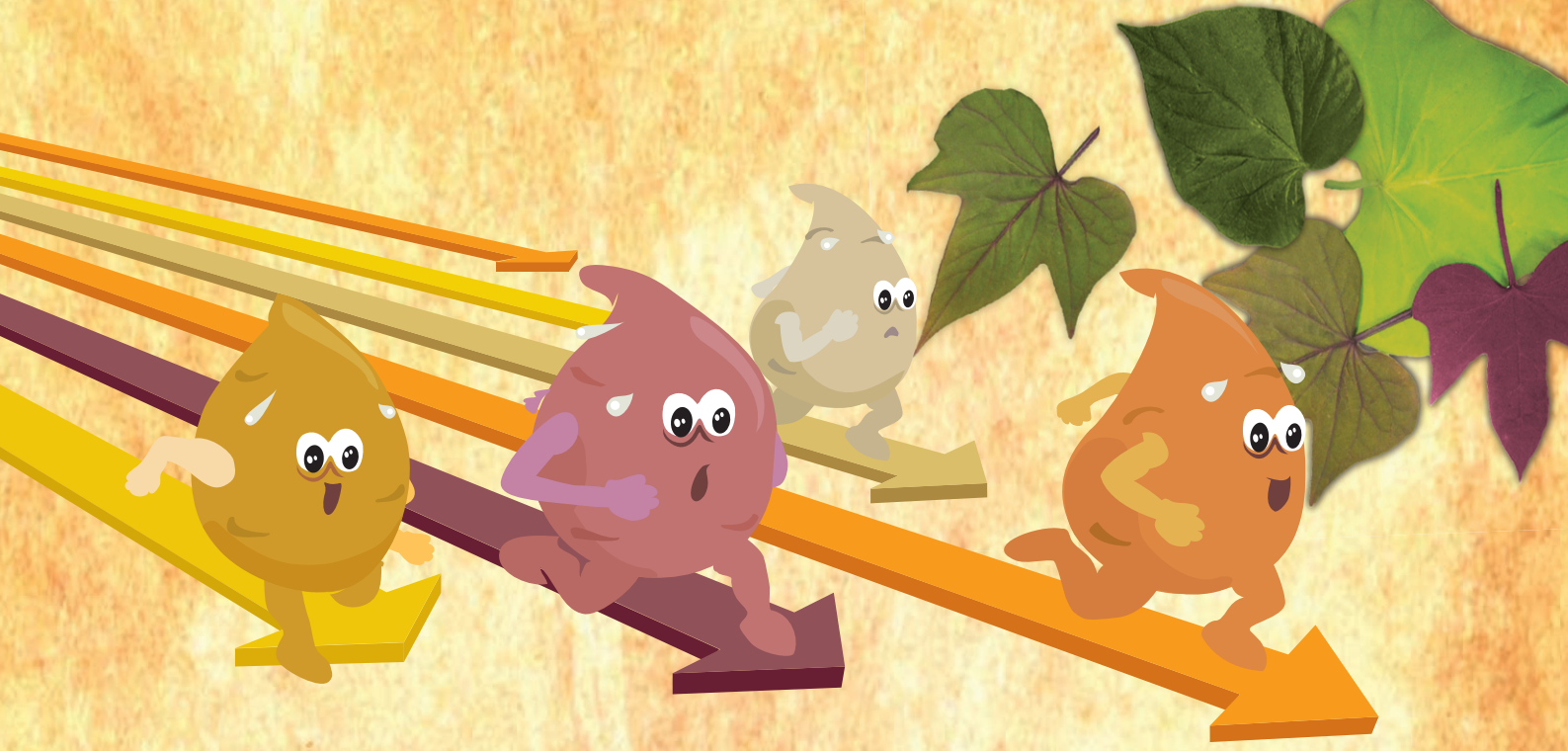

Marketing, Processing and Utilization Community of Practice

SPHI
Sweetpotato for Profit and Health Initiative

Accelerating Orange-fleshed Sweetpotato (OFSP) Value Chain Development for Nutrition and Livelihoods in Africa

Proceedings of the Fourth Annual Meeting held in Sovereign Hotel, Kisumu, Kenya

1 -3 March 2017

Compiled by Christine Bukania; Edited by Tawanda Muzhingi

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Cover design by CIP Communications and Public Awareness Department (CPAD)

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ACRONYMS

BNFB	Building Nutritious Food Baskets
CHA	Community Health Assistant
CHV	Community Health Volunteers
CIP	International Potato Center
CoP	Community of Practice
CRS	Catholic Relief Services
DGLV	Dark green leafy vegetables
DVM	Decentralized Vine Multipliers
ENA	Essential Nutrition Action
FARA	Forum for Agricultural Research in Africa
HKI	Helen Keller International
HQCF	High quality cassava flour
KALRO	Kenya Agricultural and Livestock Research Organisation
KEPHIS	Kenya Plant Health Inspectorate Service
MISST	Malawi Improved Seed Systems and Technologies
MOA	Ministry of Agriculture
MLE	Monitoring, Learning and Evaluation
MPU	Marketing, Processing and Utilization
NARI	National Agricultural Research Institute
NRI	Natural Resources Institute
ODK	Open Data Kit
OFSP	Orange-fleshed sweetpotato
PANITA	Partnership for Nutrition in Tanzania
RTB	Roots, Tubers and Bananas
SAAS	Sichuan Academy of Agricultural Sciences
SASHA	Sweetpotato Action for Security and Health in Africa
SBCC	Social Behavior Change Communication
SME	Small and Medium Enterprise
SPHI	Sweetpotato for Profit and Health Initiative
SUN	Scaling Up Nutrition
SUSTAIN	Scaling Up Sweetpotato through Agriculture and Nutrition
ToT	Training of Trainers
TWG	Technical Working Group
UK	United Kingdom
VAD	Vitamin A Deficiency
WASH	Water, Sanitation and Health
WFSP	White-fleshed sweetpotato
ZECC	Zero Energy Cooling Chamber

EXECUTIVE SUMMARY

The SPHI Marketing, Processing and Utilization Community of Practice (MPU CoP) held its 4th Annual Meeting in Kisumu Kenya on 1-3 March 2017. It was attended by 47 participants (27 men, 20 women) from 12 countries.

The theme of the meeting was accelerating orange-fleshed sweetpotato (OFSP) value chain development for nutrition and livelihoods in Africa.

The meeting was opened by Penina Muoki, the country coordinator of the SUSTAIN project in Kenya, based in Kisumu. In her address, she welcomed participants to the lakeside city of Kisumu, and highlighted the diverse formats of the meeting such as the poster competition that involved participatory judging, a field visit to SUSTAIN project sites, presentations and panel discussions. "The program prepares us to be challenged, to be excited, to learn and most of all, to be inspired," she said.

Over the course of two days, participants made oral and poster presentations based on submitted abstracts on the subthemes: OFSP product development, marketing, consumer studies, scaling models, adoption studies and promotional activities; nutrition and post-harvest development.

The meeting also featured a keynote address by Prof. Xie Jiang. He is a Professor and agro-products storage and processing specialist at the Institute of Agro-products Processing Science and Technology of Sichuan Academy of Agricultural Sciences (SAAS). His presentation was titled: **Developments and Advances in Sweetpotato Processing in China.** Honorable Professor Ruth Oniang'o, editor of the **African Journal of Food, Agriculture, Nutrition and Development (AJFAND)** facilitated a panel discussion titled; 'How strong is the evidence that food-based approaches work?' This was one of three panel discussions that were held during the event.

Participants visited Organi Ltd, a puree processing factory in Western Kenya, as well as a public-sector health facility to learn about the nutrition-health linkages. These are interventions that are being implemented as part of the SUSTAIN project in Kenya. The five-year project aims to enhance the efficiency with which farmers participate in the OFSP value chain for health and wealth creation. It is specifically targeting population segments that are most vulnerable to vitamin A deficiency, that is, pregnant women and children under five years. The project is currently being implemented in five counties in the Western Kenya region - Nyamira, Homabay, Siaya, Migori and Busia.

The field visit started off with presentations to introduce participants to Organi Ltd. in Ringa. Organi Ltd. produces OFSP puree that is used by a Kenyan supermarket chain to produce bread that is rich in vitamin A, and that specifically targets urban consumers. However, the enterprise is faced with challenges: sweetpotato production is seasonal, and there are high fluctuations in supply and demand, which in turn affect prices. The Natural Resources Institute (NRI) has been working with CIP to carry out a number of trials to develop low-cost root storage facilities that will sustain root availability for the puree processor.

Participants then visited a health center to learn about how the agriculture-health linkages are being implemented. Through this model, Community Health Volunteers refer mothers from the villages to health facilities, where they get health and nutrition education, including integration of the vitamin A rich OFSP into their diets. They are then registered and given a voucher that enables them to collect OFSP vines from registered Decentralized Vine Multipliers (DVMs). These beneficiaries also receive agronomic training to ensure that they adhere to good production practices.

The meeting was preceded by a half-day optional workshop on effective online communication using the Sweetpotato Knowledge Portal. Other activities included a welcome networking cocktail and a farewell dinner.

The MPU CoP membership is made up of professionals working on all levels of the sweetpotato value chain, as well as private sector players who are innovating processing and utilization of orange-fleshed sweetpotato for commercial products.

A panel of judges selected the top three abstracts, while participants voted for the top three posters. The winners and runners-up were awarded prizes in recognition of their excellent work.

The top three abstracts were as follows:

Position 1: Joy Musyoka: **Effects of acidification and preservatives on microbial growth during storage of orange-fleshed sweetpotato puree**

Position 2: Fausat Kolawole: **Chemical and sensory properties of cookies produced from orange-fleshed sweetpotato and sclerotium of edible mushroom**

Position 3: Cecilia Wanjuu: **Consumer knowledge and attitude towards orange-fleshed sweetpotato bread in Kenya**

The top three posters were as follows:

Position 1: Asheber Kifle: **Understanding orange-fleshed sweetpotato based products value chain and consumer preference study in Ethiopia**

Position 2: Norman Kwikiriza: **Decentralized Vine Multiplier (DVM) registration: a strategy to increase access to quality sweetpotato vines in Africa**

Position 3: George Ooko: **Quality characteristics of orange-fleshed sweetpotato crisps from selected Kenyan varieties** and Michael Akhwale: **Approaches enhancing dissemination of OFSP technologies in Western Kenya**

All documentation from this meeting is available here at the following link:

http://www.sweetpotatoknowledge.org/topics/marketing-processing-and-utilization-cop/

1. SESSION 1 – POST-HARVEST DEVELOPMENT / OFSP PRODUCT DEVELOPMENT

Penina Muoki (Chairperson)
Mercy Kitavi (Rapporteur)

1.1. EFFECT OF VINE HARVESTING ON ROOT AND VINE YIELD OF DIFFERENT SWEETPOTATO VARIETIES IN UGANDA

Gerald Kyalo, Elizabeth Akiror, Julius Mwine, Joseph Masereka, Sam Namanda, Robert O.M. Mwanga, Peter Lule, Ben Lukuyu, Sarah Mayanja and Diego Naziri

1.1.1. BACKGROUND

In Uganda, most smallholder farmers use sweetpotato vines as fodder for pigs and cattle. The vines are obtained at harvest, but it is also possible to partially remove them during the production cycle (detopping).

Feeding piglets on sweetpotato vines in Uganda

Sweetpotato vines are highly perishable, lasting 2-3 days after harvesting. This means that a large quantity goes to waste. Making silage is an easy and affordable technology for conserving roots and vines for feeding pigs in times of shortage. This project explored making silage for feeding vines, but it can also be fed to other livestock.

Sweetpotato silage pig diets have successfully been tested, validated and promoted in Uganda under the framework of the RTB-ENDURE project. Over 77 tons of silage were made, and sold in Masaka and Kamuli districts. However, vine harvesting from sweetpotato gardens to be used either as fresh fodder or processed into silage might compromise the root yield at harvest. Therefore, it is important to educate farmers about the timing of vine harvesting to achieve optimum root and fodder yield (Dual purpose). Sweetpotato varieties released/ land races were not yet categorized as dual-purpose, forage or for root production.

1.1.2. STUDY OBJECTIVES AND METHODOLOGY

The objectives of the study were to: assess the effects of vine harvesting on the root yield of the four selected sweetpotato varieties; identify suitable dual-purpose sweetpotato varieties in Uganda; and determine effect of vine harvesting on chemical composition of sweetpotato roots.

The work was done at the university farm in Nkozi, Masaka (central region) and Kamuli (eastern Uganda). Experimental design consisted of a split plot design with varieties as main plots and vine harvesting time as sub-plots. The sweetpotato varieties used were NASPOT 11 (cream), 12 O (orange), 13 O (orange) and one local variety. The plot sizes were 10m x 10m, the net plot sizes for detopping / no detopping were 4m x 5m ($10m^2$ each). Data were collected on fresh weight of vines at 85 and 150 days after planting (DAP), fresh root weight at 150 DAP, SPVD and *Alternaria blight* and weevil infestation (scale of 1-9, 1- no infection/infestation, 9-severe). Root- vine ratio was computed using root and vine dry matter. Data were analyzed using Genstat 12th edition.

1.1.3. FINDINGS

There was significant difference on the treatments. Detopping significantly affected the root and vine yield of all the varieties, apart from NASPOT 11 which performed better in terms of root and vine yield after detopping. Therefore, the vine-root ratio of NASPOT 11 was high. This is the ratio that determines whether a variety is dual-purpose. Harvesting vines from the local variety reduced yield by over 60%. Detopping increased dry matter and amount of sugars of sweetpotato roots. According to the findings, NASPOT 11 is the most suitable dual-purpose sweetpotato variety. Farmers intending to harvest vines for silage should plant NASPOT 11, or NASPOT 12 and 13. There is need to test the effect of vine harvesting on all OFSP and other sweetpotato varieties.

1.1.4. DISCUSSION

Did you evaluate beta-carotene levels?

Among the chemical constituents analyzed were sucrose and fructose, there was no effect of vine harvesting on beta-carotene.

1.2. ORANGE-FLESHED SWEETPOTATO STORAGE, PROCESSING AND LOCAL RECIPES FOR IMPROVED NUTRITION IN BURKINA FASO

Marcellin Ouedraogo

1.2.1. BACKGROUND

Eastern Burkina Faso has high levels of malnutrition among children under the age of five: wasting is at 11.1%, stunting is 35.5% (SMART 2015) and vitamin A deficiency is 12.9%.

The objective of AGRANDIS is to promote local production, marketing and consumption of the vitamin A rich OFSP in order to improve the nutritional status of women and children and promote household food security. The target population is 60 villages and 20 primary schools, reaching about 6,400 households (32,000 producers).

1.2.2. AGRANDIS IMPLEMENTATION STRATEGY

The strategies used are:

Enhanced Homestead Food Production, which combines village level model farms and training of farmers and each woman establishing a home garden for production of OFSP and vegetables.

- Farmer Field School for demonstrations
- Social Behavior Change Communication (SBCC) to increase demand for OFSP
- Essential Nutrition Action (ENA) especially for the first 1000 days
- Water, Sanitation and Health (WASH) to promote hygienic environments

The method was to increase demand and supply of OFSP vines and inputs; increase good practices for storing, processing and marketing of OFSP; incorporating OFSP into existing traditional foods for all age groups; and provide nutritional benefits and improve livelihoods. The project is funded by Margaret A. Cargill Foundation and runs from September 2014 to February 2018.

1.2.3. ACHIEVEMENTS

In Burkina Faso, particularly in the Eastern region, production has increased from 105 Ha in 2012 to 300 Ha in 2016. In 2016, 137 tons of sweetpotato were produced by 2,560 beneficiaries, with an average of 41 Kg per person.

Five varieties of OFSP were received from CIP-Kumasi. Out of these, BF59-CIP1 had lower production in comparison to Jewell and Tu-orange.

Zero Energy Cooling Chamber for storing OFSP

Storage technologies: Several storage technologies are being used. The first is Double S, in which sweetpotato roots are stored in a pit with ash for up to seven months. The second is Zero Energy Cooling Chamber (ZECC): two lines of sand that is watered every day and it is covered with the straw mats. Vegetables and other foodstuff can be kept for five months. The third is sun and solar drying that can be used for conservation for six months.

ZECC has several advantages: It uses no energy, and requires locally available materials. It is easily adopted by farmers and can be used for various crops. So far, 20 ZECCs have been established for demonstration, and this has increased the availability of OFSP tubers for processing and marketing.

Marketing OFSP using ZECC has allowed to increase farm gate price from 0.11 USD to 0.3 USD (almost triple); it has allowed for seven months of conservation. Sun drying allowed for storage and selling over a long period with good hygiene, high nutritive value, appearance, and brighter orange color.

With regard to vines, a fourth of a hectare provides 237 bundles OFSP fodder sold at 1 USD per bundle during harvesting and 2-3 USD six months later. The returns are between 948 and 2844 USD/ ha.

SBCC strategy: The strategies used include **h**ome visit, discussion groups, cooking demonstrations, field visits, theater, mass communication (broadcast; micro-program; press), social marketing, ENA in the first 1000 days, WASHA and Infant and Young Child Feeding.

OFSP recipes: There are about 30 recipes being promoted. Some of them are fried OFSP doughnuts small steamed OFSP cakes, OFSP juice made from boiled roots, OFSP juice from fresh roots, groundnut sauce with sweetpotato leaves, couscous from OFSP roots and leaves, beans and sweetpotato leaf sauce, OFSP flour made from dried chips, atieke of OFSP, pounded OFSP, sweetpotato porridge, sweetpotato relish, and OFSP salad.

1.2.4. CONCLUSIONS AND FUTURE PERSPECTIVES

OFSP contributes to increase availability of micronutrient rich food consumption. A recipe book will be finalized in the local languages and open days and exhibitions will be used to focus on OFSP. In the future, value addition will be done for local dishes and school feeding. There are plans to establish a husband school to involve more men. OFSP value chains will be promoted. An innovation platform will be set up and promotion and monitoring of marketing will be improved.

1.2.5. DISCUSSION

In Kenya, one of the challenges has been water to keep the parts moist. How much water was used and how long did it stay moist?

The quantity of water used depends on the ZECC, it can be 1m, 2.5m. The water used is between 15 and 20 liters. Watering is done in the morning and evening, and it is placed under the tree, away from direct sunshine.

How were pupils targeted in this intervention?

Teachers were trained and cooking demonstrations were done at school. School mother associations were used to introduce sweetpotato in counties. Nutrition clubs were established in schools and communication was done to create awareness, e.g. through theater.

Which backward linkage exists with the seed system?

INERA provided 100 vines to each producer. The producer paid 1000 CFA (USD 2) and the project paid USD 3 for the vines. Vines from five varieties were received from CIP-Kumasi. The varieties BFCIP1 had low production in some cases, while Jewel and BF59-CIP4 had better yield.

Did you measure the temperature and humidity on the storage?

Evaluation of humidity and temperature is not done.

1.3. FOOD SAFETY KNOWLEDGE, ATTITUDE AND PRACTICES OF ORANGE-FLESHED SWEETPOTATO PUREE HANDLERS IN KENYA

Derick Malavi

1.3.1. BACKGROUND

OFSP puree is an important ingredient used in production of baked products in Kenya. The quality and safety suitability of OFSP puree largely depends on compliance to food safety hygiene practices in processing by food handlers.

There is lack of or limited information on food safety knowledge, attitude and practices of OFSP puree handlers. Therefore, we need to generate data for developing training programs for improving knowledge and hygiene practices of OFSP puree handlers and enhance OFSP puree shelf-life and food safety.

The objective of the study was to determine the level of food safety knowledge, attitude and practices of OFSP puree handlers.

1.3.2. METHODOLOGY AND FINDINGS

A cross-sectional study design was used. Through exclusive sampling at the plant and bakery, 35 respondents were selected. A structured questionnaire was used to determine their knowledge, attitude and practices. Percentage scores above 80% were classified as high level for knowledge, positive for attitude and good for practices.

The level of knowledge was 73%, attitudes were 89% and food safety practices were 79%. The overall KAP score was 81%. This result has an implication to consumers. Low knowledge and practices of food safety could result in practices that affect the consumer negatively.

Low level of knowledge leads to poor practices in use of personal protective clothing and waste disposal procedures.

Factors influencing food safety knowledge, attitude and practices of OFSP puree handlers.

- KAP scores of OFSP puree handlers increased with *age*, *education level* and *work experience.*
- Level of education significantly influenced their *attitude* ($p<0.05$).
- OFSP puree handlers with a training in food safety had better knowledge, positive attitude and better practices ($p<0.05$).
- Training can be a tool for improving food safety knowledge, perception and behaviors of food handlers.

OFSP puree handlers demonstrated a poor understanding on food contamination, foodborne illnesses, cleaning and sanitation. Regular training should be carried out to improve their knowledge in these areas to avoid food safety risks.

There was a significant correlation between knowledge and food handling practices of OFSP puree handlers. Increasing food safety knowledge improves food handling practices of OFSP puree handlers. Positive behavioral changes of OFSP puree handlers improves food safety practices.

1.3.3. CONCLUSION AND RECOMMENDATIONS

OFSP puree handlers have low level of knowledge and poor practices. Training and provision of necessary resources are important for improving food safety in OFSP processing.

1.3.4. DISCUSSION

Food safety begins with the design of the facility. Was this taken into consideration?

The research was divided in various sections: the first looks at knowledge, attitudes, and practices. The second looked at compliance to good manufacturing practices and the microbial contamination along the processing line. Under good manufacturing practices, the assessed suitability of the processing plant and personal hygiene practices when handling puree. There was a section on pest control. Data were generated and it will inform the recommendations. The aspect of training focused on how they can improve their practices. After sometime, an assessment of their level of knowledge and compliance to good manufacturing practices will be done to determine the effect of the training.

You should be more cautious presenting regression results. If you wanted to get even more interesting results, it would be better to conduct a sequential analysis at intervals to see how knowledge is changing at different time segments.

1.4. EFFECTS OF ACIDIFICATION AND PRESERVATIVES ON MICROBIAL GROWTH IN STORED ORANGE-FLESHED SWEETPOTATO PUREE – A CHALLENGE STUDY

Joy Musyoka

1.4.1. BACKGROUND

OFSP puree is an ingredient in food processing e.g. bakery application. Currently processors use freshly made puree or frozen puree because puree is perishable, seasonal and expensive to freeze, store and transport. The proposed solution is development of a shelf-storable OFSP puree which does not require significant refrigeration (3-6 months). Potassium Sorbate, Sodium Benzoate and Citric Acid together with vacuum packing have extended puree shelf-life by 3-6 months in our trials at ambient conditions (T<25∘C). However, the gap lies on the efficacy of the preservative combination in retarding or stopping the growth of harmful pathogens in the puree.

1.4.2. THE CHALLENGE STUDY

The objectives of this study were to

1. Determine the effect of combination of potassium sorbate, sodium benzoate and citric acid i.e. mild acidification with vacuum packaging on the keeping quality of OFSP puree.
2. Determine the effect of combination of potassium sorbate, sodium benzoate and citric acid on the growth of selected pathogens: Staphylococcus aureus and Escherichia coli during storage of OFSP puree.

This was a challenge study, which is a technique that introduces the microorganisms into the puree and their effect is observed over time.

Joy working in the lab

For objective 1, the five combinations were as follows: A: Puree without preservatives; B: 0.05% sodium benzoate + 0.05% potassium sorbate + 1% citric acid; C: 0.1% sodium benzoate + 0.1% potassium sorbate + 1% citric acid; D: 0.2% sodium benzoate + 0.2% potassium sorbate + 1% citric acid; E: 1% citric acid only; E: 1% citric acid only. Samples were kept at room temperature (T<25^{o}C) and at 4^{o}C for 10 weeks. The total viable count and the yeast and molds were taken at Week 1, 2, 3, 5, 7 and 10.

For objective 2, the combinations were as follows: A: Puree without preservatives; B: 0.05% sodium benzoate + 0.05% potassium sorbate + 1% citric acid; C: 0.1% sodium benzoate + 0.1% potassium sorbate + 1% citric acid; D: 0.2% sodium benzoate + 0.2% potassium sorbate + 1% citric acid; E: 1% citric acid. Samples were inoculated with 5.2x10^{9} cfu/ml *E. coli* and 1.53x10^{9}cfu/ml *S. aureus* and kept at room temperature (T<25^{o}C) and at 4^{o}C for 10 weeks and the growth of *E. coli and S. aureus* was observed.

1.4.3. RESULTS

For objective 1, viable counts decreased over time for the two storage conditions. However, for refrigeration, growth for four treatments had already stopped by week 7 and growth for only one treatment was observed at week 10.

For the yeast and molds at room temperature, growth continued even at week 7, and for citric acid treatment, growth continued even after week 10. Under refrigeration, growth of yeast and molds stopped at week 3.

E. coli and S. aureus growth room temperature in the untreated sample increased slowly but gradually, but under refrigeration, it reduced gradually. The treatments used were able to retard *E. coli* and *S. aureus* growth in stored OFSP puree.

1.4.4. CONCLUSION

Sodium Benzoate, Potassium Sorbate and Citric acid combinations are able to destroy pathogens and ensure extensive use of puree. Even the lowest concentration of potassium sorbate and sodium benzoate is able to retard growth of pathogens in puree. Citric acid (pH 4.2) alone is not effective in inhibiting the growth of these pathogens.

1.4.5. DISCUSSION

In advertisements, there are allegations of one type of bread having more sugar than others. Is it possible to come up with a communication product highlighting the low glycemic index of sweetpotato bread as a selling point?

There is no paper is addressing flour. Maybe later on we should talk about that. Making claims about glycemic index will require scientists to show empirical evidence.

Are the microorganisms able to survive the baking temperature?

The growth temperatures for these microorganisms is 7-48 degrees centigrade. If they persist, they are destroyed during baking, but the aim of this work was to avoid the microorganisms during storage.

What is the optimum pH for the addition of sodium benzoate and potassium sorbate?

For the individual preservatives, it is 4-6.5 but there is need to figure out the optimum pH when the two are combined.

1.5. IMPACT OF INCLUSION OF CASSAVA FLOUR IN BREAD FORMULATIONS IN WEST AFRICA; LESSONS LEARNT AND RECOMMENDATIONS FOR SCALING OFSP PUREE BREAD

Ibok Oduro

1.5.1. BACKGROUND

Different recipes have been tried for development of the cassava-wheat composite bread. However, trials were under laboratory conditions and acceptance limited to small sections along the bread value chain. Thus, there was need for recipe standardization with bread stakeholders for optimum bread quality.

1.5.2. METHODOLOGY

Recipes were collected and verified on-site from 29 bakers from the Eastern and Ashanti regions. This was thought of as a 'learning to learn' strategy through which knowledge is created with the bakers to increase transfer and ownership of the recipes. Two bakers tested the recipes and modified it to

develop a standard recipe that was tested by four bakers from three regions. The recipes were based on what the bakers were already doing.

1.5.3. IMPACT OF HQCF INCLUSION ON BREADS PRODUCED

One of the bakers preparing HQCF bread

According to the comments from the bakers, some found slight differences in dough characteristics but they were not sure whether this would have an impact on bread quality. Others found no difference was observed in dough characteristics. One baker tasted cassava in the bread but liked it all the same. Another baker thought that the A1 bread was slightly lighter, hard and fibrous, but the taste was not bad, while A2 was quite heavy and thought to be better appreciated by the older generation who grew up with heavier loaves. Other comments related to the size of the bread, the texture, volume, color and general appearance. It was important to capture these comments during the process of product development. Two preferred 20% high quality cassava flour (HQCF) inclusion, one preferred the 10% and one preferred the old recipe.

It was important to note that the bakers make different types of bread, and this process involved tea bread and sugar bread.

Physical properties of tea bread: Substituting wheat flour with HQCF in tea bread significantly increased ($p<0.05$) its density. This would make it more filling per unit bread and it may be preferred by the Ghanaian consumer who looks out for heavy bread loaf. Specific volume of tea bread samples significantly decreased ($p<0.05$) with increasing substitution of HQCF. The Ghanaian consumer also prefers bigger loaves, thus the need to create the balance between the specific volume and density.

Physical properties of sugar bread: Substituting wheat flour with HQCF in sugar bread was not significantly different ($p>0.05$) for specific volume and density. Thus, when the composite flours are used in sugar bread, there may not be any observable difference in the physical characteristics.

A significant difference was observed between tea and sugar bread with respect to specific volume and density. This may be due to the variation in quantity of ingredients used by the bakers.

Consumer acceptance: A test was done on 105 consumers on taste preferences. The consumer acceptance for 10% HQCF tea bread was similar to the control for all attributes except crust color. All sugar bread samples were similar in crust color and texture, and bread aroma. Variances in recipe were in the levels of margarine, sugar and salt which reflected the bread types.

Glycaemic index: The glycaemic index of flour, tea bread and sugar bread was done. The cassava flour was low in glycaemic index. This was done in the lab, but the idea was to feed it to humans, but there was a problem in calculations and the work is still ongoing.

Shelf-life: Shelf-life of cassava composite stored under different conditions was tested. It was found that the shelf-life was shorter than when wheat was used. At elevated temperatures of 26-35 degrees centigrade, the baked control with 100% kept for 7 days 6 hours, and the composite bread with 90% wheat and 10% for 5 days 8 hours. At room temperature of 25-31 degrees centigrade, the shelf-life of the baked control was 8 days 16 hours, and that of composite flour was 6 days 9 hours. It was recommended that retailers should store bread at room temperature in order to extend the shelf-life.

1.5.4. LESSONS LEARNT

- It is essential to build the confidence and personal skills of bakers in relation to the use of composite flours in baking through teamwork.
- Bakers should get increased awareness on the use of cassava flour usage in the food industries to eliminate negative perceptions.
- Bakers have a lot of awareness on many types of bread. This information should be used when developing new products in a region.
- The Ghanaian baker already uses composite flour to make bread. Fifty-three percent of bakers interviewed had knowledge on the inclusion of other flours as composites and 37.5% knew of the inclusion of HQCF in baked products; 43.8% of these bakers had knowledge of the use of HQCF in bread making; and 81.3% of bakers were willing to use HQCF if proven to be successful.
- Tea bread and sugar bread were selected because they make up 48% and 39% of the bread baked respectively. Butter bread makes up 13%, but it was left out of the study for the time being.
- There is need to identify high quality composite flour producers, food research and involve other stakeholders for higher adoption. Adoptability is also driven by the technology used in mixing, as mixing is an essential unit operation that affects bread quality.
- Profitability of cassava composite bread: In Ghana, 61 food and bakery industries use 822 MT of HQCF out of the 1,384.3 MT supplied annually. Currently, a 50 kg bag of HQCF costs GH¢ 120.00 ($26.30) whereas wheat flour cost GH¢ 250.00 ($ 54.79). For every one naira (N1) invested into the cassava-wheat composite business, there is a profit of N3.3 if all things being equal.
- It is difficult to get bakers involved, and it takes a lot of negotiation to get them in board. At the same time, it is important to be selective when choosing bakers to work with.

1.5.5. RECOMMENDATION FOR SCALING OFSP PUREE BREAD RELIABLE OFSP FLOUR/ OFSP PUREE SUPPLY

- Based on the lessons learnt with cassava bread, the following recommendations can be made for stakeholders working on scaling up OFSP puree bread:
- Involve all major bread stakeholders in OFSP puree bread recipe formulation
- Pay attention to country specific bread types
- Study the impact of puree on dough characteristics and quality of bread produced
- Demonstrate the profitability of substituting wheat flour with OFSP puree
- Conduct a feasibility survey with bakers within small region in various countries
- Conduct epidemiology studies to establish an authoritative health claim for OFSP composite bread
- Study the shelf-life of composite OFSP puree/flour bread
- Manage the mixing of puree and wheat flour
- Explore possibilities of using existing technology by commercial bakers
- Make more effort to ensure that sweetpotato is backed by policy

1.5.6. DISCUSSION

When it comes to sweetpotato, we are working with puree that has challenges of storage? Did you deal with cassava puree before you settled on flour?

Dry matter of cassava is high, but the sweetpotato in Ghana has a low dry matter. So, if one is to reduce the water beforehand, the energy cost will be higher. That is why sweetpotato puree was selected. Processing also affects beta-carotene, and puree has higher levels of beta-carotene. Cassava puree has not been tried because people are already used to flour, and there are no nutritional concerns for processing cassava into flour.

1.6. DEVELOPING A POLICY FRAMEWORK FOR BIOFORTICATION IN MOZAMBIQUE AND LESSONS LEARNED FROM FOOD FORTIFICATION

Eduarda Mungoi

1.6.1. OVERVIEW OF NUTRITION SITUATION IN MOZAMBIQUE

The total population of Mozambique is around 26 million, with about 50% of the population being female. Most of the people are living in rural areas, and chronic malnutrition and stunting is as high as 43%. Despite many efforts, from 2008 to 2013 stunting only reduced by 1% (from 44% to 43%).

According to the government plans, the prevalence of malnutrition is expected to reduce to 35% by 2019 and to 20% by 2020.

The trends of malnutrition is higher in rural areas, because unlike in urban areas, their capacity to diversify their diets by purchasing other foods is not as high. Vitamin A deficiency is a huge public health problem, prevalent in 69% of children under the age of five. Anemia and iodine deficiencies are also high.

The government is working with partners on many interventions for prevention of micronutrient deficiencies. These include salt iodization, nutritional supplementation, promotion of breastfeeding, food and nutrition education, home food fortification, industrial food fortification and biofortification.

1.6.2. BIOFORTIFICATION

Biofortification is breeding crops to increase their nutritional value. It involves development of basic rich crops (staples) in order to achieve micronutrient is the provitamin A, and the concentrations of iron and zinc, from deficiency of these micronutrients and with a view to improving the nutritional status of the population. This approach is said to be easy to reach rural populations in situations of malnutrition at low-cost but this is debatable.

Mozambique's policy framework is enabling for agriculture and nutrition interventions, although reforms are recommended. Biofortification as a food-based approach, is still not adequately covered into the national agriculture and nutrition's policy framework available. A balanced alliance with nutrition, health, agriculture potential implementers, advocacy and media needs to be built. There is also need to engage high government officers from agriculture and health to get their commitment, especially in the proposed policy agenda setting. From demand side, there is need to engage the private sector (SMEs).

1.6.3. FOOD FORTIFICATION IN MOZAMBIQUE

Food fortification is a simple process whose success depends on the correct selection of food to be used as a vehicle for fortification and the type of compound or micronutrient to be added. This strategy is more cost-effective and sustainable prevention of multiple micronutrient deficiencies. The

food industry the focus of activities for adding micronutrient. Vitamin A is added into oil and sugar, along with vitamin D.

The government has a food fortification committee with four key areas or sub-committees (production, legislation and quality, communication and marketing, monitoring and evaluation) to work together with 38 industries dealing with food fortification. Mozambique has recently approved the regulation that obligates large, medium and small commercial scale mills to fortify. Millers have been trained on best practices and quality control. In December 2016, the new Food Fortification Strategy 2016 -2021 and Social Mobilization Strategy were approved. The table below shows the levels of fortification.

Table 1 Level of fortification

Vehicle	Min	Max
Wheat flour	20mg Iron/kg	140mg Iron/kg
Maize flour	20mg Iron/kg	140mg Iron/kg
Oil	15mg de vitamin A / L	43mg de vitamin A/L
Sugar	1mg/100g vitamin A	3mg/100g vitamin A
Salt	25ppm/kg KIO3	55ppm/kg KIO3

1.6.4. MAIN CHALLENGES AND NEXT STEPS

There have been good developments over the last 12 years with regard to food fortification in Africa. From just two countries, the number of those that have legislation to mandate fortification of wheat flour and /or maize flour had risen to 27 countries in May 2016. At least 50% of the industrially milled wheat or maize flour is fortified through voluntary efforts in five countries by May 2016. However, some challenges still exist.

For food fortification, after five years of implementation, there is still need to cover significant amounts of the population through small millers. Total dependency of imports for micronutrients and equipment's/ maintenance needs to be reduced by providing access to quality local materials. Capacity building of all stakeholders is also required.

For biofortification, the following steps are required:

- Drafting of country OFSP advocacy and resource mobilization to develop a national strategy.
- Partnerships with government/SETSAN and NGOs to integrate policy reform agenda into the government's priority in nutrition.
- Capacity building scheme to galvanize synergies between resource mobilized and OFSP implementation capacity by stakeholders and maximize the resource utilization.
- OFSP's potential to create a value chain can be used to attract the private sector/SMEs interest and investment.
- Media network as an ally to play important role in raising public awareness and setting agenda for policy reform.

1.7. PANEL DISCUSSION: CREATING A CONDUCIVE ENVIRONMENT FOR ACCELERATING OFSP VALUE CHAINS IN AFRICA

The panel discussion was led by **Kirimi Sindi** (Country Manager, International Potato Center (CIP), Rwanda), and was made up of **Eduarda Mungoi** (Advisor to the Minister of Industry and Trade, and Coordinator of the Food Fortification Program in Mozambique); **Robert Ackatia-Armah** (Deputy Program Leader for Sweetpotato at the CIP); **Ibok Oduro** (Kwame Nkrumah University of Science and Technology, Ghana) and **Gaston Tumuhimbise** (Department of Food Technology and Nutrition, Makerere University, Uganda); and **Ephraim Chabayanzara** (Technical Advisor for East Africa at the Catholic Relief Services). The areas of the value chain at the center of the discussion were seed, post-harvest handling of roots, OFSP processing and marketing. Panelists discussed the current environment, the actors involved, policy regulations and the way forward to spur marketing at different levels of the value chain.

To start the discussion off, each participant had five minutes to make opening remarks. After that, participants were given an opportunity to ask questions.

Members of the panel discussion

Gaston focused on what is going on in Uganda. He outlined the challenges, which include access to disease free planting material, and the high cost of vines. He expressed his concern that sweetpotato had not been prioritized by the government. "Most of the agricultural inputs are handled by a directorate created in the army, so if you do not have a crop that is prioritized, you cannot access that funding," he explained. According to Gaston, the fact that sweetpotato had been promoted by donors in the past had contributed to the government detachment from the crop.

In Uganda, sweetpotato processing e.g. flour and chips is still done at a small-scale. This is affected by a break in the value chain, caused by a lack of continuous supply of roots. While there are standards for handling sweetpotato flour and chips, but OFSP standards have to be very specific to conserve the important nutrients. This is a gap.

Eduarda's presentation focused on issues of going to scale. For Mozambique, she explained that there are many varieties; but the question is how to increasing the volume and access has not been realized. The country being very large makes dissemination is a big challenge.

For post-harvest, she explained that the government is working with different partners. The focus should be on quality, pricing, and technology to store and process roots. Eduarda pointed to the importance of getting the business community involved, especially by showing them the profit potential, and providing guidelines for aspects related to quality standards, labeling and so on. Looking at sustainability, she emphasized the need of including all these issues in the political

framework and integrating them within existing institutions that carry out the same functions with regard to other crops.

To conclude, she said that in Mozambique, there is room to develop biofortification strategies, using the lessons learnt when developing those for fortification. Furthermore, extension people can be part of projects so that they can benefit from the information generated by researchers. The volume is important, so transformation of sweetpotato is key.

Ibok called for stakeholders not to focus exclusively on OFSP, but to tap into the entire sweetpotato value chain. She explained that seed is moving from non-commercial to commercial. This is an area that has no policy restrictions; regulators look at quality of the materials, and once it is cleared, it enters the system. This system could be exploited to expand sweetpotato commercialization.

"No businessman will see money and run away from it," Ibok stated. This was in reference to the fact that there has been no clear evidence that investment in quality seed is worth it. She convinced the audience that getting businessmen involved in different parts of the value chain would make more business sense than focusing on government and donor driven projects.

However, she also cautioned that awareness creation about post-harvest handling was critical. The aggregators and transporters need to be sensitized so that they carry the harvested roots well. They should understand that sweetpotato roots are delicate. Conversely, sellers and consumers should know what quality of products they want. To sustain the markets, Ibok called attention to the need for innovation platforms, in which value chain actors are well represented.

In Ghana, the current environment for OFSP processing is limited, but it is growing in Ghana, Nigeria and Burkina Faso. As a way forward, Ibok suggested that demonstration sites be set up, since business people like to see something before they buy. She also advised that rather than promoting only puree, sweetpotato flour should also be promoted if it already exists, and this could be done using other sweetpotato varieties.

Robert started his presentation by reading out the definition of value chains according to the Food and Agriculture Organization, which defines a value chain as the full range of activities, which are required to bring a product or service from conception through the different phases of production, involving a combination of physical transformation and input of various producer services to deliver a final product to customers and the final disposal after use. Therefore, it does not stop at the consumer.

His presentation emphasized the need of examining multiple issues along the value chain that create a conducive environment. Some of the issues that Robert touched on include the policy environment, information about the sweetpotato value chains, post-harvest technologies etc. Consumers can dictate the conducive environment. To illustrate, Robert gave an example of a country where OFSP is grown, but at the same time, a supplier was importing OFSP because the consumers preferred specific attributes that were not available in the local varieties.

Ephraim talked from the perspective of an international organization outlining four key areas of intervention. The first is organizing communities into groups for saving, credit and marketing. The second is organizing trainings and facilitating meetings of the organized groups with researchers so that they can get technical services on issues like agronomy and post-harvest at an affordable cost. The third is provision of marketing skills; Catholic Relief services (CRS) has smart skills modules, which are used to train producers and aggregators so that they can do smart marketing and cut costs as they move up on the value chain. Savings groups are trained to enable them mobilize financial resources

to purchase vines and small-scale irrigation schemes. Producers are linked with aggregators, puree processors, small bakeries and financial institutions. The fourth is organizing of innovation platforms that bring together all the value chain actors. These platforms are provided with the capacity to negotiate and influence government on policy and regulations so as to improve the business environment.

When the discussion opened up, Jean Pankuku (Malawi), expressed her concern that while she had expected some answers to the challenges faced by market players, the panelists had instead raised many questions. She explained that governments are very influential when it comes to adoption, but at the same time donors could have conditions when they provide funding. She wondered which model would work better to link the government, donors and private sector. She explained that in Malawi, funding was previously channeled from donors directly to the government, and everything would end with the project. Involving the private sector would ensure continuity. Furthermore, when OFSP was developed in Malawi, the focus was on vitamin A, and not on processing. This has influenced product development. Olapeju Phorbee (Nigeria) added that she needed some take-away messages on how to increase government buy-in. Gerald Kyalo (Uganda) explained that in Uganda, they have successfully demonstrated that clean seed is valuable. The system is also moving from institution to private sector. Norman Kwikiriza (Uganda) wanted to find out from the breeders whether it is possible to share information about which variety is good for different products. Jude Asiimwe (Uganda) asked about pricing so that varieties that farmers grow would generate income in the market. Srini Rajendran (Kenya) wondered whether it would be possible to come up with a model showing backward and forward linkages in the value chain.

Eduarda was the first to respond to the questions. She explained that in Mozambique, the government involves ministries and other stakeholders and empowers private sector by putting in place strategies, policies and legislation, with the support of different donors. The government has set up a platform with the private sector, led by the Ministry of Industry and Trade, and reporting to the office of the Prime Minister. The OFSP agenda should get involved in the normal system, because if stakeholders realized how much work has already been done to show the result, they would get more involved in supporting OFSP. She also explained that when the donors come to work in Mozambique, they must register at the Ministry of Foreign Affairs; this helps with coordination. Nonetheless, she acknowledged that monitoring was still challenging.

Robert explained that to be a good advocate you need evidence, and that is what the community of scientists generate. However, one must think of the psyche of a politician and what would be of interest to them e.g. voters being excited about opportunities that also help their political careers. Private sector operators are interested in profits; which help them to create employment and improve incomes of the population. Ephraim added that a platform that enables everyone to send a collective message and put pressure on the government to ensure an enabling environment was important: *All of us should come together and form a platform that puts pressure on government.* On her part, Ibok said evidence should also be used to convince people interested in investing in the value chain that they would be able to get returns. For Uganda, Gaston emphasized the need to lobby the government to recognize sweetpotato as a priority crop.

To sum up the discussion, Kirimi narrated that when he started working in Rwanda in 2010, no government official wanted to see him, but the team decided to raise evidence with a few farmers. After that, the farmers started going to the local policy makers to say they would not be discouraged

from growing sweetpotato because they were benefiting. Next, they used a successful media strategy that pushed coverage of the benefits of sweetpotato onto the national agenda. With time, these efforts led to sweetpotato being recognized as a priority crop and the government came around to champion its production and utilization.

Throughout the discussion, Kirimi noted the messages that were being communicated by the panelists. These are summed up below:

- Incorporate the Ministry of Agriculture to ensure sustainability after donor-funded projects end.
- There is plenty of data that shows it makes sense to invest in clean seed and high-quality planting material. This needs to be published.
- The discussion about OFSP puree and flour are based on economics and nutrition.
- Attributes such as disease resistant, drought-resistant, unsweetpotato etc. have been developed without the value chain in mind. The message to breeders is to develop varieties that take into consideration the value chain requirements. The question is 'do we have varieties that the value chain wants'.
- Many donors are thinking about how they can provide private financing. How far are institutions linking value chain actors to private financing?
- How are the technologies being developed accessible to value chain actors?

1.8. LEARNING TOUR TO ORGANI LTD PUREE PROCESSING FACILITY, PUREE STORAGE TRIAL AND OFSP FRESH ROOT TRIAL

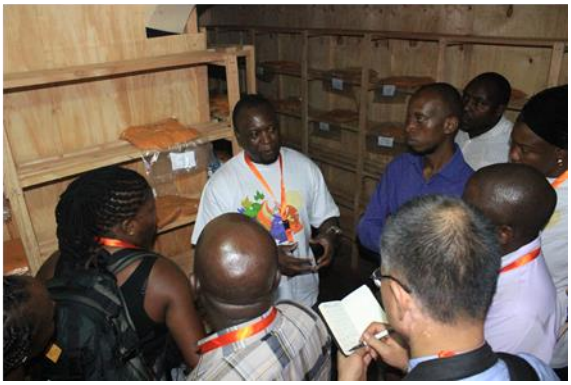
Penina Muoki, Tanya Stathers, Tawanda Muzhingi

On March 2, 2017, participants of the Marketing, Processing and Utilization CoP set out for Ringa, in Homabay County, to visit Organi limited, a value chain processor of OFSP. They later proceeded to Godber health facility where nutritional programs and agronomic activities were being conducted.

1.8.1. ORGANI LTD.

Two presentations were done. The first, led by Bethwel Kipkoech and Benard Otieno covered a brief history of Organi, root production and procurement, puree processing and market, key partners and future plans. The second was done by Tanya Stathers from Natural Resource Institute, University of Greenwich. During her presentation, MPU members were taken through root storage trials that were being run by CIP at Organi in an effort to solve supply chain risks associated with most agricultural produce. The presentation covered;

- Choice of power for storage rooms; mains and solar.
- Root appearance changes up to two months of storage; sprouting, rotting, surface mold formation, weevil damages etc.
- Root processing quality assessment; puree color, thickness, stickiness, sugar content (brix analysis).



Participants visiting Organi Ltd. in Ringa

Data collected up to the second month of storage showed that there was no major root quality deterioration in terms of appearance, sponginess and shriveling. Other quality parameters such as puree color and thickness remained high too. The trial was allowed two more months as was in the original plan.

The audience were allowed to ask questions after each presentation. Most questions centered on clean vine production, distribution and planting, root procurement and price among others. Due to time constraints, some members were not able to ask questions even though they had expressed interest to get more insight into root storage and puree processing and/or storage.

After the presentations, members were divided into three groups, each group with its leaders, to enable the participants' tour the facility's three main sections:

1. **Root storage trial:** the group was led by Tanya and Benard. Participants were shown the storage rooms (mains and solar powered). They were glad that the roots were indeed looking good after two months of storage and that temperatures were generally low despite the choice of the cooling system (evaporative cooling system).
2. **Puree processing:** the group was led by Penina, Antonio from Euro Ingredients Ltd. and Bethwel. Here, participants were taken through root quality inspection, weighing, washing up to puree processing. Antonio explained the role of Euro Ingredients Ltd. in offering the technical support that has seen Organi Ltd. double its production capacity since the inception of puree processing. He also explained that the initial challenges of low conversion rate had been overcome through the introduction of high fiber puree which involved steaming roots with the skin. The unpeeled OFSP roots make the business more profitable by increasing the puree yield. Furthermore, the skin has added nutritional value to puree due to its fiber and phytonutrients content. He however acknowledged that more could still be achieved by adopting more efficient technologies such as pressure cooking. It was generally noted that Kenya had achieved a lot in terms of puree processing. The current high fiber pureeing machine at Organi Ltd. has the capacity to produce more puree to match the demand.
3. **Puree storage trials:** The group here was led by Tawanda. Participants visited the puree storage room where different samples of puree treated with various preservative combinations were put on display. All the samples except the control sample were still looking good without signs of fermentation. Puree storage trial was purposely being conducted to solve puree storage problems that are currently being experienced at Organi Ltd. due to limited storage capacity of the freezers. The goal is to be able to store quality puree for longer period without cold chain which is expensive to run and this might lower profit margins.

Most participants were impressed by the progress Organi has made regarding puree processing. The participants cited the need for mechanization of root washing which could help to boost puree production volume. Gaps were also cited in sorting criteria of roots which needed to be improved to enable grading of roots according to quality thus payments would be based on the quality delivered by the farmer.

1.8.2. GODBER HEALTH CENTER

After leaving Organi Ltd., participants visited Godber health center, one of the health facilities working with SUSTAIN project, Kenya. At this facility, SUSTAIN project staff and partners showcased various aspects in project implementation.

At the agriculture stand, they were taken through the agriculture model of the project. Present at this stand were the Sub-County Agriculture Officer, the Ward Agriculture extension officer, one DVM and the Project Agronomist. Participants were taken through the selection criteria of DVMs, activities conducted by DVMs/role of DVMs in the project, conservation of clean planting material by DVMs through the use of net tunnels, and lessons learnt from using the net tunnels. Participants interacted with the M&E team whereby project monitoring was discussed. The day to day monitoring of project activities was show cased. The roles of each partner in project implementation and the method and tools used to monitor each role was presented to the participants. Other issues discussed included the use of mobile devices for monitoring and reporting and some of the challenges encountered during monitoring of project activities.

The approach to community nutrition education and various food recipes with OFSP incorporated were among the items at the nutrition stand. Participants were taken through how SUSTAIN Kenya conducts its nutrition education at the community level with partners from nutrition the community health department at the county level. This included training of Trainers of Trainers (ToTs) (Community health assistants and nutritionists) and further training of Community Health Volunteers (CHV) who trained targeted community members on a structured nutrition syllabus running for four months. Selection of participants, methods of message delivery and the specific topics of trainings were discussed at this stand. This session ended with participants testing various dished prepared by the nutrition team. The nutrition team composed of the Sub-County nutritionist, community Health Assistant (CHA), CHV and the project's nutrition coordinator.

2. SESSION 2 - OFSP PRODUCT DEVELOPMENT

Francis Amagloh (Chairperson)

George Abong' (Rapporteur)

2.1. Consumer knowledge and attitude towards orange-fleshed sweetpotato bread in Kenya

Cecilia Wanjuu

2.1.1. BACKGROUND

Provitamin A beta-carotene rich OFSP is important for alleviation of vitamin A deficiency in sub-Saharan Africa. At household level, OFSP is used either grated, boiled and mashed (puree) or as flour to make chapatti and mandazi. At commercial level, consumers will accept a novel quality food product that is nutritious, safe and appealing.

OFSP puree has proven to be economically feasible in baking bread and buns with up to 50% wheat replacement at commercial level. However, consumers' Knowledge, Attitude, and Practices for the OFSP puree bread are not well documented. This study aimed at determining consumer preferences for a broader marketing and promotion strategy.

2.1.2. OBJECTIVES AND METHODOLOGY

The objectives of the study were to determine the consumer demographics; their knowledge and attitudes with regard to the roots and bread; conduct a sensory evaluation to determine their acceptance of the bread and their willingness to pay.

The study was conducted at Tuskys' retail stores. Three enumerators used Open Data Kit to administer a questionnaire.

2.1.3. RESULTS

The OFSP bread is ought mostly by female consumers (60%). Majority of the buyers are above 30 years of age, are well educated (79%) and fall in the category of middle to high-income earners. Out of the total 1024 respondents, most are more aware about OFSP fresh roots and vitamin A than the OFSP puree. To determine the shelf-life, it was important to determine the storage practices. Most of them (42%) store their bread in the open, 38% in the refrigerator and 20% in the cupboards.

OFSP puree bread was generally acceptable with an overall score of 7.44 on a 9-point hedonic scale. The color and taste were appealing to them. Respondents stated that they could almost taste the OFSP.

The willingness to pay for OFSP puree bread was done in Nairobi, Kisumu, Kakamega, Kiambu and Kajiado counties. Eighty-three percent consumers were generally willing to pay the current price of OFSP puree bread of KSh. 50 for a 400g of bread. When analyzed at county level, Kiambu and Kajiado county respondents wanted to pay less. In other counties, they stated that if it was more nutritious they would be willing to pay more.

2.1.4. CONCLUSION

Demographic factors such as age, gender, education and income level influence the knowledge, practices and acceptance of OFSP and OFSP products.

The OFSP puree bread was acceptable to consumers. Consumers "moderately liked" the sensory attributes of the bread especially the texture.

Consumers were willing to pay more for the OFSP puree bread based on their knowledge on the nutritional benefits derived from the bread.

Consumers recommended proper packaging of the bread, brown OFSP puree bread and variety in unit package size to cater for large families.

2.1.5. DISCUSSION

Did you interview only OFSP bread consumers or all bread consumers? Because OFSP is already being sold at a higher price of KSh. 55 so the consumers of this would be those that are better off.

Respondents were asked if they would be willing to pay the current price. If they responded in the affirmative, the price was increased by 10%. If they said no, it was reduced by 10%. The respondents were not willing to pay more than 10%. The respondents were not restricted to those who buy OFSP bread. Out of 1000, 22% buy the bread.

2.2. EVALUATING SWEETPOTATO GENOTYPES FOR UTILIZATION (POUNDABILITY, FRIES, PASTING PROPERTIES) AT THE SWEETPOTATO SUPPORT PLATFORM FOR WEST AFRICA (A PRELIMINARY STUDY)

Damian Laryea, Martin Amofa, Thomas Tuffuor, Emmanuel P. Agyeman and Edward Carey

2.2.1. BACKGROUND

Breeding programs have resulted in the release of several varieties of sweetpotato including OFSP, with a focus on attributes such as virus resistance, yield and beta-carotene content. After release of the products, the breeder would require to collaborate with product developers to come up with acceptable products and recipes. This process relies on factors such as storability, dry matter content, and poundability and so on. Therefore, understanding variation in quality for important forms of utilization will help breeding efforts. It helps breeders to select specific attributes that fit end-user preferences.

Non-sweet varieties are currently the focus of breeding in West Africa. This is based on a research that was done in Ghana, which found that consumers in Ghana do not like sweetpotatoes because they are too sweet. However, the main problem may lie in the utilization. Pounded roots and tubers especially yam and cassava are common in West Africa (Ghana). They are not sweet. Therefore, there is a need to come up with a non-sweet sweetpotato if it will be pounded. Mealiness has been reported to be a key attribute in identifying which roots and tubers are poundable.

In Ghana, sweetpotatoes are mostly fried when yams are either out of season or not as palatable. There is a possibility to tap into this by getting sweetpotato roots that have good frying attributes. Currently, there is limited information about end-uses of newly released sweetpotato varieties and genotypes from advanced trials of the CIP-breeding program, and on the use of sweetpotato as fries/fufu for local consumption

2.2.2. MATERIALS AND METHODS

21 genotypes from the CIP fields in Fumesua, Ghana were used for this experiment, which was carried out at the CIP lab at the same location. The samples used were as follows:

White-fleshed varieties DADANYUIE, NKO31A**,** OBARE**,** OGYEFO
Cream-fleshed varieties: AP3/A, CIP440390, FAARA, OKUMKOM
Orange-fleshed varieties: BF59xCip.4, BOHYE, Mother's delight, Tiebele-2, Tu-orange
Yellow-fleshed varieties: BLUEBLUE, CIP442162, HI-STARCH, JITIHADA, LIGRI, OTOO, SANTOMPONA, SAUTI
Purple-fleshed variety: TU-PURPLE

The frying experiment involved washing, peeling, cutting into 1cmx1.5cmx5cm and frying at 180 degrees centigrade for 5 minutes. After that, a sensory evaluation was conducted using an eight-member panel. The panel looked at average appearance/taste score and average texture score. The average appearance is made up of color, caramel, starch, sogginess, oily mouth coat, and was measured on a scale of 1-9, with 1 being good and 9 being poor.

In the poundability experiment, roots were pealed, washed and reduced in size, then boiled for 20 minutes. A sensory evaluation was done for mealiness. After that, the roots were pounded to confirm the mealiness, and a sensory evaluation was conducted on the pounded roots. After that further instrumental analysis were done to relate pasting properties with poundability and to check if any of the roots were fast cooking. For average appearance/taste score: color, caramel, starch, sogginess, oily mouth coat and moistness, yam was used as the standard and the score was set at 2. For crunchiness and hardness, the standard was wet at 4. Otoo and Ogyefo were considered poundable; but we can use OFSP and other non-poundable types with cassava or yam for pounding

2.2.3. FINDINGS, CONCLUSION AND WAY FORWARD

Sauti, Santompona, Faara, Blueblue and Ogyefo were best out of the 21 for frying (when yam is considered ideal); But it is necessary to recognize that OFSP fries are a hot food trend. Trying out other frying techniques – cooking may overcome genotypic limitations. So targeted breeding for specific uses needs should be considered very carefully. Figuring out, articulating and implementing the non-sweet breeding objective is clearly a priority. The correlation between pasting properties and mealiness/poundability is not significant.

2.2.4. DISCUSSION

Did you look at the frying properties?

No instrumental oil absorption measurement was taken. Appearance was used to measure oily mouth and wateriness using a scale of 1-9.

How did you assess poundability physically and when you were comparing that to the pasting machine?

There is an attribute called mealiness or graininess, this can be assessed by feeling them by hand. This was confirmed by pounding and the measurement scale was 1-9, where 1 was pasty and 9 was very poundable. This was related to properties such as viscosity, setback viscosity etc. The correlation between measuring poundability by sensory evaluation and using instrument found that there was not significant.

2.3. LOW-COST TECHNOLOGIES FOR VALUE ADDITION OF ORANGE-FLESHED SWEETPOTATO BY SMALLHOLDER FARMERS IN WESTERN KENYA

F. O. Wayua, M. Akhwale, T. Ojuodhi, A. Kwanzu, C. A. Onyango

2.3.1. BACKGROUND

Sweetpotato is an important drought resistant crop in Western Kenya. Lake Victoria Basin accounts for over 75% of the national production. Sweetpotato is mostly grown for subsistence, but commercialization is gaining importance.

Sweetpotato varieties in Western Kenya: The varieties grown are a mixture of local varieties and superior varieties developed by Kenya Agricultural and Livestock Research Organisation (KALRO) and CIP. These include white (Mugande, SPK 013), yellow (Kenspot 1, Cuny) and orange (Kabode, Vitaa, Kenspot 4). OFSP is important for food security, income and combating vitamin A deficiency.

OFSP promotion in schools (Photo courtesy of F. Wayua/KALRO)

Need for Value Addition Technologies: Improved varieties have led to increased yield. This calls for wider utilization and expanded market. Furthermore, high perishability confines utilization to household consumption (boiling & roasting) and limited localized sales. There is also need for product diversification to increase consumer preference. For example, youths don't prefer boiled, but may accept value added products; and blended food would improve nutritive status for special groups e.g. invalids, children < 5yrs.

The project

The project started in 2014. The objective of the project is to introduce simple and affordable value addition technologies for enhancing OFSP consumption and commercialization in Siaya, Kakamega and Busia counties of Western Kenya.

KALRO and GIZ collaborated with local partners. OFSP roots produced locally on the farms were used for product development. ToTs were trained on value addition. OFSP was promoted through schools. The idea was to have OFSP included in school feeding programs, and to have parents informing their

parents about OFSP. Sensory evaluation of developed products was done to determine their level of acceptability.

Table 2 Training of ToTs on value addition

County	No. of ToTs trained			Project partner
	Males	Females	Total	
Kakamega	15	38	53	Anglican Development Services (Western)
Siaya	17	33	50	• Rural Energy and Food Security Organisation (REFSO) • Ugunja Community Resource Centre (UCRC)
Bungoma	2	23	25	Community Research in Environment and Development Initiatives (CREADIS)
Total	**34**	**94**	**128**	

2.3.2. KEY FINDINGS

Shelf-stable intermediate products such as grits, chips and flour were processed for year-round consumption of OFSP. Some value-added products include chapatti, mandazi, crackies, doughnuts, juice, salad and vegetable relish. Initially, a large number of products were developed, after which they underwent a sensory evaluation using 19 panelists. These panelists evaluated the products based on appearance, taste, texture and oral acceptability. Based on the results, the baked results were more preferred in Siaya, Bungoma and Kakamega counties.

Farmers used OFSP as a basic material, which is easily produced at farm level. Low-cost technologies including OFSP value added products (*chapatti*, *mandazi*, crackies, juice) introduced to smallholder farmers and schools in Western Kenya were used at family level (household food security), sold in local markets and schools (income) and used in schools to address VAD. *Chapatti*, *mandazi* and crackies were most preferred, compared to salad, relish and juice.

To commercialize OFSP:

- Future value addition efforts should focus on the products that were most preferred, which have higher likelihood of adoption. Such efforts should target entrepreneurs who may easily incorporate OFSP into their products, i.e. informal roadside sellers of *mandazi* and *chapattis*, school canteens, hotels, restaurants and hospitals.
- A processing facility that can absorb the produced roots should be established and farmers should be linked to those markets.
- The nutritional quality of raw roots and value-added products from the various varieties should be determined. This can help in acquisition of Quality Standardization Mark from the Kenya Bureau of Standards, which can enable marketing of products in supermarkets and high-end markets.

Did you educate people about steaming instead of boiling sweetpotato?

This is a good suggestion that will be pursued in future.

Why don't the youth like boiled sweetpotato? Is this specific to OFSP or all varieties? If it is only OFSP, what do you think can be done to improve?

The youth are an outgoing population category and they like convenient food, so they would prefer that over boiled sweetpotato. To make the youth accept OFSP, there is need for increased value addition.

2.4. COMMERCIAL PATHWAYS FOR SCALING UP PUREE OF OFSP IN AFRICA: LESSONS LEARNT ON OFSP VALUE CHAIN DEVELOPMENT IN SSA AND OPPORTUNITIES FOR SCALING UP

Tawanda Muzhingi

2.4.1. BACKGROUND

Biofortification refers to enriching beta-carotene content in sweetpotato through conventional breeding. In Africa, sweetpotato is mainly white-fleshed, not having beta-carotene. Orange-fleshed sweetpotato is among the most efficient sources of vitamin A. CIP has promoted breeding in Africa for Africa by supporting National Agricultural Research Institutes (NARIS) through regional breeding populations and training in accelerated breeding schemes. Ten African countries have released 42 OFSP varieties since 2009.

OFSP is being promoted in Africa with the aim of improving nutrition among 2.9 m households**.** The expected outcomes are evidence of efficacy and effectiveness concerning vitamin A; at least doubling of vitamin A intakes; and a 15% reduction in prevalence of vitamin A deficiency. The Mama SASHA Study (2010-2015) results showed a 7% stunting reduction in children under two years of age when mothers grew OFSP and attended ante-natal clinics and pregnant woman's clubs.

Since 2010, 2.9 million households are growing OFSP. This is driven by demand and improved delivery systems, which include: integration with health and nutrition programs; consumer education; seed system innovations; improved processing technologies; market development and partnerships with governments, NGOs and private sector.

2.4.2. THE OFSP POST-HARVEST CHALLENGE:

OFSP flour has been common, but it is a dry product that limits easy formulation into food products. Production of flour is economically inefficient, with 4-5 kg OFSP fresh roots producing only 1 kg of flour. There is loss of beta-carotene during drying and processing and the products made from OFSP flour have generally had low consumer acceptance because it affects the flavor of the finished product very much.

OFSP puree is not a perfect product. It is a wet product that is very perishable and requires a cold chain. On the positive side, it is easy to formulate into a variety of food products. It has a high conversion 1.3kg of fresh roots to 1kg of puree and there is no significant loss of beta-carotene.

African countries are in the 100 top wheat importers in the world. The top ten are: Egypt, Algeria, Morocco, Nigeria, Ethiopia, South Africa, Kenya, Mozambique, Zimbabwe and Malawi. OFSP puree can significantly reduce the need for wheat importation for their bakery applications and save the much-needed foreign currency.

2.4.3. OFSP PUREE PROCESSING TECHNOLOGIES

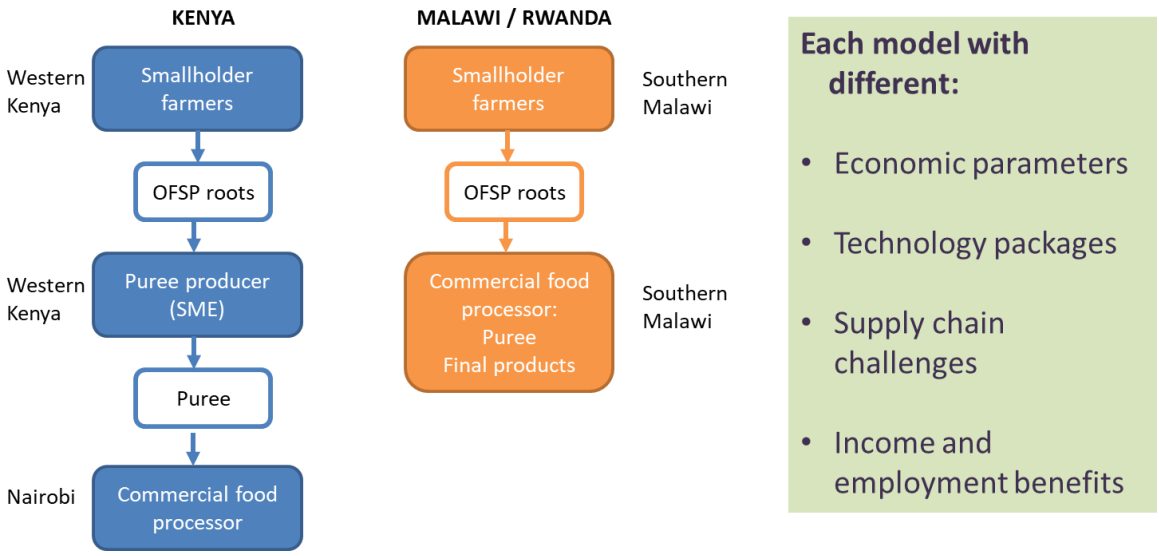
In the US, in North Carolina, they have aseptic processing of puree, using microwave technology, which produces shelf-stable puree that can last up to five years. In Africa, the puree processing technology uses a cold chain.

Figure 1: OFSP puree processing technologies

A= Aseptic microwave puree processing method in NC, USA
B= Small-scale factory puree processing with cold chain in Kenya

Two supply chain models are under proof-of-concept evaluation at the moment. The choice of the models is determined by the economic situation, the available technology, supply chain challenges and the income and employment benefits that come with it. In Kenya, there is an independent OFSP puree processor who supplies a commercial food processor with puree. Euro Ingredients Ltd. is a consultant in product development working closely with CIP to provide this puree processor with product development and equipment support.

Figure 2 Two supply chain models being implemented in Kenya, Malawi and Rwanda



2.4.4. CHALLENGES IN THE OFSP PUREE SUPPLY CHAIN AND THE SOLUTIONS

The challenges faced in the OFSP puree supply chain include:

- Supply chain management of roots is affected by seasonality and quality
- Perishability of puree (cold chain reliance)
- Adoption of technology (new technology/new food products)
- Training needs (farmers and processors)
- Consumer education (nutritional value awareness)

Tackling those challenges involves the development of shelf-stable OFSP puree. This has been achieved with 1% citric acid, 0.25% potassium sorbate, 0.25% sodium benzoate with vacuum package. When stored at temperatures below 25 degrees centigrade, the shelf-life is six months. The products made from this puree are of similar quality to those made with fresh puree.

Some of the building blocks for the highlighted challenges is off-grid technologies for fresh roots storage to bridge supply chain challenges; nutrition labeling and promotional activities for consumer education; business development for processors, e.g. business plans and linkages with suppliers; an enabling policy and standards environment; and collaboration with US institutions in the sweetpotato belt for technology transfer.

2.4.5. FUTURE OUTLOOK

Some long-term questions to be addressed include the development outcomes, such as smallholder participation, employment opportunities created and consumer benefits. The competitiveness and sustainability of the products, as well as environmental conditions and impacts also need to be taken into consideration.

There is a positive medium-term outlook, based on increasing urban demand for healthier foods, demand for sweetpotato as a wheat substitute, and favorable macroeconomic policies that promote investment and youth employment. New OFSP varieties will target processing quality traits (shape, size, starch properties, colors), and processing technologies are continuing to improve. CIP's increasing collaboration with US, China and Japan will present further opportunities.

2.4.6. DISCUSSION

I was looking forward to learning about the glycaemic index of the bread, as this could be a selling factor. Do we have data that we can use to push marketing on this bread in the media?

White and orange-fleshed roots have been found to have very low glycaemic index, but there is to date no data on the derived products. There are some research proposals to carry out this work. Hopefully this information will be available in the next CoP meeting. There are other nutritional benefits that will be pursued, e.g. antioxidant properties. Any properties that would appeal to a health-conscious consumer will be pursued to promote the marketing of products.

What are the causes of irregular sweetpotato root supply?

This is country specific. In southern Africa, the winters are too harsh, in others, the dry season is very long and irrigation might not be feasible. In Western Kenya, despite having two growing seasons, some farmers could have three harvests if they used irrigation.

2.5. KEYNOTE ADDRESS: DEVELOPMENTS AND ADVANCES IN SWEETPOTATO PROCESSING IN CHINA, MARKETING & CONSUMER ACCEPTANCE OF SWEETPOTATO PRODUCTS AND THE ROLE OF POST-HARVEST TECHNOLOGIES IN SUPPORTING SWEETPOTATO PROCESSING / DEMONSTRATION OF PRODUCTS, EQUIPMENT AND PACKAGING SOLUTIONS FROM CHINA

Prof. Xie Jiang

2.5.1. BACKGROUND OF SWEETPOTATO AND AGRICULTURE IN SICHUAN PROVINCE, CHINA

SAAS was founded in 1935, run by government. It plays a very important role in Sichuan's Agriculture science. The Institute of Agro-product processing also has components of breeding, cultivating, testing and analyzing.

Sichuan Province is located in the southwest of China. It has favorable natural conditions for sweetpotato production, and ranks first in sweetpotato production in China and the world. The province produces 0.87 million hectares of sweetpotato, with a yield of 15 million tonnes.

2.5.2. MARKETING OF SWEETPOTATO PRODUCTS

Sweetpotato processing has been done for a long time in the following forms:

- Traditional noodles: normal noodles for family dishes, hot pot use, and stable needs. It is produced in a small-scale by farmers.
- Sweetpotato snack foods such as crackers and candy. This is directly made straight from fresh sweetpotato.
- Sweetpotato flour: It is a main food, promoted by the government because of the nutrition value, especially purple- and yellow-fleshed. The flour is also used commercially, with the support of the institute to make noodles, instant flour and cakes.
- Healthy sweetpotato foods: Due to the high beta-carotene, it is good for consumption and is used to produce fermented products for the heart, blood fat etc. Foods made from flour include cake, flour, and noodles with wheat flour.

2.5.3. CONSUMER ACCEPTANCE OF SP PRODUCTS

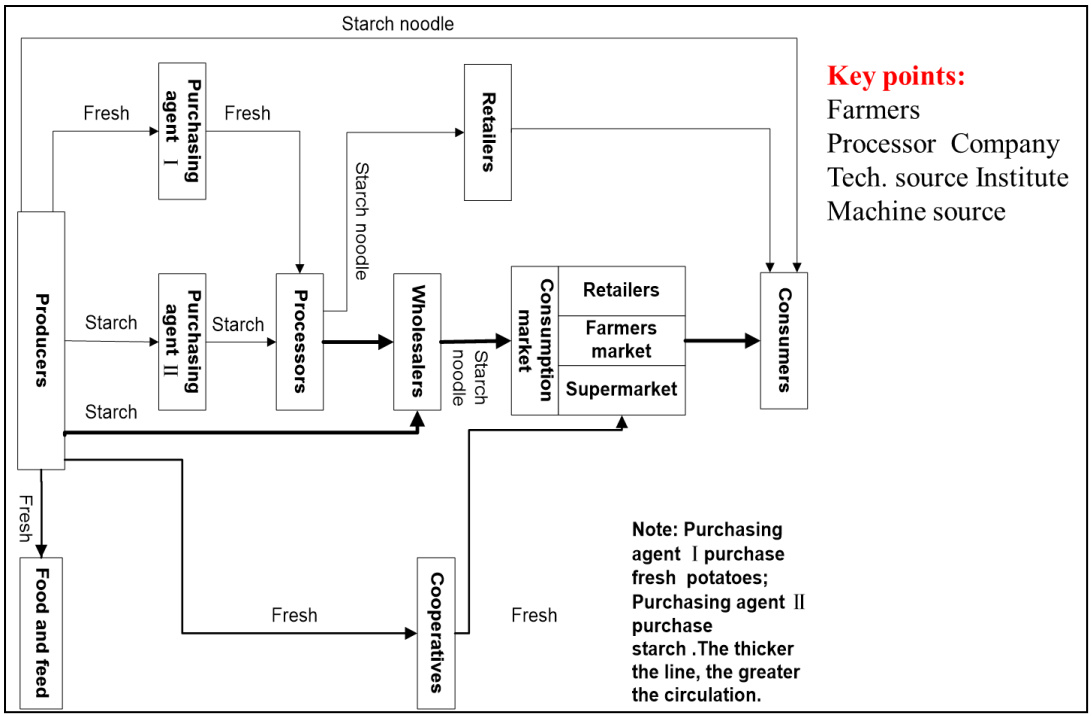
There have been significant changes in the consumer acceptance of sweetpotato over the years. In the past years before 1980, sweetpotato was used as a table food, it played a very important role in food safety and livelihood especially in the countryside. From 1980, under the support of SAAS, successful agro-industry production changed from manual to machine-made. There was increased use of starch and noodle processing. Today, instant noodles are popular because of the convenience of producing them. The largest company producing instant noodles is based in Sichuan Province. Sweetpotato flour is used in baked foods, and is mixed with wheat to make noodles. Some beverages and wines are also being produced. Purees are used to make frozen cake and mixed noodles with wheat. The key thing is to have the technology to conserve it. This processing has been carried out in more than ten counties such as San Tai, Anyue, Pengxi, Yibin and other counties and is driven by market demand. Starch and noodle production has been developed over nearly 20 years, from the traditional family-run enterprises to a successful industry through SAAS. Farmers, small/medium-scale processors and large-scale producers have formed a large industrial chain with advanced technology and machines that can produce high quality products in large quantities for local use and for export.

Noodle processing methods include:

- Manual hot water method
- Hot water method using machines
- Extruding machine (with external heating)
- Sheeting method: The procedure involves starch mixing, sheeting, steaming, cooling, aging, cutting, shaping, drying and packing

The diagram below shows the sweetpotato value chain for starch and noodles in Sichuan Province.

Figure 3 sweetpotato value chain for starch and noodles in Sichuan Province

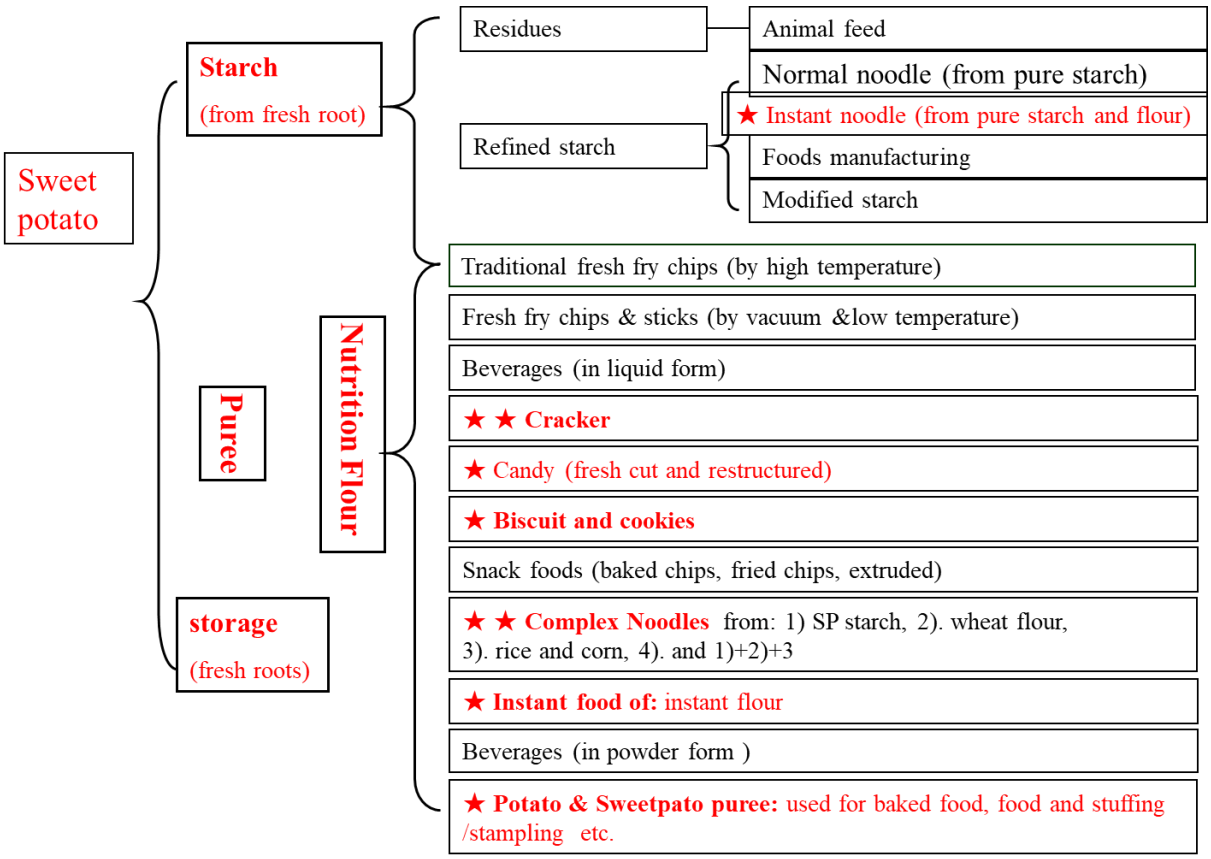


2.5.4. NEW POST-HARVEST TECHNOLOGIES GUIDE/SUPPORT SWEETPOTATO PROCESSING INDUSTRY

The main technologies that have been developed by SAAS and Sichuan Industry are:

1. Refined starch in different scale by machine
2. Sweetpotato noodle machine line (four types)
    a) Industrial production line with manual hot water method
    b) Sheeting machine line
3. Instant noodle line
4. Sweetpotato flour line (three types of drying), with sweetpotato puree: energy saving drying technology and machine line
5. Sweetpotato storage facilities (auto control temp. RH O2 CO_2 etc.)

Figure 4 Main products of sweetpotato



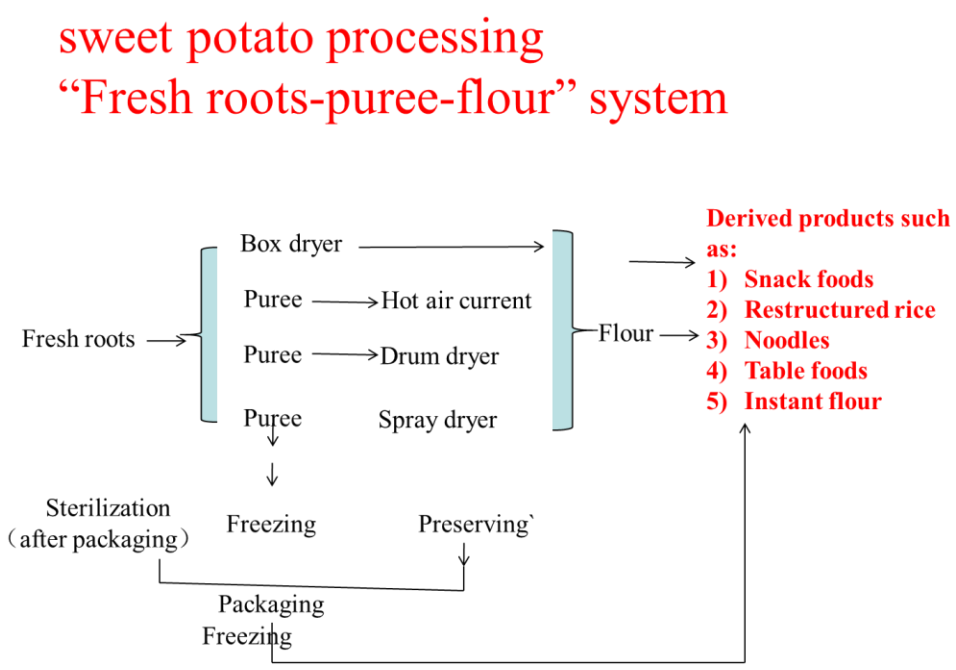
2.5.5. MACHINES FOR PROCESSING

There are three main product lines: sweetpotato flour, noodles and starch. The new technologies are energy-saving, they maintain the nutritional elements and flavor of the fresh roots and are suitable for both OFSP and other sweetpotato. They can be used widely in derived foods together with puree.

Flour: There are four improved technology systems: Chip drying technology (by hot air house/box dryer); hot air current drying technology (granule flour products); drum drying technology (flake products); and spray drying technology (beverage etc.). These technologies could be analyzed to determine which ones are suitable for the African situation. They should not be too technology intensive, and should also be energy-saving. These technologies can be used for OFSP because the product system is the same. They dry very first, taking ten seconds to complete, which preserves the nutrition content. They can be selected based on the market need.

The following diagram shows fresh roots, to make puree, and then flour. These may cost more and need more investments. It may require addition of some chemical preservatives, or can be produced in very hygienic conditions, eliminating the need for chemical additives.

Figure 5 Flow of using fresh roots to make puree then flour



Hot air drying for dehydrated chip and sweetpotato flour is a better method because it requires low investment, is suitable for small and medium-scale production of chips and vegetables. It saves energy by 30%, by inner heating, has temperature humidity control and can be shaped, cut into chip, particles and sticks.

Noodle processing technologies include extruding and water tank gelatinizing method; extruding method; hot water gelatinizing method; and sheeting method.

Starch processing: The course starch is made by small and medium-scale producers, especially farmers. Refined starch is made by medium and large-scale producers. It can be used for what instant noodle, starch noodle, food industry and cooking, family cooking and for modified starch. The improved starch procedure is as follows: fresh root -> wash -> smash -> filtration-> 'sour liquid'-> deposit -> refining -> deposit -> exchange water -> dehydration -> drying

2.5.6. KEY PRODUCTS AND TECHNOLOGIES

New technology for flour and puree

- Sweet flour by key technology of energy-saving drying from SAAS has won the Sichuan Provincial Science Prize and five Chinese patents, and it is expected to play the profound effluence to new stage for potato and sweetpotato flour processing.
- The series of derived new derived products from flour and puree can be preserved longer and developed widely.

New instant noodle and snack food technology

- The new nutrition and the traditional noodle with best quality of tolerance is suggested to be developed from the new flour/ (puree), starch and other auxiliary materials.
- The new snack foods derived from the flour and puree, with special flavor, and together with fresh roots.

Storage technology and its facility

- Set up the new comprehensive storage facilities/house for sweet potato, with the Auto test/show and control function for temperature, humidity, gas, etc.

2.5.7. CONCLUSION

For the African market, puree and flour is very important. There should be a good discussion on which of the presented technologies are best suited for this market. There should also be discussions about promoting sweetpotato, especially OFSP.

2.5.8. DISCUSSION

What progress has been made on the washing equipment?

The handouts for the washing and cleaning machines, and the brush are available. These machines help to wash the roots. Cleaning is difficult for sweetpotato because of the irregular shapes.

How are you able to add healthy ingredients into the noodles?

These ingredients can either be added manually or using a machine that tosses the noodles and mixes in the ingredients.

The sweetpotato industry is advanced. What is your advice with regard to developing a sustainable sweetpotato flour industry in Africa?

This is a comprehensive issue that needs to be considered in light of the context. The four types of technologies presented are just a starting point from which the most suitable can be selected. The production scale should not be too big. The market needs and the final product that reaches the consumer is very important. Different products need different flour compositions and therefore different machines. Flour has a higher investment requirement as compared to puree.

The consumption pattern has changed from the 1980s. What are the factors that influenced the big shift in the 1990s?

The change was influenced by the policy of the government. More important was the consumption changes. Previously, in the 1950s and 1960s, sweetpotato was consumed more than rice in the rural areas. As time went on, they started consuming more rice and wheat. When they started consuming more noodles, the consumption pattern changed, especially hot pot noodles and instant noodles.

The industrial chain model links farmers, medium-scale producers and industrial producers. Is there support provided to the farmers?

The institute played a role in promoting this industry. It is run by government, and there were many opportunities to guide the industry. The institute researched technologies and supported farmers in collaboration with other organizations.

2.6. PANEL DISCUSSION: HOW STRONG IS THE EVIDENCE THAT FOOD-BASED APPROACHES WORK?

Prof. Oniang'o introduces the panel topic

The panel was led by Prof. Ruth Oniang'o. The panel discussants were Thomas van Mourik (HKI), Ephraim Chabayanzara (CRS), Jude Asiimwe (HarvestPlus), Nutrition Coordinator (AVCD), Robert Ackatia – Armah (CIP).

Thomas: I am the regional manager of the Enhanced Homestead Food Production that tries to use multi-sector coordination and interventions to improve nutrition. It is nutrition sensitive as we try to promote in combination with other sectors like health. The question of how strong the evidence is that food-based approaches work raises two questions. First, what FBAs exist? And second, what are the indicators that we use to say the approaches work?

Helen Keller International (HKI) has been involved with three FBAs. The first is food fortification, where we have done a lot of research and advocacy work to promote mandatory fortification of flours and oils. It is really taking off in Africa. In West Africa, it is regionally mandatory. Another food-based approach is biofortification. OFSP has emerged as one of the perfect examples as a nutrient-packed and healthy biofortified food. Third is diversification of agricultural production in diets, increasing dietary diversity and improving good nutrition and hygiene practices. When it comes to indicators, the first level is the adoption of specific crops or varieties of crops, diversified production and increase production of increased plant and animal sourced foods. The second level indicators are consumption of targeted foods and increase in dietary diversity. Finally, is nutrition status of women of reproductive age, and children under the age of two.

What is the evidence that some of these approaches work? Biofortification and fortification have been shown to work but in reality, people must consume these foods for the benefits to be realized. Especially, fortified industrial foods are consumed by a small portion of African population. Biofortified crops have the advantage of local production but also have the disadvantages of food habits, the food system, the value chain, and the key element of crop adoption.

For dietary diversification, HKI has done a couple of studies with other research organizations to look at the impact pathway between production, consumption to production, other practices and nutritional status. We found that it really works well for diversified production and for dietary diversity but when it comes to nutritional status, we get varying results; anemia and iron deficiency decreases with OFSP, some cases show vitamin A deficiency decreases, some cases stunting. The results vary but the number of studies are limited and inconsistent in results. More research needs to be conducted.

Robert: I agree with Thomas. Nutrition sensitive food-based approaches is one of the elements that aid in elimination of malnutrition and hunger. Food and Nutrition Organization and World Health Organizations have acknowledged that FBAs are effective, sustainable, long-term solutions to fight

hunger and malnutrition. OFSP is a typical example of this by providing calories and malnutrition to meet different population needs.

Food has a social and economic significance within populations. We all eat food. Looking at production systems, productivity alone is not enough. Consumption really matters in effectiveness in generating significance or FBAs. Agricultural policies act as an enabling environment for evidence generation. Such environments depend on good governance through policies that ensure availability of enough foods for consumption. Before, FBAs were not understood but over time, evidence of biofortification has been sought and discovered. That has changed the perspective of government and other agencies.

Does it work? Governments and other institutions acceptance of FBAs as a viable method of dealing with malnutrition and hunger, is an indication that this is a system that really works. The science is important based on what we do. Over time, the evidence will get stronger. The critique of FBAs suggests that methodologies are not strong or that the donor community has not understood this very well, so there is need to support to do more good science.

Ruth: This is the first time nutrition was at the center of the World Food Prize and that visibility is very important in getting donors to understand as well as governments to understand the importance of governance. Can we bring in the gender aspect as well?

Jude: Gender inclusiveness will go a long way in addressing FBAs. Looking at biofortification, as HarvestPlus in Uganda, we have seen that it works, but not in isolation. It needs to be complemented with other FBAs to change malnutrition levels. When introducing a biofortified crop, like OFSP, the color and other aspects are different, so the community's attitude and perception has to be addressed. In Tom's book '**Food-Based Approaches, the Lessons Lost',** he says FBAs have done well but some elements are missing like availability of the biofortified foods, and incorporation of other vitamins that are important in absorption of nutrients. We need to ensure that supply bottlenecks are taken care of. In a study done by HarvestPlus in Zambia, it was clear that 70% of the population did not know about provitamin A maize yet it was around them. We need to involve the media, government, politicians and other stakeholders to ensure we reach the community in full scale.

Ruth: FBAs came up before we had biofortification. In Kenya, there was yellow maize from USA during a famine. There was a bad perception of the yellow maize that made people stop eating it and it went to Zimbabwe. Perception can destroy everything. Kirimi please touch on the urban population.

Kirimi: I was thinking about the topic and I ask myself was that really the correct topic for us? Isn't food supposed to be your medicine, what keeps you alive? Therefore, are we really debating on whether FBAs really work when if you did not have good food you would not be sitting in this room? It is really surprising that we have to have panels, do a lot of work, and write books, all in defense of FBAs. The question should be, why should it not work? Is there anything to the contrary? I think in the area of economics and social-economics, there is evidence that where there is a lot of investment in cash crops, e.g. sugarcane in Kenya and potatoes in Rwanda, the communities suffer from malnutrition. We need to communicate the message with the community well in order to make the correct impact and to ensure there is diversity in food rather than sticking to the one crop.

To answer your question, what do we do about urban society? I would say it is not just the urban society but also the rural, and we need to communicate effectively on how to combine food on the table that works and communicates that to the policy makers.

Ruth: Nowadays, people tend to google what they can cook. I want to give an opportunity to people to ask questions, even as we think about the google effect.

Joyce: Sara Mayanja can comment on the gender aspect, and also why do we call it food-based approach? Is it a question of how we simplify the message and communicate and debunk the myths? As I work, I find that social and cultural acceptance underpins the success of whether people consume these products. Lastly, comment on the place of capacity development in the issues of upscaling in biofortification.

Jean: Mine is a comment on nutrition. People think good nutrition is expensive. What is perceived as good has been thought traditionally as low in class. Now, the message is that the vegetables and whole foods are actually the good foods for us. This needs to be communicated to the society that is adopting unhealthy junk food as the good food.

Mercy: Kirimi, on the gender aspect where in Africa women get to farm what their husbands dictate, cook what their husbands want to eat and land does not belong to them, how do you ensure land is under biofortified crops, all this considered?

Penina: A lot of people do not invest in nutrition unlike agronomy and other aspects, we need to invest in nutrition in order to ensure the uptake of the correct foods to improve on nutrition.

Gaston: My comment is that FBAs are available and the evidence is there. For OFSP a lot has been done, even for animals. There is no way anything can work in isolation to eliminate malnutrition. We need to ensure there is also quality protein supply which needs to be adopted to ensure growth and sustainability.

Kirimi: Gender is very important. It must be deliberate and must be included even in project proposals deliberately. There must also be deliberate communication to both genders and technology that is appropriate to all genders, especially the women.

Tom: On gender, even at work, there is an involvement of women right from the top of the organization to the field, so there needs to be equity even at work. It is true that governments need to integrate nutrition in policy making, though it has been seen as the black sheep. It needs to be prioritized, put under the president, and given a budget, and this is what multi-sectoral programing is all about to make FBAs work.

Robert: We are emphasizing on FBAs to ensure maximum nutrition so although food has existed for a long time, the nutrition aspect is being improved through FBAs. Quality of food is our main agenda. It is not about whether supplementation is more important than biofortification, but sustainability over a longer period.

3. SESSION 3 - MARKETING, CONSUMER STUDIES, SCALING MODELS, ADOPTION STUDIES & PROMOTIONAL ACTIVITIES

Tawanda Muzhingi (Chairperson)
Christine Bukania (Rapporteur)

3.1. Commercializing quality planting material: A Case of Sweetpotato in Kenya

Srini Rajendran

3.1.1. INTRODUCTION

There are two different approaches; from the management perspective and the economic perspective. From the management perspective, Kevin Donaldson, a well-known American entrepreneur said, "Going into business without a business plan is like going on a mountain trek without a map or GPS support – you'll eventually get lost and starve!" The other perspective is from a professor at Harvard University Business School and the first person to come up with a supply value chain. He states that if a firm likes to maintain a sustainable business, it must understand how its products serve customer needs better than potential substitutes; the technology of production, distribution and sales; and the business costs.

Before getting into the business plan one must understand supporting activities and primary activities that execute the business. There is a difference between supply chain and value chain. Supply chain is a set of good that can be transferred from one stage to the next in the value chain without value addition. The value chain has value addition where you procure product and add value to it, process it and take it as a new product.

Before coming up with a business plan, one must also understand completive and comparative advantage of processed products. Comparative advantage refers to "the ability of a party (an individual, a firm, or a country) to produce a particular good or service at a lower opportunity cost than another party in a particular region or location." A firm can achieve competitive advantage if it possesses 'capabilities' that allow it to create not only positive value but as well additional total value than its competitors.

By understanding why a company can create value and whether it can continue to it in the future is a necessary first step in diagnosing a firm's potential for achieving a competitive advantage in the marketplace. Therefore, a firm must understand how its products serves customer needs better than potential substitutes; the technology of production, distribution and sales; and the business's costs.

3.1.2. BUSINESS PLAN FOR EARLY GENERATION SEED: HOW IT CAN BE ADOPTED FOR PROCESSING INDUSTRIES

A business plan is important when starting a new venture and to ensure it is viable. In the seed systems, the plan was implemented in three steps in National Agricultural Research Institutes (NARI); a business model, a financial analysis and institutionalizing the business plan in 14 countries. Ten institutions have started to implement their business plans; of which six institutions earned revenue from the sale of seed, to start their revolving funds.

As part of business plan, SWOT analysis was carried out; strategies for exploiting opportunities, and for mitigating weaknesses to reduce vulnerability to threats in the business environment were identified.

3.1.3. CHALLENGES

There were some challenges where the previous business plan was conducted on the basis of recall method, which is recalling prices that institutions have previously used. Secondly, a lot of assumptions were used, these have to be cleared to get precise price information. So far, this has been addressed to some extent. The pricing strategy and the mechanisms for the revolving fund have been done. There are plans to develop a database for potential buyers and a marketing strategy is being implemented.

Price determination is one of the most important factors in business. The value chain was categorized into six stages and the price of each stage was estimated on real-time data collection. The prices are not fixed, they depend on different factors like sales and consumer strategies.

3.1.4. WAY FORWARD FOR PROCESSING INDUSTRY

The processing industry must conduct real-time data collection to determine price information. This can be done in the following stages:

1. Identify members who will conduct these activities
2. Identify the activities in production
3. Identify the responsible person for production activities
4. Classify the category into fixed and variable costs
5. Identify assumptions
6. Organize files for each activity and do a pilot survey and determine cost information
7. Record all this information on a real-time basis

3.2. ADVOCACY: AN ESSENTIAL COMPONENT FOR SCALING UP BIOFORTIFIED CROPS IN NIGERIA

Olapeju Phorbee

The Building Nutritious Food Baskets (BNFB) - Scaling up Biofortified Crops for Nutrition Security in Nigeria and Tanzania has the goal of helping to reduce hidden hunger by catalyzing sustainable investment for the utilization of biofortified crops at scale in Nigeria and Tanzania. The project focus is advocacy, policy development, nutrition education and behavior change communication.

The Key Elements for scaling up in the BNFB project are:

- A clear vision for scaling up that shows large-scale impact – reaching the population.
- What is to be scaled up to achieve large-scale impact (e.g. proven technologies, evidence-based actions or interventions for scaling up)?
- An enabling environment for scaling up, such as the policy context.
- Drivers and barriers such as catalysts, champions, system-wide ownership, and incentives.
- Choosing relevant strategies, processes, and pathways for scaling up, and highlighting what will be scaled up and the appropriate pathways and processes for scale-up.
- Building operational and strategic capacities.

- Governance of scaling up impact for multi-sectoral issues, such as nutrition comprising vertical and horizontal coherence and management tradeoffs.
- Financing scale-up to ensure adequacy, stability, and flexibility.
- Embedding mechanisms for monitoring, evaluation, learning, and accountability.

3.2.1. ADVOCACY STRATEGIES

The project is anchored on three advocacy strategies.

The first is public/policy awareness on biofortification. In Nigeria, there have been sensitization activities such as the Nutrition Week, media awareness on food basket approach to fighting malnutrition, and participation in high level policy engagements with various ministries. The project is represented in the technical committee on food and nutrition and has contributed to the development of relevant documents and plans.

Advocacy tools used in BNFB

In Tanzania, the project engaged the Tanzania Official Seed Certification Institute and the national variety release committee on the need to consider biofortification as a special criterion for the release of crops in Tanzania. A working relationship was established with Partnership for Nutrition in Tanzania (PANITA), which is a nutrition advocacy platform. PANITA has been promoting and advocating for biofortification in the regions, leveraging on its wide network of civil society organizations. Ongoing discussions are centered on how to strengthen multi-sectoral policy platform for nutrition/biofortification in Tanzania.

At the regional level, the project has participated in various high-level policy discussions and meetings e.g. the 8th Meeting of the African Task Force on Food and Nutrition Development, Addis Ababa; 7th Forum for Agricultural Research in Africa (FARA) Africa Science Week meeting, in Kigali; 10th Africa Potato Association conference held in Addis Ababa, on 10–12 October; and the 7th African Nutrition Epidemiology Conference held in Marrakech, on 9–14 October 2016, among others.

The second strategy is raising national partners, champions and advocates on biofortification. On this aspect, BNFB interest coincides with national interest in Nigeria and Tanzania. For example, in Nigeria, the Nutrition Society of Nigeria made the first Lady Nigeria Nutrition Ambassador. So far, there are about 15 names identified champions in Nigeria and seven at regional level.

The third strategy is **reaching 2.175 Million Households with biofortified crops.** This is through participation in fairs, conferences and meetings to advocate for biofortification and biofortified crops, sensitizing private sector, working with councils to create awareness among farmers and enhancing project visibility through various means.

3.2.2. BIOFORTIFICATION IN POLICY, STRATEGIES AND PLAN OF ACTION

In Nigeria:

- Inclusion of biofortification in the strategic plan of action for the recently released Nigerian food and nutrition policy document
- Inclusion of biofortification as a priority area in the Food security and nutrition strategy plan (2016-2025) of the Federal Ministry of Agriculture and Rural Development
- National advocacy brief developed by the Ministry of Budgets & National Planning (MBNP)
- Nutrition Newsletter-to be published first quarter 2017

In Tanzania:

- Inclusion of biofortification in the draft "Multi-Sectoral Action Plan for Prevention of Micronutrient Deficiencies" (NMNAP 2) document
- Contributed to TFNC's 5-year strategic plan which led to the inclusion of biofortification in the document

The implications of this are: biofortification is one of the priority areas for the government; other stakeholder have also got increased interest in biofortified crops. Other implications are: ease of adoption and acceptance by farmers and processors; enhanced investors' willingness of investors in biofortification.

3.2.3. INVESTMENTS/RESOURCE MOBILIZATION.

The government of Nigeria committed USD35,000 (NGN 15,000,000) towards the ToT course on 'Everything you ever wanted to know about sweetpotato'. CRS got USD 200,000 (NGN 60,000,000) for USAID-Nigeria towards dissemination of planting materials. It is now an annual commitment

In Tanzania, the announcement of the allocation is still being awaited. In addition, there are various funding pipelines that are being pursued.

3.2.4. CHALLENGES

- There is misconception of biofortified crops for GMO.
- Buying into biofortification by some ministries that are used to supplementation and elemental fortification.
- Policy influence is time and opportunity based, which may or may not come in the project life time.
- Raising champions and advocates to lead advocacy and drive investments for biofortification takes time.
- Multi-stakeholders' management is tough.

3.3. EFFECT OF INFORMATION ON CONSUMER SENSORY RATING OF ORANGE-FLESHED SWEETPOTATO IN KERICHO COUNTY, KENYA

Penina Muoki, Jacob Wambaya and Sammy Agili

3.3.1. BACKGROUND

Kericho is traditionally a tea producing zone so it was important to check the adoptability and acceptance of the current varieties. There was also a request from the county government that is considering the economic benefits of the sweetpotato for the population. Further, the distance from Organi Ltd, who are puree processors is not very large, and the area could be a good source of roots for the enterprise.

3.3.2. THE STUDY

The objective was to determine the attributes that influence consumer preference of sweetpotato. The total population was 169 (80% farmers) of non-trained panelists in a relatively controlled environment. The 9-hedonic scale was used.

Roots were cooked under controlled conditions e.g. quantity of roots, water, heating level, time of cooking etc. The roots were steamed and served hot. The samples were blind coded with 3-digit codes. The study was conducted in Sigowet sub-county, selected due to the proximity to Organi Ltd.

The following treatments were administered to groups of panelists:

- **Treatment 1:** Will not be provided with any information on OFSP during the consumer sensory acceptability questioning. This group will go to the trials after tasting the boiled roots.
- **Treatment 2:** Will have received information on agronomic aspects of OFSP.
- **Treatment 3:** Will receive information on agronomic properties plus potential of OFSP to improve nutrition and health.
- **Treatment 4:** Will receive information on agronomic properties plus negative perceived sensory properties.

3.3.3. FINDINGS

Sixty-four percent of the respondents were already consuming sweetpotato at least once in a week and throughout the year. The region has valleys in which sweetpotato can be grown during the dryer seasons.

The ratings were influenced by whether someone had been told about the sensory properties only or nutrition information only. There was no significant difference between those that preferred Chebolol and Kabode and Vita. The sugar level, softness and mealiness of Chebolol was more preferred, but the difference was not too large. Respondents were willing to pay more for Kabode as compared to the other varieties.

Kabode and Vita are rated closely to Chebolol variety. This is an indication that they can be easily accepted. The orange color was surprisingly liked by adults in this study. Softness of the orange varieties was not rated negatively which confirms findings from previous studies. It appears that the information provided to the consumers did not influence their sensory acceptability of the orange varieties as compared to the white variety.

3.4. SOARING THE VISIBLE TRAITS, HOW BRANDED OUTLETS HAVE CHANGED ORANGE SWEETPOTATO MARKETS IN UGANDA

Jude Asiimwe

3.4.1. BACKGROUND

Uganda is the second highest producer of sweetpotato globally. In the country, sweetpotato is the third most consumed staple, and the per capita consumption stands at 73kg. When one looks at the market share of OFSP compared to the white-fleshed, it has an 18% market share. Yet Uganda loses up to USD 145 million in minerals and vitamin deficiencies. This is high, but it provides an opportunity to scale up sweetpotato.

HarvestPlus has promoted OFSP extensively for 10 years. There are seven varieties on the market, and more than 420,000 farmers were reached in five years. However, from the marketing perspective, the question has been where OFSP can be found.

3.4.2. THE PROBLEM

In the first year, the attitudes, perceptions towards the first varieties (Kabode and Vita) was poor. They were soft and the way they were cooked made them unacceptable. The sweetpotato is consumed at the household level, and less than 20% reached the market. Therefore, for producers, the question was where they would sell OFSP.

3.4.3. THE MARKETING STRATEGY

Since 2016, HarvestPlus has established 32 points of sale and nine highway points of sale. This targeting fresh sweet potato markets. They are spread across the for regions; Northern, Eastern, Central and Western. The objective of these branding outlets was to:

- Increase OFSP product availability and visibility in markets (where is “the OFSP”?).
- Share nutritional information on the OFSP.
- Provide markets for OFSP for root producers.
- Understand the trends especially with regard to demand.

The points were located in strategic market areas, painted orange and located where there was clear visibility along roads. They were connected to supply lines of commercial farmers and promoted through media, especially radio. Market awareness campaigns targeted consumers through radio talk shows, agricultural and tradeshows and branded packing materials for various outlets.

3.4.4. RESULTS

A highway point of sale

The preliminary results are based on data collected over a period of three months, showing pre- and post-branding data. The general result has shown an increase in the sale of OFSP. More than ten people stop, ask and buy OFSP each day. The Kampala- Masaka road received the highest increment because it is a road with high traffic. Mbale sold more volumes due to longer project interventions. More time is needed to assess variety choices/ repeat purchases.

There was a significant increase in sales of fresh roots at all outlets. Nutritional information was shared with buyers. This has impacted on production practices of farmers of OFSP.

Some of the challenges faced include inconsistency in supply due to drought; poor infrastructure hinder flow of products and the short shelf-life of OFSP. To avoid wastage, efforts are being made to link the sellers to a processor.

The approach being implemented is different because consumer awareness is being raided through the media, and commercial farmers are being linked to the outlets. There are continuous efforts to maintain brand visibility and create business to business linkages.

3.4.5. CONCLUSION

Branding significantly improves brand visibility and sales, but it requires a network of commercial farmers to thrive. It also needs an elaborate consumer campaign in short run and consistent messaging about nutrition.

3.5. VIDEO PRESENTATION

Thomas van Mourik

3.5.1. BACKGROUND

A video created as a part of the SPRING project to raise awareness about the benefits of OFSP was presented. The SPRING project aims to reach a large number of beneficiaries through demand creation for nutrition related products and services, an extensive SBCC strategy including multiple channels and innovative partnerships with community based organizations (CBOs), government, NGO's and the private sector. Community videos and dissemination of these, using the Digital Green approach are key to exposing communities to new technologies, such as OFSP and encouraging their adoption.

Lack of awareness about OFSP and its benefits was identified as a key constraint and was chosen for the production of a video. The conception process and final result of a community video on the promotion of OFSP will be presented, showing (1) the advantages of OFSP

compared to white-fleshed sweet potato, (2) the different delicious dishes that can be made with OFSP and (3) men's engagement in making the production of OFSP a success.

Community videos are proposed as a cost-effective approach for creating awareness and demand for good nutrition practices and nutritious foods that can be produced locally.

3.5.2. DISCUSSION

Did the community members make the video?

This is an approach from Digital Green, they train local video production hubs, with people who know something about computers and sound. In this case they chose people from the local radio stations. Expert input, community input, and videographers gave direction on the script and process

4. SESSION 4 - NUTRITION

Robert Ackatia-Armah (Chairperson)
Rachael Cox (Rapporteur)

4.1. ENHANCING ADOPTION OF OFSP IN MALAWI THROUGH AN INTEGRATED PROMOTION APPROACH

Brian Kachisa

4.1.1. BACKGROUND

Undernutrition in Malawi is high: 800,000 children under the age of five are stunted and one million suffer from vitamin A deficiency (VAD). OFSP varieties stand out as a proven, cost-effective tool to reduce VAD and provide additional vital nutrients to vulnerable populations. Fortunately, six OFSP varieties are available for scaling out in Malawi. However, there is limited awareness of the benefits of OFSP varieties beyond these direct beneficiaries.

In the Feed the Future Malawi Improved Seed Systems and Technologies (MISST) project, the lives of 62,500 households will be directly impacted through OFSP out-scaling activities. Enhanced adoption depends on promotional activities.

4.1.2. KEY AREAS FOR AWARENESS CREATION

- Limited understanding of the contribution of OFSP to food and nutrition security and mitigating the effects of climate change
- Poor knowledge and skills on rapid vine multiplication and vine conservation over the dry season resulted in insufficient quantities of the planting materials at the onset of the rainy season
- Poor linkages between buyers and suppliers of OFSP planting material
- Limited knowledge on the market potential of the OFSP roots
- Limited awareness on options for utilization at household level

4.1.3. PROMOTION AND DEMAND CREATION ACTIVITIES

Mother baby trials: The name 'mother & baby' was coined by one of the early participating farmers. It consists of one central, farmer-hosted location that has all treatments (varieties) surrounded by many farmers hosted satellite fields that have only one treatment. All participating farmers and all interested farmers are invited to field days to harvest the mother plots and discuss varietal performance and sweetpotato in general. Cooking demonstrations and sensory evaluations are also conducted.

Vine multiplication: Over 15 commercial (left) and 90 community based (right) multipliers are now actively multiplying and selling clean planting material of the six OFSP varieties. This benefits local communities as well as NGO's seeking to procure clean planting material.

Variety demos and farmer trainings: Over 40,000 direct beneficiaries received planting material and training on agronomic practices, vine conservation and nutrition messages through mother baby trials.

Chefs of hotels in Lilongwe undergo a training on using OFSP

Newspaper articles and other publications: In Malawi there are two major print newspapers. Several columns are available on which agriculture articles can be published. CIP-MISST OFSP Component is publishing in the local media to reach a wider audience on the benefits of OFSP.

Television and radio adverts: Television and radio adverts were developed to reach a wider audience. Currently, only the National Radio (MBC Radio 1 & 2) and MBC-TV are broadcasting but this will be expanded in the next quarter.

Live comedy and theater: The project engaged a nationally known comedian (*Chindime* and *Samalani*) to create awareness on the benefits of OFSP; three sites per district (7 Districts) were identified and 21 sites in total were reached. The activity took place on market days to reach as many people as possible. It is estimated to have reached 15,000 men, women boys and girls.

OFSP promotional song: A nationally known musician (Skeffa Chimoto) was engaged to compose an OFSP song. He has done several USAID promotional activities and is currently the brand ambassador. The song details the nutritional benefits of OFSP to the target beneficiaries. The audio song has been developed, but the video is yet to be developed. The song and video will be part of the song album to be released later this year. This will ensure that it is not a stand-alone activity.

Nutrition trainings and recipes: 190 frontline workers have been trained in nutrition and recipe demonstration to be rolled out at community level. Chefs of hotels and restaurants in Lilongwe have been trained on recipes to create urban demand for OFSP.

Nutrition-led agriculture: CIP/MISST engaged with government Departments of Nutrition, HIV and AIDS (DNHA) and department of Agricultural Extension Services to explore the gap in availability of IEC materials on nutrition sensitive agriculture. The government approved a separate technical working group (TWG) on nutrition-led agriculture to report to the National Nutrition Committee in Malawi. The TWG will contribute to enhancing agriculture-nutrition linkages and IEC materials in Malawi.

Training of Hotel Chefs on OFSP Recipes: Sweetpotatoes fits everybody's dish was done. Urbans hotels and restaurants can embrace OFSP. This will allow urban consumers to incorporate OFSP in their diet. The project trained hotels and restaurants chefs on different OFSP recipes. These will be aired on radio and TV for wider adoption in the targeted households.

Storage and Marketing: Staff from more than ten project partners received trainings on root storage and marketing. Twenty-five on-farm sweetpotato root storage evaluation sites (left) have been established.

IEC material development: There is continuous development and dissemination of IEC materials on all aspects of OFSP value chain (seed, agronomy, pest and disease management, marketing, promotion and processing). These materials are distributed to the targeted audience during meetings, trainings, workshops, field days, open days. They include t-shirts and wrappers.

4.1.4. MEASURING EFFECTIVENESS OF THE APPROACHES

Measurement will be done using the following indicators:

- Number of rural and urban households adopting the nutritious OFSP varieties through conducting a survey and or stakeholder meetings
- Radio and TV listenership/viewership of promotional songs and adverts will be used to gauge the number of people reached

4.1.5. BARRIERS AND OPPORTUNITIES FOR ADOPTION

Some barriers for adoption of OFSP by smallholder farmers addressed by MISST include: limited availability of planting materials for OFSP; and significant proportion of communities unaware of the nutritional benefits of OFSP and the six available OFSP varieties.

Opportunities to enhance adoption include:

- More intensive awareness creation campaigns
- Many partners are interested in adopting OFSP in their programs with technical support from CIP
- The color and texture of OFSP is acceptable in Malawi, and even more acceptable to children
- Market potential in fresh root markets as well as a huge opportunity to increase production driven by value addition (example: 40-50% of wheat flour in bread can be replaced by OFSP puree, crisps, biscuits, baby food, urban hotels and restaurants)

4.1.6. DISCUSSION

How did you link producers with marketing?

There is high potential for farmer markets. The first thing that was done was set up seed systems. The outlets for selling is the local market. Now there is the potential market of direct to chefs and restaurants. New markets on processing might be possible.

4.2. STABILITY OF B-CAROTENE DURING BAKING OF ORANGE-FLESHED SWEET POTATO-WHEAT COMPOSITE BREAD AND ESTIMATED CONTRIBUTION TO VITAMIN A REQUIREMENTS

Madjaliwa Nzamwita; Amanda Minnaar; Gyebi Duodu

4.2.1. INTRODUCTION

VAD is a public health problem. The main strategy used to fight against VAD has been the distribution of high dose capsules of vitamin A. There is need for an alternative source of vitamin A. OFSP is recognized as a rich and cheap source of vitamin A as it contains high amounts of beta-carotene. However, the baking process may adversely affect beta-carotene in OFSP-wheat composite breads as well as their vitamin A activity.

4.2.2. ANALYSIS OF CAROTENOIDS

Color analysis was done based on L*a*b* value:

L* (measure of lightness ranging from 0-100 indicating black to light),

a* (+a, redness and –a, greenness) and

b* (+b, yellowness and –b, blueness) values

Chroma and hue angle according to the method of Little (1975) is as follows:

Chroma = a^2+b^2

Hue angle = $\tan^{-1}(b/a)$

4.2.3. RESULTS AND CONCLUSIONS

An absorption analysis was done to identify carotenoids in the different bread products. Results found that baking causes one type of carotenoid to convert into others, but the one that decreased (all-trans-beta-carotene) was the one that is best for vitamin A. Still, enough all-trans-beta-carotene was found with breads with 20 or 30% OFSP composition, so that it could eradicate vitamin A deficiencies. The bread would provide enough vitamin A for children but not necessarily enough for pregnant or lactating women who require more.

In conclusion, baking causes the degradation of all-*trans*-beta-carotene which results into the formation of new forms of carotenoids in the *cis* configuration with low vitamin A activity. Nevertheless, breads (100 g portion) containing 20% and 30% OFSP flour can potentially be used for the eradication of VAD in children as they were found to contribute more vitamin A for children between the age of 3 and 10 years.

As far as pregnant and lactating women are concerned, they may need more of OFSP bread (> 100 g) to fulfil both their vitamin A requirements and those of their children.

These findings indicate that color parameters such as a* value, hue angle and chroma may, in part, be used to predict the β-carotene content in breads or any other products containing OFSP flour if the OFSP cultivar used does not contain other natural colorants.

4.2.4. DISCUSSION

Why was an America OFSP variety and where can one get it?

One of the researchers worked with it in his studies in South Africa. He has information about its availability.

Why did you choose to blend the crust and the crumb for color analysis?

Both the crust and crumb contribute to beta-carotene, so it is important to use both in the color analysis. As you add other ingredients that do not contain gluten protein, you will affect the bread characteristics, especially the low volume. As you substitute more instead of wheat flour, you will surely affect the volume of the bread product. He can provide data. Acceptability of the bread was not studied.

4.3. DARK GREEN LEAFY VEGETABLES: NUTRIENT AND TOTAL POLYPHENOLS CONTENTS, AND ESTIMATION OF IRON BIOAVAILABILITY USING THE IN VITRO DIGESTION/CACO-2 CELL MODEL

Francis Kweku Amagloh; Richard Atinpoore Atuna; Richard McBride; Edward Ewing Carey; Tatiana Christides

4.3.1. BACKGROUND

Dark green leafy vegetables (DGLV) are generally considered to be important sources of micronutrients such as iron and vitamin A. DGLV were reported to contribute about 19-39% of iron and 42-68% of vitamin A.

Iron deficiency in SSA is public health concern, especially for people living rural communities where DGLV form a significant part of diet. Sauce prepared from amaranth or Jews mallow/corchorus, examples of DGLV, eaten with a thick maize paste by young Burkinabe women did not increase the amount of iron absorbed.

An inadequate dietary intake of bioavailable iron and vitamin A could be the primary cause of iron and vitamin A deficiencies. Concentration of micronutrients may not indicate bioavailability. Polyphenols and phytates in cereal and leguminous foods have been shown to limit bioavailability of essential micronutrients including iron, calcium and zinc, and these staples are usually consumed with these DGLV that may also contain significant levels of these inhibitors. Ascorbic acid and beta-carotene are enhancers of iron absorption from food and are relatively high in DGLV.

The *in vitro* digestion/Caco-2 cell model has been suggested to an appropriate physiological tool to predict iron availability. Thus, it was used to measure iron bioavailability of selected greens available in Ghana in comparison with five varieties of sweetpotato.

4.3.2. STUDY FOCUS

To compare the nutrient contents and iron bioavailability using the *in vitro* digestion/Caco-2 cell model of five different cultivars of sweetpotato with five other commonly consumed DGLV in Ghana: cocoyam, corchorus, baobab, kenaf and moringa.

The experimental design was a completely randomized design. Compositional analyses were carried out i.e. *In vitro* digestion/Caco-2 cell model for iron.

4.3.3. FINDINGS

- Among the DGLV investigated, iron content does not explicitly indicate its bioavailability.
- The sweetpotato leaves and cocoyam had similar iron bioavailability; thus, the sweetpotato leaves could be used in culinary preparations, and have an added advantage of increasing dietary intake of beta-carotene compared to that of cocoyam.
- Generally, the level of iron bioavailability from the DGLV was relatively low (6 - 10 ng ferritin/mg protein) compared with our previous work from the same laboratory on complementary food (12 - 34 ng ferritin/mg protein).
- The composition of nutrients in moringa compared with the other DGLV contributed to the highest bioavailability of iron as obtained from the in vitro Caco-2 cells model study.
- OFSP1 had significantly similar levels of beta-carotene and iron to moringa, and a third of the total polyphenols of baobab, its iron bioavailability was lower than moringa, indicating that the reported caffeoylquinic acid derivatives in sweetpotato leaves may have limited the bioavailability of iron.
- In addition, the level of total polyphenols irrespective of the concentrations of ascorbic acid, beta-carotene and iron appeared to be the major factor limiting iron bioavailability of OFSP1 and Baobab.

4.3.4. CONCLUSIONS AND RECOMMENDATIONS

- Within the limits of this study, iron bioavailability is influenced by a complex interplay of several components in DGLV including protein, ascorbic acid, β-carotene and total polyphenols.
- Moringa had the best iron bioavailability, and the lowest was found in baobab and one of the orange-fleshed sweetpotato with purplish young leaves.
- Estimating iron bioavailability in greens based on the mineral concentration may lead to incorrect conclusions.
- Based on the similarity of the iron bioavailability of the sweetpotato leaves and cocoyam leaf, the widely promoted “nutritious” DGLV in Ghana, the former greens have an added advantage of increasing dietary intake of provitamin A.

4.3.5. DISCUSSION

Were the fresh leaves cooked or dried? The way they are consumed affects the bioavailability.

Leaves were boiled as they are eaten at home. Leaves were put together with the cooking water. Then a freeze-dried sample was made. Moisture content was taken out at all the steps. For compositional analysis, this moisture was put back.

4.4. UTILIZATION OF ORANGE-FLESHED SWEET POTATO IN TEFF-BASED COMPLEMENTARY FOODS IMPROVED VITAMIN A COMPOSITION

Mesfin Tenagashaw, John Kinyuru, Glaston Kenji and Eneyew Melaku

Being free of malnutrition declared basic human right (UN, 1948). However, micronutrient malnutrition/hidden hunger are a major problem in SSA and South-east Asia. One third of the world's population is affected, especially infants and children transiting to complementary foods. The major micronutrient deficiencies are vitamin A, iron, zinc, folic acid, and iodine. Globally, 127 million children affected by VAD. This has negative impact on economic development of a nation especially due to the public health costs.

In Ethiopia, micronutrient deficiencies contribute to 53% of infant deaths, the sixth highest rate in the world and second in Africa. Sixty-one percent of children (6-59 months) are affected by VAD and 44% are anemic. Only 4% of children (6-23 months) are fed appropriately. The current recommendations on infant feeding are to start complementary feeding at six months, use local crops (cereals, legumes, tubers) through blending; apply household level or small-scale processing methods and improve energy and nutrient density, digestibility, bioavailability and porridge consistency. Thus, there is a need for complementary foods with appropriate formulation and processing that are readily available and affordable, nutritious and safe, of desirable consistency and acceptable in a given community.

4.4.1. THE STUDY

The objective was to develop and evaluate vitamin A, selected minerals and their bioavailability in complementary foods produced from a blend of teff, soybean and OFSP using household level combined methods and extrusion cooking.

Two different processing approaches were employed household level (combined strategies); and industrial level (extrusion cooking). In this study only the industrial blend was used, however the possibility of a household blend is considered for food security interventions.

At industrial level, extrusion cooking was done, where a high-temperature short-time thermal and mechanical process that precooks a food ingredient through a number of different integrated unit operations using an extruder. The table below shows the complementary foods and their proportions.

4.4.2. RESULTS AND DISCUSSION

Significantly high vitamin A values were obtained. Calcium, iron and zinc compositions of all complementary foods met recommended levels for 6–8-month-old infants. Phytate contents of teff and soybean were significantly reduced both by household- and industrial level approaches. However, the reduction was not significant for the complementary foods prepared through the household level approach. Phytate:mineral molar ratios for calcium and zinc were below the critical limits indicating that their bioavailabilities were improved while the bioavailability of iron was improved only for the industrial level complementary foods.

Table 3 Developed complementary foods and their ingredients with proportions (%)

ComF Formulation	Processing method	Ingredients	Proportion (%)
ComF1	Extrusion cooking	Ungerminated teff	70
		Unprocessed soybean	20
		Processed sweet potato	10
ComF2	Household-level methods	Ungerminated teff	60
		Germinated teff - 24 h	10
		Blanched soybean	20
		Processed sweet potato	10
ComF3	Household-level methods	Ungerminated teff	60
		Germinated teff - 24 h	10
		Roasted soybean	20
		Processed sweet potato	10
ComF4	Household-level methods	Ungerminated teff	60
		Germinated teff - 48 h	10
		Blanched soybean	20
		Processed sweet potato	10
ComF5	Household-level methods	Ungerminated teff	60
		Germinated teff - 48 h	10
		Roasted soybean	20
		Processed sweet potato	10

Ingredients and CFs analyzed for beta-carotene, calcium, iron and zinc, phytates and bioavailability.

These results show that complementary foods produced from Teff-soybean-OFSP mixture can meet the requirements of V-A, Ca, Fe and Zn for 6 to 8-month-old infants. It can also support the various initiatives being carried out in low-income countries to reduce malnutrition problems including VAD. The bioavailability of the minerals should be checked in vivo for checking true absorption.

4.4.3. DISCUSSION

Is checking in vivo bioavailability possible?

Analysis was done specifically for beta-carotene. Although the results of all the carotenes were collected, the one specific to beta-carotene was selected.

The phytate activity needs to be optimized by doing time-step measurement.

Optimization of phytase enzyme that creates the phytates was done, but the result was not significant. This was not one of the objectives so it was not optimized. However, the indication is, that the phytase activity might be higher during the 21-hour range than the 48-hour range. Time durations in that range must be taken to know when the highest activity occurs.

4.5. PANEL DISCUSSION: PROGRESS IN ADDRESSING CHALLENGES WITH OFSP PRODUCT DEVELOPMENT AND CONSUMER ACCEPTANCE

Tawanda Muzhingi, the moderator of the panel discussion is a food scientist with CIP, based in Nairobi.

Antonio Magnaghi is a process specialist and CEO of Euro Ingredients, which has a base in Nairobi. He is specialized in equipment and product development. Antonio talked about the challenges with the technology aspects of OFSP product development.

Jean Pankuku works with Universal Industries, a food processing company in Malawi and one of the first to get involved in OFSP product development. She is involved in quality assurance, product development and project management. Her presentation drew on the experience in Malawi in commercializing OFSP products.

George Abong' is a lecturer at the University of Nairobi, Department of Food Science, Nutrition and Technology. His presentation focused on the challenges with regard to acceptability of new OFSP products.

Roland Brouwer works for SUSTAIN project in Mozambique. He talked about economic viability of introducing new OFSP products to the market.

Ganiyat Olatunde is a lecturer, researcher at the Federal University of Agriculture in Abeokuta in Southwest Nigeria. She also carries out extension activities. She talked about the role of promotional activities on OFSP product development and consumer acceptance.

Key points from Antonio

- Messaging on the technologies needs to be clear. Often, small and medium processors are not quite clear on the cost of the technologies required for introducing sweetpotato puree and flour derived products.
- Sweetpotato contains high levels of starch that is easily gelatinized during boiling. To avoid this, OFSP should be steamed for puree. The process should be demonstrated so that there is better replacement of products and the use of the equipment.
- There is no specific technology for the puree industry. Most of the technology is borrowed from the meat industry. There are a few challenges: one is the hygiene, whereby people do not clean the equipment well; the second is abuse of equipment, where people force the machine to bear more load than it should. For cleaning, solutions like high pressure water that could be implemented.
- The color of the skin influences recipes. Breeders should consider the influence of color for commercialization.

Key points from Jean

- As a private sector player, there must be demand from the market to guarantee demand. In the case of OFSP, where the drive is the health and nutritional products, and being a new product coming into the value chain, there is a challenge of getting private sector interested in the idea. They would have to invest in new technologies without being sure of the demand.
- Supply of OFSP roots of the needed varieties is not consisted. Going into a business within

such a context is risky. The farmer and processor preferences are very different. This causes some challenges within the supply chain.

- New products have to go through certification. In the case of OFSP in Malawi, there were no standards. This caused delays in launching the product. This is a clear indication that there has been stronger collaboration in the breeding and production areas than in the processing and trade areas of government.
- There is increasing recognition of the role of private sector within the Scaling Up Nutrition (SUN) movement civil society group, and OFSP has been included in the strategies for addressing malnutrition.

Key points from George

- In any product development, the uptake of a product follows a certain pattern. At the beginning, the acceptability is low and demand has to be created through marketing strategies and strategic messaging. Information has to be transmitted repeatedly until people realize that the product is beneficial. At that point, the product enters the accelerated face where demand becomes higher than supply. After this, one enters another slow phase, in which demand is constant. This is where the strategy has to be changed e.g. through rebranding.

Key points from Roland

- There is a correlation between margin and volume. If you have a small profit margin, you must sell high volumes and vice versa.
- With regard to investment and return, when the investment is high, the returns must be high to make the investment viable. This is very important in the efforts to scale up.
- The initiatives set up in Mozambique were based on feasibility studies (juice, biscuits, bread etc.). However, the inflation rate in Mozambique affected wheat and packaging materials for juice. This made some of the previously unviable options better options for investment. These are options that have less technological requirements.
- Acceptability of bakery products is good. Publicity is done on Facebook but the product is popular without much marketing.

Key points from Ganiyat

- Advocacy and promotion activities are integrated. They draw attention of people to something, in this case, it is OFSP and the derived products.
- The choice of advocates depends on the target audience and the kind of information they need. There are four categories of audiences. These are government, researchers, enterprises and consumers.
- The products developed must be suitable to the end-users. When promoting these products, one should reflect on the interest of the target audience, e.g. financial returns for entrepreneurs. The technology must also be appropriate and fit within the existing way of processing. There should be willingness to provide technical support to the entrepreneurs. The availability of raw materials should be addressed as part of promotion.
- To promote OFSP to consumers, the factors that should be paid attention to include, sensory and aesthetic appeal, nutritional advantage and reasonable price.

Key points from the audience

- The OFSP bread should be marketed for what it is. The nutritional benefits should be spelled out on the packaging.
- Community members know that vitamin A is supplemented for children under the age of five. The messages should be packaged appropriately to reach out to all the age groups, including adolescents. In this regard, the selection of advocacy agents for the products are very important.
- For large-scale processors, the chances of sustainability are high. This is because the process for product development is thorough, and the new products are included into product lines with already established packaging and marketing systems.
- There are many ways of identifying the target group. For example, in SUSTAIN Mozambique, the focus is on people who are health conscious between the ages of 18 and 45. The bread is not marketed at all, and it is the demand that has driven the production of the OFSP bread. Therefore, the lesson is that if one provides what the consumers really need, promotion will not be a problem.

4.6. MESSAGE TO SEED SYSTEMS COP

Gerald Kyalo and Srini Rajendran

The presentation focuses on what the Seed Systems CoP would like to learn from the meeting and it will be fed back to the Seed Systems CoP, not just as information – but as a reflection and action on how seed systems practice can be improved through inputs from MPU CoP. It also provides some messages to the MPU CoP.

4.6.1. MESSAGE TO THE SEED SYSTEMS COP

- Are the current OFSP varieties tailored to the product development demands? Seed systems works hand in hand with breeders, and therefore this point warrants reflection.
- Root producers must have formal linkages with processing industries and learn about quality standards required.
- Cost sharing activities with buyers can be encouraged for upscaling activities on vine multiplication and root production (i.e., lessons learned from the Burkina Faso study). It encourages farmers to buy good quality vines.
- Moving sweetpotato seed systems from non-commercial to commercial based to achieve sustainability is needed. Currently, multipliers are producing for the project. The question is whether they would continue to produce if the project came to an end.
- Is investment in quality/ clean planting material economically worth it? Demonstration of yield and economic gains from using quality planting material needed. Other studies have shown that crop rotation is an economically viable options for DVM producers.
- Vine multiplication for OFSP still limited in some countries.
- DVMs can also provide information on available food varieties and nutritional benefits when they distribute vine to farmers.

4.6.2. MESSAGE TO THE MPU COP

- Processing industry must have business plan to run their business sustainably in the long-run.
- Procurement of the roots must be from the farm to avoid transaction cost.
- Processing industry can browse financial services as a commitment linkage with farmers.

4.7. MESSAGE TO SPEEDBREEDERS COP

Mercy Kitavi

The main message to breeders is "**Do we have the right variety in/for the market in Africa?"**

There are many key attributes for OFSP marketing, processing and utilization. These include nutrition, storability, derived use, flavor, high dry matter, dual-purpose, taste, shape, size, weevil resistance etc.

Sweetpotato is a complex plant with six sets of chromosomes. Every time the parents are identified with the desirable traits, they do hand crossing to produce thousands of seeds. Field trials are done to screen varieties with traits of interest and advance them. Therefore, fixing the traits that are required for processing could take up to 6-8 years.

The breeders' goals are based on attributes that are in different varieties. The traits desired by processors are many and are expected to be contained in one variety. To achieve this, the breeder has to do gene pyramiding.

It can be done using new technologies and innovations such as marker-assisted selection, which is an approach for precision plant breeding and biotechnology.

The message to the breeders is that they must identify the genes that are responsible for the desirable traits. The first step is to identify the shared needs between breeders, farmers and processors. This requires active networking and steady exchange of information and knowledge to create synergies and make outcomes more accessible to end users. This will lead to better coordination and offer opportunities for innovation, while achieving economies of scale and avoiding overlaps.

The message to breeders is:

- Apply technologies and innovations widely for sweetpotato selected value chains, to competitively and sustainably increase productivity; and contribute to agricultural growth, nutrition and food security in Africa.
- Programs/collaborations should therefore enhance the overall economic welfare of farmers, producers and marketers throughout the value chain.
- The stronger the links among these different parts, the better the whole system will function.

4.8. MESSAGE TO THE MONITORING, LEARNING AND EVALUATION COP

Norman Kwikiriza

The MLE CoP had five members attending the meeting. The meeting was well attended and had an interesting mix of formats, e.g. oral and paper presentations, keynote speaker and panel of experts. This is something that the MLE CoP can learn from.

A lot of work has been done; for example, technologies to extend shelf-life of roots for more than two months have been developed, and varieties that are good for making silage are being exploited. Kenya has 21 recipes and Burkina Faso has 31 recipes. The challenge for the MLE CoP is to identify the recipes that are preferable, the recipes and products that are affordable and costing at every stage to determine which ones are affordable. The MLE CoP can help to come up with tools that help to predict which of the developed technologies are most likely to survive.

With regard to policy, it is important to monitor policy changes as regards integration of OFSP in our government policies. Do we have enough hard evidence that food-based approaches address malnutrition Do we have record of the success stories? MLE CoP should work harder to ensure that these stories are captured and well presented.

There is need to design strategies for investment in vines, roots and sweetpotato products to ensure that evidence of the business sense are clearly visible.

The MLE CoP has a focus on learning. The Organi Ltd OFSP Processor would provide a good case study to learn about financial feasibility; socio-economics in the supply of roots. Other areas that warrant further learning are willingness to pay, DVMs supply of vines to non-project beneficiaries etc.

Finally, together, the CoPs can hit the SPHI goal of reaching 10 million households that consume OFSP, but a strategy is required for the CoPs to work closely together.

5. CLOSING SESSION

5.1. VOTE OF THANKS BY PARTICIPANTS

Ephraim Chabayanzara appreciated the work that has been done by CIP, and the efforts that the CoP has made to bring the international organizations on board. He urged the CoP members to think about how to incorporate NGOs more actively. This would help create a stronger link with the targeted beneficiaries.

5.2. AWARD OF POSTER PRIZES

The award of prizes for the best poster presentations was done by Tanya Stathers (NRI). She urged participants to rise to the challenge to

6. ANNEXES

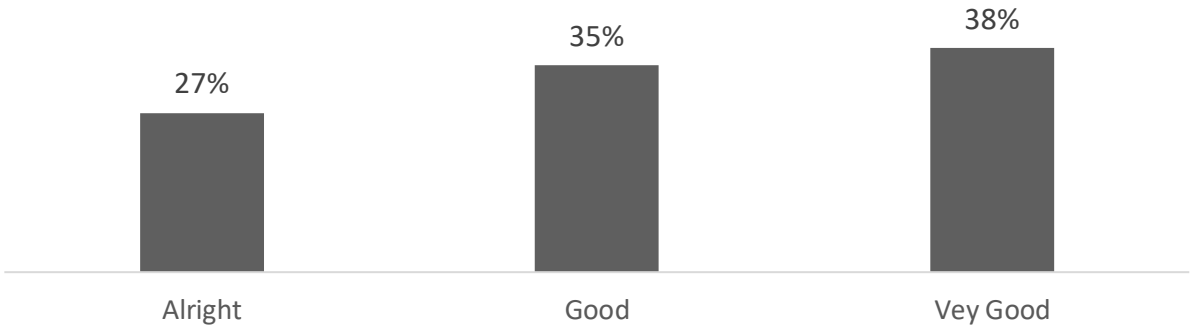
5.3. ANNEX 1: EVALUATION REPORT

Demographics: At the end of the meeting, participants were asked to provide feedback on the quality of this meeting and suggestions for improving the quality of future meetings. Semi-structured questionnaires were used to capture data from respondents. A total of 37 respondents completed the evaluation with the majority being male (54%) and 46% female. The majority of the participants (65%) were between the age group of 30-50 years; 24% between 24-30 years while a smaller proportion (11%) were above 50 years. The mean age of respondents was 39.9 years.

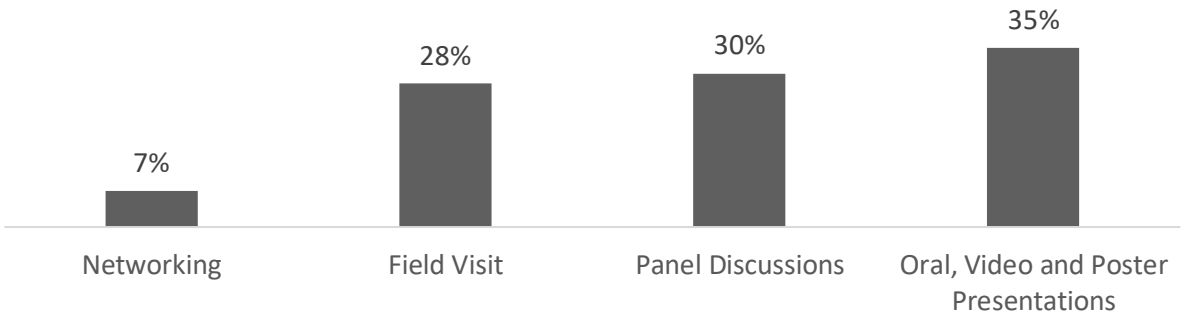
Expectations: More than half (57%) of the participants felt that the meeting fully met their expectations; 40% responded that the meeting met most of their expectations while 3% felt the meeting had somehow met their expectations.

Content: Most of the participants were satisfied with the content delivery in the meeting with 62% rating it as good (62%) and 38% very good.

Organization of the meeting: Respondents were asked to rate the meeting in terms of logistics and communication. Most of them were satisfied with the arrangements which were rated as good (35%) and very good (38%) as shown in the chart below.



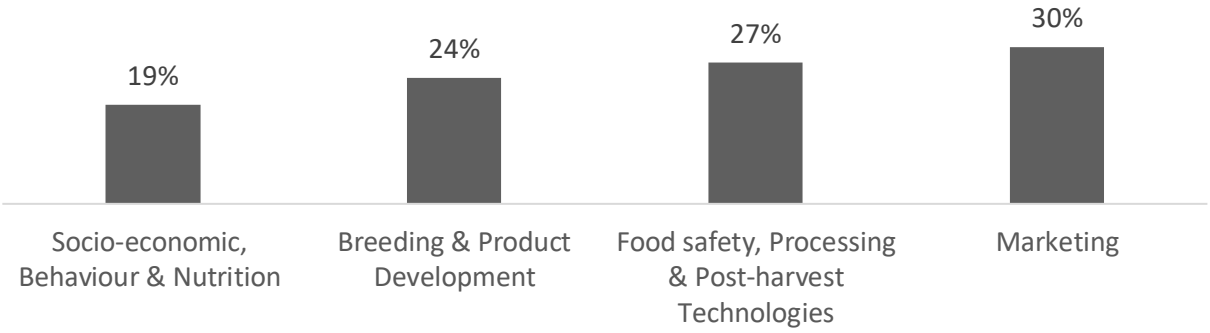
Most useful parts of the meeting: Respondents were asked to list parts of the meeting that were most useful to them. Oral, video and poster presentations was listed as most useful by 35% of the participants; panel discussions came second with 30%; field visits to the puree processing company (Organi limited) and the health facility came third with 28% and lastly networking with other researchers at 7%.



Areas for Improvement in the next meetings: Nineteen percent of respondents felt there is need for improvement on planning, communication and other logistic issues. They suggested communication to invitees be done a few months before the meeting to allow them make necessary travel

arrangements i.e. obtaining visas; 38% suggested improvement of time management during presentations and field visits; 31% suggested inclusion of other stakeholders from the government, private investors, policy makers, farmers and students in the meeting while 12% of the respondents felt there is a need to extend the number of days the meeting is held to 3-4 days.

Topics for the next meeting: Respondents were asked to suggest topics to be addressed in the next meeting. The results are indicated in the chart below.



Sweetpotato Knowledge Portal Training: Respondents were asked on whether they attended the pre-meeting training on online communication and the knowledge portal. Forty-six percent of the respondents attended the training while the majority (54%) did not attend the training. Participants who had attended the training were further asked to rate the quality of the training in terms of its usefulness. The training was useful to all the participants with 53% rating it as very good; 35% good and 12% felt it was just alright to them.

5.4. ANNEX 2: AGENDA

Marketing, Processing and Utilization Community of Practice meeting

Theme: Accelerating OFSP Value Chain Development for Nutrition and Livelihoods

Sovereign Hotel, Kisumu

March 1 -3, 2017

Programme

1 March, 2017		
11:00-14:00	Arrival and registration of participants	Tassy Kariuki
14:00-17:00	Pre-meeting training: Effective online communication and Sweetpotato Knowledge Portal	Christine Bukania
18:00-20:00	Reception cocktail: Introductions and networking	Christine Bukania
2 March, 2017		
SESSION 1 – POST-HARVEST DEVELOPMENT / OFSP PRODUCT DEVELOPMENT *Penina Muoki (Chairperson)* *Mercy Kitavi (Rapporteur)*		
8:00 – 8:15	Welcome address	Penina Muoki
8:15 – 8:30	Effect of vine harvesting on root and vine yield of different sweetpotato varieties in Uganda	Gerald Kyalo
8:30 – 8.45	Orange-fleshed sweetpotato storage, processing and local recipes for improved nutrition in Burkina Faso	Marcellin Ouedraogo
8.45 - 9.00	Food safety knowledge, attitude and practices of Orange-fleshed sweetpotato puree handlers in Kenya	Derick Malavi
9:00-9.15	Effects of acidification and preservatives on microbial growth during storage of orange-fleshed sweetpotato puree	Joy Musyoka
9:15-9:30	Inclusion of cassava flour in bread making in West Africa; lessons and recommendations for scaling OFSP puree bread	Ibok Oduro
9:30-9:45	Developing a policy framework for biofortification in Mozambique and lessons learnt from food fortification	Eduarda Mungoi
9:45-10:30	*Panel Discussion* Creating a conducive environment for accelerating OFSP value chains in Africa	Sindi Kirimi (Leader) Panel Discussants: Eduarda Mungoi Robert Ackatia-Armah Ibok Oduro Kisumu County Government representative Gaston Tumuhimbise

10:30 – 11:00	**Health break**	
LEARNING TOUR TO ORGANI LTD PUREE PROCESSING FACILITY, PUREE STORAGE TRIAL AND OFSP FRESH ROOT TRIAL **Coordinators: Penina Muoki, Tanya Stathers, Tawanda Muzhingi**		
11.00	Departure from Sovereign Hotel, Kisumu	
12:00	Arrival at Organi Ltd, Ringa, Homa Bay	
12.10	Presentation by Tanya Stathers: Storing fresh sweetpotato roots long-term to reduce puree Supply chain risks	
12:25-	Tour of facilities	
12:50	Departure for Kabondo community nutrition activities	
15:30	Departure from Homa Bay	
16:30	Arrival at Sovereign Hotel, Kisumu	
3 March, 2017		
SESSION 2 - OFSP PRODUCT DEVELOPMENT *Francis Amagloh (Chairperson)* *George Abong' (Rapporteur)*		
8:00-8:15	Consumer knowledge and attitude towards orange-fleshed sweetpotato bread in Kenya	Cecilia Wanjuu
8:15-8:30	Evaluating 21 genotypes of sweetpotato for poundability and fries	Damian Laryea
8:30-8:45	Lessons learnt on OFSP value chain development in SSA, and opportunities for scaling up	Tawanda Muzhingi
8:45-9:00	Low-Cost Technologies for Value Addition of Orange-Fleshed Sweetpotato by Smallholder Farmers in Western Kenya	Francis Wayua
9:00-10:00	Keynote address: Developments and advances in sweetpotato processing in China, Marketing & consumer acceptance of sweetpotato products and the role of post-harvest technologies in supporting sweetpotato processing / demonstration of products, equipment and packaging solutions from China	Prof. Xie Jiang
10:00-10:30	**Group photo and health break**	
SESSION 3 - MARKETING, CONSUMER STUDIES, SCALING MODELS, ADOPTION STUDIES & PROMOTIONAL ACTIVITIES *Tawanda Muzhingi (Chairperson)* *Christine Bukania (Rapporteur)*		
10:30-10:45	Commercializing quality planting material: A Case of sweetpotato in Kenya	Srini Rajendran
10:45-11:00	Advocacy: an essential component for scaling up biofortified crops in Nigeria	Olapeju Phorbee
11:00-11:15	Effect of information on consumer sensory rating of orange-fleshed sweetpotato in Kericho County, Kenya	Penina Muoki
11:15-11:30	Soaring the visible traits, how branded outlets have changed Orange sweetpotato markets in Uganda	Jude Asiimwe
11:30-12:30	***Panel Discussion*** How strong is the evidence that food-based approaches work?	Prof. Ruth Oniang'o (Leader) Panel Discussants: Thomas van

		Mourik (HKI) Ephraim Chabayanzara (CRS) Jude Asiimwe (HarvestPlus) Nutrition Coordinator (AVCD) Robert Ackatia – Armah (CIP)
12:30-13:00	***Video presentation followed by poster session: Voting for posters closes at 14:00***	Madjaliwa Nzamwita
13:00-14:00	**Lunch**	
SESSION 4 - NUTRITION *Robert Ackatia-Armah (Chairperson)* *Rachael Cox (Rapporteur)*		
14:00-14:15	Enhancing adoption of OFSP in Malawi through an integrated promotion approach	Brian Kachisa
14:15-14:30	Stability of β-carotene during baking of orange-fleshed sweet potato-wheat composite bread and estimated contribution to vitamin A requirements	Madjaliwa Nzamwita
14:45-15:00	DGLV: Nutrient and total polyphenols contents, and estimation of iron bioavailability using the in vitro digestion/Caco-2 cell model	Francis Amagloh
15:00-15:15	Utilization of Orange-Fleshed Sweet Potato in Teff-Based complementary foods Improved Vitamin A Composition	Mesfin Tenagashaw
15:15-15:45	***Panel Discussion*** Progress in addressing challenges with OFSP product development and consumer acceptance	Tawanda Muzhingi (Leader) Panel Discussants: Antonio Magnaghi (EIL) Jean Pankuku (Universal) Simon Gule (Tuskys) George Abong' (UoN) Roland Brouwer (CIP)
15:45-16:00	**Health Break**	
16:00-16:30	Message to SpeedBreeders CoP	Mercy Kitavi
	Message to MLE CoP	Norman Kwikiriza
	Message to Seed Systems CoP	Srini Rajendran

16-30:0-17:15	• Elevator pitch by Poster shortlist • Announcement of abstract and poster winners • Award ceremony	Antony Masinde/James Mwololo
17:15-17:30	Evaluation and vote of thanks	Jan Low
19:00-21:00	Farewell dinner and official closing	Jan Low
4 March, 2017		
09:00-11:00	MPU CoP Executive Committee Meeting	Tawanda Muzhingi Penina Muoki Francis Amagloh Madjaliwa Nzamwita

VIDEO AND POSTER PRESENTATIONS	
Asheber Kifle	Understanding Orange-fleshed sweetpotato based Products Value Chain and Consumer Preference Study in Ethiopia
Bethwel Kipkoech	Where We Are, and What We Expect to Achieve with OFSP Puree Processing and Storage at Organi in Western Kenya
George O. Abong'	Quality characteristics of orange-fleshed sweetpotato crisps from selected Kenyan varieties
Lelgut Lanoi Daisy C.,	Situational analysis of orange-fleshed sweet potatoes (OFSP) in Kenya
Masinde Antony Kilwake	Strengthening the last mile in Orange sweetpotato marketing –A case for Traditional Informal Markets in Nairobi County
Mercy Kitavi	Breeder's role in accelerating orange-fleshed sweetpotato (OFSP) value chain development for nutrition and livelihoods in Africa
Moses Akhwale	Approaches Enhancing Dissemination of OFSP Technologies in Western Kenya
Norman Kwikiriza	DVM Mapping: A strategy to increase access to quality planting materials in sub-Saharan Africa
Rachael Cox	The Impact of nutrition behavior change interventions on OFSP knowledge and consumption in Rwanda
Sarah Mayanja	Gender and sweetpotato current marketing practices in Uganda: do women and men have access to lucrative markets?
Tom van Mourik	Community videos promote Orange-Fleshed Sweet Potato (OFSP) for improved nutrition in Senegal

5.5. ANNEX 3: FIELD VISIT HANDOUTS

Using locally adapted approach to multiply and disseminate OFSP planting material and reaching household targets

SUSTAIN, which is a 5-year project (2013-2018) aims to enhance the efficiency with which farmers participate in the orange-fleshed sweetpotato value chain for health and wealth creation. The project is specifically targeting population segments that are most vulnerable to VAD i.e. pregnant women and children under five years. During 2013/2014, this up scaling project was implemented in seven community units (CUs) drawn from three counties of Nyanza province-namely Nyamira, Homabay and Siaya. In order to reach a wider segment in the region during the period 2014/2015 the project identified additional 26 CUs for implementation of its activities. This brought on board two additional counties-Migori and Siaya making a total of five counties as project intervention areas.

The program continues to work through partnership with Ministry of Agriculture (MOA) to strengthen capacity of the DVMs for multiplication and distribution of OFSP planting material DVMs are selected local farmers with access to suitable land and water within 30 minutes' walk of most target beneficiaries Each DVM produces and disseminate two varieties- vita and Kabode which has been selected for their high beta-carotene content among other traits. The project is supporting DVMs through training and linkages with pre-basic seed supply from Kenya Plant Health Inspectorate Service (KEPHIS). Criteria for Identification and Selection of Decentralized Vine multipliers- SUSTAIN Kenya is an inclusive process that involves the community health committees, community members where the DVMs will serve and the Ministry of Agriculture local extension office. Once selected the DVMs undergo a 4 days intensive training on vine multiplication techniques, vine conservation methods developing vine production calendars, record keeping and some basic information on good agronomic practices for root production. The training involves group work, field practical's and lectures in class. Below is the project selection criteria for the DVMs and the activities that they are expected to conduct:

Selection criteria

A – Mandatory (*Criteria which must be met for first selection***)**

1. Availability of a minimum of 1 (one) acre of arable land that is fairly fertile to be set aside solely for rapid multiplication for at least 5 years
2. Access to nearby permanent water source throughout the year for irrigation
3. Literacy level (Minimum standard 8 Level)
4. Farming Interest and some experience in sweetpotato growing (*Crops diversity on the farm)*
5. Willingness/ability to work himself on the farm
6. Proximity to model one health facility (<2km)

B – Secondary *(rate whether-good-2, Fair-1 or poor-0 by observations & interviews)*

7. Accessibility to a major road
8. Previous working experience with MOA & NGOs
9. Good public relations in the community
10. Ability to commit some 3 days within every week of the project life solely for the project
11. Ability to provide labor to work on the multiplication (demo plot) field
12. If risk of animal attack is high, willingness to invest in fencing
13. Willing to have demonstration plots (Compare with local material in a separate plot on the multiplier's farm)
14. Willing to link up with research system to obtain more material over time

Activities conducted by DVMs

1. **Planting and maintenance of OFSP vines**

- Prepare land, plant (timely according to advice from agric. Officers) and maintain vines under rapid multiplication ensuring their availability throughout the year.
- Label the varieties including the dates of planting and planting number according to the planting schedule.

2. Distribution of vines

- Frequently link up with the health facility service provider to provide information on the status of vines in their field (helps the provider to refer correctly the beneficiary to supply)
- Available at home on the two days of the week that have been agreed on ***(days to serve voucher recipients)***
- Give out healthy cuttings (tips) of 25-30-centimeter length to those who present a voucher from the facility
- The pregnant women/lactating mothers'/care givers are direct beneficiaries, but might not be the one to pick the vines up; if other people, they record on their tracking form who the person is (husband, son, daughter etc.) and the corresponding code
- Record information from ***voucher*** on to their ***voucher redemption tracking sheet***
- Provide exactly the number of cuttings indicated on the voucher (e.g. 100 cuttings of Kabode and 100 cuttings Vita)
- Give some technical advice on how to plant according to what they have learnt
- They Keep the vouchers and use them to claim reimbursement for cuttings given out from the SUSTAIN
- SUSTAIN will pick up the vine redemption tracking forms once per month (*during feedback meetings*!) to make a scan of each. They Retain their original copy for their records

3. Attend Monthly feedback meetings

- Once per month attend feedback meeting with CHWs, antenatal care service providers and agriculture extension officers at health facility.
- Exchange on challenges of the month.
- Share voucher redemption record with CHWs, ANC service providers and agriculture extension officers on who redeemed vouchers during the previous month.

4. Other activities (occasional)

- Attend community meetings to sensitize on OFSP related aspects
- Attend pregnant women club sessions
- Attend SUSTAIN training sessions when called upon
- Attend other meetings with project partner

DVMs selected, trained and working in SUSTAIN intervention areas segregated by gender

County	Female	Male	Total
Kisumu	2	2	4
Nyamira	3	3	6
Siaya	6	10	16
Homabay	8	12	20
Migori	11	9	20
Total	**30**	**36**	**66**

As at January 2017, the project has distributed planting material to 26,953 HH with pregnant women or a child under five. The project has also trained tire two partners DVMs- Aim- to increase number of multipliers in our interventions areas, this will enable more farmers access clean vines for production of storage roots especially in areas where we are targeting commercial production, a total of 25 DVMs have been trained under this arrangement

Conservation of clean planting material by DVMs through the use of Net tunnels

Sweetpotato plants can accumulate pests and diseases over time leading to reduction in quality of vines and ultimately yields. To boost the quality of the seed material and the capacity of DVMs to retain that material SUSTAIN has invested in these net tunnels. Net tunnels are community based kind of screen houses that are constructed using locally available materials and skills except the netting material is similar to what is used in screen houses. The aim of using the net tunnels is to keep off pest from pre-basic grade of vines and increase DVMs access to high quality sweetpotato planting material and to lower the cost of maintaining virus-free planting material on-farm. The DVMs are expected to use vines from these net tunnels to expand their vine multiplication in the open fields. To date the project has constructed 116 net tunnels for 58 DVMs (23 females and 35 males). The project has also disseminated training manuals on this technology to partners in agricultural extension to facilitate wide diffusion and adoption among farmers.

Some lessons learnt from using the net tunnels

- ✓ Poor closure using binding wire causes holes in the netting
- ✓ Termite damage to both elastic sticks and the net
- ✓ Moles destruction of vines within the tunnels
- ✓ Need to replace planting material inside the net after six seasons
- ✓ Training of net tunnel skills are friendly to both women and men

Figure 1 Construction of net tunnels

Figure 2 disease index sweetpotato cutting from KEPHIS

Irrigation support for the DVMs

The project has supported the DVMs with some basic irrigation equipment. This is to helps them cope up with the dry weather conditions and to ensure timely supply of planting material at the onset of rains. To date the project has distributed 42 money maker tread pumps; three motorized water pumps and 16 2000liter tanks

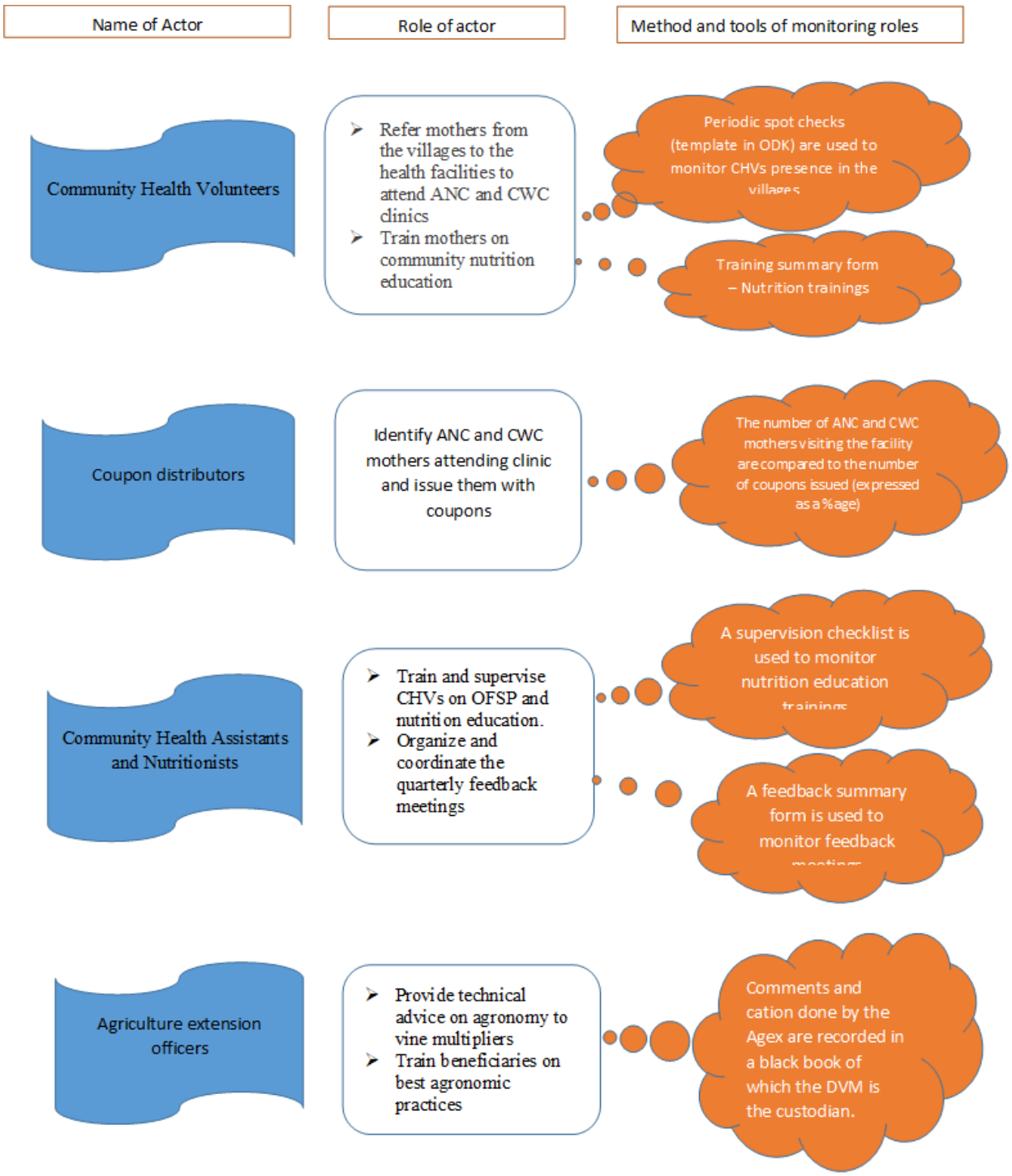
Figure 3 Money maker tread pumps distrinuted to DVMs

An overview of day-to-day Monitoring of Project Activities: SUSTAIN Kenya.

Project activity	Role of partners	Method of monitoring	Comments
Identification of potential beneficiaries	➢ CHVS refer mothers from the villages to the health facilities to attend ANC and CWC clinics ➢ At this point, the CHV introduces OFSP to the mothers.	➢ Periodic spot checks are carried out in the villages at household level. ➢ This confirms whether the CHVs indeed the in the villages and the influence CHVs have in creating awareness on OFSP and encouraging mothers to attend clinics.	It is expected that more mothers will be visiting the health facilities for ANC and CWC clinics.
Registering of potential beneficiaries	➢ Identified ANC and CWC mothers (by CHV) are registered as potential beneficiaries at the health facility and issued with a voucher (coupon). This voucher will enable them get vines from a DVM	➢ Details of mothers in the coupons are counter checked with the details in the ANC and CWC clinic registers. ➢ This helps in ensuring only the target groups (ANC and CWC mothers) are issued with coupons	The coupon plays the follo 1. It is presented to a DVM by a mother (ANC or CWC) and vines given in return 2. It contains details that enables tracking of beneficiaries to household level 3. It is proof that vines have been supplied to a beneficiary; hence a basis for payment to the DVMs for vines supplied
Redeeming of coupons (picking vines from DVM)	➢ CHVs refer the clients to the nearest DVM to pick vines and also get some agronomic training concerning OFSP	➢ This is monitored though spot checks and reports from CHVs during feedback meetings	➢ **Data on the number of households receiving vines is obtained at this point.** • It is collected from the DVM in form of the number of coupons submitted by ANC and CWC

			mothers in exchange for vines
Nutrition education to beneficiaries	➢ CHVs carry out nutrition trainings to beneficiaries in the villages with support from the project.	➢ The trainings are monitored monthly using the training summary form filled by CHVs and a supervision checklist filled by the CHAs and nutritionists.	➢ CHAs and Nutritionists conduct monthly supervisions through attending some of the sessions being facilitated by CHVs. This has been put in place to check on quality of the trainings.

ROLES OF DIFFERENT ACTORS IN PROJECT IMPLEMENTATION



Use of Mobile devices for reporting

Open Data Kit (ODK) has been used on a pilot basis for reporting by agriculture extension officers and the CHAs

For the Agex, the pilot was a success. Up to 87% submission of reports on a monthly basis and 68% adherence to deadlines for report submission was achieved.

For the CHAs, 38% submission of reports was reported. This did not go well due to: inconsistency in carrying out feedback meetings and the reporting tool taking a lot of time to fill which contributed to the CHAs losing morale. Reporting on nutrition trainings will be done using ODK using a short and simplified reporting tool.

Major Challenges in ML&E

	Challenge	Comments
1	Poor filling of monitoring forms by partners resulting in omission of important information required for ML&E	Continuous training of partners gradually improves the quality of reports submitted.
2	Repetition of issues raised in reports and meetings despite a solution/way forward having been found	Widening the duration of reporting e.g. from monthly to quarterly ensures issues raised are unique and of value.
3	Partners reporting of activities not done especially trainings	Use of technology will reduce this. For example, using ODK to report with features like GPS coordinates and taking photos will give evidence of an activity done.

5.6. ANNEX 4: PARTICIPANTS LIST

Marketing, Processing, and Utilization Community of Practice Meeting
March 1-3, 2017
Kisumu - Kenya
Participants Details

	First Name	Last Name	Title	Position	Institution	Country	Telephone No.	Mobile No.	Skype	Email address
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The **Sweetpotato for Profit and Health Initiative (SPHI)** is a 10-year, multi-donor initiative that seeks to reduce child malnutrition and improve smallholder incomes through the effective production and expanded use of sweetpotato. It aims to build consumer awareness of sweetpotato's nutritional benefits, diversify its use, and increase market opportunities, especially in expanding urban markets of Sub-Saharan Africa. The SPHI is expected to improve the lives of 10 million households by 2020 in 17 target countries.

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