





DECEMBER 4-8TH 2017

Food Safety Training Workshop

Theme: Managing Food Safety and Quality in Small-scale Food Processing for Roots, Tubers and Bananas (RTB) value chains in Sub-Saharan Africa

Venue: Biosciences for East and Central Africa (BecA) Hub, International Livestock Research Institute (ILRI), Nairobi, Kenya.

Compiled by: Joyce Musyoka, Faith Njung'e and Tawanda Muzhingi

CIP INTERNATIONAL POTATO CENTER
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biosciences eastern and central africa

NEPAD TRANSFORMING AFRICA

ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

CGIAR Science for a food-secure future

UNIVERSITY of GREENWICH
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Cover Photo: *Various Roots, Tubers & Banana products and processing. (Photo credits: Sara Quinn CIP)*

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Acronyms

AFA	Agriculture and Food Authority
AMR	Antimicrobial resistance
BC	Bioactive compounds
BecA	Biosciences for eastern and central Africa
CCP	Critical control point
FAO	Food and Agriculture Organization
HACCP	Hazard Analysis and Critical Control Point
KEBS	Kenya Bureau of Standards
KEPHIS	Kenya Plant Health Inspectorate Service
NRI	Natural Resources Institute
OFSP	Orange-fleshed sweetpotato
PRPs	Prerequisite programs
RTB	Roots, Tubers and Bananas
SMEs	Small and medium enterprises
SSA	Sub-Saharan Africa
TQM	Total Quality Management

Executive summary

Managing food safety and quality in small-scale food processing for Roots, Tubers and Bananas (RTB) value chains in Sub-Sahara Africa training workshop took place on 4th – 8th of December 2017 at the International Livestock Research Institute in Kenya. The training was attended by 27 participants (15 men and 12 women) from 11 countries (Ethiopia, Kenya, Ghana, Nigeria, Uganda, Cameroon, Tanzania, DRC, Malawi, USA, and UK). They also came from various sectors including government, academia, private-sector (food processors), non-profit organizations and religious organizations.

The objective of the training workshop was to enhance compliance to food safety regulations by small-scale enterprises involved in RTB processing in sub-Saharan Africa (SSA). The actors gained skills and knowledge from the training important in addressing food safety challenges that arise from lack of compliance to good Hygiene and Manufacturing Practices.

Figure 1: Food Safety Workshop Training Participants

The training was opened by Josephine Birungi, the Deputy Director/Technology Manager Biosciences for eastern and central Africa (BecA) who gave a brief introduction to BecA-ILRI, highlighting the core activities carried out by BecA. Over the course of five days, different topics were discussed by several facilitators covering food safety considerations during processing and

development of products, food safety regulations, food safety issues and their implications and food hygiene and nutrition activities. There was a panel discussion which was facilitated by Dr. Tawanda Muzhingi on Food Safety and Legislation in Africa; covering the role of Bureaus of Standards, challenges, and strategies to register a new product encountered mostly by small and medium enterprises in Africa.

The training was facilitated by Dr. Richard Fuchs. He is a Principal Scientist: Food Safety Specialist and Programme Leader – MSc. Food Safety and Quality Management at the Natural Resources Institute (NRI), University of Greenwich, United Kingdom. The training was an introductory course leading to Royal Society for Public Health Level 2 Award in Food Safety and Hygiene which constituted topics such as an Introduction to Food safety, Microbiological hazards, Contamination hazards and controls, Food poisoning and its controls, Personal hygiene, Design of food premises and equipment, Cleaning and disinfection, Food pests and control and Food safety management. Another keynote speaker was Dr. Matt Jon Stasiewicz, an assistant professor of Applied Food Safety at the University of Illinois Champaign-Urbana, Illinois, USA.

The workshop experience was also enriched by contributions from Dr. Andrew Edewa formerly Africa Union Food Safety Officer and now with the Food and Agriculture Organization of the United Nations (FAO) Kenya office. Andrew gave an overview of the Food safety issues at continental level in Africa. Mr. Antonio Magnaghi, the Food Application Director at Euro-Ingredients Limited gave a lecture on food safety in processing plants, kitchens, equipment considerations and during product development using Orange-fleshed sweetpotato examples. Dr. George Ooko Abong' from the University of Nairobi's Food Science Department impressively taught on the current efforts on the food standard development on roots and tuber crops in Kenya and also highlighted the food safety scene in Kenya. Ms. Victoria Mwenda, Nutrition Sector Coordinator with the United Nations Children's Fund (UNICEF)-Kenya office lectured on Environmental Enteric Dysfunction (EED), a subclinical inflammatory disorder of the gut, is also highly common among impoverished inhabitants of environments with poor sanitation and hygiene, such as those often found in developing countries such as Kenya and brought to life the UNICEF conceptual framework on the causes of malnutrition.

Field tours: Participants visited BecA nutrition and Food safety platforms where they were introduced to the facilities in which research on food safety and nutrition is carried out. Some of the food safety research carried out in BecA include; the analysis of mycotoxins in food and feed, microbial analysis of food products especially sweetpotato roots and sweetpotato products, nutritional analysis of food products including proximate analysis, vitamin C determination, antioxidants and β-carotene among others. Participants then visited a pilot plant at the Department of Food Science, Nutrition and Technology, University of Nairobi. This is a small enterprise which is mostly used by students in the same department for practical purposes. The plant is involved in the production of both meat and dairy products that are sold at the university institutions. The products include; yogurt, *Mala*, ice-cream, cheese and bacon among others.

Group activities: Each participant presented a summary of the work on the roots, tuber and banana value chains. The participants were grouped according to their crop interests. Participants were then introduced to the UK's safer food, better business (SFBB) program which helps small businesses with food safety management procedures and food hygiene regulations. Working in groups participants developed their own food safety management systems using the different roots, tubers and banana value chains.

Lessons learnt: The main lessons learnt was that this kind of trainings on Food Safety, Food Processing and WASH are important at national level especially in Kenya at county level. Future training should also actively seek government and country officials in order to have a bigger impact. Food safety issues are universal and affect both poor and industrialized countries. This training will help CIP and partners contribute effectively to the attainment of sustainable development goals (SDGs) by promoting the consumption of nutritious and safe foods. Major lessons learnt was that safe and nutritious foods are essential for nutrition sensitive value chain development. FAO and UNICEF recommended the training be opened up to government and other food safety players such as bureau of standards and donors. BecA ILRI Hub were impressed with the quality of the training and its relevance to CGIAR, they would like a training next year and requested A4NH CRP and One Health consortium to be involved.

1. INTRODUCTION TO BECA HUB AND CAPACITY BUILDING IN AFRICA

Josephine Birungi

Biosciences Eastern and Central Africa - International Livestock Research Institute (BecA-ILRI) Hub is a shared research platform that provides access to world-class research facilities. It supports the work of scientists from National Agricultural Research Systems (NARS) and scientists from other institutions globally. Its core activities include provision of a research platform, capacity building, and facilities to Eastern and Central Africa. Research at BecA is focused on areas such as livestock, crop improvement, food safety and nutrition, climate change mitigation and exploiting the potential of underutilized crop and animal species.

Figure 2: Josephine Birungi Deputy Director/technology Manager (BecA-ILRI)

The capacity building program is branded the Africa Biosciences Challenge Fund (ABCF) and is delivered through research fellowships involving scientists from African NARS undertaking research at BecA-ILRI Hub; training workshops conducted annually to enhance skills in fields such as bioinformatics, proposal writing, genomics, scientific writing and molecular biology; institutional capacity building and creating linkages between researchers and institutions for joint linkages. BecA provides research facilities and services to students and African scientists. A number of technology platforms have been established which include bioinformatics, molecular breeding, genomics, nutrition and mycotoxin analysis and cloning.

2. INTRODUCTION TO FOOD MICROBIOLOGY AND HUMAN HEALTH

Matt Stasiewiez

Food microbiology is defined as microorganisms and food, whether used for human benefit or are deteriorative to humans. It involves fermentation, quality of food and food safety as related to human health. Microorganisms account for 90 % of the earth's biomass and the types of microorganisms include those that are involved in fermentation, spoilage microorganisms causing food spoilage characterized with bad smell but do not cause diseases and pathogenic microorganisms that lead to foodborne diseases.

The factors that influence microbial growth in a food product are classified into intrinsic which are the characteristics of the food such as nutrients, extrinsic factors which constitute the environment surrounding the food like humidity, and explicit factors which are other organisms such as bacteria and fungi growing in the food. Vehicles of foodborne illnesses are both plant and animal tissues while the sources of food contamination include water, air, sewage, soil and humans from which microorganisms find their way into food.

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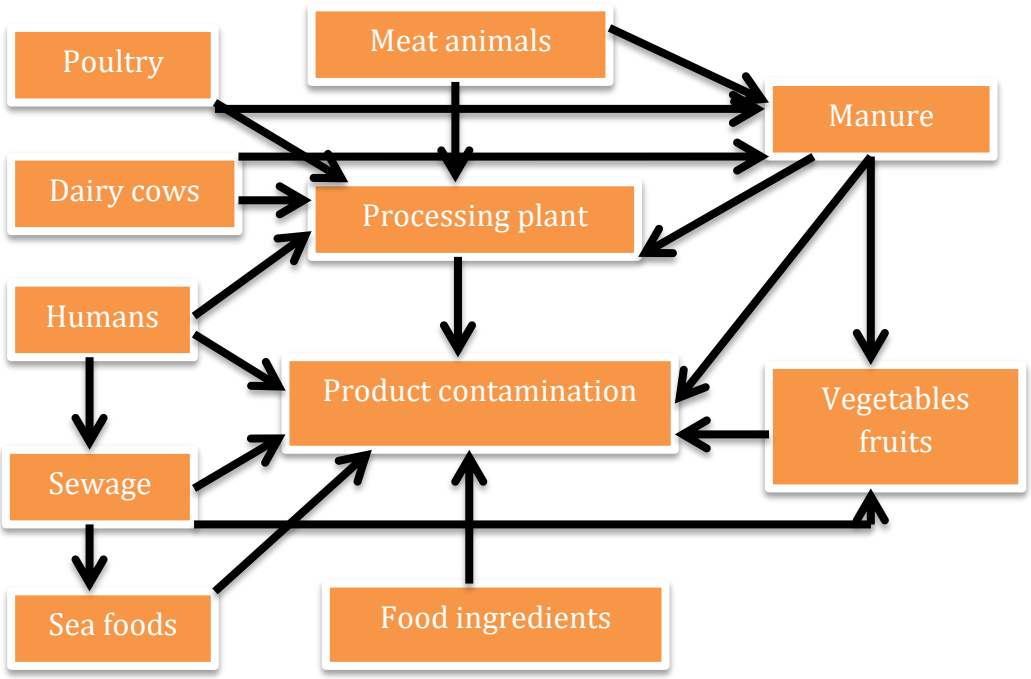

Figure 3: Pathways for product contamination with pathogens

Hazards in food can be categorized as physical such as metals, chemical such as natural toxins, contaminants, and allergens and biological such as foodborne pathogens which include parasites, fungi, bacteria, viruses, prions and toxic phytoplanktons. Foodborne illnesses are illnesses caused by agents that enter the body through food. Foodborne illnesses are very common though it is difficult to relate and or trace back a sickness to food. The types of foodborne illnesses include intoxications, infections, and toxin-mediated infections. Food intoxications involve the ingestion of food containing preformed toxins. Food infections arise from ingestion of food containing microorganisms thus causing infections while toxin-mediated infection arise from ingestion of food containing microorganisms which then produce toxins in the intestines causing disease.

3. FOOD SAFETY AND FOOD MICROBIOLOGY CONSIDERATIONS IN FOOD PRODUCT DEVELOPMENT AND PROCESSING

Antonio Magnaghi

Some of the food safety issues of concern during food handling and preparation that lead to compromise on the quality of food include lack of food handlers' training on handling of raw materials and food products, post-cooking contamination of food whereby cross-contamination occurs when processed products are stored together with raw products.

Figure 4: Processed products stored together with raw products

Figure 5: Improperly cleaned Equipment

The choice of equipment to be used for food processing is done by considering if the equipment is easy to clean and maintain and the material used to manufacture the equipment. During processing, enough time should be allocated for the cleaning of equipment and the cleaning procedures for each equipment documented. The installation

of the equipment should be done such that it allows for easy cleaning of all its parts. The challenges and the cost of cleaning have food safety implications.

4. PARTICIPANTS PRESENTATIONS FOR THEIR RTB ACTIVITIES

George Abong'

Each participant presented a summary of their work on RTBs. The activities on RTBs carried out by the participants according to countries include;

- Tanzania-Value addition of OFSP into OFSP flour, OFSP flour + soya, jam, ketchup, crisps. Biofortification of products like OFSP flour, composite flour (OFSP + yellow maize + sorghum)
- Kenya-OFSP puree- there is progress in food safety at Organi limited. One of the biggest challenges on food safety is working with semi-illiterate staff. Preservation of potatoes, cassava, and bananas by farmers.
- Uganda-Charcoal cooler for storing peeled bananas to avoid enzymatic browning during trading.
- Ethiopia-Development of microorganisms that can be used to reduce cyanide toxicity in cassava during fermentation.
- Nigeria-Value addition of sweetpotato to commercially viable products. Extension services to increase the capacity of SMEs and the youth. Research on the impact of RTB on the human health, checking on their glycemic index and the association between malnutrition, sanitation, and hygiene.
- Malawi-Processing of sweetpotato and cassava into products such as sweetpotato bread, buns, high-quality cassava flour, potato crisps and french fries. Training of small groups involved in the value addition of roots and tubers.
- Ghana-Value addition along the RTBs food chain. Training sessions on the processing of sweetpotato and the incorporation of sweetpotato in indigenous dishes. Root and tuber processing to control losses. Some of the products are drinks from OFSP, bread, and garri from cassava chips.

- Cameroon-processing of plantain flour that is used to make biscuits and processing of plantain chips. Food quality control laboratory for bananas for export to check on pesticide residues and physicochemical analysis.

The participants were then introduced to the UK's safer food, better business (SFBB) program which helps small businesses with food safety management procedures and food hygiene regulations. The SFBB pack contains a series of easy to understand safe methods for cooking, chilling, cleaning, cross-contamination and management. It is designed to be easily tailored to suit smaller businesses and can be implemented in a relatively short period of time.

5. FOOD SAFETY AND REGULATIONS IN AFRICA

Andrew Edewa

The global burden of foodborne diseases is caused by various food scares some of which are caused by pathogens like *Escherichia coli* and *Staphylococcus aureus.* Some of the food scares that have been identified globally include Hepatitis B, Yellow fever, Typhoid fever, Cryptosporidiosis among others.

There are international standards governing food to ensure that the country's consumers are supplied with food that is safe to eat. These include general agreements on tariffs and trade (GATT) which is general measures necessary to protect human, plant and animal health. Technical Barriers to Trade (TBT) are standards for all products that enable a country to take regulatory measures while ensuring that they do not cause unnecessary barriers to trade. Some of the regulatory measures undertaken by countries are laboratory analysis for compliance to food safety.

The regulations in a certain country try to conform to those of the SPS agreement. Sanitary and phytosanitary (SPS) agreement are standards on food and agricultural products to protect human, plant and animal health. The SPS agreement gives a country the right to protect human, animal and plant health while ensuring that they avoid unnecessary barriers to trade. There are various food scares in Africa as shown in the table below.

Place	No. of cases	Incidence	Source
Kenya	More than 400	Acute Aflatoxicosis	Maize Meal
South Africa	2 deaths	Type A Botulinum	Tinned fish in tomato sauce
South Africa	578 deaths	Shigella Flrxneri	Maize Meal
Burkina Faso	29 deaths	Fatal Encephalopathy	Unripe Ackee fruit
Ethiopia	79 deaths	Salmonella (Newport)	Unpeeled undercooked eggs
Swaziland	40912 deaths	Escherichia coli	Beef and untreated water
Mozambique	772 deaths	Haemorrhagic colitis	Cooked food at marketplace

Table 1: Current food scares in Africa

Food-borne diseases present serious threats to the health of millions of people in Africa. Serious outbreaks of food-borne diseases have been reported, illustrating both the public health and economic significance of these diseases. These outbreaks are likely to be only the most visible aspect of a much broader, more persistent problem. Many African countries suffer from persistent food insecurity and up to 60 % of the food supply is imported or donated to supplement local production. The safety of imported food cannot always be assured, adding to the risk of widespread food contamination. The failure to meet food-safety and quality standards hampers the continent's efforts to increase agro-food trade.

The major food safety concerns in East Africa include; mycotoxins in cereals and nuts which have caused several deaths in the region, high cyanide levels in certain varieties of cassava affecting food security and trade, concerns of pesticide residues, heavy metals (Cadmium, Lead, Tin, etc.) in fruits and vegetables, Zoonoses and residues of veterinary drugs in food in milk and meat, Mercury and residues of veterinary drugs in fish and increased concerns about antimicrobial resistance (AMR) in East Africa leading to epidemics of typhoid.

6. FOOD MICROBIOLOGY AND SAFETY ISSUES: LESSONS FROM USA

Matt Stasiewiez

Food laws in the US have evolved out of response to crisis. Due to the serious consequences caused by outbreaks, some innovative systems such as HACCP and whole genome sequencing for public health were developed even though they are still not perfect.

7. FOOD SAFETY ISSUES AND IMPLICATIONS IN KENYA

George Abong'

There are various bodies in Kenya that deal with food safety issues and these including Ministry of Health (Public Health Department), KEBS, KEPHIS, County health offices and AFA. Some of the food safety issues and media reports in Kenya reported between January and December 2017 include;

- Groom dies of 'food poisoning' just two months to wedding-KICC poisoning https://www.standardmedia.co.ke/article/2001248211/groom-dies-of-food-poisoning-just-two-months-to-wedding
- 140 students sent home in food poisoning scare-expired bread. https://www.standardmedia.co.ke/article/2001255149/140-students-sent-home-in-food-poisoning-scare.
- NASA leader Raila Odinga treated for food poisoning. Read more: https://www.standardmedia.co.ke/article/2001231961/nasa-leader-raila-odinga-treated-for-food-poisoning.
- What health authorities had been told about Nairobi food: https://www.standardmedia.co.ke/health/article/2001248318/what-health-authorities-had-been-told-about-nairobi-food.
- January research reports showed contamination hence warned MOH not to license any untrained food handlers.
- Up to a third of food handlers seeking medical certificates carry highly drug-resistant germs:https://www.standardmedia.co.ke/health/article/2001262112/eastlands-blamed-for-recent-food-poisoning-in-city-hotels.

- Punish traders using toxic chemicals in human food: http://www.nation.co.ke/oped/letters/Punish-traders-using-toxic-chemicals-in-human-food/440806-4209476-cggovc/index.html.
- Nairobi County bans open-air cooking, food hawking. Read more: https://www.standardmedia.co.ke/article/2001247672/nairobi-county-bans-open-air-cooking-food-hawking.
- Bacterial contamination of kales-common vegetables: https://pdfs.semanticscholar.org/49d6/7960628796ad8e38d0a2cd425c160dba4c98.pdf
- CSs Rotich and Mohammed hospitalized with cholera symptoms. Read more at https://www.standardmedia.co.ke/article/2001247561/css-rotich-and-mohammed-hospitalised-with-cholera-symptoms.

The food safety issues on RTBs in Kenya include heavy metals such as lead and cadmium, pesticide residues such as Dithiocarbamates, Organophosphorus compounds, Glycoalkaloids in potatoes, chemical by-products such as chloroform during water decontamination and compounds that develop during processing such as acrylamide**.**

8. ROYAL SOCIETY FOR PUBLIC HEALTH LEVEL 2 AWARD IN FOOD SAFETY AND HYGIENE

Richard Fuchs

8.1 An introduction to food safety

There are various types of hazards that can be introduced in food which include microbiological hazards, physical hazards, chemical hazards and allergenic hazards. The most common hygiene faults that result in food poisoning include; preparing food too far in advance and storing at room temperature, slow cooling of food, not reheating food, contaminated food (cross-contamination or raw), not thawing completely before cooking and food handlers being infected/having bad personal hygiene. Ensuring food safety in a food establishment has various benefits such as it gives the company a good reputation, it protects the brand, there is less risk of food poisoning, less waste, it provides good working conditions, and the company is able to register higher profits.

8.2 Microbiological hazards

The types of microorganisms are bacteria, moulds, and viruses. Bacteria are found everywhere and can only be seen using a microscope. They comprise of pathogens that are capable of causing illness, spoilage bacteria that makes food unfit and some helpful/useful bacteria, for instance, the one used in making yoghurt. When food is contaminated by bacteria, moulds, viruses or parasites, the bacteria is able to multiply in the food to unsafe levels and some of the pathogens are able to survive in the food even for longer periods. Bacteria require warmth, moisture, food and time to multiply in food and some can double in number in every 10 minutes.

There are various ways in which the multiplication of food poisoning bacteria in food can be prevented and these include; the use of cold temperatures, hot temperatures, short time in danger zone, rapid cooling of food, use of salt/sugar/acid, dehydration and keeping food dry and the use of preservatives. Various methods can be used to preserve food such as the use of high temperatures, very low temperatures, chemicals or use of irradiation and ultraviolet light.

Bacteria are dead

Most pathogens start to die at 63 °C and above.

Bacteria multiply rapidly between 20 °C –50 °C

Spoilage slow growth; most pathogens no growth <5°C

Bacteria are dormant with no growth of spoilage or pathogens at -18 °C.

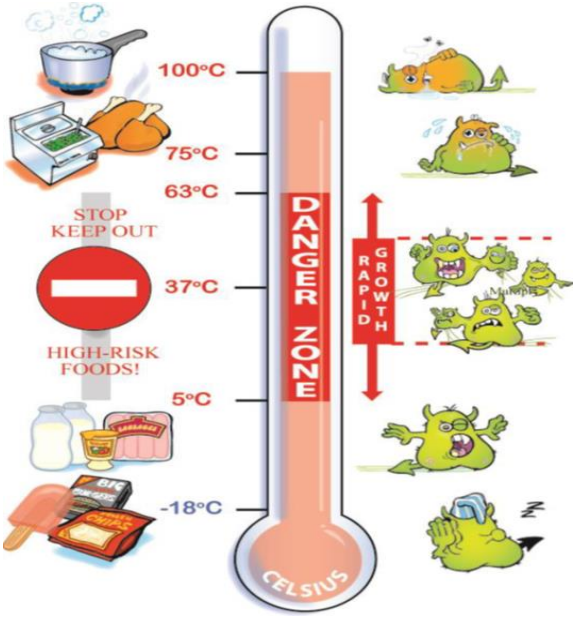

Figure 6: Activity of bacteria at different temperatures during storage

Some bacteria are able to produce toxins as they grow in food and many of these toxins are heat resistant, unaffected by freezing and have a short incubation period. Some bacteria are able to

form a spore which is the dormant state of the bacteria and which can survive high temperatures, for instance, boiling for up to five hours, chemicals (disinfectants) and dehydration (drying). Spores do not multiply, they do not keep the bacteria warm or cold and they can survive freezing.

High-risk food is ready-to-eat and supports the growth of bacteria, usually needs refrigerated/frozen storage or hot storage above 63 °C. Raw foods to be cooked must be separated from ready-to-eat food because they are a major source of food poisoning bacteria. Low-risk food can usually be stored at ambient/room temperatures as they do not support the multiplication of pathogenic bacteria. Some of the signs of food spoilage are off smells, discoloration, slime/stickiness, mould, texture change, unusual taste, the production of gas, blown cans or packs.

8.3 Contamination hazards and control

The main types of contamination hazards are physical, microbiological, allergenic and chemical. These hazards may be present in raw materials or introduced during storage, preparation or service. The sources of bacteria are origins of bacteria that bring them into food premises and include insects, raw food, animals, birds, soil and dust, people, sewage, contaminated packaging, refuse, and waste. The vehicles of bacteria transfer bacteria from sources to ready-to-eat food and they include hands, cloths, food and hand-contact surfaces.

Cross-contamination is also a way in which microbiological hazards are introduced into food. Cross contamination is an inadvertent transfer of bacteria or other contaminants from one surface or substance to another especially because of unsanitary handling procedures. Cross-contamination occurs when bacteria transfer from raw food to ready-to-eat food through direct contact. Cross-contamination can be controlled through training and supervision of food handlers, handwashing between raw and cooked food, separating raw and ready-to-eat food (color coding), using disposable paper cloths or color-coded cloths, cleaning and disinfection, using separate equipment for raw and ready-to-eat food, and not using hand washbasins for washing food or equipment.

Sources of physical hazards in food include:

- Raw ingredients (leaves, stalks, stones etc.)
- Cleaning materials/equipment
- Maintenance –bolts/screws/nails
- People
- Packaging
- Notice boards/pins
- Building equipment
- Pests

Physical contamination of food can be controlled through the implementation of:

- A glass policy and a glass breakage policy
- Ensuring that equipment and structure are well maintained and in good repair and condition
- Avoiding repair of equipment in food rooms
- Ensuring that pests don't end up in food
- Staff training
- Including the need to report defects immediately
- Avoiding pins or drawing pins in food rooms
- Ensuring that all staff wear appropriate protective clothing
- Checking deliveries and de-box area ensuring that no staples, string or card
- Waste control
- Reporting damaged equipment
- Not storing food in unsuitable containers such as old ice-cream tubs
- Enforcing dress code i.e. wearing head covering/no jewelry/short nails/no nail varnish/no personal effects
- Effective cleaning

The sources of chemical hazards include:

- Deliveries
- Packaging materials (leaching)
- Maintenance operatives/contractors
- Cleaning chemicals
- Pesticides and additives

Chemical hazards can be controlled in food premises through purchasing from approved suppliers, safe packaging, training of cleaners, separation of chemicals from food, not storing food in old chemical containers, not storing chemicals in unmarked containers, following correct dilution procedures, rinsing following chemical cleaning, protecting food-cleaning, pest control, not cleaning above open food and the use of approved food-grade chemicals.

Allergenic hazards in food are an increasing problem because they can represent a serious health hazard to consumers. Food processors must ensure their products are not contaminated with allergens that are not declared on their labels. An allergen is any protein that is capable of producing an abnormal immune response in sensitive segments of the population.

The symptoms of an allergic reaction are;

- Shortness of breath/wheezing
- Swelling of tissue in the mouth and throat
- Difficulty in swallowing and speaking
- Severe asthma
- Cramps/gastrointestinal symptoms
- Generalized flushing of the skin
- Body rash/hives
- Alterations in heart rate
- Sudden feeling of weakness
- Collapse and unconsciousness and death

The most common allergic ingredients are cereals containing gluten, crustaceans, eggs, fish, peanuts, soya, milk (including lactose), nuts, celery, mustard, sesame seeds, sulphur dioxide and sulphites, Lupin, molluscs and any products containing these ingredients.

All products should be labeled such that any allergy information on a product is given. Food labels must list all the ingredients, and ingredients derived from allergenic foods must be clearly identified in the ingredient list. This helps people with a food allergy or intolerance to identify the ingredients they need to avoid. Allergenic hazards can be controlled in food through obtaining raw materials from approved suppliers, suitable packaging and labelling, segregation of allergens from delivery to service, separate preparation areas, separate equipment (color coding), discard/re-label accidentally or potentially contaminated food, cleaning and clearing spillages, handwashing, communication such as staff training and labelling.

8.4 Food poisoning and its control

Food poisoning can be defined as any disease of an infectious or toxic nature caused by the consumption of food or water. The duration of food poisoning is one to seven days and the symptoms include stomach cramps, diarrhea, vomiting, nausea/feeling sick, fever, dehydration and collapsing. The most group of people with the highest probability of food poisoning are the elderly, very young children/babies, pregnant women/unborn babies and people who are ill.

The causes of food poisoning are mostly microorganisms such as bacteria and toxins, molds (mycotoxins), viruses and poisonous plants/fish, poisonous metals and poisonous chemicals. The common food vehicles causing food poisoning are poultry, desserts, milk and milk products, cooked meat and meat products, shellfish and fish, egg products and eggs, salads, vegetables, and fruit. Some of the food-borne diseases include Campylobacter, *Escherichia coli* O157, Norovirus, Listeria (refrigerator), Typhoid/paratyphoid (Salmonella), Hepatitis A and Parasites.

8.5 Personal hygiene

Food handlers must have high standards of personal hygiene, wear clean protective clothing, not work if ill or suspected of being a carrier of harmful bacteria (contaminate food)-report to supervisor, be trained in line with work activities.

The facilities required for handwashing should have a clean wash-hand basin not used for food or equipment, sinks for food or equipment not used for hands, non-hand operated taps recommended, hot and cold running water (mixed 30-40 °C), liquid soap (disposable cartridge), soft, heat-resistant, clean nailbrush, hygienic hand-drying facilities, preferably paper towels. Effective hand washing involves wetting hands under warm running water, applying one shot of liquid soap to hands, rubbing hands together under running water while cleaning all parts of hands especially nails and fingertips, rinsing all the lather, drying hands completely using a paper towel or warm air dryer, using paper towel to turn off tap and disposing paper towel in a foot-operated container.

Protective clothing should protect food from risk of contamination, be easy to clean and keep clean, have no buttons, have no outside pockets, completely cover own clothing, head covering-to reduce risk of hair in food, not worn outside.

8.6 Design of premises and equipment

The risk of contamination from premises can be reduced through linear workflow to prevent cross-contamination, separating areas for raw and ready-to-eat (color coding can assist in this), good ventilation to prevent condensation and reduce temperature, cleaning, and disinfection.

The law requires that food equipment must be kept clean and in good condition, be designed to allow cleaning and disinfection, be installed to allow cleaning of the surrounding area, and minimize the risk of contamination. Food handlers have a responsibility of keeping surfaces and equipment clean, keeping windows and doors closed, not ruining good design such as placing food under an electric fly killer, not using dirty or broken equipment (clean it or replace it), only using sinks or washbasins for the correct purpose, not making temporary repairs, ensuring they clear-and-clean-as-you-go and keeping waste areas tidy.

8.7 Cleaning and disinfection

Food premises and all food-contact equipment to be cleaned and, where appropriate, disinfected as often as necessary. Hot water, chemicals, and physical energy are requirements for effective

cleaning. Cleaning is important as it reduces the risk of food poisoning, removes the food supply for bacteria, removes materials/food for pests, reduces the risk of food contamination, removes dirt and grease, allows disinfection, promotes a good image of the company and provides a safe and pleasant workplace. During cleaning, disinfection is applied on food-contact surfaces such as food utensils/equipment, chopping boards, preparation surfaces, and walls adjacent to preparation surfaces, sinks, and refrigerators, hand-contact surfaces such as touch points like handles on doors, drawers, refrigerators, taps/hand washbasins and nailbrushes.

8.8 Food pests and control

A pest is an animal, insect or bird which lives in or on food. It contaminates food and is noxious, destructive or troublesome. Pests contaminate food through breeding in food, feeding (vomit back previous meal), feces, walking on it/work surfaces, laying eggs on uncovered food and dead bodies. The common food pests are rodents such as rats and mice, insects such as flies, wasps, cockroaches, and animals such birds, dogs, and cats. It is important to control pests in food premises because they lead to food poisoning, they contaminate food, lead to wastage, complaints from customers, staff loss and can lead to legal action. Pests can be destroyed in food premises by use of UV fly killers, sticky boards, traps for rodents, hormone traps–insects, solid bait for rodents and sprays or powder for insects.

8.9 Food safety and Quality management in SMEs

Total Quality Management (TQM) controls all aspects of the product; both safety and quality. It must be proactive and easily adaptable. Personnel in SMEs have to receive appropriate training on TQM. Appropriate system of documentation should be put in place to give an assurance that all the procedures are in place. The views about quality have changed over the years:

Traditional View	Total Quality Approach View
1. Improvement of quality is expensive	Quality pays for itself
2. It is a reactive culture	It is preventative
3. There are acceptable quality levels	Aims at a defective free product/service through continuous improvement

4. It is worker's fault	It is everyone's responsibility
5. There should be detecting and checking for errors or faults	The process ensures that it is right first time and every time

Table 2: Traditional and Total Quality approach on quality

There are various causes of failure in quality. It is not therefore appropriate to rely on end product testing. Sampling plan can be designed to improve chances of detecting something in food.

Cause	**Proportion**
Human error	12 %
Bad inspection	10 %
Bad specification	16 %
Design faults	36 %
Poor planning	14 %
Others	12 %

Table 3: Causes of failure in quality

Quality of a product is aimed at achieving complete customer satisfaction. It is about giving the customers what they want every time and at the right cost. Quality is achieved through satisfying customer needs, getting closer to customers, putting all quality measures in place, making sure that performance standards are in place, measuring the performance standards, pressing for continual improvement and recognizing achievements. In pursuit of achieving quality, some of the weaknesses to be eliminated include; doing what has always been done, not understanding or ignoring competitive position, confusing quality with grade, the "Not my problem" syndrome and firefighting is *macho*. Staff must always be trained to evaluate the situation, plan accordingly, do what is required of them, check and amend.

The Quality Management system used globally is **EN ISO 9001-2015.** Prerequisite programs (PRPs) are systems that have to be in place before the HACCP system is in place. The importance of PRPs is that they provide sound foundation for HACCP, they cover low-risk hazards, they allow HACCP plan to be process specific and focused and they streamline HACCP plans. The areas

covered by PRPs are cleaning and disinfection, pest control, plant, and equipment sanitation, premises, and structures, services like water and energy, storage, distribution and transportation, waste management, maintenance, personnel hygiene and training and zoning (Physical separation of activities to prevent potential food contamination).

Management of food safety involves the HACCP which is a system used to ensure food safety. HACCP is a legislative requirement recommended by CODEX which identifies, evaluates and controls hazards which are significant for food safety. The structure of HACCP should be designed such that it is user-friendly and documents should be put in place. The HACCP principles involve, identification of the hazard, determination of the Critical Control Point (CCP), control of the CCP, monitoring the system, corrective action, correction in case of deviations, verification of the HACCP procedure and documentation.

The reasons why we use HACCP system as a food safety management system is to manage the product safety, to reduce the increasing incidences of food safety issues, to eliminate limitation of traditional quality control methods, due to customer pressure-customers demand for safe foods and because it is a legislative requirement.

There are various benefits of HACCP systems which include it's a preventive system, it increases confidence in your products, it ensures that resources are used effectively, it is cost-effective, it demonstrates due diligence, it's internationally accepted, it strengthens quality management systems, it facilitates regulatory inspections and demonstrates management commitment. Some of the barriers to the HACCP implementation among the SMEs include; time, cost, personnel, Knowledge, and understanding on the HACCP, motivation, trust in legislation and trust in enforcement.

8.10 Food safety law and enforcement

Food laws apply in the hygiene of food handlers, premises and equipment, preventing contamination, temperature control, HACCP (food safety management system) and are important as they help in setting the minimum food standards; they reduce the risk of food poisoning and protect public health. They apply to food business owners/managers and food handlers.

9. BECA NUTRITION AND FOOD SAFETY PLATFORMS TOUR

Participants visited the food and nutritional evaluation laboratory (FANEL) at the International Potato Center (CIP), hosted by the BecA-ILRI Hub's nutritional analysis and mycotoxin diagnostics platform. The tour was facilitated by Julius and Josephine who explained the various research that is undertaken in FANEL and the various equipment that is used.

Figure 7: Participants at FANEL BecA-ILRI

Some of the analysis include; mycotoxins in food and feed, microbial analysis of food products especially sweetpotato roots and sweetpotato products, nutritional analysis of food products including proximate analysis, vitamin C determination, antioxidants and β-carotene among others.

10. PANEL DISCUSSION: FOOD SAFETY AND LEGISLATION IN AFRICA: THE ROLE OF BUREAU OF STANDARDS, CHALLENGES AND STRATEGIES TO REGISTER A NEW PRODUCT

The panel was led by **Tawanda Muzhingi** (International Potato Centre (CIP), Kenya) and was made of **George Abong'** (Senior Lecturer, University of Nairobi, Kenya), **Andrew Edewa** (Food Safety expert, FAO), **Jean Pankuku** (Food Technologist, Malawi) and **Zena Chagula** (Tanzania). The areas at the center of discussion were opportunities and challenges that small and medium-sized

enterprises face to register new products. To start the discussion off, each participant was given five minutes each to give opening remarks on the topic after which the participants were given an opportunity to ask questions.

Andrew focused on the challenges that enterprises in Africa have to go through to get their products certified with the European Union. Enterprises face a variety of challenges; they require some levels of scales in order to carry out their production while considering the health of humans, animals and plants and this poses a great challenge. Another challenge comes in when we ask who else is doing it? The bigger organizations that have been there for some time act as predators to the small and medium enterprises thus limiting their opportunities for growth. A bigger challenge is in the scale of production whereby many businesses in Africa die off in the first three years of operation and even the cost of starting the businesses is too high. If the businesses would come together and work as a cluster, they would, therefore, benefit from common marketing and combined sourcing of raw materials.

Businesses need training for knowledge and capacity building in order to upgrade their scales and systems. Lack of knowledge on standardization, the costs of obtaining the standards required and the costs of hiring a consultant for training and certification becomes expensive for small businesses to start. There is also a challenge on facilities like laboratories for testing services. If the facilities are there, the methods used are not validated, the laboratories are not accredited and the cost of outsourcing testing services is very high especially for pesticide residues. Most of the inspections and testing services are provided by the public bodies which use old laws for certification and this may not guarantee actual food safety. In conclusion, governments need to play a big role to facilitate enterprises to grow.

Jean Pankuku focused on the opportunities and challenges on food safety concerns as she carries out processing of sweetpotato and cassava in Malawi. Development of standards in Malawi is done by the Bureau of standards involving the relevant stakeholders and chaired by the University. In the development of a new product where no standards exist, the product is certified using the general standards that are not specific to a particular product, for instance, the hygiene and labeling standards in order to make sure that they conform before specific

standards for the product are developed. However, the challenge is that some of these standards are very old and reviewing takes long.

George Abong' focused on the work that he has been doing on RTBs and standards of RTB products in Kenya. He started off by giving reasons why products are developed. It is because we want standardization of the product, in order to facilitate trade and to assure safety and quality of the product. The mandate of developing standards in Kenya is given to KEBS who acts as the secretariat and they bring the stakeholders together to discuss the standards. The stakeholders include the public sector, the private sector, the business and the research institutions who agree on the standards depending on science and business matters.

The mandate of developing and reviewing standards on RTBs is given to the RTB national committee. Consumers are also involved in the development of products. Across East Africa, the bureau of standards in each country is required to give one secretariat during harmonization of standards and if one country fails to agree, the standards are stalled and are not published. We have standards for potato and its products, sweetpotato and its products and for cassava and its products. With these standards, you can trade anywhere in East Africa. Standards for OFSP bread are not yet developed but we are in the process of developing.

Zena Chagula focused on the challenges that they face in the processing of Orange-fleshed sweetpotato (OFSP) in Tanzania. OFSP provides a good opportunity especially in Tanzania but the challenge comes in the quality of the sweetpotato, packaging of the products and labeling. Everyone in Tanzania wants to process OFSP into various products however, it becomes a challenge to get sweetpotato from the farmer to the processor. Another challenge is that most people in Tanzania are not aware of the benefits of consuming OFSP and creating awareness on the nutritional benefits of OFSP is a challenge. Certification of the various products processed from OFSP is difficult and this compromises on the safety and quality of the products and also getting the right packaging material for the products.

10.1 Discussion

When the discussion opened up, one of the participants expressed their concerns that the panelists highlighted only the challenges that SMEs face. He wanted to know what

recommendations they would give concerning the challenges highlighted since they affected all African countries. Another participant wanted clarification on how clusters work in sourcing out materials collectively. Another participant explained that the disagreements in the development of standards between various countries come in because of the various factors that affect the specific product like climate. The participant was wondering if at all the countries do not agree on those standards, will they even agree on the safety of the products and are there any international standards that they refer to or do they develop the standards on their own.

Another participant explained that, as part of a technical committee for developing products, we have a problem with scientific data especially when the product is only found in one country and the data obtained is very old and varies a lot from different researchers. He added that the results are not even consistent and you end up doing research again and end up lagging behind. He, therefore, wanted to know the panelist's view of such situation.

Another participant wanted to know why standards are sold if we have representatives from every sector in developing standards, which means that everybody participates. Another participant wanted to know what kind of data on OFSP products is required in the development of standards concerning these products.

George was the first to respond to the questions. He explained that there are general standards and specific standards for specific products. In developing a new product with similar qualities with an existing product in terms of things like moisture content, microbiological limits, then the standards for the existing product are used on the new product. If there are no standards on a similar product, then it becomes a big task to get scientific data on that product in order to be able to develop standards for that product and this may take longer. In the development of standards, we refer to international standards and sometimes we even adopt the international standards and change only a few things.

Andrew explained that before an organization places products in the market, they ought to be standardized. He added that before OFSP products are introduced into the market, they need to be registered in regard to hygiene standards which are general in order to continue in operation before the specific standards are developed. In the private sector, if you have very few products,

it is very expensive to transport and so you can combine your products with other small enterprises so that you can enjoy the benefits of working together with others for instance sourcing raw materials as a group and also marketing together.

11. LEARNING TOUR OF FOOD SCIENCE, NUTRITION AND TECHNOLOGY DEPARTMENT OF UNIVERSITY OF NAIROBI

George Abong'

Participants visited the pilot plant in the Department of Food Science, Nutrition and Technology, University of Nairobi which is small enterprise whose main objective is to adequately provide experience in Food Processing to Food Science, Nutrition and Technology Students especially in the areas of dairy technology, food engineering systems, fruits and vegetables technology, beverages and fermentation biotechnology, cereal technology and meat technology.

Figure 8: Participants at the University of Nairobi's Pilot plant

Isaac, one of the personnel working in the pilot plant led the participants through some of the operations that are carried out which mainly involve processing of milk and milk products and also meat and meat products. The Plant is fully equipped to handle demonstrations in all aspects of Food Processing and Engineering and to also be able to carry out production on a pilot basis in order to sustain its operations.

Figure 9 : Participants get a run through of operations at the plant

12. CARBOHYDRATE-BASED CARRIERS OF BIOACTIVE COMPOUNDS: A STEP TOWARDS NOVEL FUNCTIONAL FOODS

Dr. Srinivas Janaswamy

Bioactive compounds (BCs) provide health benefits, especially for the prevention and treatment of chronic diseases such as diabetes, obesity, cardiovascular disease, and cancer. Research clearly highlights the benefits of consuming foods rich in anthocyanins and dietary flavonoids to maintain a healthy weight. Functional foods and food supplements enriched with BCs are effective in preventing diseases and improving health. However, the intrinsic low aqueous solubility of BCs, and instability to temperature, oxygen, and light (encountered during processing and storage) and pH, enzymes and other nutrients (encountered in the gastrointestinal (GI) tract) significantly limit their activity and potential benefits.

The important thing is to preserve the bioavailability of the BCs by enriching it with a carrier which plays a role in protecting and delivering BCs. In order for the carriers to be efficient, they should preserve the structural form of the BC until the time of delivery and they should effectively deliver the preserved form to the physiological target. Carriers with stable structure are better to use compared to those with non-rigid structure. Therefore, the best approach is to use carbohydrate-based polymers that are compatible with the human digestive systems. Carbohydrates composed of starches and polysaccharides are staple foods and form basic energy source for humans. Starches are ubiquitous plant products and are one of the most widely used natural biopolymers in food and non-food applications due to their renewability and low-cost nature.

13. FOOD HYGIENE, NUTRITION AND WASH ACTIVITIES IN KENYA/UNICEF

Victoria Mwenda

Poor sanitation and hygiene is the main cause of malnutrition in children and microbial contamination of water occurs at various points in the food chain from the source, transport and also during storage. The conceptual framework of malnutrition by UNICEF involves health, hygienic conditions and how they link to diseases.

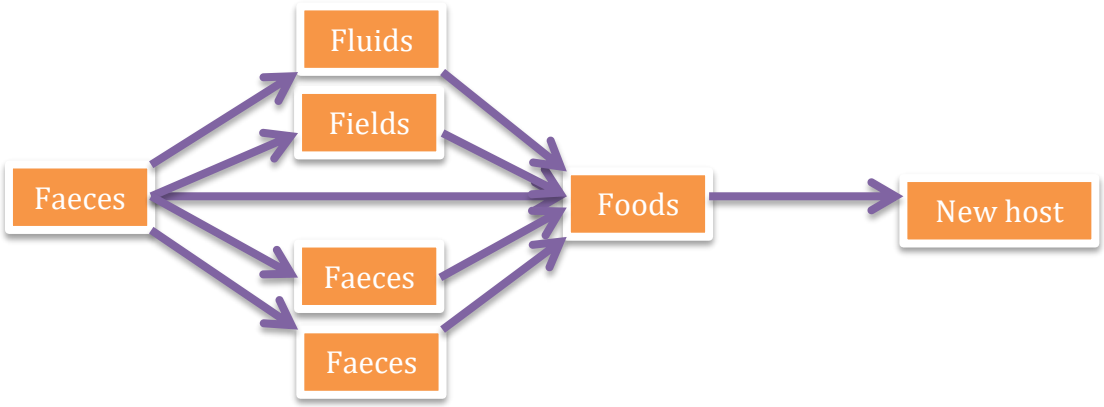

Figure 10: Fecal-oral route

WASH is involved on the control of diseases such as diarrhea, intestinal parasitic infections and environmental enteropathy which is the chronic ingestion of pathogens causing recurring inflammation and damage to the gut leading to malabsorption of nutrients. The areas of intervention are hygiene involving handwashing with soap, food hygiene and environmental hygiene, sanitation involving both household and community sanitation including safe disposal of infant feces and water supply, involving provision of safe drinking water, safe collection, and storage of water. The nutrition interventions by UNICEF include communication, nutrition counseling for dietary intake and prevention and treatment of diarrhea. The factors that enable UNICEF ensure success nutritional outcomes are coordination, shared planning, shared monitoring and an enabling environment.

14. VOTE OF THANKS BY PARTICIPANTS

Moise Roger appreciated the work that had been done by CIP and BecA to make sure that the training was a success. He appreciated the facilitators of the training and all the participants.

15. AWARDING OF CERTIFICATES

At the end of the training workshop participants received certificates of attendance from Biosciences for eastern and central Africa (BecA) at ILRI.

All the participants took the Royal Society for Public Health Level 2 exam in Food Safety and Hygiene administered by the Natural Resources Institute (NRI) and 22 out of 25 participants passed and received their certificates.

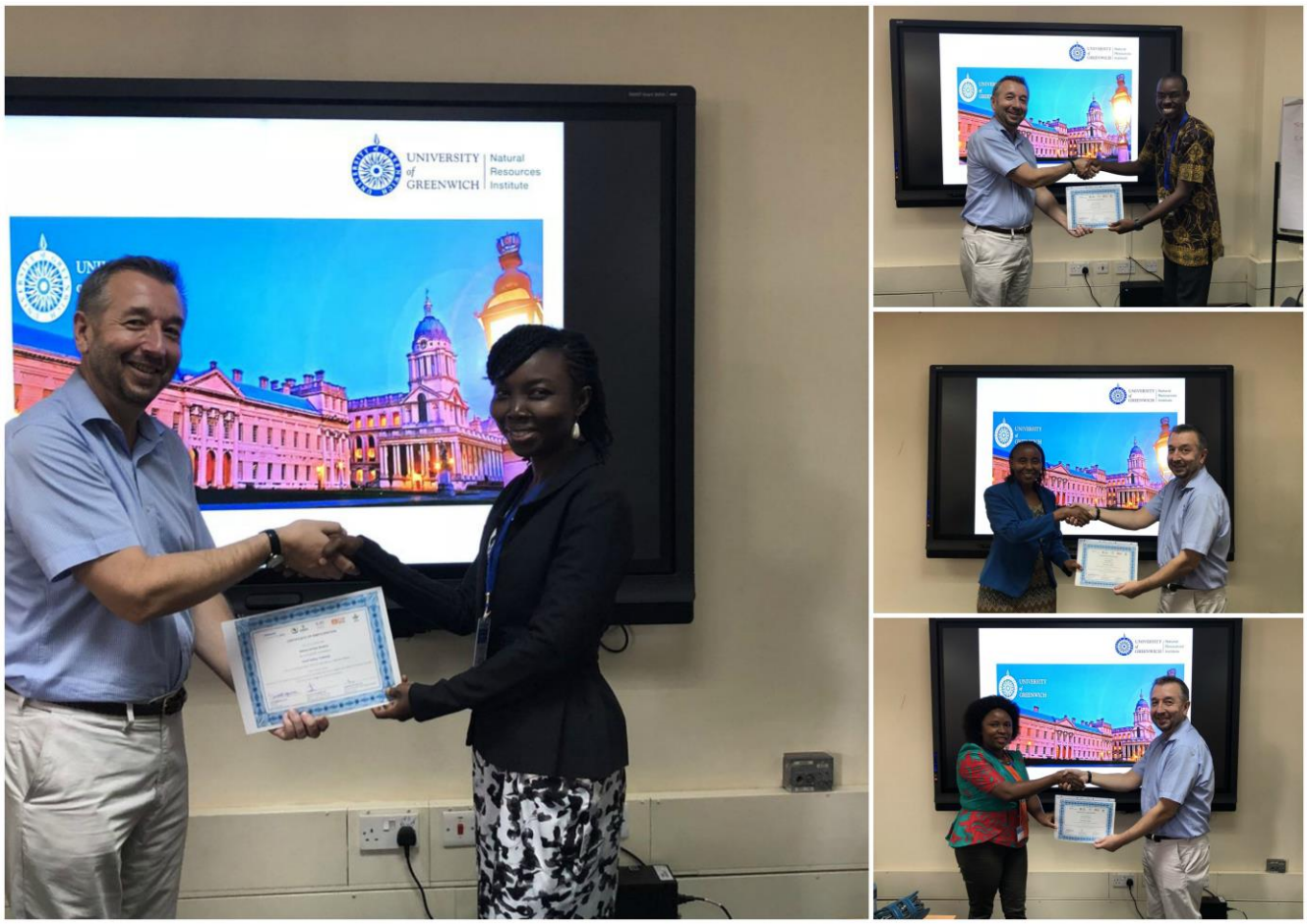

Figure 11: Participants receive certificates

The International Potato Center (known by its Spanish acronym CIP) is a research-for-development organization with a focus on potato, sweetpotato, and Andean roots and tubers. CIP is dedicated to delivering sustainable science-based solutions to the pressing world issues of hunger, poverty, gender equity, climate change and the preservation of our Earth's fragile biodiversity and natural resources.

www.cipotato.org

CIP is a member of CGIAR.

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