Published paper 1

Title: Physico-chemical properties of selected Irish potato varieties grown in Kenya

Authors: Evelyne N. Gikundi, Daniel N. Sila, Irene N. Orina and Ariel K. Buzera

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

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Published paper 2

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

Authors: Johnson Mwove, Samuel Imathiu, Irene Orina and Paul Karanja

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.

Published paper 3

Title: Food safety knowledge and practices of street food vendors in selected locations within Kiambu County, Kenya.

Authors: Johnson Mwove, Samuel Imathiu, Irene Orina and Paul Karanja

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.

Published Paper 4

Title: Non-destructive techniques for the detection of fungal infection in cereal grains

Authors: Irene Orina, Marena Manley, Paul J. Williams

Abstract

Infection of cereal grains by fungi is a serious problem worldwide. Depending on the environmental conditions, cereal grains may be colonised by different species of fungi. These fungi cause reduction in yield, quality and nutritional value of the grain; and of major concern is their production of mycotoxins which are harmful to both humans and animals. Early detection of fungal contamination is an essential control measure for ensuring storage longevity and food safety. Conventional methods for detection of fungal infection, such as culture and colony techniques or immunological methods are either slow, labour intensive or difficult to automate. In recent years, there has been an increasing need to develop simple, rapid, non-destructive methods for early detection of fungal infection and mycotoxins contamination in cereal grains. Methods such as near infrared (NIR) spectroscopy, NIR hyperspectral imaging, and electronic nose were evaluated for these purposes. This paper reviews the different non-destructive techniques that have been considered thus far for detection of fungal infection and mycotoxins in cereal grains, including their principles, application and limitations.

Published paper 5

Title: Use of High-Resolution X-Ray Micro-Computed Tomography for the Analysis of Internal Structural Changes in Maize Infected with *Fusarium verticillioides*

Authors: Irene Orina, Marena Manley, Paul J. Williams

Abstract

X-ray micro-computed tomography (X-ray micro-CT) is a non-destructive, three-dimensional (3D) imaging and analysis technique for the investigation of internal structure of a large variety of materials, including agricultural produce. As a relatively new method in the field of food science, X-ray micro-CT has been applied successfully to obtain microstructural information of foods undergoing different physical and chemical changes. In this study, high-resolution X-ray micro-CT was used for non-destructive analysis of the internal structure of maize kernels infected with *Fusarium verticillioides*. The major anatomical features of the maize kernel were identified based on their differences in X-ray attenuation, i.e. the germ, scutellum, vitreous and floury endosperm. Fungal infection caused changes in the internal structure of the kernels over time, which included a decrease in total kernel volume and an increase in total volume of void space, with more voids observed in the germ and floury endosperm regions. No significant (P > 0.05) difference was observed between the apparent that the changes observed in the infected kernels were not solely as a result of fungal growth. The grey level histograms of the control and infected kernels shifted to the lower grey value intensity range over time indicating an increase in void space within the kernels. In the 3D images, the increase in total volume of void space with fungal progression was clearer and the effect of fungal damage on the internal structure was evident.

Published paper 6
Title: Application of Image Texture Analysis for Evaluation of X-Ray Images of Fungal-Infected Maize Kernels.

Authors: Irene Orina, Marena Manley, Sergey Kucheryavskiy, Paul J. Williams

Abstract

The feasibility of image texture analysis to evaluate X-ray images of fungal-infected maize kernels was investigated. X-ray images of maize kernels infected with Fusarium verticillioides and control kernels were acquired using high-resolution X-ray micro-computed tomography. After image acquisition and pre-processing, several algorithms were developed to extract image textural features from selected two-dimensional (2D) images of the kernels. Four first-order statistics (mean, standard deviation, kurtosis and skewness) and four grey level co-occurrence matrix (GLCM) features (correlation, energy, homogeneity and contrast) were extracted from the side, front and top views of each kernel and used as inputs for principal component analysis (PCA). The first-order statistical image features gave a better separation of the control from infected kernels on day 8 post-inoculation. Classification models were developed using partial least squares discriminant analysis (PLS-DA), and accuracies of 67 and 73% were achieved using first-order statistical features and GLCM extracted features, respectively. This work provides information on the possible application of image texture as method for analysing X-ray images.

Keywords: Image texture analysis, fungal invasion, X-ray micro-computed tomography, maize, GLCM