09:15 - 09:45 **Moderated Poster Session 1: Food Safety - Microbiological, Physical and Chemical Safety of Agricultural Products and Processed Foods** **Theater 1**

Combined Effect of Antimicrobial Coating and Air Negative Ionization with the Addition of Controlled Ozone on Ready-to-eat Vegetables Quality **MP1.1**

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Introduction and Objectives: Ready-to-eat vegetables can easily be cross-contaminated by pathogens bacteria during the industrial process. It is then necessary to develop a new method ensuring food safety quality. Industrial environments are usually characterized by an excess of positive ions and a negative ion defect. The negative air ionization can be used to restore the balance between those particles. Microorganisms in the environment can come from airborne particles or aerosols and are responsible for the production of odors and contamination of food. When not controlled, those microorganisms can lead to the deterioration of food. The objective is to evaluate the effect of an antimicrobial coating in combination with negative ionization of the air with the addition of controlled ozone on safety and sensorial qualities of vegetables.
Methods: An antimicrobial formulation was developed and applied on vegetables. Total flora (isolated from vegetables) and non-pathogenic E. coli 25922 strain were used for bacterial inoculation on vegetables. Vegetables were treated with the antimicrobial formulation before inoculation with bacteria (103 CFU/g). Samples were then stored for 7 days at 4°C in presence of negative ionized air with controlled ozone. For each day of analysis, vegetables were homogenized with peptone water, pour plated in specific medium and incubated at 37°C for 48h before bacterial enumeration. Sensorial analyses were performed with 37 panellists, who evaluated the smell, the taste and the texture based on a 9 point hedonic scale.
Results: The antimicrobial formulation allowed reducing the E. coli load, with a 2-log reduction over storage. The combined treatment antimicrobials + negative ionized air was more effective since the bacterial level was under the detection limit even after 7 days of storage. For the total flora, a 1-log reduction was observed after 1 day and was maintained over time. As for the sensorial qualities, the addition of the antimicrobial formulation did not affect the smell, the taste or the texture as compared to the control vegetables.
Conclusions: The combination of an antimicrobial coating and air negative ionization with the addition of controlled ozone can be used to reduce the microbial load, and maintain food safety. This innovative combined treatment can easily be implanted in food industries as a decontamination process, allowing improving food safety and also reducing economic losses due to spoilage.

MP1.2

Safety Assessment of Ogilisi (Newbouldia laevis) Plant Leaf and Extract

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Introduction: Consumption and marketing of nutraceuticals rich in antioxidants have grown in recent years. Many nutraceutical and functional foods products imported into Nigeria are very expensive. Nigeria is endowed with many plant resources with vast nutraceutical potentials such as Newbouldia laevis (Ogilisi), however, limited scientific information on its processing, safety and efficacy limits its use as nutraceutical in food formulations. The objectives of the study

were to: (i) produce nutraceutical base from the leaf of Newbouldia laevis, (ii) determine the effect of the base on some histopathology functions using rat bioassay.
Methodology: Nutraceuticals were produced using 50:50 water/ethanol from blanched and unblanched Newbouldia laevis leaves. Product together with powdered blanched and unblanched Newbouldia leaves were evaluated for safety using rats Acute toxicity study was conducted by administering a single dose of 2000mg/kg body weight of samples to female albino rats (5 per group) for 14 days using the acute toxicity fixed dose procedure 420 Guideline (OECD, 2001). In the subchronic study, female albino rats (45) were shared into 9 groups and orally fed with 100, 300 and 600 mg/kg body weight of the products daily for 30 days. The 9th group served as the control group. Toxicological parameters namely clinical signs, body weight, water, and food consumption, relative organ weight, hematological and serum parameters, and histopathological assessment was conducted.
Results: Acute toxicity test at 2000mg/kg aqueous ethanol extracts, blanched and unblanched leaf powder of Newbouldia laevis oral administration did not cause mortality or any clinical signs of acute toxicity, showed no effect on macroscopic examination of organs, body weight, food and water consumption in the rats observed for 14 days. In sub-chronic toxicity study, oral administration of same products at 100, 300 and 600 mg/kg mg/kg for 30 consecutive days to female albino rats did not produce mortality nor change behavior, body weight. No significant differences were found in relative organ weights. Moreover, biochemical and hematological studied parameters in treated groups compared to control group. No obvious histological changes were observed in organs of treated animals compared to control.
Conclusion: The results of our toxicological investigation are indicative that the ethanol extracts, blanched and unblanched leaf powder of Newbouldia laevis is well tolerated for both single and chronic administration.

MP1.3

Development of Safety Management System for *nunu* (Indigenous Yoghurt) Processing in Northern Nigeria

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Nunu is a fermented milk product in West African sub-region produced mostly by nomadic *Fulani* women. It is a meal often relish by its consumers in the sub-region. Its production is a value addition to raw milk and fulfills multiple purposes in rural economies (Akabanda et al. 2010; Owusu-Kwarteng et al., 2012). However, despite the nutritional and economic benefits of this product, it is being avoided by many in the cities due to mistrust about the hygiene of its processing and vending. Consequently, a community based action research project was initiated with the aim of developing a safety management system for *nunu* processing in rural communities of Northern Nigeria through the applications of hazard analysis critical control point (HACCP) and good manufacturing practice (GMP) strategies. A hazard analysis study of *nunu* was carried out in three villages in Kwara State of Nigeria. This analysis involved observation of raw materials and environments, and watching all steps of the processing. Subsequently, flow diagram for the processing of nunu was developed with critical control points identified. Samples were taken at different stages of processing for microbial assay. Air sampling and swabbing of equipment for microbial analysis was also done. *E-coli, Klebsiela, Shigella, S. aureus* and *B. cereus* were isolated from the samples. Presence of these organisms indicated that the processing was carried out in highly contaminated environment and holding at vending conditions could be risky. Control measures

were tested and validated. Processors were thereafter educated on the imperativeness of hygienic environment and importance of monitoring hazard and critical control points. It expected that applications of the above tools would lead to increase in production of nunu and enhance processing efficiency which would make the processing of this product appeal to small scale enterprise, establishment of safety management system to enhance consumers' confidence in consumption of the products and at the long run translate to more income with improved livelihood for the processors who are mainly rural women.

MP1.4

Characterization of Germination of *Clostridium estertheticum* Spores

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The storage life of vacuum packaged beef primal cuts, the form of beef widely traded nationally and internationally, can exceed 120 days. However, the meat can be spoiled by gross distension of the vacuum packs well before the expected storage life, i.e. blown pack spoilage (BPS). BPS is caused primarily by the anaerobic spore-forming organism *Clostridium estertheticum*. Spores are dormant structures and resistant to the decontaminating treatments routinely applied at beef packing plants. However, the germinated cells are less resistant. The objective of this study was to characterize the germination conditions for *C. estertheticum* spores, with a view to identifying means of controlling BPS. *C. estertheticum* on vacuum packaged beef that had been or had not been spoiled by BPS was quantified using real-time PCR. The effect of pH, temperature and oxygen on germination of *C. estertheticum* spores was determined in meat juice medium. Spores were enumerated using a modified differential spore stain (Wirtz-Conklin). Amino acids and lactate were screened as possible germinants of *C. estertheticum* spores by monitoring the release of dipicolinic acid (DPA). *C. estertheticum* was detected on meat in most of the packages and the numbers of *C. estertheticum* were somewhat correlated with the degree of pack swelling. Germination rate of spores increased as pH approached neutrality, with an optimal germination rate at pH 7.0. Temperatures between -1.5 and 10°C did not affect germination of spores. Spores germinated equally well in aerobic conditions as they did in anaerobic conditions. A fraction of heat activated *C. estertheticum* spores germinated and died when heated in meat juice medium at 80°C for 10 min. *C. estertheticum* spores germinate in meat with lactate as the potential germinant.
The findings of this study show that vacuum packaged beef stored at chiller temperature provides all the conditions required for the germination of spores of *C. estertheticum* and that BPS could be potentially controlled by thermal inactivation of germinated spores on meat.

MP1.5

Analysis and Formation of (E)-2-Alkenals in Heat-processed Food

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Introduction and Objectives 2-Alkenals, e.g., acrolein or crotonaldehyde, are formed during heat-processing of food and are of special interest due to their toxicological relevance. But, up to now, no quantitation methods are available on the basis of stable isotopically labeled standards and their formation pathways are not clearly proven and remained largely hypothetical. Thus, the objectives of this study were (i) to develop a stable isotope dilution analysis for the simultaneous quantitation of acrolein and crotonaldehyde and ii) to clarify the mechanism of (E)-2-alkenal formation using several synthesized precursors like partially [13C]-labeled triglycerides in model systems. Methods Acrolein

and crotonaldehyde were quantitated in food and model systems directly by headspace gas chromatography-mass spectrometry (GC-MS) or after derivatization by GC-MS or high performance liquid chromatography-MS using isotopically labeled [13C3]-acrolein and [13C4]-crotonaldehyde as internal standards. Results The newly developed quantitation method on different types of oils varying in their fatty acid compositions revealed significant differences in the concentrations of both (E)-2-alkenals, which were formed after heating at different temperatures and times, e.g., 0.32 mg crotonaldehyde and 0.62 mg acrolein/kg of coconut oil or 12.0 mg crotonaldehyde and 23.4 mg/kg of rapeseed oil after heat-processing for 24 h at 180 °C. Comparison of the results showed that the concentration of formed (E)-2-alkenals seemed to be correlated with the amount of linolenic acid in the oils. To prove this assumption, various isotopically labeled precursors (triglycerides) differing in their fatty acid moieties as well as in their labeling pattern were synthesized revealing a clear dependency of the formation on the respective fatty acid pointing out linolenic acid as the most effective one. Conclusions Using stable isotopically compounds enabled the development of precise and reliable quantitation methods for the toxicologically relevant compounds acrolein and crotonaldehyde as well as the elucidation of the formation pathway, for which contradictory statements could be found in literature. With these data at hand, ingested amounts by the consumers' diet can be calculated and used for a new toxicological evaluation. Further, the knowledge of formation pathways, which are influenced by processing parameters, offers industry mitigation strategies to produce "healthier" food.