treated with Dermaseptin B2 and Antiproliferative activity was assayed using the resazurin and migration assays at three time-points. In order to determine the gene expression profiles of *MYC*, *NOTCH1*, *FGFR1* and *CXCR7*, total RNA was extracted from the cells and q-RT-PCR was performed with β -*Actin* as reference gene.

Results: Dermaseptin B2 inhibited the proliferation of RD cells in a time and concentration dependent manner as with IC₅₀ values of 7.679 μ M, 7.235 μ M, 5.993 μ M. The 2-dimensional wound healing assay showed inhibition of migration and motility of the RD cells at time-points of 6, 24, 48 and 72-hours with the greatest inhibition observed at 72-hours. Dermaseptin B2 downregulated the target *MYC* (fc; 1.5013, 1.5185, 2.4144), *CXCR7* (fc; 2.8818, 4.4430, 3.9924), *FGFR1* (fc; 2.3515, 2.0809, 2.2543), *NOTCH1* (fc; 2.4667, 4.6274, 4.3352) genes for the three-time points respectively. *NOTCH1* and *CXCR7* showed higher fold changes with respect to β -*Actin* than *MYC* and *FGFR1*.

Conclusion: The results of this study indicate that Dermaseptin B2 is a target molecule for signaling pathways including PI3K/AKT, RTK and NOTCH pathways that could affect the transcription of these genes and overall inhibition of cancer progression. Further studies are needed to give a better understanding of the detailed mechanisms of action as well as the effects of the Dermaseptin B2 peptide *in vivo*.

iCMoB 2021-06

Culturing live foods for fish larviculture using non-microalgal diet: The role of waste-generated bacteria and selected commercial probiotics—A review.

Robert Nesta Kagali, Erick Ochieng Ogello, Catherine Wachera Kiama, Hee-Jin Kim¹ Stenly Wullur Yoshitaka Sakakura, Atsushi Hagiwara (2021)

Abstract

Condensed suspension of live microalga cells, for example, *Chlorella vulgaris*, *Nannochloropsis oculata* and *Tetraselmis tetrathele* is often utilized as diets for mass production of live food resources, that is, rotifers, copepods, cladocerans and *Artemia*. These live food resources are essential for fish larviculture in hatcheries. However, the production of sufficient microalgae is costly, laborious and fragile, and thus require costeffective and stable production technologies, especially for the emerging countries. Studies have shown that locally available biowastes such as

fish wastes and chicken manure provide substrates for generating billions of heterotrophic bacterial cells and microparticles as well as growth hormones, which can be used in propagating live food resources. The fish wastes contain essential nutrients that are important for the growth of both live foods and fish larvae. With single feeding of fish wastes, the culture condition of live foods may become unstable, and thus bacterial isolates and selected probiotics, for example, genus *Pseudomonas*, *Moraxella* and *Micrococcus* are needed to stabilize the culture conditions to increase reproduction capacity of the cultured live foods. This article consolidates the results and conclusions of our recent studies on the culture of live food resources, that is, *Proales similis* de Beauchamp, *Brachionus rotundiformis* Tschugunoff, *Tigriopus japonicus* Mori and *Diaphanosoma celebensis* Stingelin, using waste-generated bacteria from fish waste diet (FWD) and selected probiotics. The non-algal materials reviewed in this article are important to ensure constant supply of cheap live foods to improve aquaculture, especially in the developing countries, which lack sophisticated technology for production of high-density microalgae.

iCMoB 2021-07

Prokaryotic diversity and composition within equatorial lakes Olbolosat and Oloiden in Kenya (Africa).

Catherine Wachera Kiama, Moses Mucugi Njire, Anne Kelly Kambura, Julius Ndirangu Mugweru, Viviene Njeri Matiru, Eliud Nalianya Wafula, Robert Nesta Kagali, Josiah Ochieng Kuja (2021)

Abstract

Total community 16S rDNA was used to determine the diversity and composition of bacteria and archaea within lakes Olbolosat and Oloiden in Kenya. The V3-V4 hypervariable region of the 16S rRNA gene was targeted since it's highly conserved and has a higher resolution for lower rank taxa. High throughput sequencing was performed on 15 samples obtained from the two lakes using the Illumina Miseq platform. Lakes Olbolosat and Oloiden shared 280 of 10,523 Amplicon Sequence Variants (ASVs) recovered while the four sample types (water, microbial mats, dry and wet sediments) shared 4 ASVs. The composition of ASVs in lake Olbolosat was highly dependent on Cu⁺, Fe²⁺, NH₄⁺, and Mn²⁺, while L. Oloiden was dependent on Mg²⁺, Na⁺, Ca²⁺, and K⁺. All the alpha diversity indices except Simpson were highest in the dry sediment sample (EC1 and 2) both from lake Oloiden. The abundant phyla included Proteobacteria (33.8%), Firmicutes (27.3%), Actinobacteriota (21.2%), Chloroflexi (6.8%), Cyanobacteria (3.8%), Acidobacteriota (2.8%), Planctomycetota (1.9%) and Bacteroidota (1.1%). Analysis of similarity (ANOSIM) revealed a significant difference in ASV composition between the two lakes ($r = 0.191$, $p = 0.048$), and between the sample types ($r = 0.6667$, $p = 0.001$). The interaction network for prokaryotic communities within the two lakes displayed Proteobacteria to be highly positively connected with other microbes. PERMANOVA results suggest that temperature controls the functioning of the two ecosystems.

iCMoB 2021-08

Carica Papaya Leaf Extract Silver Synthesized Nanoparticles Inhibit Dengue Type 2 Viral Replication *in Vitro*

Antonia Windkouni Bere, Omuyundo Mulati, James Kimotho, and Florence Ng'ong'a (2021)

Abstract

The current global occurrence of dengue infection annually is approximately 400 million, with a case fatality rate of 2.5%. However, there are no antiviral agents. *Carica papaya* leaf extract is known for its medicinal value, due to the presence of organic compounds that possess antimicrobial, anti-inflammatory, and antioxidant activities. This study determined the anti-dengue effect of *C. papaya* leaf extract silver synthesized nanoparticles. In this study, aqueous and non-aqueous extractions were carried out, followed by the synthesis of silver nanoparticles as well as characterization through Fourier transform infrared spectroscopy (FTIR) and scanning electron microscopy. The in vitro anti-dengue effect was evaluated using a focus reduction neutralization test on kidney Vero E2 cell lines. In silico studies involved molecular docking to determine the potential interactions between the bioactive compounds in *C. papaya* leaf extract and the viral NS5 protein. *C. papaya* leaf methanol extract silver synthesized nanoparticle was the most promising with an IC₅₀ of 9.20 µg/mL. Molecular docking showed 5,7 dimethoxycoumarin as the best ligand, with binding energy of -7.75 kcal/mol, indicating high affinity for the NS5 protein. These results highlight that *C. papaya* leaf methanol extract silver synthesized nanoparticles could be used to inhibit dengue virus type 2 viral replication. However, we recommend further studies to determine their toxicity and the safety profiles.

Keywords: dengue virus, *Carica papaya*, silver nanoparticles, antiviral activity

iCMoB 2021-09

Urinary Tract Infection among Adults Seeking Medicare at Kiambu Level 5 Hospital, Kenya: Prevalence, Diversity, Antimicrobial Susceptibility Profiles and Possible Risk Factors.

Wanja, F., Ngugi, C., Omwenga, E., Maina, J. and Kiiru, J. (2021). *Advances in Microbiology*, 11, 360-383. doi: [10.4236/aim.2021.118028](https://doi.org/10.4236/aim.2021.118028).

Abstract

Urinary tract infections are among the most prevalent extra-intestinal infections, with high prevalence globally. This cross-sectional study established prevalence of bacterial aetiology causing urinary tract infection (UTI) and their antimicrobial susceptibility profiles. A questionnaire was used to capture socio-demographic data and possible UTI risk factors among the 206 consented adults seeking medicare at Kiambu Level 5 Hospital. The collected midstream urine samples were subjected to dipstick analysis, microscopy and culture for UTI diagnosis. Results: The overall prevalence rate of UTIs was 27.6%, with women's prevalence rate being significantly higher at 80.7% compared to men 19.2%. Pregnant women had UTI prevalence at 34% which was higher than other sets of participants. Women who did not frequently change their underpants daily had a higher UTI cases at 34.8%. *Escherichia coli*, *Staphylococcus aureus* and *Klebsiella pneumoniae* were the most prevalent bacterial pathogens at 38.5%, 21% and 19.3%, respectively. Antimicrobial sensitivity analysis revealed high resistances towards Sulfamethoxazole and Ampicillin at range between 50% - 85%, suggesting that these drugs are no longer effective for UTI empirical treatment. The resistance patterns towards Cefotaxime, Cefepime and Ciprofloxacin were below 40%. However, more resistance patterns at a range between 14% - 40% revealed towards Amoxicillin-clavulanic and Nitrofurantoin imply that these are drugs remain potent but there is the need to revise the current UTI management guidelines. In addition, to elude treatment failure, innovation of

prophylactic measures is key to halt UTI contraction and offer support to pharmaceutical industries that have fewer new antibiotics in the pipeline.

iCMoB 2021-10

Screening for antifolate and artemisinin resistance in *Plasmodium falciparum* clinical isolates from three hospitals of Eritrea

Harriet Natabona Mukhongo, Johnson Kang'ethe Kinyua, Yishak Gebrekidan Weldemichael², Remmy Wekesa Kasili (2021).

Abstract

Background: Antimalarial drug resistance is a major challenge hampering malaria control and elimination. *Plasmodium falciparum*, the leading causative parasite species, has developed resistance to basically all antimalarials. Continued surveillance of drug resistance using genetic markers provides important molecular data for treatment policies. This study sought to verify the genetic mechanism of resistance to sulfadoxine- pyrimethamine and assess the occurrence of point mutations associated with artemisinin resistance in *P. falciparum* clinical isolates from Eritrea.

Methods: Nineteen dried blood spot samples were collected from patients visiting Adi Quala, Keren and Gash Barka Hospitals, Eritrea. The patients were followed up after receiving treatment with first line artesunate- amodiaquine. Nested polymerase chain reaction and Sanger sequencing techniques were employed to genotype point mutations in the *P. falciparum* bifunctional dihydrofolate reductase-thymidylate synthase (*Pfdhfr*, PF3D7_0417200), dihydropteorate synthase (*Pfdhps*, PF3D7_0810800) and kelch 13 (*PfK13*, PF3D7_1343700) genes.

Results: Eight of nineteen (42%) of the dried blood spot samples were successful for PCR-amplification. Data analyses of the PCR-positive isolates revealed the following point mutations: *Pfdhfr* N51I in four isolates, C59R in one isolate, S108N in four isolates, a rare non-synonymous substitution V45A in four isolates and *Pfdhps* K540E in four isolates. No *PfK13* point mutations were reported.

Conclusions: *Pfdhfr* C59R and *Pfdhps* K540E point mutations are reliable markers for the sulfadoxine-pyrimethamine quintuple mutant haplotype combination. These findings highlight first reports in Eritrea, which verify the underlying genetic mechanism of antifolate resistance. Continuous monitoring of the *PfK13* marker is recommended.

iCMoB 2021-11

Enrichment approach for unbiased sequencing of respiratory syncytial virus directly from clinical samples

Jacqueline Wahura Waweru, Zaydah de Laurent, Everlyn Kamau, Khadija Said, Elijah Gicheru, Martin Mutunga, Caleb Kibet, Johnson Kinyua, D James Nokes, Charles Sande, George Githinji (2021).

Abstract

Background: Nasopharyngeal samples contain higher quantities of bacterial and host nucleic acids relative to viruses; presenting challenges during virus metagenomics sequencing, which underpins agnostic sequencing protocols. We aimed to develop a viral enrichment protocol for unbiased whole-genome sequencing of respiratory syncytial virus (RSV) from nasopharyngeal samples using the Oxford Nanopore Technology (ONT) MinION platform.

Methods: We assessed two protocols using RSV positive samples. Protocol 1 involved physical pre-treatment of samples by centrifugal processing before RNA extraction, while Protocol 2 entailed direct RNA extraction without prior enrichment. Concentrates from Protocol 1 and RNA extracts from Protocol 2 were each divided into two fractions; one was DNase treated while the other was not. RNA was then extracted from both concentrate fractions per sample and RNA from both protocols converted to cDNA, which was then amplified using the tagged Endoh primers through Sequence-Independent Single-Primer Amplification (SISPA) approach, a library prepared, and sequencing done. Statistical significance during analysis was tested using the Wilcoxon signed-rank test.

Results: DNase-treated fractions from both protocols recorded significantly reduced host and bacterial contamination unlike the untreated fractions (in each protocol $p < 0.01$). Additionally, DNase treatment after RNA extraction (Protocol 2) enhanced host and bacterial read reduction compared to when done before (Protocol 1). However, neither protocol yielded whole RSV genomes. Sequenced reads mapped to parts of the nucleoprotein (N gene) and polymerase complex (L gene) from Protocol 1 and 2, respectively. Conclusions: DNase treatment was most effective in reducing host and bacterial contamination, but its effectiveness improved if done after RNA extraction than before. We attribute the incomplete genome segments to amplification biases resulting from the use of short length random sequence (6 bases) in tagged Endoh primers. Increasing the length of the random nucleotides from six hexamers to nine or 12 in future studies may reduce the coverage biases.

iCMoB 2021-12

Expression of The Fab Enzymes (Fab I and Fab Z) From Plasmodium Falciparum After Exposure to Artemisia Afra Plant Extracts and Drugs Screening

Ndeye Fatou, Mutinda Cleophas Kyama, Ahmed Hassanali Mouhamadou Diallo Francis Kimani (2021).

Abstract

Malaria is still a big concern into the Africa health system due to its high number of death yearly. Africa is the most affected where more than 90% of the death occur in those sub-Saharan countries. Today we are facing a big challenge concerning the spread of the resistance to main drugs widely spread in South East Asia a treat that can drive into Africa. New indigenous gene mutations of the Plasmodium falciparum parasite were discovered in Rwanda in 2020. The mutation is about a new indigenous lineage concerning the pfkelch13 R561H that can drive Artemisinin resistance (1). This raises need for developing new drugs that can overcome that resistance. Researchers are getting more and more focused on the use of medicinal plants as a polytherapy that works better into overcoming parasite resistance. Artemisia afra is one of those promising medicinal plant with a high antimalarial effect and not toxic in high dosage. This plant is growing widely from Cape to the Eastern part of Africa, and where used for decades by traditional healers it is one of the best known medicinal plant. The list of uses covers a wide range of ailments from coughs, colds, fever, loss of appetite, colic, headache, earache, intestinal worms to malaria (2, 3, 4). In this project different strains of malaria parasite W2 (CQ resistant) and D6 (CQ sensitive) were exposed to different extracts of Artemisia afra collected from Burundi, to monitor the expression level of different genes Fab I and Fab Z that belong to the Fab enzymes, type II pathway implied in the fatty acid biosynthesis of the malaria's

parasite. Those Fab enzymes are crucial for the parasites survival and spreading mostly during the liver stage, and are targets for the development of new drugs candidate. Studying their expression when exposing the parasites to the plant extracts can bring a lot of informations about using those genes as target for new drugs.

iCMoB 2021-13

Investigation of single nucleotide polymorphisms in MRPA and AQP-1 genes of *Leishmania donovani* as resistance markers in visceral leishmaniasis in Kenya.

Anna Kapambwe Bwalya, Robinson Mugasiali Irekwa, Amos Mbugua, Matthew Mutinda Munyao, Peter Kipkemboi Rotich, Tonny Teya Nyandwaro, Caroline Wangui Njoroge, Anne Wanjiru Mwangi, Joanne Jepkemei Yego, Shahiid Kiyaga, Samson Muuo Nzou (2021). *Volume 8, Issue 2: 149-160. doi: 10.3934/molsci.2021011*

Abstract

Visceral Leishmaniasis (VL) remains a major public health problem mainly affecting the poorest populations across Asia, Africa, Middle East, Europe, Southern and Central America. For seven-decade now, the first-line drug of choice for leishmaniasis has been pentavalent antimonials. However, the clinical value of these drugs is threatened by the emergence of drug-resistant parasites. Clinical resistance to sodium stibogluconate (pentostam) has been a challenge in the Indian subcontinent, raising concerns for the endemic countries in Africa. This study aimed to identify and describe Single Nucleotide Polymorphism (SNPs) in gene markers associated with drug resistance among the clinical samples. The study was an experimental laboratory investigation on Dry Blood Spots (DBS). DNA was extracted from 18 VL positive samples, and Internal Transcribed Spacer-1 Polymerase Chain Reaction confirmed the positivity. Two target resistance markers, aquaglyceroporin 1 (*AQP-1*) and the Multi-Drug Resistant Protein A (*MRPA*), were PCR-amplified and resulting amplicons sequenced using the Sanger sequencing platform. Multiple sequence alignments were performed using ClustalW, and the phylogenetic tree was constructed in MegaX using the Maximum Likelihood method. A total of 84 SNPs in the *AQP-1* gene were identified from six clinical samples. Fifty-nine of the SNPs (70.2%) were non-synonymous, while 25 (29.8%) were synonymous. Among the non-synonymous SNPs, three (5.1%) were nonsense, and 56 (94.9%) were missense point mutations. Two missense SNPs A188T and E185A in S17608 reported to be associated with drug resistance phenotype were observed. The study describes the resistance associated with the pentostam uptake by *Leishmania donovani*.

iCMoB 2021-14

Artemisinin acts by inhibiting *Plasmodium falciparum* Ddi1, a retropepsin, resulting into the accumulation of ubiquitinated proteins

Noah Machuki Onchieku, Sonam Kumari, Rajan Pandey, Vaibhav Sharma, Mohit Kumar, Arunaditya Deshmukh, Inderjeet Kaur, Asif Mohammed, Dinesh Gupta, Daniel Kiboi, Naseem Gaur, Pawan Malhotra (2021). *doi: https://doi.org/10.1101/2021.07.12.452004*

Abstract

Reduced sensitivity of the human malaria parasite, *Plasmodium falciparum*, to Artemisinin and its derivatives (ARTs) threatens the global efforts towards eliminating malaria. ARTs have been shown to cause ubiquitous cellular and genetic insults, which results in the activation of the unfolded

protein response (UPR) pathways. The UPR restores protein homeostasis, which otherwise would be toxic to cellular survival. Here, we interrogated the role of DNA-damage inducible protein 1 (*PfDdi1*), a unique proteasome- interacting retropepsin in mediating the actions of the ARTs. We demonstrate that *PfDdi1* is an active A₂ family protease that hydrolyzes ubiquitinated substrates. We further show that treatment with ARTs lead to the accumulation of ubiquitinated proteins in the parasites and blocks the destruction of the ubiquitinated substrates by *PfDdi1*. Besides, whereas the *PfDdi1* is predominantly localised in the cytoplasm, exposure of the parasites to ARTs leads to DNA fragmentation and increased recruitment of the *PfDdi1* into the nucleus. Furthermore, *Ddi1* knock-out *Saccharomyces cerevisiae* cells are more susceptible to ARTs and the *PfDdi1* protein robustly restores the corresponding functions in the knock-out cells. Together, these results show that ARTs act by inducing DNA and protein damage, and impairing the damage recovery by inhibiting the activity of *PfDdi1*, an essential ubiquitin- proteasome retropepsin.

iCMoB 2021-15

Mass spectral fragmentation of tithonia diversifolia phytochemicals using gc–ms profiles and green nanoparticle bond formation.

Hellen Chebet, Johnson Kinyua, Patrick Kareru, Njiema Gitaari, Kevin Mbogo, Edward Tirop (2021). *International Research Journal of Modernization in Engineering Technology and Science* Volume:03/Issue:04 pg 1353-1366

Abstract

The phytochemical constituent of local *Tithonia diversifolia* plant growing in Juja central Kenya was analyzed using GC-MS (gas chromatography coupled with mass spectrometer). The main constituents of the plant were cis-3,14- clerodadien-13-ol(17.79%),4-[3,4-dimethoxycyclohexyl]-n-butanol (17.68), phorbol 12,13-dihexanoate (16.62%), butanamide, 2 hydroxy-N 2,3,3 tetramethyl (2.86%),14-methyl-14-(3-oxobutyryloxy)-hexadec 15 enoic acid (8.21%), 3- hydroxy-6-isopropenyl-4,8a-dimethyl (5.15%). These components represent the major ones that are present in the plant. The structures of the compounds were determined based on their electron ionization, molecular mass. The dominant characteristic ions were [M- CH₃]⁺, [M-CH₂]⁺ and [M-H₂O]⁺. The metal ion bound to functional groups in the components with lone pair of electrons/*pi* electrons forming covalent bonds that are strong and stable.

Keyword; *Tithonia diversifolia*, phytochemicals, fragmentation, nanoparticles, GC-MS.

iCMoB 2021-16

Fatty acids composition of Nile tilapia (*Oreochromis niloticus*) fingerlings fed diets containing different levels of water spinach (*Ipomoea aquatica*).

M. Chepkirui, P.S. Orina, M. Opiyo, P. Muendo, K. Mbogo, R. Omondi (2021). *Journal of Agriculture and Food Research* 5 (2021) 100156

Abstract

Fish is a major source of n-3 LC-PUFA for humans. Fatty acids especially n-3 and n-6 polyunsaturated fatty acids (PUFAs) play important role in human health. This study was conducted to evaluate the effects of different inclusion levels of *Ipomoea aquatica* on fatty acids composition of *Oreochromis niloticus* fingerlings. Five diets containing 0%, 5%, 10%, 15% and

20% *Ipomoea aquatica* were formulated. The results indicated that 18 types of fatty acids with different saturation levels were detected. Total saturates, n-3 PUFAs, n-6 PUFAs in all the tissues were not significantly affected by the different levels of *I. aquatica*. Fish fed 10% diet recorded the highest level of muscle docosahexaenoic acid (DHA). The tissue composition of docosahexaenoic acid (DHA) was significantly higher than eicosapentaenoic acid (EPA). There was an increase in PUFAs with increased levels of *I. aquatica*. There was no significant difference ($P > 0.05$) in fatty acids in all the tissues. The study suggests that 20% dietary inclusion of *I. aquatica* resulted into high DHA in all tissues thus *I. aquatica* can be used to increase fatty acid.

iCMoB 2021-17

The fungus *Leptosphaerulina* persists in *Anopheles gambiae* and induces melanization.

Godfrey Nattoh, Joel L. Bargul, Gabriel Magoma, Lilian Mbaisi Hellen Butungi, Enock Mararo, Evan Teal, Jeremy Keith Herren (2021). <https://doi.org/10.1371/journal.pone.0246452>

Abstract

Anopheles mosquitoes are colonized by diverse microorganisms that may impact on host biology and vectorial capacity. Eukaryotic symbionts such as fungi have been isolated from *Anopheles*, but whether they are stably associated with mosquitoes and transmitted transstadially across mosquito life stages or to subsequent generations remains largely unexplored. Here, we show that a *Leptosphaerulina* sp. fungus isolated from the midgut of *An. gambiae* can be stably associated with *An. gambiae* host and that it imposes low fitness cost when re-introduced through co-feeding. This fungus is transstadially transmitted across *An. gambiae* developmental stages and to their progeny. It is present in field-caught larvae and adult mosquitoes at moderate levels across geographical regions. We observed that *Leptosphaerulina* sp. induces a distinctive melanotic phenotype across the developmental stages of mosquito. As a eukaryotic symbiont that is stably associated with *An. gambiae* *Leptosphaerulina* sp. can be explored for paratransgenesis.

iCMoB 2021-18

Supplementing Blood Diet with Plant Nectar Enhances Egg Fertility in *Stomoxys calcitrans*

Simon K. Tawich, Joel L. Bargul, Daniel Masiga,¹ and Merid N. Getahun (2021).[doi: 10.3389/fphys.2021.646367](https://doi.org/10.3389/fphys.2021.646367)

Abstract

Stomoxys calcitrans (stable fly) is a cosmopolitan biting fly of both medical and veterinary importance. Unlike blood-feeding-related behavior of stable fly, its plant feeding, the fitness value, and the *S. calcitrans*–plant interaction is less understood. Here we show based on two chloroplast DNA genes, ribulose biphosphate carboxylase large chain (*rbcL*) and the intergenic spacer gene *trnH-psbA*, that field-collected male and female stable flies fed on various plant species. We investigated the fitness cost of plant feeding using *Parthenium hysterophorus*, one of the plant species identified to have been fed on by the field-collected flies. Supplementation of blood feeding with a flowering *P. hysterophorus* plant as nectar source enhanced egg hatchability significantly as compared to blood alone, showing the fitness value of nectar supplementation. However, nectar supplementation did not affect the number of eggs laid or longevity of *S. calcitrans* as compared to flies that fed on blood alone. *S. calcitrans* maintained on sugar alone failed to lay eggs. The various plants stable flies fed on demonstrated chemodiversity with their own signature scent. The

behavioral response of *S. calcitrans* to these signature compounds varied from strong attraction (γ -terpinene) to neutral (linalool oxide and myrcene) to repellency (butanoic acid). Our study demonstrated that stable flies feed on nectar, and plant nectar supplementation of blood feeding enhanced larval emergence. Thus, our result has implication in stable fly reproduction, survival, disease transmission, boosting laboratory colony, and the possibility of using plant-derived odors for mass trapping of stable fly, for instance, using γ -terpinene.

Keywords: *Stomoxys calcitrans*, nectar feeding, insect-plant interaction, fertility, larval emergence

iCMoB 2021-19

Genomic analysis reveals independent evolution of *Plasmodium falciparum* populations in Ethiopia.

Deriba Abera, Caleb K. Kibet, Teshome Degefa, Lucas Amenga-Etego, **Joel L. Bargul** & Lemu Golassa (2021). *Malaria Journal* volume 20, Article number: 129

Abstract

Background: *Plasmodium falciparum* parasite populations in Ethiopia have been experiencing local selective pressures from drugs and immunity, leading to evolutionary adaptation. However, there was a paucity of data on genomic characterization and evolutionary adaptations of *P. falciparum* isolates from the central area of Ethiopia.

Methods: Whole-genome analysis of 25 *P. falciparum* isolates from central Ethiopia, specifically from West Arsi, were studied to determine their genetic diversity, population structures, and signatures of selection in known drug resistance alleles against global isolates from Cambodia, Thailand, DR Congo, and Malawi.

Results: A total of 18,517 high-quality single-nucleotide polymorphisms (SNPs) were identified in Ethiopian *P. falciparum* isolates. About 84% of the Ethiopian *P. falciparum* isolates had a FWS value >0.95 showing a dominant single genotype infection in most isolates at the time of collection with little potential for out-crossing as expected in areas with low transmission intensity. Within-host diversity of Ethiopian infections was significantly different from East Africa ($p < 0.001$), but not Southeast Asian infections ($P > 0.05$). A significant population structure has been observed by PCA and population differentiation between Ethiopian parasites and East African ($F_{st} \sim 10\%$) and Southeast Asian populations ($F_{st} \sim 18\%$), suggesting limited gene flow and the independent evolution of the Ethiopian parasite population. Moreover, a total of 125 genes under balancing selection was found that include *ama1*, *trap*, *eba175*, and *lsa3*, previously identified as targets of human host immunity. Recent directional selection analysis using integrated standardized haplotype score (IHS) did not detect any selection signatures in the *Pfcr1*, *Pfdhfr*, *Pfdhps*, *Pfmdr1*, and *PfK13* genes. However, known drug resistance-conferring mutations analysis showed that at least one SNP marker was fixed in these genes, but not in *Pfdhps* and *PfK13*.

Conclusion: *Plasmodium falciparum* populations in the central region of Ethiopia was structurally diverged from both Southeast Asian and other East African populations. Malaria infections in Ethiopia had low within-host diversity, and parasites carry fixed chloroquine resistance markers despite the withdrawal of this drug for the treatment of *P. falciparum*.

iCMoB 2021-20

Extracellular vesicles on host peripheral blood mononuclear cells

Shaban J. Mwangi, Agnes Gwela, Kioko Mwikali, **Joel L. Bargul**, Eunice W. Nduati, Francis M. Ndungu, Philip Bejon, Julian C. Rayner, Abdirahman I. Abd (2021).

Abstract

Background: Exaggerated immune activation has a key role in the pathogenesis of malaria. During blood-stage infection, *Plasmodium falciparum* can interact directly with host immune cells through infected red blood cells (PfiRBCs), or indirectly by the release of extracellular vesicles (EVs). Here, we compared the impact of PfiRBCs and *P. falciparum* small-sized EVs (PfsEVs, also known as exosomes) from a Kenyan clinical isolate (PfKE12) adapted to short-term laboratory culture conditions on host peripheral blood mononuclear cells (PBMC). Methods: PfsEVs were isolated from cell-free culture-conditioned media by ultracentrifugation while mature trophozoite PfiRBCs were purified by magnetic column separation. The PfsEVs and the PfiRBCs were co-cultured for 18 hours with PBMC. Cellular responses were quantified by cell surface expression of activation markers (CD25, CD69) and cytokine/chemokine levels in the supernatant. Results: Relative to negative control conditions, PfsEVs induced CD25 expression on CD4+, CD19+ and CD14+ cells, while PfiRBCs induced on CD19+ and CD14+ cells. Both PfsEVs and PfiRBCs induced CD69 on CD4+, CD8+ and CD19+ cells. In addition, PfiRBCs induced higher expression of CD69 on CD14+ cells. CD69 induced by PfiRBCs on CD4+ and CD19+ cells were significantly higher than that induced by PfsEVs. Secretion of MIP1 α , MIP1 β , GM-CSF, IL-6, IL-8, and TNF α were significantly induced by both PfsEVs and PfiRBCs whereas MCP-1, IL-10, IL-17 α were preferentially induced by PfsEVs and IP-10 and IFN- γ by PfiRBCs. Prior exposure to malaria

iCMoB 2021-21

Transmission of *Candidatus Anaplasma camelii* to laboratory animals by camel-specific keds, *Hippobosca camelina*

Joel L. Bargul, Kevin O. Kidambasi, Merid N. Getahun¹, Jandouwe Villinger, Robert S. Copeland, Jackson M. Muema, Mark Carrington, Daniel K. Masiga (2021)

<https://doi.org/10.1101/2021.04.02.438174>

Abstract

Anaplasmosis, caused by infection with bacteria of the genus *Anaplasma* is an important veterinary and zoonotic disease. The characterization of transmission has concentrated on ticks and little is known about non-tick vectors of livestock anaplasmosis. This study investigated the presence of *Anaplasma* spp. in camels in northern Kenya and whether the hematophagous camel ked, *Hippobosca camelina*, acts as a vector. Camels (n = 976) and >10,000 keds were sampled over a three-year study period and the presence of *Anaplasma* species was determined by PCR-based assays targeting the *Anaplasma* tetracycline resistance gene. Camels were infected by 'Candidatus *Anaplasma camelii*' occurring from 63-78% during the dry (September 2017), wet (June-July 2018), and late wet seasons (July-23 August 2019). 10-29% of camel keds harbored 'Ca. *Anaplasma camelii*' acquired from infected camels during blood feeding. We determined whether *Anaplasma* positive camel keds could transmit 'Ca. *Anaplasma camelii*' to small laboratory animals via blood-feeding. We show competence in pathogen transmission and subsequent

infection in mice and rabbits by both direct detection in blood smears and subsequent molecular identification by PCR. Transmission of 'Ca. Anaplasma camellii' to mice (8- 47%) and rabbits (25%) occurred readily after tick bites. Hence, we demonstrate, for the first time, the potential of *H. camelina* as a vector of anaplasmosis. This key finding provides the basis for establishing tick control programmes for improvement of livestock and human health.

iCMoB 2021-22

Identification of a rapidly-spreading triple mutant for high-level metabolic insecticide resistance in *Anopheles gambiae* provides a real-time molecular diagnostic for anti-malarial intervention deployment

Harun Njoroge, Arjen van't Hof, Ambrose Oruni¹, Dimitra Pipini¹, Sanjay C. Nagi, Amy Lynd, Eric R. Lucas¹, Sean Tomlinson¹, Xavi Grau-Bové, Daniel Mc Dermott, Francis T. Watsenga, Emile Z. Manzambi, Fiacre R. Agossa, Arlette Mokuba, Bilali Kabula, Charles Mbogo, Joel Bargul Mark J.I. Paine¹, David Weetman¹ and Martin J. Donnell (2021)

Abstract

Insecticide resistance provides both an increasingly pressing threat to the control of vector-borne diseases and insights into the remarkable capacity of natural populations to show rapid evolutionary responses to contemporary selection. Malaria control remains heavily dependent on deployment of pyrethroid insecticides, primarily in long lasting insecticide treated nets (LLINs), but resistance in the major malaria vectors has increased over the last 15 years in concert with dramatic expansion of LLIN distributions. Identifying genetic mechanisms causing high-level resistance in mosquitoes, which may almost entirely overcome pyrethroid efficacy, is crucial for the development and deployment of potentially resistance-breaking tools. Using the *Anopheles gambiae* 1000 genomes (Ag1000g) data we identified a very recent selective sweep in Ugandan mosquitoes which localized to a cluster of cytochrome P450 genes, including some commonly implicated in resistance. Further interrogation revealed a haplotype involving a trio of mutations, a nonsynonymous point mutation in Cyp6p4 (I236M), an upstream insertion of a partial Zanzibar-like transposable element (TE) and a duplication of the Cyp6aa1 gene. The mutations appear to have originated recently in *An. gambiae* from the Kenya-Uganda border region around Lake Victoria, with stepwise replacement of the double-mutant (Zanzibar-like TE and Cyp6p4-236M) with the triple-mutant haplotype (including Cyp6aa1 duplication), which is hTanzania. The triple-mutant haplotype is strongly associated with increased expression of genes able to metabolise pyrethroids; is strongly predictive of resistance to pyrethroids most notably deltamethrin, a commonly-used LLIN insecticide, but importantly, appears less effective against nets co-treated with the synergist piperonyl butoxide (PBO). Frequencies of the triple-mutant haplotype remain spatially variable within countries, suggesting an effective marker system to guide deployment decisions for limited supplies of PBO-pyrethroid co-treated LLINs across African countries. Duplications of Cyp6aa1 gene are common in *An. gambiae* across Africa and are likely to be a useful diagnostic for high levels of pyrethroid resistance.

iCMoB 2021-23

Gene co-expression network analysis of *Trypanosoma brucei* in tsetse fly vector. *Parasites & Vectors*

Kennedy W. Mwangi Rosaline W. Macharia & Joel L. Bargul (2021). volume 14, Article number: 74

Abstract

Trypanosoma brucei species are motile protozoan parasites that are cyclically transmitted by tsetse fly (genus *Glossina*) causing human sleeping sickness and nagana in livestock in sub-Saharan Africa. African trypanosomes display digenetic life cycle stages in the tsetse fly vector and in their mammalian host. Experimental work on insect-stage trypanosomes is challenging because of the difficulty in setting up successful *in vitro* cultures. Therefore, there is limited knowledge on the trypanosome biology during its development in the tsetse fly. Consequently, this limits the development of new strategies for blocking parasite transmission in the tsetse fly.

Methods: In this study, RNA-Seq data of insect-stage trypanosomes were used to construct a *T. brucei* gene co-expression network using the weighted gene co-expression analysis (WGCNA) method. The study identified significant enriched modules for genes that play key roles during the parasite's development in tsetse fly. Furthermore, potential 3' untranslated region (UTR) regulatory elements for genes that clustered in the same module were identified using the Finding Informative Regulatory Elements (FIRE) tool.

Results: A fraction of gene modules (12 out of 27 modules) in the constructed network were found to be enriched in functional roles associated with the cell division, protein biosynthesis, mitochondrion, and cell surface. Additionally, 12 hub genes encoding proteins such as RNA-binding protein 6 (RBP6), arginine kinase 1 (AK1), *brucei* alanine-rich protein (BARP), among others, were identified for the 12 significantly enriched gene modules. In addition, the potential regulatory elements located in the 3' untranslated regions of genes within the same module were predicted.

Conclusions: The constructed gene co-expression network provides a useful resource for network-based data mining to identify candidate genes for functional studies. This will enhance understanding of the molecular mechanisms that underlie important biological processes during parasite's development in tsetse fly. Ultimately, these findings will be key in the identification of potential molecular targets for disease control.

iCMoB 2021-24

Fine scale human genetic structure in three regions of Cameroon reveals episodic diversifying selection.

Kevin K. Esoh, Tobias O. Apinjoh, Steven G. Nyanjom, Ambroise Wonkam, Emile R. Chimusa, Lucas Amenga-Etego, Alfred Amambua-Ngwa & Eric A. Achidi (2021). *Scientific Reports* volume 11, Article number: 1039 (2021)

Abstract

Inferences from genetic association studies rely largely on the definition and description of the underlying populations that highlight their genetic similarities and differences. The clustering of human populations into subgroups (population structure) can significantly confound disease associations. This study investigated the fine-scale genetic structure within Cameroon that may underlie disparities observed with Cameroonian ethnicities in malaria genome-wide association

studies in sub-Saharan Africa. Genotype data of 1073 individuals from three regions and three ethnic groups in Cameroon were analyzed using measures of genetic proximity to ascertain fine-scale genetic structure. Model-based clustering revealed distinct ancestral proportions among the Bantu, Semi-Bantu and Foulbe ethnic groups, while haplotype-based coancestry estimation revealed possible longstanding and ongoing sympatric differentiation among individuals of the Foulbe ethnic group, and their Bantu and Semi-Bantu counterparts. A genome scan found strong selection signatures in the HLA gene region, confirming longstanding knowledge of natural selection on this genomic region in African populations following immense disease pressure. Signatures of selection were also observed in the *HBB* gene cluster, a genomic region known to be under strong balancing selection in sub-Saharan Africa due to its co-evolution with malaria. This study further supports the role of evolution in shaping genomes of Cameroonian populations and reveals fine-scale hierarchical structure among and within Cameroonian ethnicities that may impact genetic association studies in the country.

iCMoB 2021-25

Insecticide Resistance Status of *Anopheles Arabiensis* in Irrigated and Non-Irrigated Areas in Western Kenya.

Pauline Orondo, Steven Nyanjom, Harrysone Atieli, John Githure et al (2021).

DOI:<https://doi.org/10.21203/rs.3.rs-139000/v1>

Abstract

Background: Malaria control in Kenya is based on case management and vector control using longlasting insecticidal nets (LLINs) and indoor residual spraying (IRS). Irrigation practices maintain vector population and thus transmission during dry season. Development of insecticide resistance further compromises the effectiveness of insecticide-based vector control programs. The aim of this study was to assess the status and mechanism of insecticide resistance in malaria vectors in irrigated and non-irrigated areas in western Kenya and the contribution of public health interventions and agriculture to insecticide resistance. Methodology: The study was carried out in 2018–2019 in Homa Bay County, western Kenya. Anopheline larvae were collected in irrigated and non-irrigated.

iCMoB 2021-26

***Annona Muricata* Silver Nanoparticles Exhibit Strong Anticancer Activities Against Cervical and Prostate Adenocarcinomas Through Regulation of CASP9 and The CXCL1/CXCR2 Genes Axis.**

Gavamukulya Yahaya, Maina Esther N., El-Shemy Hany A., Meroka Amos M., Kangogo Geoffrey K., Magoma Gabriel, Wamunyokoli Fred (2021) *Tumor Biology*, vol. 43, no. 1, pp. 37-55. DOI: [10.3233/TUB-200058](https://doi.org/10.3233/TUB-200058)

Abstract:

Green synthesized nanoparticles have been earmarked for use in nanomedicine including for the development of better anticancer drugs.

Objective: The aim of this study was to undertake biochemical evaluation of anticancer activities of green synthesized silver nanoparticles (AgNPs) from ethanolic extracts of fruits (AgNPs-F) and leaves (AgNPs-L) of *Annona muricata*.

Methods: Previously synthesized silver nanoparticles were used for the study. The effects of the AgNPs and 5-Fluorouracil were studied on PC3, HeLa and PNT1A cells. The resazurin, migration and colonogenic assays as well as qRT-PCR were employed.

Results: The AgNPs-F displayed significant antiproliferative effects against HeLa cells with an IC₅₀ of 38.58µg/ml and PC3 cells with an IC₅₀ of 48.17µg/ml but selectively spared normal PNT1A cells (selectivity index of 7.8), in comparison with first line drug 5FU and AgNPs-L whose selectivity index were 3.56 and 2.26 respectively. The migration assay revealed potential inhibition of the metastatic activity of the cells by the AgNPs-F while the colonogenic assay indicated the permanent effect of the AgNPs-F on the cancer cells yet being reversible on the normal cells in contrast with 5FU and AgNPs-L. *CASP9* was significantly over expressed in all HeLa cells treated with the AgNPs-F (1.53-fold), AgNPs-L (1.52-fold) and 5FU (4.30-fold). *CXCL1* was under expressed in HeLa cells treated with AgNPs-F (0.69-fold) and AgNPs-L (0.58-fold) and over expressed in cells treated with 5FU (4.95- fold), but the difference was not statistically significant. *CXCR2* was significantly over expressed in HeLa cells treated with 5FU (8.66-fold) and AgNPs-F (1.12-fold) but under expressed in cells treated with AgNPs-L (0.76-fold).

Conclusions: Here we show that biosynthesized AgNPs especially AgNPs-F can be used in the development of novel and better anticancer drugs. The mechanism of action of the AgNPs involves activation of the intrinsic apoptosis pathway through upregulation of *CASP9* and concerted down regulation of the *CXCL1/CXCR2* gene axis.

iCMoB 2021-27

Prevalence of asymptomatic *P. falciparum* gametocyte carriage in schoolchildren and assessment of the association between gametocyte density, multiplicity of infection and mosquito infection prevalence

Abdoulie O. Touray, Victor A. Mobegi, Fred Wamunyokoli, Hellen Butungi, Jeremy K. Herren (2021). <https://doi.org/10.12688/wellcomeopenres.16299.2>

Abstract

Background: Asymptomatic *Plasmodium falciparum* gametocyte carriers are reservoirs for sustaining transmission in malaria endemic regions. Gametocyte presence in the host peripheral blood is a predictor of capacity to transmit malaria. However, it does not always directly translate to mosquito infectivity. Factors that affect mosquito infectivity include, gametocyte sex-ratio and density, multiplicity of infection (MOI), and host and vector anti-parasite immunity. We assess the prevalence of gametocyte carriage and some of its associated risk factors among asymptomatic schoolchildren in Western Kenya and to further analyse the association between gametocyte density, multiplicity of infection (MOI) and mosquito infection prevalence. **Methods:** *P. falciparum* parasite infections were detected by RDT (Rapid Diagnostic Test) and microscopy among schoolchildren (5-15 years old). Blood from 37 microscopy positive gametocyte carriers offered to laboratory reared *An. gambiae* s.l. mosquitoes. A total of 3395 fully fed mosquitoes were screened for *Plasmodium* sporozoites by ELISA. *P. falciparum* was genotyped using 10 polymorphic microsatellite markers. The association between MOI and gametocyte density and mosquito infection prevalence was investigated. **Results:** A significantly higher prevalence of *P.*

falciparum infection was found in males 31.54% (764/2422) (p-value < 0.001) compared to females 26.72% (657/2459). The microscopic gametocyte prevalence among the study population was 2% (84/4881). Children aged 5-9 years have a higher prevalence of gametocyte carriage (odds ratios = 2.1 [95% CI = 1.3–3.4], P = 0.002) as compared to children aged 10-15 years. After offering gametocyte positive blood to *An. Gambiae* s.l. by membrane feeding assay, our results indicated that 68.1% of the variation in mosquito infection prevalence was accounted for by gametocyte density and MOI (R-SQR. = 0.681, p < 0.001). Conclusions: We observed a higher risk of gametocyte carriage among the younger children (5-9 years). Gametocyte density and MOI significantly predicted mosquito infection prevalence.

Keywords. *P. falciparum*, asymptomatic, gametocyte density, MOI, mosquito infection prevalence, Mbita.

iCMoB 2021-28

Molecular Detection of Drug-Resistant Mycobacterium tuberculosis in Sputum Specimens from the New and Previously Treated Tuberculosis Cases at the National Reference Chest Diseases Laboratory in Lusaka, Zambia

Mumena DK, Kwenda G, Ngugi CW, Nyerere AK.

J Biomed Res Environ Sci. 2021 Apr 15; 2(4): 232- 243. doi: 10.37871/jbres1218, Article ID: JBRES1218

Abstract

Background: Drug-Resistant Tuberculosis (DR-TB) is one of the major public health issues globally. Zambia is highly burdened by TB and multi-drug resistant TB. In this study, sputum samples obtained from the new and previously treated cases of TB were examined for drug-resistant Mycobacterium tuberculosis (MTB).

Methods: Sputum specimens were processed using the N-Acetyl-L-cysteine-sodium hydroxide method, stained and examined using fluorescent technique and microscopy respectively. Mycobacterial DNA was extracted using the Genolyse kit, then subjected to multiplex polymerase chain reaction amplification and reverse hybridization. Drug-resistance and mutations in MTB genes were detected using the Genotype MTBDRplus VER 2.0 and MTBDRsl VER 2.0 assays.

Results: A total of 329 MTB-positive sputum specimens, 102 from the new TB cases and 227 from previously treated TB cases, were analysed for drug-resistance. Among the new TB cases, 3.9% had Rifampicin (RIF) mono-resistance, 12.8% Isoniazid (INH) mono-resistance, and 17.7% had Multi-Drug Resistance (MDR). For the previously treated TB cases, 10.1% had RIF mono-resistance, 6.6% INH mono-resistance, 33.0% MDR, 1.8% poly-drug resistance, and 0.8% had pre-Extensively Drug-Resistance (pre-XDR). Mutations identified were rpoB (Ser531Leu, His526Asp, Asp516Val, His526Tyr, and Glu510His), katG (Ser315Thr 1 and Ser315Thr 2), InhA (Cys15Thr), gyrA (Ala90Val and Asp94Gly), and eis (Cys14Thr), each with a varying frequency.

Conclusion: DR-TB is prevalent, especially MDR-TB, which is currently the most worrisome form of DR-TB and an emerging threat hampering efforts in the control of TB in Zambia. The early detection and effective treatment of TB cases are key in the control of DR-TB.

iCMoB 2021-29

Prevalence, Species Distribution and Antifungal Susceptibility Profile of Candida Species Isolated from Bloodstream of Critical Care Unit Patients in a Tertiary Care Hospital in Kenya

Danait Andemichael Solomon, Andrew K. Nyerere, Alice Kanyua, Caroline Wangari Ngugi..

Open Journal of Medical Microbiology Vol.11 No.1, March 11, 2021.
DOI: 10.4236/ojmm.2021.1111003

Abstract

The upsurge of candidemia in the past years has been an immense encumbrance on public health and the number of deaths caused by candidemia particularly in critical care unit patients is devastating. *Candida* species harbor a 30% - 60% mortality rate and compared to stable people or those with less serious illnesses, this ranges from 60% to 80% of those who are chronically ill patients. Grounded on a recent report from a tertiary care hospital in Kenya showing the emergence of previously unobserved species: *Candida auris*, this study aimed to determine the prevalence, species distribution, and antifungal susceptibility profile of candidemia in critical care unit patients of the hospital. 378 Critical Care Unit patients were enrolled for the study from January 2019 to January 2020. Positive archived isolates were sub-cultured using Sabouraud Dextrose Agar. *Candida* species were identified utilizing API20C AUX and Vitek-2. Antifungal susceptibility testing was conducted using the Liofilchem MIC Test strip. Out of 378 patients, thirty-one presented a positive culture for *Candida* species. The prevalence of Candidemia was **8.2%** with **9 (29.03%)** *Candida auris*, **8 (25.81%)** *Candida albicans*, **6 (19.35%)** *Candida parapsilosis*, **3 (9.68%)** *Candida famata*, **3 (9.68%)** *Candida tropicalis*, **1 (3.23%)** *Candida duobushaemolumonii*, and **1 (3.23%)** *Candida lusitanae*. A resistance pattern to Fluconazole was observed among *Candida auris* and *Candida parapsilosis*, and resistance to Flucytosine was observed in *Candida tropicalis*, whereas susceptible MIC values were obtained for the other drugs. There is an increase in candidemia among critical care unit patients in the health facility posing a public health challenge. Moreover, the onset of new species *Candida auris* which is unprecedented in Kenya warrants enhanced infection control, and the uniform resistance of *Candida auris*, *Candida parapsilosis*, and *Candida tropicalis* towards Fluconazole and Flucytosine necessitate constant drug monitoring for empirical treatment regime. In contrast, the high potency of Echinocandins and Amphotericin-B demonstrate them as the drug of choice.

Keywords:Critical Care Unit, *Candida* Species, *Candida auris*, Candidemia, Antifungal Susceptibility

1.2. Compilation of Abstracts from iPIC Sub-Task Force

iPIC 2021-01

Consolidation Design as an Adaptation Strategy in The Toi Market, In Nairobi, Kenya

Georgia Cardosi, Susan N. Kibue and Mauro Cossu

Enhancing Disaster Preparedness, From Humanitarian Architecture to Community Resilience, pp. 167-187, 2021.

Abstract

Lack of tenure, infrastructure, and services is a risk multiplier at the Toi Market, the second-largest informal market in Nairobi. In this contested trading space, constant risks of demolitions, evictions, conflicts, floods, and fires make the traders' lives precarious. However, since the 1980s, the traders have portrayed an unwavering resilience, withstanding and adapting to threats through design and self-build initiatives. Using design as an analytical lens, we explored adaptation mechanisms through the Toi Market's physical transformations during a period of relative social stability. Consolidation design emerged as an adaptive strategy toward the market's development. Whereas design facilitated the social cohesion needed to secure tenure, its potential was reduced by the traders' reactive measures to demolitions and hazards, which fragmented the design initiatives. Yet, the value of the design processes carried out by nonprofessionals in adverse conditions assuaged the risks and enhanced the slum's consolidation.

Keywords: Adaptive capacities, Herbert Simon, Informal markets, Informal settlements, Longitudinal case study, Nonprofessional design, Spatial organization.

iPIC 2021-02

Evaluation of Different Transmission Modes in Coordinated Homogeneous and Heterogeneous Networks.

A. Onim, S. Musyoki and P. K. Kihato.

International Journal of Scientific and Technology Research, Vol. 10, Issue 1, January 2021.

Abstract

LTE supports different transmission modes such as: Single Input Single Output (SISO), Transmission diversity (TxD) and Multiple Input Multiple Output (MIMO). TxD aims at improving the signal strength at the receiver by using two or more transmit antennas while MIMO techniques are used to increase the throughput according to the number of antennas used. Coordinated Multipoint (CoMP) techniques reduce interference and improve signal strength. Homogeneous networks consist entirely of macrocells while heterogeneous networks (HetNets) have both macrocells and femtocells. HetNets are used to meet increased mobile traffic demands by providing low power nodes closer to the user equipment. This paper reviews popular transmission modes and investigates their performance in both homogeneous and heterogenous CoMP networks. Simulation of the different transmission modes is carried out and results show that CLSM is the best transmission mode to use in in homogeneous networks, and that CLSM and OLSM perform equally well in HetNets, Additionally, HetNets were found to provide significant throughput gains over homogeneous.

iPIC 2021-03

Performance Evaluation of Proportional Fair and Round Robin Schedulers in Two-Layer FFR.

A. Onim, S. Musyoki and P. K. Kihato.

International Journal of Scientific and Technology Research, Vol. 10, Issue 1, January 2021.

Abstract

Different fractional frequency reuse (FFR) schemes have been proposed in literature, with the most common being the two-layer scheme. In this scheme, the cell is divided into an inner region and an outer region. Different frequency sub-bands are used in each region, with the inner region typically having a reuse-1 scheme and the outer region a reuse-3 scheme. This has been shown to be effective in reducing inter-cell interference and subsequently improving reception for the cell edge users. This paper investigates the effect of using different schedulers in the inner and outer regions of a two-layer FFR scheme. The schedulers chosen for evaluation are the proportional fair scheduler and the round robin scheduler. Different scheduler combinations are investigated for various values of β_{FR} to evaluate performance trends. Metrics considered for evaluation are the mean, peak and edge throughput, as well as fairness. Simulation results clearly show that the proportional fair scheduler outperforms the round robin scheduler in both throughput and fairness. We also conclude that optimal FFR performance can only be obtained by trading between throughput (spectral efficiency) and fairness, regardless of any scheduler combination considered.

iPIC 2021-04

Optimal SINR Threshold Selection in Fractional Frequency Reuse Using Otsu's Method.

A. Onim, S. Musyoki and P. K. Kihato.

International Journal of Scientific and Technology Research, Vol. 10, Issue 1, January 2021.

Abstract

Fractional Frequency Re-use (FFR) is a popular technique for controlling inter-cell interference in OFDMA cellular networks. FFR involves dividing each cell into inner and outer layers, with different frequency re-use ratios for each layer. Important design parameters in FFR are the signal-to-interference-plus-noise ratio (SINR) threshold, Γ_{th} , and the frequency allocation ratio, β_{FR} . In conventional FFR schemes, Γ_{th} and β_{FR} are fixed and do not vary with cell conditions. A dynamic FFR scheme is developed where the optimal SINR threshold is determined using Otsu's method, a digital image processing technique. The optimal SINR threshold is calculated based on periodic SINR values in the cells, and β_{FR} then set proportionately to the number of users in each layer. The designed system is evaluated through system-level simulations is found to outperform conventional FFR in terms of both throughput and fairness.

iPIC 2021-05

Hydrodynamic performance study of a fixed–floating asymmetric chamber offshore oscillating water column–wave energy converter

Kiptoo Hillary, Christiaan A. Adenya and Hiram M. Ndiritu

Journal of Sustainable Research in Engineering, Vol. 7(1) 2022, 11 – 30.

Abstract

For the design and optimization processes of Oscillating Water Column (OWC) systems, knowledge of their hydrodynamic performance behavior is essential. While there have been extensive research efforts on understanding the hydrodynamic performance behavior of fixed-floating offshore OWCs, studies focusing on quantifying the effect of applied damping over a broad range of incoming wave heights are limited. Besides, no attempt has thus far been undertaken to optimize the hydrodynamic

efficiency of fixed-floating offshore OWCs using the sequential optimization procedure proposed and used in a 2D onshore OWC in the literature. This paper addresses these omissions by deeply investigating the influence of wave height, wave period, and turbine damping parameters on the hydrodynamic performance behavior of a fixed-floating offshore OWC system. To realize these objectives, a nonlinear 3D incompressible Computational Fluid Dynamics (CFD) model based on the Reynolds-Averaged Navier-Stokes (RANS) equations and the Volume of Fluid (VOF) approach was implemented in the open-source OpenFOAM® suite to numerically simulate fluid-structure interaction under regular wave conditions. The validity of this numerical model was verified using experimental measurements in the literature, where a reasonably good correlation was achieved. The results demonstrate that the aforementioned design parameters strongly affect the device's hydrodynamic performance. It has also been shown through a sequential optimization approach that at an optimum wave period of 1.07 s, optimum wave height of 0.01948 m, and a pneumatic damping value of 0.02 m, about 87% of peak hydrodynamic efficiency is possible for the fixed-floating offshore OWC device used in the study.

Keywords: offshore oscillating water column device, turbine damping, wave height, wave period

iPIC 2021-06

Performance Assessment of Heat Exchangers for Process Heat Integration

Fenwicks Shombe Musonye, Hiram Ndiritu and Robert Kinyua

Energy Engineering, Vol. 118 (2), 2021, pp. 211-224

Abstract

Pinch Analysis is an attractive solution for reduction of thermal energy costs in thermo-chemical industries. In this approach, maximum internally recoverable heat is determined and a heat exchange network is designed to meet the recovery targets. The thermal performance of a heat exchanger over its lifetime is however a concern to industries. Thermal performance of a heat exchanger is affected by many factors which include the physical properties of the shell and tube materials, and the chemical properties of the heat transfer fluid. In this study, thermal performance of shell and tube heat exchangers designed to meet heat recovery targets in a Pinch Analysis study is simulated. The aim of this paper is to present predictions of thermal performances of shell and tube heat exchangers with different heat transfer fluids and geometries as they undergo fouling degradation. Engineering approaches based on thermodynamic analysis, heat balance and Kern Design equations, as well as what-if simulation modeling are used in this work. Shell and tube heat exchangers were designed to meet internal heat recovery targets for three process plants, A, B and C. These targets were published in a separate paper. The effects of degradation of the tubes-due to incremental growth of fouling resistance - on thermal performance of the exchanger were simulated using Visual Basic Analysis (VBA). Overall, it was found that growth in fouling reduces thermal efficiency of shell and tube heat exchangers with an exponential relationship. An increase of 100% of fouling resistance leads to an average reduction of 0.37% heat transfer. Higher values of logarithmic mean temperature difference (LMTD) and higher ratios of external diameter to internal diameter of the exchanger tubes amplify the effect of fouling growth on thermal performance of the exchangers. The results of this work can be applied in pinch analysis, during design of heat exchangers to meet the internal heat recovery targets, especially in predicting how fouling growth can affect these targets. This can also

be useful in helping operators of shell and tube heat exchangers to determine cleaning intervals of the exchangers to avoid heat transfer loss.

Keywords: Pinch analysis; internal heat recovery; thermal performance; fouling resistance; fouling growth; what if simulation; shell and tube heat exchangers.

iPIC 2021-07

Recipe Development and Mechanical Characterization of Carbon Fibre Reinforced Recycled Polypropylene 3D Printing Filament.

Mwambe Polline, James M Mutua, Thomas Ochuku Mbuya, Kyekyere Ernest
Open Journal of Composite Materials, Vol. 11 (3), 2021, pp. 47-61

Abstract

Recycled polypropylene filaments for fused filament fabrication were investigated with and without 14 wt% short fibre carbon reinforcements. The microstructure and mechanical properties of the filaments and 3D printed specimens were characterized using scanning electron microscopy and standard tensile testing. It was observed that recycled polypropylene filaments with 14 wt% short carbon fibre reinforcement contained pores that were dispersed throughout the microstructure of the filament. A two-stage filament extrusion process was observed to improve the spatial distribution of carbon fibre reinforcement but did not reduce the pores. Recycled polypropylene filaments without reinforcement extruded at high screw speeds above 20 rpm contained a centreline cavity but no spatially distributed pores. However, this cavity is eliminated when extrusion is carried out at screw speeds below 20 rpm. For 3D printed specimens, interlayer cavities were observed larger for specimens printed from 14 wt% carbon fibre reinforced recycled polypropylene than those printed from unreinforced filaments. The values of tensile strength for the filaments were 21.82 MPa and 24.22 MPa, which reduced to 19.72 MPa and 22.70 MPa, respectively, for 3D printed samples using the filaments. Likewise, the young's modulus of the filaments was 1208.6 MPa and 1412.7 MPa, which reduced to 961.5 MPa and 1352.3 MPa, respectively, for the 3D printed samples. The percentage elongation at failure for the recycled polypropylene filament was 9.83% but reduced to 3.84% for the samples printed with 14 wt% carbon fiber reinforced polypropylene filaments whose elongation to failure was 6.58%. The SEM observations on the fractured tensile test samples showed interlayer gaps between the printed and the adjacent raster layers. These gaps accounted for the reduction in the mechanical properties of the printed parts.

Keywords: Fused Filament Fabrication, Fused Deposition Modeling, 3D Printing, Carbon Fibre Reinforced Polymers, Polypropylene, Plastic Recycling.

iPIC 2021-08

Optimization of process parameters in fused deposition modelling of thermoplastics: A review

G. Nyiranzeyimana, J. M. Mutua, B. R. Mose, T. O. Mbuya
Materialwissenschaft und Werkstofftechnik, Vol. 52 (6), 2021, pp. 682-694

Abstract

Among the several techniques for additive manufacturing (AM), fused deposition modelling (FDM) is widely used. Fused deposition modelling process uses a thermoplastic material, which is melted and then extruded layer by layer through a nozzle, in order to create a three-dimensional object. As a result of the default setting of process parameters provided by the manufacturers, produced parts normally have a poor surface finish, low mechanical properties, low dimensional accuracy, and increased residual stresses compared to the parts produced using conventional manufacturing processes like molding (casting). Qualities of fused deposition modelled (FDMed) parts are generally affected by process parameters including the layer thickness, extrusion temperature, build orientation, printing speed, raster angle, infill density, raster width, nozzle diameter, and air gap. Increasing infill density, printing temperature, and decreasing print speed and layer thickness lead to increase mechanical strength and improve the surface finish of the printed parts. The optimal process parameters are preferred to achieve superior properties of the parts. This paper reviews the optimal fused deposition modelling process parameters on part qualities for making the stability of used deposition modelled parts for use. Various process parameters are identified in order to obtain desirable qualities in the manufactured parts. Areas for future research are proposed.

iPIC 2021-09

A Grey-Based Taguchi Method to Optimize Fused Deposition Modelling Process Parameters for Manufacture of a Hip Joint Implant

G. Nyiranzeyimana, J. M. Mutua, B. R. Mose, T. O. Mbuya

Materialwissenschaft und Werkstofftechnik, Vol. 53 (1), 2021, pp. 89-108

Abstract

Controlling process parameters to configure a component has long been regarded as a value-added function of additive manufacturing. Factors that contribute to the quality of total hip prostheses are the degree of dimensional accuracy, surface finish, and manufacturing time. In this study, Digmatt-additive manufacturing software has been used for finite element analysis to determine the quality of a fused deposition modelling printed carbon fiber polyamide 12 composite hip joint implant. The influence of three process parameters namely, printing temperature, layer height, print speed together with interactions were investigated using Taguchi's orthogonal array. The grey relational Taguchi method was used to optimize the process parameters on the part deflection and build time. The results showed that a printing temperature of 255 °C, a high layer thickness of 0.3 mm, and a print speed of 50 mm/s were optimum settings for both responses. Experimental work was carried out and the results used to validate the finite element results which showed good agreement. Microstructural analyses and surface analysis of printed parts were performed using scanning electron microscopy. The results identified that the surface texture of the manufactured implant was rough within the acceptable range for better bone-to-implant contact.

iPIC 2021-10

Optimization of Juice Extraction Velocity of a Multi-fruit Extractor

Denis Koech, Onesmus Muvengei, James Mutua

Journal of Sustainable Research in Engineering, Vol. 6 (4), 2021, pp. 108-118.

Abstract

Machines used in various production processes have an efficiency which is less than a hundred percent. This can be due to inadequate design, inappropriate implementation of the designed mechanisms, and machine controls. In this study, a multi-fruit juice extractor was improved towards optimum performance. The juice extraction velocity was optimized by variation of geometrical parameters of extraction compartment. The auger pitch and diameter, the sieve length and outlet diameter were considered. Juice extraction was analyzed by multiphase modelling in ANSYS Fluent. Optimization was performed using Genetic Algorithm (GA) whereas Design of Experiment (DoE) facilitated analysis of effect of the geometrical parameters on performance. Results show that geometrical parameters have a significant effect on performance of the machine. Indeed, an increase in auger pitch led to an increase in juice extraction velocity. However, blanket increase in auger diameter, sieve length and sieve outlet diameter results in reduced juice extraction velocity. The optimal values for the auger diameter, auger pitch, sieve length, and sieve outlet diameter were determined to be 73 mm, 88.595 mm, 400 mm and 155 mm respectively for an optimum juice extraction velocity of 204.008 mm/s at juice extraction capacity of 64.847 g/s. The results obtained informs redesigning of the multi-fruit juice extractor to enhance performance. On the other hand, effect of each parameter on machine performance gives insights on design process of food processing equipment which utilize similar mechanism.

Keywords: Genetic Algorithm, Juice extraction velocity, Optimization, Multiphase modelling, geometrical parameters.

iPIC 2021-11

Performance of Water in Glass Evacuated Tube Solar Water Heater under Kenya Climatic Condition

Ernest Kyekyere, Hiram Ndiritu, Meshack Hawi, Polline Mwambe

Computational Water, Energy, and Environmental Engineering, Vol.10, No.2, 2021.

Abstract

Solar water heaters which provide a cost-effective and environmental friendly approach to hot water generation are in widespread application. Evacuated tube solar water heaters perform better than flat plate solar water heaters as a result of their greater surface area exposed for sunlight absorption. Water-in-glass evacuated tube solar water heaters are widely used as compared to heat-pipe solar water heaters due to their short payback periods. In this study, the performance of water-in-glass evacuated tube solar water heater is investigated through experiments under the climatic conditions in Kenya. The results revealed a daily efficiency range of 0.58 - 0.65 and a daily final outlet temperature greater than 55°C given an initial temperature of 25°C.

Keywords: Solar Water Heater, Water-in-Glass Evacuated Tube, Solar Collector, Solar Irradiation.

iPIC 2021-12

Computational Studies of the Structural, Electronic and Catalytic Properties of Hetero-atom Doped Graphene

Christabel Ngetich, James Mutua, Patrick Kareru, Kabini Karanja, Evan Wanjiru.

Journal of Sustainable Research in Engineering, Vol. 6 (4), 2021, pp. 119-129

Abstract

Graphene's physical, chemical, and high electrical properties makes it an excellent material for electronics, and energy conversion devices in particular low temperature fuel cells that experience sluggish reactions at the cathode where oxygen is reduced. However, the chemical inertness of pristine graphene has been a hindrance to its widespread use. In this work, computational studies based on first principles density functional theory (DFT) calculations are conducted to investigate the structural, electronic, and catalytic activities of graphene upon hetero-atom doping. The dopants explored include: Boron (B), nitrogen (N), aluminium (Al) and sulfur (S) as single atom types. The DFT calculations are also performed on graphene co-doped with Al and S atoms. Compared with pristine graphene, the incorporation of dopants alters the bond lengths within the graphene structure with B and N only causing minimal alterations in the lattice due to their covalent radii being very close to that of carbon (C) atom. Aluminium and S on the other hand causes noticeable alteration to graphene unit cell. The calculated electronic density of states (DOS) and band structures results show the zero-gap behavior of pristine graphene with the conduction and valence bands touching at the K-point. However, upon doping with B atom a band-gap opening of 0.1922 eV is observed. Being electron deficient, the B dopant causes the Fermi level to shift downwards inducing p-type doping. When graphene is doped with N atom, a band-gap of 0.1909 eV is realized and the DOS results indicate that the N dopant induces n-type doping. On the other hand, the incorporation of S and Al dopants in graphene induces a band-gap of 0.2436 eV and 0.3944 eV respectively. It is observed that co-doping graphene with Al and S further opens the energy gap with a band-gap of 1.059 eV resulting. These results shows that by doping graphene, the electronic properties are enhanced and such can be utilized in electronics and energy devices applications. The catalytic activity of Al-S was also investigated through the DFT calculations of the adsorption energy and oxygen reduction reaction (ORR) mechanism of the intermediate states and the obtained results show that Al-S co-doped graphene could be a potential electro-catalyst for low-temperature fuel cells.

Keywords: Graphene, Hetero-atom, First principles, Density Functional Theory, Density of states, Oxygen reduction reaction.

iPIC 2021-13

Laser Butt Welding of Thin Ti6Al4V Sheets: Effects of Welding Parameters.

P. O. Omoniyi, R. Mahamood, N. Arthur, S. Pityana, S. Skhosane, Y. Okamoto, T. Shinonaga, M. R. Maina, T. Jen and E. T. Akinlabi.

Journal of Composite Sciences, Vol. 5, No. 9, pp.246: 1-9, (2021).

Abstract

Titanium and its alloys, particularly Ti6Al4V, which is widely utilized in the marine and aerospace industries, have played a vital role in different manufacturing industries. An efficient and cost-effective way of joining this metal is by laser welding. The effect of laser power and welding speed on the tensile, microhardness, and microstructure of Ti6Al4V alloy is investigated in this paper. Results show that the microhardness is highest at the fusion zone and reduces towards the base metal. The microstructure at the fusion zone shows a transformed needle-like lamellar α phase, with a martensitic α' phase observed within the heat affected zone. Results of tensile tests show an improved tensile strength compared to the base metal.

Keywords: fractography; laser welding; microhardness; microstructure; Ti6Al4V.

iPIC 2021-14

Investigation and Optimization of Heat Treatment Process on Tensile Behaviour of Ti6Al4V Alloy.

P.O. Omoniyi, R. Mahamood, N. Arthur, S. Pityana, S. A. Akinlabi, Y. Okamoto, M. R. Maina, and E. T. Akinlabi.

Materials Science & Engineering Technology, Vol. 52, No. 10, pp.1057-1063, (2021).

Abstract

This article examines the microstructure and tensile strength of annealed Ti6Al4V alloy at different temperatures and times. Taguchi based L9 (32) design was used for the experimental design matrix and optimization of the tensile strength of heat treated samples. The optimum parameter combination was at the temperature of 950 °C and soaking time of 1 hour. ANOVA results show that temperature is the most influencing parameter and a regression equation of degree two was developed to predict tensile strength. Results of the microstructure show lamellar structure development within the samples heat-treated at 1000 °C.

iPIC 2021-15

Investigation of the Mechanical and Microstructural Properties of TIG Welded Ti6Al4V Alloy.

P. O. Omoniyi, R. M. Mahamood, N. Arthur, S. Pityana, S. A. Akinlabi, S. Hassan, Y. Okamoto, M. R. Maina, and E. T. Akinlabi.

Advances in Material Science and Engineering, LNME Springer, pp. 111–118, (2021).

Abstract

The joint integrity of 1 mm thick sheets of Ti6Al4V alloy welded autogenously using TIG welding was investigated in this article. The current and gas flow rate were varied and their effects on the mechanical properties and microstructure of the weld were analyzed. Results show that the microstructure within the weld zone consists of α' martensitic phase and are coarse, which results in higher microhardness within the weld zone compared to the base metal. The samples with a higher gas flow rate were observed to also improve the tensile strength, while samples with a lower gas flow rate resulted in tensile strength below that of the base metal.

iPIC 2021-16

Effects of Superposition of 532 nm and 1064 nm Wavelengths in Copper Micro-welding by Pulsed Nd:YAG Laser.

M. R. Maina, Y. Okamoto, K. Hamada, A. Okada, S. Nakashiba and N. Nishi.

Journal of Materials Processing Technology, Vol. 299, 2022, pp.117388.

Abstract

Unstable and low absorption of laser energy is experienced in copper welding at around 1000 nm wavelength. At 532 nm wavelength, there is stable and high laser absorption by copper. Past researches have shown that transitional processing condition between keyhole and heat conduction welding results in a stable micro-welding process characterized by good surface quality and deep

penetration. In order to adapt laser welding to copper using pulsed Nd:YAG lasers, investigations of welding quality and efficiency were addressed. Processing was done under transitional processing condition between heat conduction and keyhole welding. Copper C1020 specimens were processed using superposed laser wavelengths of 1064 nm and 532 nm. Effects of irradiation delay and power density on the process were clarified by taking measurements of molten volumes, and by analyzing the weld beads. In addition, the dynamics of molten area and keyhole formation were investigated through three-dimensional FEM analysis. A stabilized laser absorption and increased molten volume was achieved by superposition using 532 nm laser of an appropriate high power density coupled with a short irradiation delay for the 1064 nm laser, which resulted in high-efficiency welding of copper.

Keywords: Absorption rate; Copper; Heat conduction; Keyhole; Laser welding; 532 nm laser; 1064 nm laser.

iPIC 2021-17

Joint integrity evaluation of laser beam welded additive manufactured Ti6Al4V sheets.

P. O. Omoniyi, R. M. Mahamood, N. Arthur, S. Pityana, S. Skhosane, Y. Okamoto, T. Shinonaga, M. R. Maina, T. C. Jen, E. T. Akinlabi
Scientific Reports, Vol. 12 (1), 2022, pp. 1-9.

Abstract

The feasibility of joining laser metal deposited Ti6Al4V sheets using laser beam welding was investigated in this article. The additive manufactured sheets were joined using a 3 kW CW YLS-2000-TR ytterbium laser system. The mechanical properties and microstructure of the welded additive manufactured parts (AM welds) were compared with those of the wrought sheets welded using the same laser process. The welds were characterized and compared in terms of bead geometry, microhardness, tensile strength, fractography, and microstructure. The differences in characteristics are majorly found in the width of the bead and tensile strength. The bead width of AM welds appears wider than the wrought welds, and the wrought welds exhibited higher tensile strength and ductility than the AM welds.

iPIC 2021-18

Structural Performance of Laterite Soil Stabilised with Cement and Blue Gum (Eucalyptus Globulus) Wood Ash for Use as a Road Base Material.

Blaise Dabou, Christopher Kanali, Zachary Abiero-Gariy

International Journal of Engineering Trends and Technology, Vol. 69 (9), 2021, pp. 257-264.

Abstract

This study examines the effect of partially replacing cement with blue gumwood ash (BGWA) in stabilizing laterite soil to be used as a potential road base material. Initially, Ordinary Portland Cement was introduced to the soil at varying contents from 0 to 12% in steps of 3% by weight of the soil sample. Each wet sample of the soil was subjected to the Californian bearing ratio (CBR) and unconfined compressive strength (UCS) tests in determining the optimal soil-cement mix. Results show that CBR and UCS values increased as cement content increased, and a 6% cement content corresponding to a UCS value of 2.88 MPa at 7 days of curing met the specifications of the

Overseas Road Note 31 to be used in the construction of road bases. The second treatment involved partially replacing the 6% cement content with BGWA in decreasing steps of 1%. Peak CBR value of 348% at 2% BGWA content (>160% recommended by Kenya road design manual) and UCS value of 2.99 MPa at 7 days of curing were obtained. Thus, BGWA can partially replace cement in stabilizing laterite soil for use in the construction of road bases as per the Overseas Road Note 31 specifications.

Keywords: Blue gum wood ash, Californian bearing ratio, Laterite, Unconfined compressive strength.

iPIC 2021-19

Distribution and Concentrations of Heavy Metals in Tropospheric Suspended Particulate Matter (PM₁₀) In Nairobi City, Kenya.

Faith Ndunge Mutua, Paul Njogu, Christopher Kanali

Open Journal of Applied Sciences, Vol. 11, 2021, pp. 899-907.

Abstract

Air pollution presents the greatest threat to human health and welfare in urban environments. Population growth, industrial activities, expanded transport system, vehicular traffic, poor road planning, poor land use and traffic congestion contribute to the problem. Particulate matter (PM_{2.5} and PM₁₀) has become the principal pollutants due to increased material use, energy demand and use as a result of global economic growth. This study assessed the levels of PM₁₀ in ambient air and heavy metal composition in Nairobi city. Sampling sites were classified into three categories namely; controlled areas, industrial and residential areas as proscribed in the EMCA Air Quality Regulations, 2014. Portable Mini-Vol ambient air samplers were used for fine particulate monitoring. The concentrations of manganese, lead, and cadmium was determined in PM₁₀ samples from all sampling sites. The lead concentration mean was $0.07 \pm 0.06 \mu\text{g}/\text{m}^3$, $0.34 \pm 0.35 \mu\text{g}/\text{m}^3$ and $1.10 \pm 0.59 \mu\text{g}/\text{m}^3$ for residential, controlled and industrial areas respectively. Generally, all afternoons had high particulate matter while the lowest concentration levels of PM₁₀ were recorded at night.

Keywords: Air Pollution, Heavy Metals, Tropospheric, Particulate Matter.

iPIC 2021-20

Heteroatom-Doped Reduced Graphene Oxide/Polyaniline Nanocomposites with Improved N-Type Thermoelectric Performance

Ali, Mariamu Kassim, Amr Hessein, Mohsen A. Hassan, Mohsen Ghali, Nagih M Shaalan, Koichi Nakamura, and Ahmed Abd El-Moneim.

Journal of Applied Polymer Science 138, no. 34 (2021): 50852. doi.org/10.1002/app.50852.

Abstract

Polyaniline (PANI) is a potential candidate for n-type thermoelectric (TE) materials owing to its intrinsic electrical conductivity, low thermal conductivity, and facile synthesis techniques. However, its low Seebeck coefficient and power factor have limited its widespread usage. In this study, nitrogen-doped, and sulfur-nitrogen co-doped reduced graphene oxide (rGO) were used for tuning the TE properties of PANI. Doped rGO and PANI/doped-rGO nanocomposites were

prepared via hydrothermal technique and chemical oxidative polymerization respectively and thereafter characterized. The TE properties of the nanocomposites were also studied and an optimized Seebeck coefficient, power factor and ZT value of -1.75 mV K^{-1} , $95 \mu\text{W m}^{-1} \text{ K}^{-2}$ and 0.06, respectively were reported for the PANI nanocomposite containing 1 wt% sulfur-nitrogen co-doped rGO. These results suggest that PANI/heteroatom-doped rGO can serve as promising candidates for n-type based TE applications.

iPIC 2021-21

Gas phase doping of pre-fabricated CNT yarns for enhanced thermoelectric properties

Ali, Mariamu Kassim, Naofumi Okamoto, Ryo Abe, Manish Pandey, Ahmed Abdel Moneim, and Masakazu Nakamura.

Synthetic Metals 280 (2021): 116874. doi.org/10.1016/j.synthmet.2021.116874.

Abstract

Carbon nanotubes (CNTs) has drawn extensive attention for flexible thermoelectric (TE) applications due to its unique electronic properties, mechanical robustness, and lightweight, however, its low figure of merit (ZT) greatly limits its practical use in device application. In this study, we tuned the carrier concentration of pre-formed CNT yarns by a practical vapor-phase doping process under atmospheric pressure to circumvent the limitations of solution-phase doping such as invasiveness to the pre-formed chemical structures in the CNT yarns. 7,7,8,8-tetracyanoquinodimethane (TCNQ) and 2,3,5,6-tetrafluoro-tetracyanoquinodimethane (F4TCNQ), were adopted as p-type dopants. Charge transfer between the dopant molecules and CNT yarns enhanced their electrical conductivity, and the ZT, which is in the range of 10^{-2} – 10^{-3} , improved by 1.5 and 1.6-fold compared to a pristine yarn by the TCNQ- and F4TCNQ-doping, respectively.

iPIC 2021-22

Laboratory Investigation of the Physico-Mechanical Properties of Coral Limestone of Vipingo Area in Kenya's Coastal Region

Joan Atieno Onyango, Dorothy Mwanzia Kanini, Dyson Moses, Cho Thae Oo, Ulaankhuu Batsaikhan, Seelae Phaisopha, Ian Tsuma Krop. (<https://doi.org/10.47001/IRJIET/2022.602009>).

Abstract:

This study investigates physical and mechanical characteristics of the Pleistocene coral limestone of Kenya's coastal plain by laboratory experiments based on ASTM standards. The experiments have done include uniaxial compression test, indirect tensile test, ultrasonic pulse velocity (UPV) test, saturation porosity for porosity and direct shear test. Engineering properties of brittleness, Schmidt's rebound number, fracture index and drillability index are calculated from empirical equations based on the tensile strength and uniaxial compressive strength available in published literature. The various moduli are also calculated from equations based on the P-wave and S-wave velocities from UPV test. The average values of the investigated physical properties include bulk density (2199 kg/m^3), porosity (8.47%). The average investigated mechanical properties values include uniaxial compressive strength (16.41MPa), tensile strength (1.61MPa), Elastic modulus (31.62 GPa), cohesion (133.33 kPa) and friction angle (410). The P-wave and S-wave velocities are 4797 m/s and 2288 m/s respectively. The results presented in this work highlight the influence of rock porosity as an inherent structural feature that affects intact rock properties. The

results are discussed with a focus on the variation of properties with porosity, with the conclusion that empirical relationships developed for porous rock should include porosity as a parameter which contributes to variations in rock properties. This paper presents the first published geomechanical data of coral limestone from the reef coral rock formation making up Kenya's coastline.

iPIC 2021-23

Evaluating Rock Mass Properties of Vipingo Coral Limestone Quarry Based on a Modified Geological Strength Index (GSI) and State of Karstification

Joan Atieno Onyango, Takashi Sasaoka, Hideki Shimada, Akihiro Hamanaka, Dyson Moses, Dintwe Tumelo. (<https://doi.org/10.4236/ojg.2022.121003>)

Abstract:

The process of evaluating rock mass strength requires that major structural features such as joints that influence rock strength are considered. In carbonate rock masses, however, the strength of the rock mass is largely dependent on intact rock strength and structural features play a secondary role. Laboratory experiments on porous rock have shown that intact rock strength reduces with increasing porosity, which has a direct effect on the rock mass strength. Rock porosity has however not been well accounted for in rock mass characterization methods currently in use. This research applies the modified GSI method for carbonate rock masses which is based on a combination of GSI and total porosity. The main aim is to quantify the GSI with respect to rock porosity which is a direct indicator of the state of karstification, as an inherent feature that affects rock mass strength. An empirical equation is proposed whereby the GSI as observed in the field is modified by a natural log of the value of porosity, giving rise to a modified GSI (GSI_m). The GSI_m together with laboratory properties of rock is used to determine the properties of Vipingo coral limestone from RocLab software. A deterministic parametric slope stability analysis is done using the finite element software Phase 2 with the rock mass properties as input parameters. The analysis results point to a direct dependence of the slope stability on slope angle, slope height and rock mass strength of the lithological unit. The graphs make a useful design guide for slopes engineered in this type of rock mass.

iPIC 2021-24

Karst-Induced Geohazards in Kenya's Coastal Region: A Case Study of Vipingo Coral Limestone Quarry

Joan A Onyango, Dyson N Moses (<https://doi.org/10.24018/ejgeo.2021.2.5.158>)

Abstract:

As the human population grows, the demand for space to settle and infrastructure development puts a strain on land resources hence people move to occupy areas of difficult terrain such as mountainous regions and karst environments. The trends in anthropogenic activities mean that there will be increased human interaction with the perilous terrain and consequently geohazards associated with them. Studies on geohazards in Kenya have focused mostly on landslides in mountainous regions but not much has been reported on geohazards that are common in areas of carbonate rocks such as coral limestone. Vipingo coral limestone quarry, a coastal quarry, is taken as a case study as a number of hazardous situations have been encountered during mining. This paper outlines the karst features, their formation processes in the coralline limestone rock mass, and the resultant geohazards. Field visits made to the quarry complemented with previous exploration reports enabled

the collection of field data on rock mass characteristics, karst features, and potential hazardous sites were mapped out. Karstification is evident in traces of pores and fissures filled with soil in the upper layers of the rock. Cavities, voids, and caves occur randomly in the rock mass and are the genesis of incidents such as bench collapse, sagging of overlying rock slabs leading to sinkholes. The rock mass is weak and prone to slope failures. Suggestions have been fronted for geohazard mitigation and further research work for the scientific community. Thus, this work constitutes an important knowledge base for infrastructure development and any other quarries around the area, and for those who are settled around this karst environment in order to preempt geo-accidents.

iPIC 2021-25

Application of remote sensing in mapping hydrothermally altered zones in a highly vegetative area - A case study of Lolgorien, Narok County, Kenya

Sammy O Ombiro, Akinade S Olatunji, Eliud M Mathu, Ajayi Taiwo (2021)

Indian Journal of Science and Technology Volume: 14 Issue: 9

DOI: 5. <https://doi.org/10.17485/IJST/v14i9.68>

Abstract

Objectives: Application of remote sensing in mapping hydrothermally altered zones in a highly vegetative area - A case study of Lolgorien, Narok County, Kenya Sammy O Ombiro^{1*}, Akinade S Olatunji², Eliud M Mathu³, Taiwo R Ajayi² ¹ Pan African University, Life and Earth Sciences Institute, University of Ibadan, Nigeria ² Department of Geology, University of Ibadan, Nigeria ³ Department of Geology and Meteorology, South Eastern Kenya University, Kenya **Abstract Objective:** To map areas of possible hydrothermal alteration using remote sensing technology; To map geological structures controlling mineralisation using remote sensing; To carryout field mapping to ground truth the features identified by remote sensed data.

Methods: Landsat 8 Operational Land Imager (OLI) and Shuttle Radar Topography Mission (SRTM) remote sensed images were downloaded from USGS website. Landsat images were processed using band ratios, band composites, principal component analysis techniques in ArcGIS to map areas of possible hydrothermal alteration. SRTM image was analysed using hillshade analysis technique in ArcGIS to map geological structural features controlling mineralisation.

Findings: The study found that in several areas especially Southern, South Eastern, Central and North Western part of Lolgorien, there is a possibility of hydrothermal alteration as spectral signatures associated with iron oxide and clay minerals were identified. It was also found that areas with possibility of hydrothermal alteration are also associated with relatively large number of lineaments. It was also found that Southern and South-Eastern part of Lolgorien are also associated with numerous artisanal mines proving the fact that indeed gold mineralisation may be found in these places. However, due to thick vegetation cover, mapping of different types of lithological units found in Lolgorien was not possible.

Novelty/Application: The application of remote sensed technology helped in identification of new areas of possible mineralisation such as Central and North-Western parts of Lolgorien which despite having similar geological properties (in terms of lineament density and hydrothermal alteration) have never been exploited for gold or other minerals.

iPIC 2021-26

Integration of geophysics and remote sensing techniques in mapping zones mineralised with disseminated gold and sulphide minerals in Lolgorien, Narok County, Kenya

Sammy O Ombiro, Akinade S Olatunji, Eliud M Mathu, Ajayi Taiwo R (2021)

Journal: Tanzania Journal of Science, Volume: 47 Issue: 2 DOI: <https://dx.doi.org/10.4314/tjs.v47i2.31>

Abstract:

Even though ground geophysical surveys (especially Induced polarization and resistivity) are applied in mineral exploration, their effectiveness in identification of mineralised zones is often enhanced by integrating other mineral exploration techniques such as remote sensing and geological investigations. Integrating different techniques helps in reducing uncertainty that is often associated with mineral exploration. The methods being integrated also depend on characteristics of mineralisation and those of host rock. In this study, geophysical survey methods (induced polarization and resistivity) were integrated with remote sensing and geological methods to delineate mineralised zones in Lolgorien beyond reasonable doubt. By integrating these methods, it was found that Lolgorien's gold and sulphide minerals (disseminated minerals) are hosted in massive quartz veins and auriferous quartz veins hosted in Banded Iron Formations. It was also found that this mineralisation was controlled by faults which mainly trend in two directions (NW-SE) and (NE-SW).

iPIC 2021-27

Mapping of Geological Structural Features in Lolgorien, Narok County, Kenya: Using Hillshade Analysis

Sammy O Ombiro, Akinade S Olatunji, Eliud M Mathu, Ajayi Taiwo R (2021)

Tanzania Journal of Science Volume: 47 Issue: 2

Abstract:

Despite Lolgorien being one of the most active gold mining areas in Kenya, it is one of the most geologically understudied areas. To the best knowledge of the authors, Lolgorien geological map was last updated in the 1940s. Current technologies such as remote sensing allows new structural features such as faults to be easily identified. In this regard, this study employed remote sensed data to map structural features found in and around Lolgorien Subcounty, Narok, Kenya. This was done to identify any new structural features that might have been missed in the past. Shuttle Radar 152 Topography Mission Digital Elevation Model (SRTM-DEM) image was downloaded and analysed using hillshade technique. From this analysis, the research identified new structural features which were not included in the current geological map but exist on the ground. One such structural feature (fault) is located approximately at 9866237, 703601 (Universal Transverse Mercator, UTM coordinates) and trends in NW–SE direction. The study also found that most of the lineaments are concentrated in the southern part of Lolgorien area and around or at areas dominated by the banded iron formations. Petrographic analysis of the few samples collected from the area showed presence of gold, pyrite and chalcopyrite mineralisation.

iPIC 2021-28

Effect of Agglomeration of Coal Slimes by Use Flomin C9606 as A Collector

Richard M Kasomo, **Sammy Ombiro (2021)**

International Journal of Mining and Mineral Engineering Volume: 11 Issue: 1

Abstract

In many coal preparation concentrators, coal slimes form the major challenge due to difficulties in its processing and upgrading. Several techniques are currently being devised in coal industries to aid in beneficiation of the coals in their finer sizes. Ultra-fine coal particles are exclusively processed by oil agglomeration, selective flocculation or hydrophobic flocculation flotation techniques. In this research, the focus is on hydrophobic flocculation flotation to clean ultrafine coal particles. Collector dosage, agitation stirring speed and grinding fineness batch tests were conducted, followed by flocculation and froth flotation. The results showed that optimum collector dosage (Flomin C9606) was 10 kgs/ton, the impeller speed 1,500 rpm and 30 minutes achieved the best grinding fineness. Two stage flow sheet produced froth recovery of 86.28% and ash content was 6.39%. It was therefore concluded that Flomin C9606, as a collector, was capable of obtaining clean coal product from these results.

1.3. Compilation of Publication Abstracts from iCCATS Subtaskforce

iCCATS 2021-01

A Survey on Mobile Applications for Smart Agriculture: Making Use of Mobile Software in Modern Farming.

Isaac Nyabisa Oteyo, Matteo Marra, Stephen Kimani, Wolfgang De Meuter, Elisa Gonzalez Boix: *SN Computer. Science.* 2(4): 293, 2021.

Abstract

The increasing global demand for food and nutrition security has raised the need to automate processes in modern farming. As such, a promising way to automate those processes is by using smart agriculture applications (SAAs). Different studies in the literature classify these applications based on agricultural themes, agricultural domains, and farming scenarios. However, this classification is not sufficient for researchers and industry to gain deeper insights on software engineering issues pertaining to SAAs. In this survey, we explore SAAs and further classify them based on architectural models, supported software engineering issues, and target mobile platforms. The survey results show that SAAs in general (1) follow different architectural models, (2) are targeted for different mobile platforms, and (3) satisfy different software engineering issues. Most importantly, the key findings from this study reveal that SAAs can fail to meet their intended purpose if developers ignore key software engineering issues. These findings can be used as a starting point for researchers and industry to implement smart agriculture related mobile applications.

Keywords: Mobile applications, Cloud computing, Smart farming, Internet of things, Smart agriculture application

iCCATS 2021-02

Spectrum Sensing for Cognitive VHF Land Mobile Radio Communication Networks Using Energy Sensing Techniques.

Godfrey Niringiye, Isaac Nyabisa Oteyo, Tonny Bulega,

IEEE AFRICON, 2021, pp. 1-6, doi:10.1109/AFRICON51333.2021.9570941.

Abstract

The 2015 migration from Very High Frequency (VHF) Analog to Digital television (TV) created plenty of white spaces in the entire VHF TV Band (174–230 MHz). These white spaces can be used by other wireless applications and internet services whose radio spectrum is already pushed to maximum utilization and is therefore scarce for emerging wireless applications such as IP Television, high-speed wireless internet, cellular telephony, multimedia services, Zigbee, WiMax-Advanced. In this study, we implemented a VHF Land Mobile Radio System (LMRS) that can utilize the Television White Spaces (TVWS) in the upper VHF TV band for mission critical voice transmissions. We detected VHF Land Mobile Radio (LMR) transmissions in the TVWS using energy sensing techniques, with the real-time energy detector developed on the Software-Defined Radio (SDR) testbed composed of RTL-SDR device, VHF Radio and GNU Radio. We used a simulated energy detector using GNU Radio to set the evaluation benchmark. In both, the simulations and the real-time platform, a Narrow Band Frequency Modulation (NBFM) was generated and transmitted through the TVWS. The performance of the implemented real-time energy detector compared to the simulated one was lower, due to the noise distribution being not perfectly Additive White Gaussian Noise (AWGN), and thermal noise from the RTL-SDR. In addition, the transmission in TVWS was high in signal energy compared to transmission in traditional LMR frequency (approximately 10% improvement), and thus improved penetration in remote areas and thick forests.

iCCATS 2021-03

Building Smart Agriculture Applications Using Low-Code Tools: The Case for DisCoPar.

N. Oteyo, A. L. S. Pupo, J. Zaman, S. Kimani, W. De Meuter and E. G. Boix,

2021 IEEE AFRICON, 2021, pp. 1-6, doi: 10.1109/AFRICON51333.2021.9570936.

Abstract

Modern farming is experiencing increased adoption of mobile and cloud computing applications as efforts are being made to automate farming processes. In this context, the mobile and cloud computing applications, that we refer to as smart agriculture applications (SAAs), can be used in data collection that can be entered directly into the applications by end-users (i.e., farmers) or via sensors. Implementing SAAs is often done using text-based approaches that require advanced skills and experience in software programming. There are low-code development tools (LCDTs) that farmers with less programming experience can use to implement their own SAAs. The LCDTs offer different features and techniques for application development e.g., some employ form-based application specification while others use graphical drag-and-drop techniques. As such, the different LCDTs are best suited for different specific tasks. For instance, a farmer may need to implement an application that connects to sensors to receive data and generate timely notifications when set thresholds are exceeded. However, to the farmer, it can be difficult to know which kind of LCDTs

to choose and what category of these tools are best suited for the task. In this paper, we contrast different LCDTs and show how to use DisCoPar to develop SAAs by non-expert programmers. As a contribution, this paper presents properties for LCDTs that can be beneficial to farmers and demonstrates how DisCoPar can be used in developing SAAs.

iCCATS 2021-04

Design Requirements for Crop-Specific Online and Web-Based Portals.

Oteyo I.N., Oyier P.A., Kimani S. HCI International 2021 - Late Breaking Papers: HCI Applications in Health, Transport, and Industry. HCII 2021. Lecture Notes in Computer Science, vol 13097. Springer, Cham.

Abstract:

Legumes such as common beans (*Phaseolus vulgaris L.*) continue playing a critical role in making developed and developing economies food sustainable as alternative sources to animal proteins. The crops bring together different stakeholders in their value chain such as farmers, service providers, researchers and policymakers. Web-based portals are emerging as important tools that these different stakeholders can use to perform various tasks, access, and share vital information pertaining to common beans. However, designing portals that are specific to common beans has not been given adequate consideration in the literature. In this study, we administered a survey to profile challenges and design requirements for web-based portals that are specific to common beans. We present the survey findings in this paper. The findings provide useful insights to researchers and industry in developing future agricultural web-based portals, and can be applied to portals on other crops or different domains.

Keywords: User requirements, User interface design, Online portals, Food security.

iCCATS 2021-05

Ensemble Model for Enhancing Classification Accuracy in Intrusion Detection Systems

S. M. Nzuva, L. Nderu and T. Mwalili, "Ensemble Model for Enhancing Classification Accuracy in Intrusion Detection Systems," *2021 International Conference on Electrical, Computer and Energy Technologies (ICECET)*, 2021, pp. 1-7, doi: 10.1109/ICECET52533.2021.9698798.

Abstract:

Currently, cases of data breaches are prevalent, partly due to the inability of the Intrusion Detection Systems (IDS) used to offer on-demand network protection through real-time intrusion detection. This study sought to develop an ideal machine learning model for enhancing accuracy in network intrusion detection to address this problem. Naïve Bayes, Artificial Neural Network, K nearest Neighbor, Support Vector Machine, and C 4.5 algorithms were trained and tested on the CIC-IDS2017 dataset using the k-folds cross-validation approach. AdaBoost, Bootstrap Aggregation, and Stacking ensemble models, using each of the five algorithms as base models, were also trained and tested on the same dataset. A comparison of the performance of the individual models and the ensemble models was done, and the best performing model was selected and tuned with respect to the number of iterations, batch size, and weight threshold to further enhance its quality and accuracy in prediction. AdaBoost ensemble model with C 4.5 as the base algorithm was found to give an

effective model that could be implemented on IDS to enhance precision and recall, which translates to increased accuracy and efficiency in the classification of new instances. Depending on the volume of the data packets being transmitted on the organizational network, the model may require tuning on the batch size and the number of iterations in order to increase its accuracy, efficiency, and consistency in light of the available computational resources.

iCCATS 2021-06

Implementation of a Low-Power Intrusion Detection System for IoT

V. Maina, D. Kaburu and T. Mwalili, "Implementation of a Low-Power Intrusion Detection System for IoT," *2021 International Conference on Electrical, Computer and Energy Technologies (ICECET)*, 2021, pp. 1-4, doi: 10.1109/ICECET52533.2021.9698683.

Abstract:

Technological advances in internet of things have enabled processing, storage and retrieval of information with minimal resource overhead. However, these battery-powered systems cannot host computationally intensive intrusion detection and prevention systems such as cloud-based machine learning intrusion detectors or block chain encryption. We propose a low-power security setup for the internet of things. Power consumption is reduced by under clocking the gateway device processor, limiting peripherals and employing efficient network intrusion detection schemes. Security performance of the system is validated by comparing penetration test results for the power-optimized system and a baseline system running on default power configurations. This setup confirms that power savings of up to forty-four percent can be achieved without compromising system security.

iCCATS 2021-07

A Chaotic Elephant Herding Optimization Algorithm for Multilayer Perceptron based on Opposition-based Learning

N. Kamau, R. Rimiru and L. Nderu, "A Chaotic Elephant Herding Optimization Algorithm for Multilayer Perceptron based on Opposition-based Learning," *2021 IEEE AFRICON*, 2021, pp. 1-6, doi: 10.1109/AFRICON51333.2021.9570917.

Abstract:

This work proposes a new multilayer perceptron (MLP) training algorithm known as chaotic elephant herding optimization based on opposition-based learning (OCEHO). Two chaotic maps were incorporated into various phases of the standard EHO, as well as an opposition-based learning concept, to improve the global convergence of the population members and also to prevent the algorithm from falling into local optimal solutions. The proposed OCEHO-MLP model was then applied to two separate customer churn data-sets that are used for prediction, which were acquired from GitHub. The proposed model results were compared with those of the standard EHO and PSO used as MLP base trainers, as well as those of conventional MLP based on back-propagation. It is shown that the suggested training method OCEHO is significantly beneficial in enhancing the prediction rate of MLPs, with improved accuracy, convergence, and stability achieved in a fair amount of time.

iCCATS 2021-08

Mitigating Preconception in Machine Learning Classifiers

H. M. Ngie, L. Nderu, L. Mutanu and D. M. Gicuku, "Mitigating Preconception in Machine Learning Classifiers," *2021 International Conference on Electrical, Computer, Communications and Mechatronics Engineering (ICECCME)*, 2021, pp. 1-6, doi: 10.1109/ICECCME52200.2021.9591043.

Abstract:

Modern Machine Learning (ML) approaches are aimed at enhancing model performance (behaviors and accuracy) through historical data available for the specific model. Continued use of machine learning has been witnessed in the real-world business including self-driving cars, health diagnosis systems, fraud detection, and customer churn predictions among other areas demanding intense safety and testing. Amid the intense application of the technology, however lies a growing user concern and interest in insights and decisions made by a classifier due to the increasingly complex models known for hiding crucial information regarding their outcome generation. Overreliance in model performance therefore can no longer be considered a sure metric to model performance due to the underlying trust issues and therefore the need for model interpretation or explanation to extend and make machine models potential sources of knowledge. This research paper delves into the understanding of the various approaches to successful model interpretation, further proposing enhancement of Local Interpretable Model-agnostic Explainer (LIME) via 'Calculus Local Interpretable Model-agnostic Explainer' (C-LIME) as an intuitive approach to black-box ML model interpretation. We further evaluate the framework performance demonstrating significant enhancement in black-box model interpretations without compromising prediction accuracy

iCCATS 2021-09

In Silico-Driven Analysis of the *Glossina morsitans morsitans* Antennae Transcriptome in Response to Repellent or Attractant Compounds.

Gakii C, Bwana BK, Mugambi GG, Mukoya E, Mireji PO, Rimiru R. In silico-driven analysis of the *Glossina morsitans morsitans* antennae transcriptome in response to repellent or attractant compounds. *Peer J.* 2021 Jul 1;9: e11691. doi: 10.7717/peerj.11691. PMID: 34249514; PMCID: PMC8255069.

Abstract

High-throughput sequencing generates large volumes of biological data that must be interpreted to make meaningful inference on the biological function. Problems arise due to the large number of characteristics p (dimensions) that describe each record $[n]$ in the database. Feature selection using a subset of variables extracted from the large datasets is one of the approaches towards solving this problem. In this study we analyzed the transcriptome of *Glossina morsitans morsitans* (Tsetsefly) antennae after exposure to either a repellent (δ -nonalactone) or an attractant (ϵ -nonalactone). We identified 308 genes that were upregulated or downregulated due to exposure to a repellent (δ -nonalactone) or an attractant (ϵ -nonalactone) respectively. Weighted gene coexpression network analysis was used to cluster the genes into 12 modules and filter unconnected genes. Discretized and association rule mining was used to find association between genes thereby predicting the putative function of unannotated genes. Among the significantly expressed chemosensory genes

(FDR < 0.05) in response to ϵ -nonalactone were gustatory receptors (Gr1A and Gr28b), ionotropic receptors (Ir41a and Ir75a), odorant binding proteins (Obp99b, Obp99d, Obp59a and Obp28a) and the odorant receptor (Or67d). Several non-chemosensory genes with no assigned function in the NCBI database were co-expressed with the chemosensory genes. Exposure to a repellent (δ -nonalactone) did not show any significant change between the treatment and control samples. We generated a coexpression network with 276 edges and 130 nodes. Genes CAH3, Ahcy, Ir64a, Or67c, Ir8a and Or67a had node degree values above 11 and therefore could be regarded as the top hub genes in the network. Association rule mining showed a relation between various genes based on their appearance in the same item sets as consequent and antecedent.

Keywords: Association rule mining; Co-expression network; Discretization; In silico analysis; RNASeq data.

iCCATS 2021-10

Predicting Students Academic Performance using a Hybrid of Machine Learning Algorithms

R. Ayienda, R. Rimiru and W. Cheruiyot, "Predicting Students Academic Performance using a Hybrid of Machine Learning Algorithms," 2021

IEEE AFRICON, 2021, pp. 1-6, doi: 10.1109/AFRICON51333.2021.9571012.

Abstract:

Educational data mining (EDM) has become a very interesting field of study in machine learning (ML), since it has enabled searchers to mine knowledge from educational databases for improvement in students' and instructors' performance. The most challenging task in prediction is to identify which features and algorithms to select which will give satisfactory results. In this research, a hybrid algorithm of weighted voting classifier (WVC) in conjunction with 10-fold cross validation (10-CV) and five other machine learning algorithms that are support vector machine (SVM), multi-layer perceptron (MLP), logistic regression (LR), k-nearest neighbor (KNN) and naive bayes (NB) were used. We evaluated our proposed model on the student grade prediction dataset taken from kaggle. In this paper, the metrics that were measured included: accuracy, precision, recall, f1-score and area under the curve (AUC). An accuracy of 97.6% was achieved. The proposed model was able to identify 634 students out of 650 as (Fair, Good, and Excellent), therefore recommending the model to the school for student performance prediction since it will devise mechanisms to alleviate student dropout rates and improve their performance.

iCCATS 2021-11

Identification of Cancer Related Genes Using Feature Selection and Association Rule Mining

Consolata Gakii, Richard Rimiru, Identification of cancer related genes using feature selection and association rule mining, *Informatics in Medicine Unlocked*, Volume 24,2021,100595,

ISSN 2352-9148, <https://doi.org/10.1016/j.imu.2021.100595>

Abstract

High throughput sequencing generates large volumes of high dimensional data. Identifying informative features from the generated big data is always a challenge. Feature selection reduces complex data into a smaller number of variables while preserving the information as much as possible. In this study, we used DaMiRseq, DESeq2, edgeR and Limma + voom to identify

differentially expressed genes in 79 small cell lung cancer (sclc) and 7 normal controls. A gene network was used to identify any co-expressed genes. Association rule mining was used to identify any association between connected genes in the network. Limma + voom identified the highest number of differentially expressed genes. However, 81 genes were common in the four differential gene expression analysis methods used. After filtering out all nodes with a degree less than 5, the final network had 43 nodes and 63 edges. Association rule mining on the co-expressed genes generated 263 rules. Genes that were common in the rules were: SLC34A2, CAV2, EPAS1, CTSH, AQP1 and LRRK2. These genes have been associated with various types of cancer. Therefore, feature selection using differential gene expression analysis, co-expression networks and association rule mining could help infer relationships among genes and their possibility of having a shared biological function.

Keywords: Feature selection, Discretization, Association rule mining, Co-expression network

iCCATS 2021-12

Secure Contactless Mobile Payment System

V. Njebiu, M. Kimwele and R. Rimiru, "Secure Contactless Mobile Payment System," *2021 IEEE Latin-American Conference on Communications (LATINCOM)*, 2021, pp. 1-6, doi: 10.1109/LATINCOM53176.2021.9647831.

Abstract:

Near-field communication technology is a great enabler of contactless applications, which has resulted in exponential growth of contactless payment systems. While the NFC technology has an advantage over other wireless technologies like Bluetooth and barcode due to the close communication proximity and speed, it is still susceptible to security threats such as eavesdropping, relay, and replay attacks. Cryptographic protocols resist most attacks mounted on the NFC systems, but relay attacks remain evasive to such attempts. We propose a relay attack countermeasure that ensures mutual authentication of paring devices during contactless payment. The protocol combines proximity token and challenge/response key exchange to verify the communicating devices' proximity before authentication. In this paper, we detail the architecture of the proposed contactless payment system, discuss its fully functional prototype, and present the experiment results when subjected to relay attacks. The experiment results show additional time while the user device terminates the communication where the relay attack was detected. From the experiment, the protocol is secure, easy to use, and practical.

iCCATS 2021-13

Lexicon-pointed hybrid N-gram Features Extraction Model (LeNFEM) for sentence level sentiment analysis

Abstract

Sentiment analysis of social media textual posts can provide information and knowledge that is applicable in social settings, business intelligence, evaluation of citizens' opinions in governance, and in mood triggered devices in the Internet of Things. Feature extraction and selection is a key determinant of accuracy and computational cost of machine learning models for such analysis. Most

feature extraction and selection techniques utilize bag of words, N-grams, and frequency-based algorithms especially Term Frequency-Inverse Document Frequency. However, these approaches do not consider relationships between words, they ignore words' characteristics and they suffer high feature dimensionality. In this paper we propose and evaluate a feature extraction and selection approach that utilizes a fixed hybrid N-gram window for feature extraction and minimum redundancy maximum relevance feature selection algorithm for sentence level sentiment analysis. The approach improves the existing features extraction techniques, specifically the N-gram by generating a hybrid vector from words, Part of Speech (POS) tags, and word semantic orientation. The vector is extracted by using a static trigram window identified by a lexicon where a sentiment word appears in a sentence. A blend of the words, POS tags, and the sentiment orientations of the static trigram are used to build the feature vector. The optimal features from the vector are then selected using minimum redundancy maximum relevance (MRMR) algorithm. Experiments were carried out using the public Yelp dataset to compare the performance of the proposed model and existing feature extraction models (BOW, normal N-grams and lexicon-based bag of words semantic orientations). Using supervised machine learning classifiers the experimental results showed that the proposed model had the highest F-measure (88.64%) compared to the highest (83.55%) from baseline approaches. Wilcoxon test carried out ascertained that the proposed approach performed significantly better than the baseline approaches. Comparative performance analysis with other datasets further affirmed that the proposed approach is generalizable.

iCCATS 2021-14

OAAE: Optimized Adaptive Anomaly Detection Ensemble-Base Model Boosting by Parameter Optimization

Joash Bii, Richard Rimiru, Waweru Mwangi. OAAE: Optimized Adaptive Anomaly Detection Ensemble-Base Model boosting by parameter optimization. Engineering Reports 2021. <https://doi.org/10.1002/eng2.12449>

Abstract

Irregular data or anomalies may occur due to human error, miscalculation, or malicious system behavior. The detection of anomalies is a difficult task that requires the use of multiple strategic methods and models. The ideal detection model should assess the strengths and optimize the results of its base models before making final decisions. This task of optimizing the results of the base models contributes to the generation of more accurate results overall. This work presents an optimized adaptive anomaly detection ensemble using heterogeneous algorithms. In the first stage, it adaptively boosts the outcomes of preceding models by weighting their decisions and finding high-performance ones, and in the second stage, it optimizes the base models by score margin maximization, which enlarges the contrast between the scores of the anomalies and other data prior to fusion to improve detection accuracy. To validate the model, baselines and test results from 10 benchmark datasets are compared. To assess its effectiveness in terms of distinguishing anomalies, the proposed model is tested and evaluated. The analyzed data are presented as cross-tabulations, with detailed explanations and interpretations. The experiments show an improvement in results even when the least of anomalies (single cases up to 10%) are used.

iCCATS 2021-15

Comparative Performance of Machine Learning Algorithms in Prediction of Cervical Cancer

E. Ahishakiye, W. Mwangi, P. Muthoni, L. Nderu and R. Wario, "Comparative Performance of Machine Learning Algorithms in Prediction of Cervical Cancer," *2021 IST-Africa Conference (IST-Africa)*, 2021, pp. 1-

Abstract

Cervical cancer is among the most common types of cancer affecting women around the world despite the advances in prevention, screening, diagnosis, and treatment during the past decade. Cervical cancer can be treated if diagnosed in its early stages. Machine learning algorithms like multi-layer perceptron, decision trees, random forest, K-Nearest Neighbor, and Naïve-Bayes have been used for the prediction of cervical cancer to aid in its early diagnoses. In this study, we compare the performance of ensemble methods (AdaBoost, Stochastic Gradient Boosting, Random Forests, and Extra Trees), and classification algorithms (K-Nearest Neighbor and Support Vector Machine) in the prediction of cervical cancer basin g risk factors. Ensemble methods and classification algorithms were used during this study. Ensemble methods were selected because they combine several machine learning techniques into one model to decrease variance, bias, or improve performance while the classification methods were selected because our dataset was generally categorical and therefore could work well with our problem domain. Experimental results revealed that all the algorithms did not perform well on the “imbalanced” dataset. Experiments on balanced revealed an improved performance. The performance metrics used include F1-score, Area Under Curve (AUC), and Recall. Extra Trees performed better than the rest when using the F1-score metric, Stochastic Gradient Boosting and Random Forest performed better than the rest when using the AUC metric, K-Nearest Neighbors outperformed the rest using the recall metric, and Extra Trees had the best accuracy 0.96. The application of machine learning methods in the prediction of cervical cancer using risk factors may lead to early detection of the disease which can be treated if diagnosed early. Six algorithms have been considered in this study. The general performance reveals that ensemble methods performed better than classification