



Marketing, Processing and Utilization Community of Practice



Scaling up of marketing, processing and utilization of vitamin A-rich sweetpotato varieties
Proceedings of CoP meeting held in Qaribu, Inn Nairobi

20-21 May 2015

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ACRONYMS

| | |
|------------------|---|
| ADPs | Agricultural Development Programmes |
| AgDevCo | Africa Agricultural Development Company |
| ANC | Antenatal Clinic |
| ARDAP | Appropriate Rural Development Agriculture Program |
| BCR | Benefit-Cost Ratio |
| CHW | Community Health Worker |
| CIP | International Potato Center |
| CoP | Community of Practice |
| COVA | Nested Cohort Study |
| CREADIS | Community Research in Environment and Development Initiatives |
| CRS | Catholic Relief Services |
| DDBC | Developing & Delivering Biofortified Crops project. |
| DERN | Le programme de Développement Rural du Nord |
| DFID | Department for International Development |
| DVM | Decentralized Vine Multipliers |
| EU | European Union |
| FANTA | Food and Nutrition Technical Assistance |
| FEW | Field Extension Worker |
| FGD | Focus Group Discussion |
| FMARD | Federal Ministry of Agriculture and Rural Development |
| FRI | Farm Radio International |
| FUNAAB | Federal University of Agriculture, Abeokuta |
| GAIN | Global Alliance for Improved Nutrition |
| HCU | Health Child Uganda |
| HH | Household |
| HSDS | Health Services Delivery System |
| ICT | Information and Communication Technology |
| IEC | Information, Education and Communication |
| ILRI | International Livestock Research Institute |
| MINAGRI | Ministry of Agriculture |
| MIYCN | Maternal, Infant and Young Child Nutrition |
| MINISANTE | Ministry of Health |
| NaSRRI | National Semi-Arid Resources Research Institute |
| NFNP | National Food and Nutrition Policy |

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| NFNSP | National Food and Nutrition Strategic Plan |
| NGO | Non-governmental Organization |
| NRCRI | National Root Crops Research Institute |
| NRIF | National Resources Institute Fellowship |
| OFSP | Orange-fleshed sweetpotato |
| pVACs | Provitamin A carotenoids |
| RAB | Rwanda Agriculture Board |
| SASHA | Sweetpotato Action for Security and Health in Africa |
| SPHI | Sweetpotato for Profit and Health Initiative |
| UNICEF | United Nations Children’s Fund |
| USAID | United States Agency for International Development |
| VEDCO | Volunteer Efforts for Development Concern |
| VHT | Village Health Team |
| WHO | World Health Organization |
| YWCA | Young Women Christian Association |

Table of Contents

| | |
|---|----|
| ACRONYMS | 1 |
| EXTENDED EXECUTIVE SUMMARY | 8 |
| INTRODUCTION..... | 14 |
| 1. EXPECTATIONS FROM COP ON MARKETING, PROCESSING AND UTILIZATION AND POST-HARVEST RESEARCH IN SASHA PHASE 2 | 14 |
| 2. WHERE WE ARE, AND WHAT WE EXPECT TO ACHIEVE WITH ORANGE-FLESHED SWEETPOTATOES (OFSP) IN RWANDA: NUTRITION FOCUS | 16 |
| 2.1. Progress..... | 17 |
| 2.2. CIP's role in Rwanda OFSP landscape | 18 |
| 2.3. Expected achievements with OFSP | 19 |
| 2.4. Summary of question and answer session | 20 |
| 3. DISSEMINATING ORANGE-FLESHED SWEETPOTATOES THROUGH DISTRICT HEALTH SYSTEMS IN WESTERN UGANDA..... | 20 |
| 3.1. Prevalence of vitamin A deficiency in Uganda..... | 20 |
| 3.2. HarvestPlus Work..... | 20 |
| 3.3. Models used in the DDBC project | 21 |
| 3.4. The HSDS Model-Case Study HCU..... | 21 |
| 3.5. Summary of question and answer session | 23 |
| 4. EVALUATING THE EFFECTIVENESS OF A NUTRITION-SENSITIVE AGRICULTURAL INTERVENTION IN WESTERN KENYA: DESIGN AND PRELIMINARY FINDINGS OF THE MAMA SASHA PROJECT..... | 23 |
| 4.1. Evaluation strategy | 24 |
| 4.2. Project Reach | 25 |
| 4.3. Preliminary findings: Endline | 25 |
| 4.4. Preliminary Findings: Outcome..... | 28 |
| 4.5. Lessons learned from Mama SASHA project | 29 |
| 4.6. Summary of question and answer session | 29 |
| 5. UNDERSTANDING CONSUMER PREFERENCES AND ESTIMATING WILLINGNESS TO PAY FOR ORANGE-FLESHED SWEETPOTATO JUICE | 30 |
| 5.1. Objectives of the Rwanda Super Foods project..... | 31 |
| 5.2. Methodology..... | 31 |
| 5.3. Findings | 31 |
| 5.4. Summary of question and answer session | 32 |

| | | |
|-------|--|----|
| 6. | VITABREAD: CONSUMER AND BAKER PREFERENCES, ECONOMIC AND NUTRITION POTENTIALS | 32 |
| 6.1. | Economic sense of sweetpotato | 32 |
| 6.2. | Results and discussion | 35 |
| 6.3. | Challenges | 36 |
| 7. | SUSTAIN MOZAMBIQUE AND ZEBRA FARM INTEGRATE TWO VALUE CHAINS IN JUICE AND BISCUITS | 37 |
| 7.1. | Profitability of the products | 37 |
| 7.2. | Marketability of juice and biscuits | 38 |
| 7.3. | Summary of question and answer session | 38 |
| 8. | CAROTENOID RETENTION AND VITAMIN A ACTIVITY IN DRIED ORANGE-FLESHED SWEETPOTATO THAT IS COOKED, FRIED, OR STORED | 39 |
| 8.1. | Storage under controlled conditions | 39 |
| 8.2. | Food preparation study | 41 |
| 8.3. | Overall conclusions and recommendations | 41 |
| 8.4. | Summary of question and answer session | 41 |
| 9. | EFFECT OF DIFFERENT COOKING TREATMENTS AND AMYLASE ACTIVITY ON SUGARS AND SWEETNESS OF SWEETPOTATO ROOT | 42 |
| 9.1. | Problem statement and objectives | 42 |
| 9.2. | Results and discussion | 42 |
| 9.3. | Conclusion | 44 |
| 9.4. | Summary of question and answer session | 44 |
| 10. | ORANGE-FLESHED SWEETPOTATO PRODUCT DEVELOPMENT IN MALAWI | 44 |
| 10.1. | Background | 44 |
| 10.2. | Progress of OFSP product development by Universal Industries | 45 |
| 10.3. | Observations and challenges | 45 |
| 10.4. | Summary of questions and answers session | 45 |
| 11. | THE USE OF SWEETPOTATO RESIDUES AS FEED IN RURAL AND PERI-URBAN SMALLHOLDER PIG SYSTEMS IN UGANDA | 46 |
| 11.1. | Background | 46 |
| 11.2. | Constraints and opportunities of pig feeding in Uganda in smallholder Systems | 46 |
| 11.3. | Importance of sweetpotatoes in Uganda and Eastern Africa | 48 |
| 12. | CAN RADIO GET SWEETPOTATO MARKETS GOING? RADIO AND SWEETPOTATO PROMOTION | 49 |

| | | |
|-------|---|----|
| 12.1. | FRI's work with OFSP..... | 50 |
| 12.2. | Examples of ongoing partnerships..... | 50 |
| 12.3. | My children | 51 |
| 12.4. | Outcomes | 52 |
| 12.5. | Conclusions | 53 |
| 12.6. | Summary of question and answer session | 53 |
| 14. | DEVELOPMENT AND CHARACTERIZATION OF PEANUT BUTTER ENHANCED WITH OFSP | 54 |
| 14.1. | Background | 54 |
| 14.2. | Objectives of the study | 54 |
| 14.3. | Materials and Methods..... | 55 |
| 14.4. | Results and discussions | 56 |
| 14.5. | Conclusion and recommendations | 58 |
| 14.6. | Summary of question and answer session | 58 |
| 16. | STORAGE OF SWEETPOTATO ROOTS IN ZERO ENERGY COOL CHAMBER..... | 61 |
| 16.1. | Methodology..... | 62 |
| 16.2. | Results and findings | 62 |
| 16.3. | Conclusion and recommendations | 64 |
| 16.4. | Summary of question and answer session | 64 |
| 17. | RAINBOW PROJECT IN NIGERIA: PROGRESS ON TECHNICAL AND ADAPTIVE RESEARCH ON FRIED AND BAKED SWEETPOTATO-BASED PRODUCTS – | 65 |
| 17.1. | About RAINBOW Project..... | 65 |
| 17.2. | Value chains components | 65 |
| 17.3. | Identification of Enterprises..... | 65 |
| 17.4. | Nutritional Analysis of Existing Baked & Fried Products..... | 67 |
| 17.5. | Technical and adaptive Research..... | 67 |
| 18. | PANEL DISCUSSION: ECONOMICS VERSUS NUTRITION IMPACT OF SWEETPOTATO PROCESSING..... | 68 |
| 19. | SWEETPOTATO VALUE CHAINS IN WESTERN KENYA: CURRENT AND POTENTIAL | 69 |
| 19.1. | Background | 69 |
| 19.2. | Approach..... | 70 |
| 19.3. | Findings | 70 |
| 19.4. | Summary of question and answer session | 74 |
| 21.1. | Challenges faced | 78 |

| | | |
|-------|--|----|
| 21.2. | Current Initiatives Recommendations | 78 |
| 22. | FUTURE RESEARCH TOPICS: PLENARY DISCUSSION | 79 |
| 22.1. | Group 1: sweetpotato fresh root marketing and storage | 79 |
| 22.2. | Group 2: OFSP product development including puree storage | 80 |
| 22.3. | Group 3: Understanding the distribution of revenue along the value chain – including costing out product development and gender issues | 80 |
| 22.4. | Group 4: Note to breeders. What do we need to tell them about product linked characteristics? | 81 |
| 22.5. | Group 5: Integrating crops, livestock and nutrition can households improve their systems? | 81 |
| 23. | THE FUTURE OF THE CoP | 82 |
| 24. | Evaluation | 83 |
| 25. | ANNEXES | 85 |
| | Annex 1: Meeting evaluation results | 85 |
| | Annex 2: Meeting programme..... | 90 |
| | Annex 3: List of Abstracts..... | 92 |

LIST OF TABLES

| | | |
|-----------|---|----|
| Table 1: | Snapshot of households reached between December 2014 and April 2015..... | 19 |
| Table 2: | Endline: Finding 1..... | 26 |
| Table 3: | Summary of projected results from Zebra Farm / So Soja..... | 37 |
| Table 4: | LWG (g day ⁻¹) in local and crossbred pigs fed on concentrates, SP silage- and fresh local feeds-based diets ¹ | 48 |
| Table 5: | LWG, FCR and economic benefits in pigs fed on farmers' diets or sweetpotato silage-based diets + supplements in Sichuan | 48 |
| Table 6: | Potential listeners of <i>My Children</i> radio play in Uganda..... | 51 |
| Table 7: | Cost analysis of enhancing peanut butter with OFSP in Uganda | 55 |
| Table 8: | Sensory evaluation of freshly produced OFSP enhanced peanut butter | 56 |
| Figure 9: | Total soluble solids | 63 |
| Table 10: | Baked and fried goods produced by enterprises | 66 |
| Table 11: | Nutritional quality of existing baked and fried products | 67 |
| Table 12: | Varying supply seasons of fresh SP roots in Busia, Homa Bay, Migori, Siaya and Kericho | 70 |

LIST OF FIGURES

| | |
|---|----|
| Figure 1: Projects and programs disseminating sweetpotato in the SSA region | 15 |
| Figure 2: Extension System Model | 21 |
| Figure 3: The HSDS model | 21 |
| Figure 4: Mama SASHA Project: testing linking OFSP to health services for pregnant women for increased impact on nutrition in Western Kenya | 24 |
| Figure 5: Timeline for major implementation and research activities under Mama SASHA | 25 |
| Figure 6: Change in prevalence of underweight among children 6-23 mo of age from baseline to endline ¹ | 28 |
| Figure 7: Change in prevalence of stunting among children 6-23 mo of age from baseline to endline ¹ | 28 |
| Figure 8: Change in prevalence of VAD among children 6-23 mo of age from baseline to endline ¹ | 28 |
| Figure 9: Wheat flour importation | 33 |
| Figure 10: Method of Vitabread production | 34 |
| Figure 11: Bread consumption in Ghana based on regions and gender | 35 |
| Figure 12: Willingness of consumers to buy vitabread before (left) and after (right) being informed of the health benefits..... | 35 |
| Figure 13: Willingness of bakers to bake Vitabread before (left) and after (right) health advice | 36 |
| Figure 14: Storage under controlled conditions | 40 |
| Figure 15: Effect of temperature, aw and oxygen on storage of sweetpotato | 40 |
| Figure 16: Maltose content (%dwb) of raw, baked, steamed and microwaved sweetpotato roots | 42 |
| Figure 17: Sucrose content (%dwb) of raw, baked, steamed and microwaved sweetpotatoes | 43 |
| Figure 18: Sweetness levels (%) of raw and baked sweetpotato roots | 43 |
| Figure 19: Use of fodder sources in smallholder pig systems in Uganda, as a function of value chain domain .. | 47 |
| Figure 20: Relative availability of feeds along the year in smallholder | 47 |
| Figure 21: A business model promoted under Roots, Tubers and Bananas (RTB)-ENDURE, by ILRI, CIP and partners in Uganda | 49 |
| Figure 22: Changes in acid and peroxide values of peanut butter samples with storage time | 57 |
| Figure 23: Beta-carotene retention of OFSP enhanced peanut butter with storage time | 57 |
| Figure 24: How evaporative cooling works | 61 |
| Figure 25: Model of the storage structure in use in India | 62 |
| Figure 26: Appearance of sweetpotatoes in farmer storage and storage structure after 0 and 36 days | 63 |
| Figure 27: sweetpotato trader's expenditure and margin when trading prim sized sacks. | 72 |
| Figure 28: Comparison of gross margins/ Prim sack of sweetpotato roots along the value chain | 72 |
| Figure 29: Comparison of annual profits per sweetpotato value chain actor | 73 |
| Figure 30: Reasons for OFSP Product Preference | 75 |
| Figure 31: Flow chart of production - marketing continuum | 77 |
| Figure 32: Parts of the meeting that were found to be most useful | 84 |

EXTENDED EXECUTIVE SUMMARY

Background

The Marketing, Processing and Utilization Community of Practice (CoP) met on 20 and 21 May 2015 in Qaribu Inn in Nairobi, to discuss how to scale up marketing, processing and utilization of vitamin-A rich sweetpotato varieties.

The CoP brings together 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.

This CoP meeting was held under the umbrella of the Africa-wide Sweetpotato for Profit and Health Initiative (SPHI). SPHI is a 10-year initiative led by the International Potato Centre (CIP), and it is expected to improve the lives of 10 million households by 2020 in 17 target countries. Launched in 2009, the project had already reached over 1 million households by the end of December 2014. One of the key intervention areas is improving the sweetpotato value chain by researching and implementing actions that will remove bottlenecks related to processing, marketing and utilization of sweetpotato products. The overall objective continues to be to develop the essential capacities, products, and methods to reposition sweetpotato in food economies to alleviate poverty and under-nutrition in Africa.

Introduction and objectives

The meeting was officially opened by **Francis K. Amagloh** from the University of Development Studies in Ghana, who is the co-leader of the CoP. In his address, he urged participants to consider the fact that farmers would not grow any crop that they can eat only; but rather, they would grow crops that they could sell. With this in mind, he stated that it was the responsibility of the participants to dedicate themselves in exploring ways in which they could help to add value to the farmers' crops. He wished the participants successful and enriching deliberation.

Jan Low, the SPHI leader, presented the expectations from CoP on Marketing, Processing and Utilization and Post-Harvest research in SASHA Phase 2. She explained that in this project phase, a decision had been made to establish technically focused CoPs to increase focus in terms of topics and objectives. She called on participants to think of innovative ways to fast-track the achievement of the SPHI targets.

Summary of presentations

Where we are, and what we expect to achieve with orange-fleshed sweetpotatoes (OFSP) in Rwanda: Nutrition focus: **Robert Ackatia-Armah** outlined the progress made in improving the status of OFSP as a nutritionally strategic crop in Rwanda. He outlined the role that CIP was playing in coordinating nutrition activities and described ongoing project activities. The Scaling up OFSP nutrition through Scaling up Sweetpotato through Agriculture and Nutrition (SUSTAIN) project emphasizes on maternal nutrition during pregnancy and lactation and on complementary feeding as entry for OFSP in a diversified food system within households. He outlined successes of advocacy

efforts, such as the inclusion of OFSP as part of biofortification initiative in the National Food and Nutrition Policy (NFNP) and National Food and Nutrition Strategic Plan (NFNSP).

Disseminating OFSP through district health systems in western Uganda: **Angela Atero** presented HarvestPlus' Developing and Delivering Biofortified Crops (DDBC) project which aims to reduce VAD by improving dietary intakes of vitamin A for 225,000 households in 13 districts of Uganda by 2016. She outlined some of the commonly used models by HarvestPlus in disseminating biofortified crops i.e. (i) the Extension System Model and (ii) Health Services Delivery System (HSDS) model and explained the activities and outcomes of the HSDS model was implemented in three sub-counties (Ruganda, Ndejja and Mwizi) in Mbarara district.

Evaluating the effectiveness of a nutrition-sensitive agricultural intervention in western Kenya: design and preliminary findings of the mama SASHA project: **Fred Grant** made a presentation about a five-year study in Western Kenya (2009). The aim of the study was to establish whether linking OFSP access and nutritional training to existing health services could provide (a) an incentive to pregnant women to increase health service utilization; and (b) increases in consumption of OFSP and other vitamin A rich foods by the women and their young infants in a cost-effective manner. He outlined the lessons learnt in health, agriculture and nutrition, which in turn stimulated discussions about integration of agriculture and nutrition into public health service delivery systems.

Willingness to pay for orange-fleshed sweetpotato juice: **Temesgen Bocher** described a survey of 957 individuals undertaken by the Rwanda Superfoods Project. The *two stage Heckman Selection model* was used to identify factors affecting the willingness to pay; and the *multinomial logit model* was applied on both individual characteristics and juice attributes which influences the decision to choose a particular juice. The findings indicated that people were more willing to drink and pay for OFSP juice when they were informed about the nutritional attributes.

Vitabread: consumer and baker preferences, economic and nutrition potentials: **Francis Kweku Amagloh** presented results of a survey undertaken in four regions of Ghana: Greater Accra, Ashanti, Northern and Upper East and targeted both consumers and bakers. This involved: a Benefit-Cost Ratio analysis; a consumer preference evaluation using the 5-point Likert¹ scale with a panel of 100 undergraduate students and a β -carotene assay. Findings show that awareness about the health benefits of vitabread increased the willingness of consumers to pay for it and bakers to bake it. Francis reported that vitabread containing 45% OFSP puree was an excellent source of vitamin A. He recommended the use of nutritional education to encourage the adoption of OFSP products.

SUSTAIN Mozambique and Zebra Farm integrate two value chains in juice and biscuits: **Lucas Mujuju** introduced participants to two products under development by Zebra Farm/Só Soja, two enterprises producing and processing soybean and sweetpotato. The two products are OFSP juice and cookies made from OFSP and soybean pulp. The OFSP juice was subjected to hedonic tests using a 9-point Likert scale; and the products were subjected to willingness to pay tests and profitability assessment. Mujuju expressed moderate optimism that business will be profitable; however he recommended more nutrition quality tests. In addition he stated that more work needs to be done to improve the texture of the cookies and address the unpleasant aftertaste of the juice.

Carotenoid retention and vitamin A activity in dried OFSP that is cooked, fried or stored:

Aurelie Bechoff presented findings of two studies that were undertaken in Uganda. In the first one, Ugandan dried chips (Ejumula variety) were stored under four different conditions of temperature, water activity and oxygen. In the second one, chapatti processors and 10 porridge makers (households) were interviewed; and samples made by processors using the same initial ingredients were taken and analysed. The findings of the study showed that carotenoid degradation in dried sweetpotato could be predicted. Degradation was fast under ambient conditions (about 70% after 4 months). During food preparation, losses could be as high as 30%, but boiled sweetpotato, or porridge and chapattis made from freshly dried flour could provide a significant amount of pro-vitamin A to the diet. The method of preparation did not have an impact on the method of carotenoid retention.

Effect of different cooking treatments and amylase activity on sugars and sweetness of sweetpotato root: Eric Owusu presented a study whose objective was to determine the effect of three cooking methods (boiling, baking and micro-waving) and β -amylase activity on sugars and sweetness of sweetpotato varieties in Ghana. This study established that sugar contents and sweetness levels in sweetpotato roots are significantly dependent on cooking treatment, and amylase activity of the roots. The effect of baking treatment on sweetness was the most profound, and microwave treatment was minimal. He explained that this kind of analysis is important in selecting the right variety of roots depending on the purpose for which it is intended.

OFSP product development in Malawi: Jean Pankuku presented the progress made by Universal Industries Ltd. Malawi in developing some OFSP products such as OFSP puree, soft cookies, and crisps. Trials have been done with OFSP puree using different varieties and it has been determined that differences occur as a result of levels dry matter, fibrous material and moisture content. For the cookies, trials for substituting wheat flour with OFSP puree have been done successfully. With the use of puree, sugar and fat content in the biscuit is reduced. Nutritional analysis is underway. Pankuku outlined some challenges such as roots storage without loss of beta-carotene, seasonal variations in supply and price. The company still needs to establish economic viability before going to scale.

The use of sweetpotato residues as feed in rural and peri-urban smallholder pig systems in Uganda: Daniel Pezo explained that in Uganda, which has shown the highest growth in pig production in sub-Saharan Africa in the last 30 years sweetpotato vines are the most preferred fodder for pigs, followed by cassava leaves in rural areas and yam leaves in peri-urban settings. The findings from their work show that the use of sweetpotato silage as pig feed results in significant increases in live weight gain and a reduction in feeding costs by partial replacement of commercial concentrates; therefore it could contribute to improve the livelihoods of poor households that raise pigs and grow sweetpotatoes.

Can radio get sweetpotato markets going? Radio and sweetpotato promotion: Sheila Rao outlined for participants the work that Farm Radio International is doing to promote OFSP. The organization has supported HarvestPlus in Uganda, who want to reach 225,000 farming households in three regions and create demand for OFSP throughout the country through their *Developing and Delivering Biofortified Crops* initiative. A serialized radio drama, *My Children* features a heroine who decides to grow OFSP to feed her family. According to Rao, the outcomes are that farmers claim to have gained knowledge on the nutrition content of OFSP and its use, vitamin A and effects of VAD.

Development and characterization of peanut butter enhanced with OFSP: Joseph Mulindwa explained the work done to develop shelf stable acceptable pro-vitamin A enriched peanut butter. The study carried out chemical analysis of total pro-vitamin A carotenoid content; sensory evaluation using 50 semi-trained panelists and shelf stability analysis of acid value and peroxide value. The method used was able to produce an acceptable product. Beta carotene in OFSP enriched peanut butter increased with increased addition of OFSP. More research needs to be done to determine the quantities of peanut butter required to reach recommended daily vitamin A intake; effectiveness of OFSP enhanced peanut butter to change vitamin A status of individuals; and (iii) OFSP's potential to reduce the oxidation of oils and levels to use.

Storage of sweetpotato roots in zero energy cool chambers: Madjaliwa Nzamwita presented the research that has been going on to improve storage technologies in Rwanda. Two structures were tested for storage of different sweetpotato varieties: one was the farmer's house, while the other was the storage structure. Generally, the roots lost a lot of water in storage. Those in the storage structure lost less weight and rooted slower than those in farmer's house. It was concluded that the cool storage structure can increase the shelf-life of roots, but this also depends on the variety. Work should be done to increase the relative humidity inside the storage structure to minimize the rate of evaporation and to conduct chemical analyses on the roots (Starch, sugars, carotenoids, enzymatic activity etc.).

Rainbow project in Nigeria: progress on technical and adaptive research on fried and baked sweetpotato-based products: Ganiyat Olatunde highlighted the work done by the Rainbow Project to promote sweetpotato value chains. The project aimed to identify at least two enterprises interested in investing in baked and fried OFSP products; and to develop consumer acceptable baked and fried OFSP-based products and demonstrate its economic viability in addition to high pro-vitamin A potential amongst other nutrients. Five small-scale, semi-mechanized enterprises were selected to partner for product development/pilot study. Consumer studies were done on sweetpotato crisps, which was a pilot product. The studies involved 300 consumers from 3 locations. In conclusion, potential for baked and fried products to utilize sweetpotato was confirmed. There is potential for consumer acceptance of products, as well as potential for increased profit.

Sweetpotato value chains in western Kenya: current and potential: Tanya Stathers' presentation covered a study that investigated (i) sweetpotato root production, availability and service provision in the counties of Homa Bay, Migori, Siaya, Busia, and Kericho in Kenya; (ii) trade of fresh sweetpotato roots to major urban markets in Nairobi, Nakuru and Kisumu; (iii) existing and proposed OFSP processing; and (iv) potential for fresh sweetpotato root storage. Some findings are that sweetpotato (particularly the yellow and white fleshed varieties) is harvested virtually throughout the year. Large quantities of yellow-fleshed, red skinned sweetpotato roots are traded in urban areas, but there are limited amounts of OFSP, whose production is hampered by issues such as market, taste, cooking properties. There is some processing into flour and dry chippings in Busia and Kabondo. One finding of the storage facility capacity and cost analysis is that while the weekly cost to buy fresh roots in low supply season is higher than the weekly storage costs for both types of facility, the advantage disappears during high season.

OFSP Puree Processing in Kenya and building on the Mama SASHA experience: Penina Muoki focussed on the achievements made in delivering at least one commercially marketed

processed product that uses OFSP as a major ingredient in each target country. A survey was undertaken in four stores to determine consumer sensory acceptability and willingness to pay for OFSP-wheat flour baked products (bread, queen cake, buns and cookies). Overall preference of the four products was higher than corresponding control products. Substituting 50 percent of wheat flour for OFSP puree reduced the cost of producing bread and buns by approximately 13 percent. Penina presented the process through which a buying contract was signed between the puree processor and Tuskys Supermarket and the lessons learnt that (i) a collaborative approach helps to define roles clearly and avoid problems in the production-marketing continuum and (ii) a competitive approach to selecting a puree processor to work with helped to get buy-in from the investor.

Challenges faced in marketing porridge flour with OFSP as an ingredient: Jean Onyait stated that the introduction of OFSP flour has seen families start consuming sweetpotato flour for porridge. However, acceptability of OFSP porridge has faced a couple of challenges. Most or all consumers derive their interest towards consuming OFSP Porridge based on available nutritional information and the visual quality of packaging and branding. To improve acceptability, SOSPPA is conducting farmer mobilization, facilitating linkages and supply of fresh and processed commodities AND conducting awareness campaigns of sweetpotato value added products and trains farmer communities.

Panel Discussions




Two panel discussions were held. The first discussion was led by Akoto Osei. The panel discussants were: Robert Ackatia-Armah (Nutritionist), Kirimi Sindi (Agro-Economist), Jean Pankuku and Tawanda Muzhingi (Food Scientists). The discussion focused on challenges to scaling up of food and nutrition initiatives in Africa. Some of the points raised during the discussion include: the need to combine scientific and business skills; adoption of a problem-solving approach at industrial level; to innovate scale up of agricultural practices through irrigation and other methods; and bridge the gap between innovators, policy makers and other stakeholders.

In the second discussion, Tawanda Muzhingi (Food Scientist), Penina Muoki (Value Chain Specialist) and Antonio Magnaghi (Euro Ingredients) discussed the experiences in development of new products, and shared challenges faced by sweetpotato processors, such as hygiene and quality assurance, reliability of supplies and access to machinery. They also carried out a demonstration of puree making.

Future research topics: plenary discussion

Participants were put into five groups to discuss areas of interest for future research. These are summarized below:

Sweetpotato fresh root marketing and storage

-  What are the incentives for producing OFSP and for adhering to specific process needs in production, harvesting and marketing?
-  What are the appropriate, relevant policies that can be put in place?
-  What are communications needs that will help support?

OFSP product development including puree storage

- 📖 Baked products: need to make it more attractive and more nutritious by adding sesame seeds; consider dough improvement like enzymes
- 📖 Fried products: reduce amount of oil absorb by products – forms of processing
- 📖 Beverages: need to mix with the other juices and depends on the starch contents of the juice
- 📖 Puree: waiting on the current trials
- 📖 Need to consider OFSP spread with pea-nut butter but how do we call it?

Understanding the distribution of revenue along the value chain – including costing out product development and gender issues

- 📖 Documenting income and revenue distribution
- 📖 Link between increased income and nutrition
- 📖 Affordability of final product
- 📖 Willingness to pay for values generated
- 📖 Assessment of costs of setting up business
- 📖 Estimates of what savings at private sector and regional levels in country
- 📖 What are the income implications of scaling up production

Note to breeders. What do we need to tell them about product linked characteristics?

- 📖 Develop a catalogue of traits e.g. starch, sugar, moisture, dry matter content, amino acids, amylase activity, fiber and ability to retain beta carotene after heating for processing. This would help to decide which varieties are good for fried foods, puree, flour, starch as thickening component etc.
- 📖 The group also had a note to the breeders: They requested the breeders to consider the need to breed more for shape (oblong) and form (no bumps) and size (200-300 g) and how to better capture odor in breeding, since this seemed to be an issue especially with OFSP.

INTRODUCTION

The Marketing, Processing and Utilization Community of Practice (CoP) met on 20 and 21 May 2015 in Qaribu Inn in Nairobi, to discuss how to scale up marketing, processing and utilization of vitamin-A rich sweetpotato varieties.

The CoP brings together 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.

This CoP meeting was held under the umbrella of the Africa-wide Sweetpotato for Profit and Health Initiative (SPHI). SPHI is a 10-year initiative led by the International Potato Centre (CIP), and it is expected to improve the lives of 10 million households by 2020 in 17 target countries. Launched in 2009, the project had already reached over 1 million households by the end of December 2014. One of the key intervention areas is improving the sweetpotato value chain by researching and implementing actions that will remove bottlenecks related to processing, marketing and utilization of sweetpotato products. The overall objective continues to be to develop the essential capacities, products, and methods to reposition sweetpotato in food economies to alleviate poverty and under-nutrition in Africa. Speaking at the start of the event, Jan Low, the SPHI leader, called on participants to think of innovative ways to fast-track the achievement of the SPHI targets.

The meeting was officially opened by Francis K. Amagloh from the University of Development Studies in Ghana, who is the co-leader of the CoP. In his address, he urged participants to consider the fact that farmers would not grow any crop that they can eat only; but rather, they would grow crops that they could sell. With this in mind, he stated that it was the responsibility of the participants to dedicate themselves in exploring ways in which they could help to add value to the farmers' crops. He wished the participants successful and enriching deliberation.

1. EXPECTATIONS FROM COP ON MARKETING, PROCESSING AND UTILIZATION AND POST-HARVEST RESEARCH IN SASHA PHASE 2

JAN LOW, International Potato Center (CIP)

In phase one of Sweetpotato Action for Security and Health in Africa (SASHA), there was a lot of focus on releasing varieties that were adapted to the specific conditions in Africa. There was a lot of breeding and germplasm exchange, with the following outcomes: 46 new varieties were released, 37 of which are orange-fleshed sweetpotato (OFSP). In addition, a CoP for breeders – the Sweetpotato Speed Breeders – was established. The Speed Breeders held regional level annual meetings and in Mozambique, Ghana and Uganda, resident breeders provided sub-regional backstopping. At sub-regional level, bi-annual meetings were held on varied topics.

The focus of this component of the SASHA 2 is on breeding a wide range of varieties with the combinations of traits suited to agro-ecological conditions and to consumer and producer demands. The point is to create an integrated breeding system akin to the one that exists for cereal breeding, but focused on the producer and consumer preferences of resource-poor women and children.

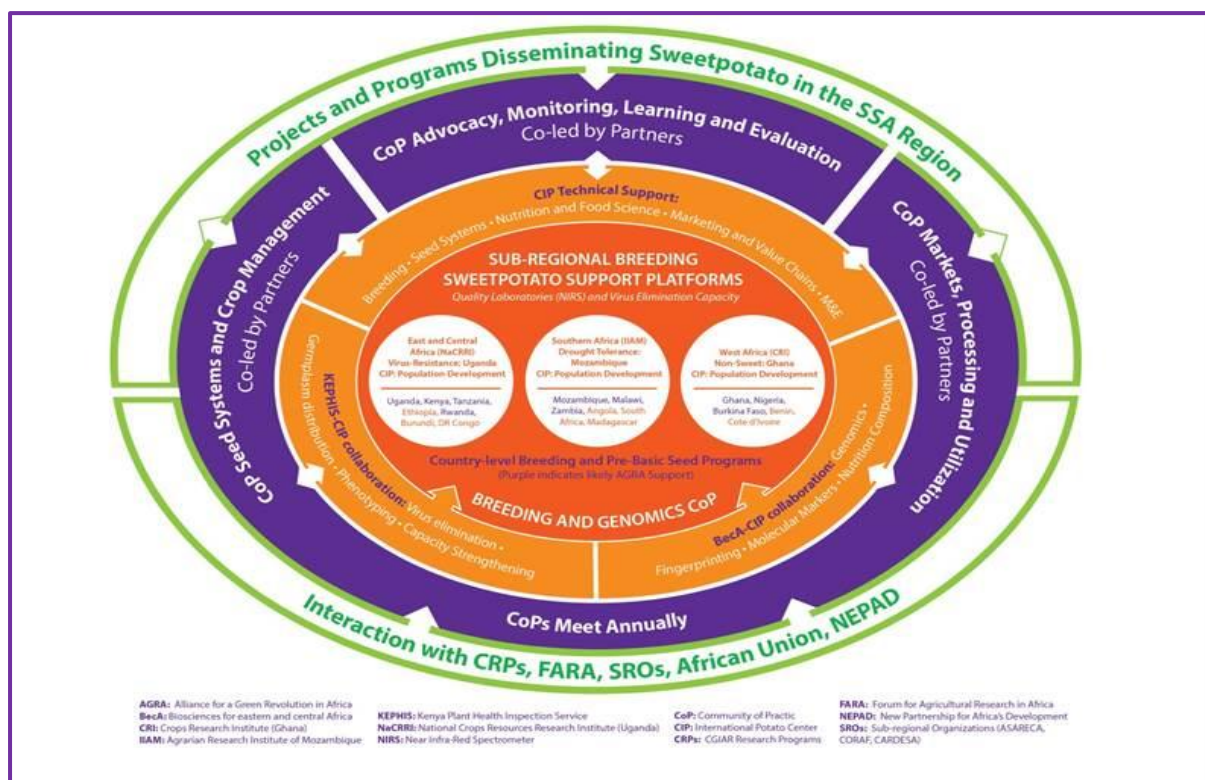
This component draws on biotechnology to develop weevil-resistant sweetpotato varieties for Sub-Saharan Africa. Sweetpotato weevils are the most important sweetpotato pest in the world – responsible for crop losses ranging from 60 to nearly 100% during pronounced drought.



Children enjoy a meal of vitamin A rich OFSP

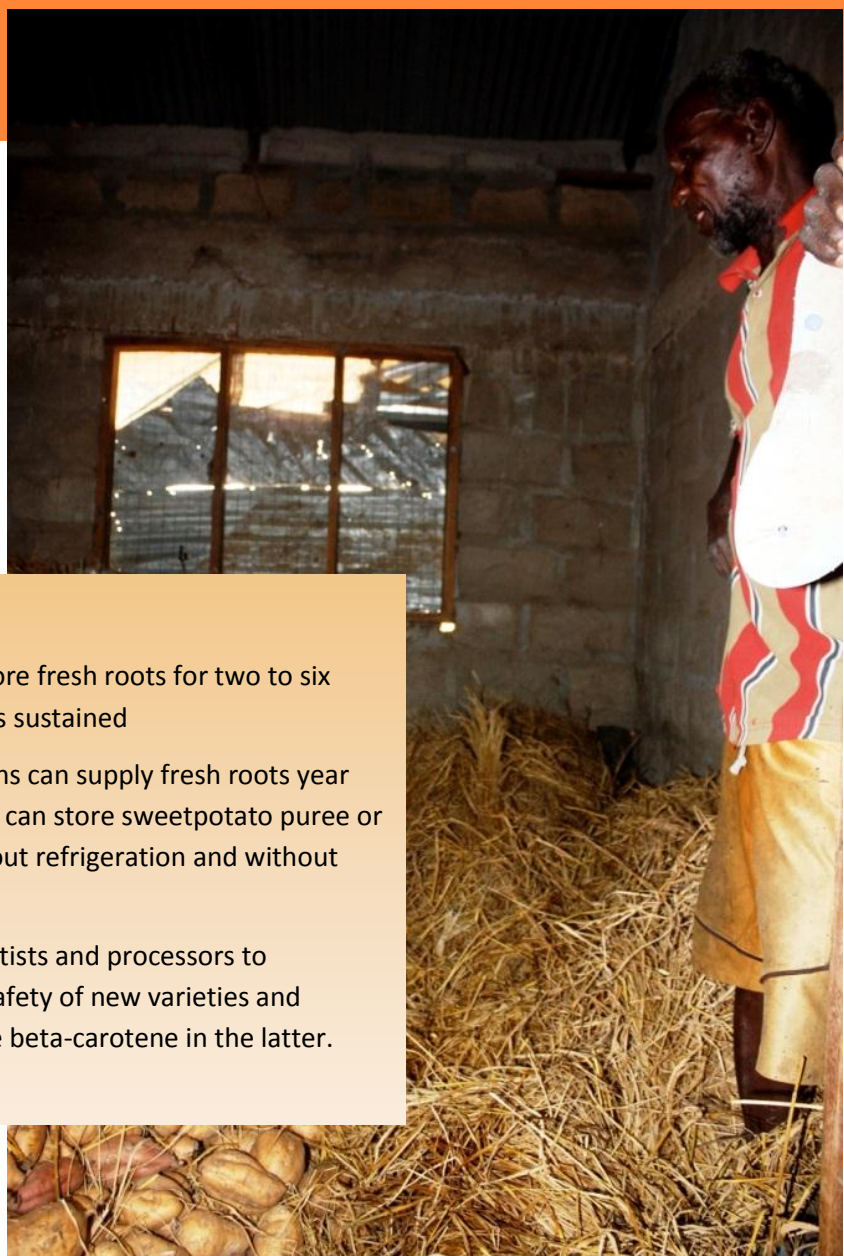
At the end of phase 1, a survey was done, and many felt that the support platforms were not focused enough in terms of topics and objectives. It was observed that the breeders were making more progress because the same people were meeting regularly over a period of time. This led to the decision of moving from support platforms at sub-regional level to establishing technically focused CoP groups.

Figure 1: Projects and programs disseminating sweetpotato in the SSA region



The CoPs will decide how they want to carry out online discussions, which supplement the face to face discussions.

The CoP will be focused on constraints that research can address in SASHA 2.



Vision of Success:

1. Rural households can cost-effectively store fresh roots for two to six months with key nutritional quality traits sustained
2. Commercially oriented farm organizations can supply fresh roots year round and sweetpotato agro-processors can store sweetpotato puree or concentrate for four to six months without refrigeration and without quality loss.
3. Regional capacity exists to support scientists and processors to determine the nutritional content and safety of new varieties and products, and the bio-accessibility of the beta-carotene in the latter.

2. WHERE WE ARE, AND WHAT WE EXPECT TO ACHIEVE WITH ORANGE-FLESHED SWEETPOTATOES (OFSP) IN RWANDA: NUTRITION FOCUS

ROBERT ACKATIA-ARMAH, CIP

Sweetpotato is widely consumed in Rwanda as a major household crop. It is mainly relied on as a food security crop and popularly called “local defence” for its resilience. Regardless of this, sweetpotato is not considered an important national food security crop or major income crop. It was not included in any of the last government policies on nutrition or food security.

OFSP has been introduced, bred and released by national research station through the Rwanda Agricultural Board (RAB) - mainly with support of CIP/SASHA projects.

2.1. Progress

Through new scaling up efforts by CIP projects such as SUSTAIN, OFSP is beginning to gain popularity and coverage. Through awareness creation of the benefits of OFSP, adoption and use are gradually increasing. Rwandan households, local government, and policy makers are recognizing the important contribution OFSP can make to fighting malnutrition and increasing income.



OFSP now considered as part of biofortification initiative in the National Food and Nutrition Policy (NFNP) and National Food and Nutrition Strategic Plan (NFNSP) coordinated by the Social Cluster Ministries. OFSP now considered as part of biofortification initiative in the NFNP of the (Ministry of Health) MINISANTE and NFNSP plan of the Ministry of Agriculture (MINAGRI).

Use of biofortified crops: “Rwanda has moved forward with research and trials of biofortified agricultural crops including biofortified beans. The bean varieties have been shown to be acceptable to farmers, have substantially higher yields and high levels of iron. Broad sales of these beans in Rwanda began in 2013 and other biofortified crops are also being promoted including varieties of cassava and **sweetpotatoes**”. p13

Interventions to support improved availability, affordability and quality of nutritious food: “including extension and input support to producers of bio-fortified bean and maize seeds and **sweetpotato vines** as well as communication campaigns to promote planting and consuming of bio-fortified foods, the benefits of milk consumption for children”. p28

Agricultural and dietary diversity

“The most important commodities for consumption are **sweetpotatoes**, cooking bananas, beans, maize, cassava and Irish potatoes”

To better address micronutrient deficiencies, the work required include relatively diverse strategies that will be carried out simultaneously and range from fortification of staple foods and commonly used condiments (oil, wheat flour, rice salt,) and targeted supplementation (vitamin A, Iron and Folic Acid) to in-home fortification of complementary foods with multiple micronutrients powders, and promotion of biofortified beans, **sweetpotatoes**, cassava and other

The Social Cluster Ministries include Ministry of Health (MINISANTE) Ministry of Agriculture and Livestock Resources (MINAGRI), Ministry of Gender and Family Promotion (MIGEPROF), Ministry of Infrastructure (MININFRA), Ministry of Public Service and Labor MINFOTRA

crops. (SOURCES: **Rwanda National Food and Nutrition Policy National Food and Nutrition Strategic Plan; Draft Nutrition Action Plan 2013 – 2018**)

Several international and local Non-governmental Organizations (NGOs) are beginning to add OFSP to their programs. These include: CARITAS, Catholic Relief Services (CRS), Concern Worldwide, FHI 360, World Relief Rwanda, Partners in Health, World Vision, One Acre Fund, Imbaraga, Young Women Christina Association (YWCA), Le programme de Développement Rural du Nord DERN etc.

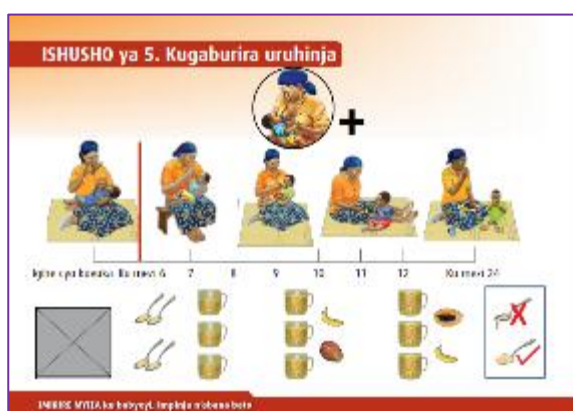
2.2. CIP's role in Rwanda OFSP landscape

SASHA served as a good basis/baseline for introduction of OFSP in Rwanda. CIP together with RAB is acting as a coordinator for all OFSP produced, brought in and distributed in country. This includes establishing partnerships with major donors such as United Nations Children's Fund (UNICEF), United States Agency for International Development (USAID), Department for International Development (DFID) and European Union (EU) to fund /coordinate funded activities related to OFSP. CIP is contributing to fight micronutrients malnutrition, particularly, vitamin A. This effort includes supporting NFPN activities through training of community health workers and multiplication and distribution of clean sweetpotato planting material (vine cutting) to implementing partners, and training of decentralized vine multipliers (DVM).

1.1.1.1 CIP's current activities

1. Scaling up OFSP nutrition through Scaling up Sweetpotato through Agriculture and Nutrition (SUSTAIN) project: The focus of this project is on Maternal, Infant and Young Child Nutrition (MIYCN) and Scaling Up Nutrition (SUN) activities related to first 1000 days. Emphasis is on maternal nutrition during pregnancy and lactation and on complementary feeding as entry for OFSP in a diversified food system within households. This includes:

- Feeding frequency and consistency/energy density
- Dietary diversification (link to national kitchen gardens policy)
- Cooking demonstrations



Information and education products produced as part of the MIYCN activities

2. Training key national, partner and NGO staff on basic MIYCN and for consistency of nutrition messages related to OFSP.
3. Provision of nutrition messaging materials during vine distribution/dissemination.

4. Supporting farmer cooperatives and private sector to improve nutritional quality of processed foods already on market by including OFSP puree through:
 - Provision of technical support in the areas of processing of OFSP roots into puree as ingredient for baked products in ensuring improved nutrition and income,
 - In future will provide nutritional analysis of all products support through or in partnership with CIP,
 - Managing consumer acceptance of OFSP roots and health concerns about OFSP processed products.

Table 1: Snapshot of households reached between December 2014 and April 2015

| DISTRICT | NUMBER OF HH REACHED | TOTAL VINES | DISTRICT | NUMBER OF HH REACHED | TOTAL VINES |
|-----------------------------|----------------------|------------------|---------------------------|----------------------|------------------|
| SUSTAIN AND PARTNERS | | | CARITAS | | |
| MUHANGA | 3,528 | 529,200 | MUHANGA | 681 | 266,801 |
| GAKENKE | 3,004 | 432,600 | KAMONYI | 690 | 254,187 |
| KAMONYI | 817 | 112,550 | NYAMAGABE | 680 | 257,187 |
| RUHANGO | 701 | 105,150 | NYARUGURU | 1,259 | 254,187 |
| RULINDO | 1,030 | 154,500 | RUHANGO | 683 | 258,354 |
| KAYONZA | 1,906 | 350,100 | SUB-TOTAL | 3,993 | 1,290,703 |
| GICUMBI | 1,502 | 225,300 | WORLD VISION | - | 400,000 |
| RWAMAGANA | 436 | 65,400 | GARDENS FOR HEALTH | 1,600 | 200,000 |
| TOTAL | 9,315 | 1,533,750 | TOTAL | 9586 | 3,181,419 |

In addition to the table above, 10 health promoters and 35 community health workers have been trained.

2.3. Expected achievements with OFSP

Building up on the progress made in Rwanda, the following achievements are expected:

- Increased adoption and consumption as “local defence” image improves based on its contributions to nutrition and income
- Government and NGO promote OFSP as a major bioavailable sustainable source of vitamin A as much as they promote ‘iron beans’ for iron
- OFSP as a major complementary base food based on attributes

- Improved OFSP and general nutrition knowledge of community health staff, pregnant and lactating mothers and households with children under 5
- Increase in minimum meal frequency and minimal acceptable diet in project areas based on capacity building of frontline workers and partner staff

2.4. Summary of question and answer session

The questions raised by the participants to the presenter, and the subsequent responses to these questions, can be categorized under the following broad categories:

Accurate labeling: The first issue raised was related to the accuracy of labeling, especially considering that there is still no unified agreement on the definition of biofortification. In the case of Rwanda, the labeling is in the hands of the private sector. CIP Rwanda has facilitated good analysis of nutritional content – by using universities such as Jomo Kenyatta University (JKUAT), Makerere and a university in the UK. The guidelines used are the United States Food and Drug Administration (FDA) guidelines, which state that if a product provides 20% source of daily vitamin A requirement, it is an excellent source and if it provides 10%, then it is a good source. The information contained on the packaging right now states that the product is made from OFSP which is rich in vitamin A. The labels also provide information on the benefits of vitamin A.

3. DISSEMINATING ORANGE-FLESHED SWEETPOTATOES THROUGH DISTRICT HEALTH SYSTEMS IN WESTERN UGANDA

ANGELA ATERO - HARVESTPLUS

3.1. Prevalence of vitamin A deficiency in Uganda

The most common malnutrition problems in Uganda are deficiencies of vitamin A and iron).² About 33 percent of children (6-59 months old) in Uganda are categorized as having vitamin A deficiency (VAD).³ In 2005 UNICEF estimated the deaths at 29,000 and the percentage of children less than 6 years of age with sub-clinical VAD to be 66%.⁴

3.2. HarvestPlus Work

HarvestPlus leads a global effort of public and private sector partners to improve nutrition and public health by developing and disseminating staple food crops that are rich in vitamins and minerals.

The objective of the (Developing and Delivering Biofortified Crops project (DDBC) project is to reduce VAD by improving dietary intakes of



² FANTA (2010). The Analysis of the Nutrition Situation in Uganda. Food and Nutrition Technical Assistance II Project (FANTA-2), Washington, DC: AED Pg. 4-62 <http://www.fantaproject.org/wordpress/wp-content/uploads/2010/11/FANTA-2-Analysis-of-the-Nutrition-Situation-in-Uganda.pdf> (15 November 2011)

³ Uganda Bureau of Statistics (UBOS) and Macro International Inc., 2011. Uganda Demographic and Health Survey 2011. <http://dhsprogram.com/pubs/pdf/FR264/FR264.pdf>

⁴ UNICEF., 2005. A partnership drive to end hidden hunger in Sub Saharan Africa. <http://www.micronutrient.org/vmd/countryfiles/subsaharan> (6 December 2007).

vitamin A for 225,000 households in 13 districts of Uganda by 2016.

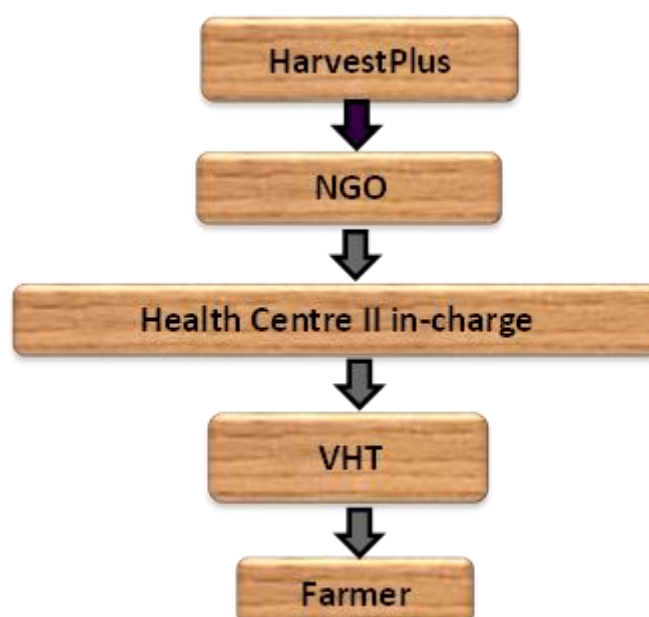
3.3. Models used in the DDBC project

Some of the commonly used models by HarvestPlus in disseminating biofortified crops are (i) the Extension System Model and (ii) Health Services Delivery System (HSDS) model.

Figure 2: Extension System Model



Figure 3: The HSDS model



In the HSDS model, HarvestPlus provides guidance to the NGO who in turn trains health centre staff. The Health Centre II In-charge trains the Village Health Teams (VHTs), plants and maintains the OFSP garden at health centre. The VHT monitors and helps 30 households in their catchment areas.

3.4. The HSDS Model-Case Study HCU

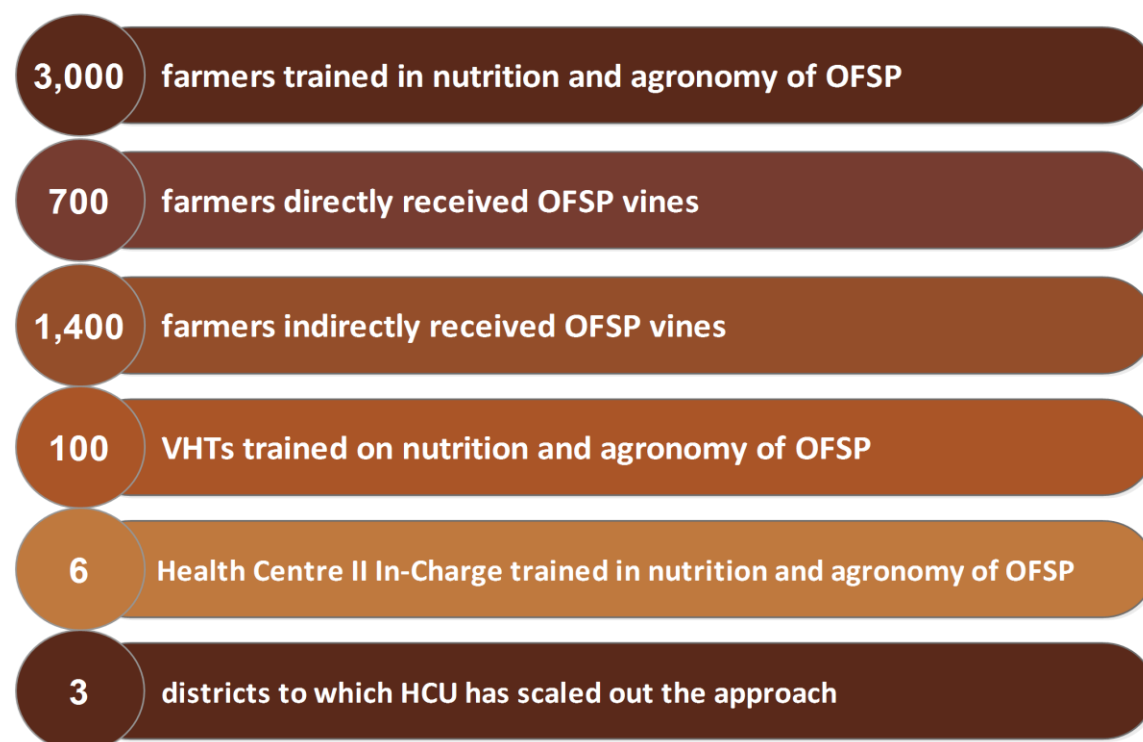


Three sub-counties (Ruganda, Ndejja and Mwizi) in Mbarara district were selected from which six parishes were selected. In each Parish, one health centre II was included in the project and 100 VHTs selected at village level. Seven households out of 30 per VHT were selected and received free OSP vines.

Nutrition and agronomy training charts provided to VHTs. Demonstration gardens at health centres were established to provide planting material. During immunization days, the health centre supervisors passed on

nutrition and agronomic messages to the mothers.

3.4.1. Achievements of the HSDS Model



3.4.2. Why the HSDS Model?

VHTs are well informed on issues of health and nutrition. They are farmers who command respect in their communities. Because of their support for one another, the turn up trainings was high and payback of vines by farmers was almost 100 percent. The work of HarvestPlus/HCU was known up to district level. The model promotes sustainability of project benefits e.g. through OFSP gardens at Health Centre II.

3.4.3. Challenges of Using the HSDS Model

- Lack of commitment from some VHTs
- Heavy workload on VHTs
- Health Centre II In-Charge nurses and VHTs poorly facilitated to do their work
- Biased towards health
- Motivating VHTs is difficult

3.4.4. Improvements to the HSDS Model

- HCU has recruited a [Field Extension Worker \(FEW\)](#)
- Farmers organise the selves into groups of about 30 farmers including VHTs
- Close follow-up and monitoring visits by FEW
- New areas per season
- Marketing of OSP for income generation
- Community dramas

In conclusion, HarvestPlus has had to adopt different models for better delivery of its strategy.

3.5. Summary of question and answer session

One participant wanted to know to what extent women and men were being jointly integrated into both nutritional and agronomic training interventions. This question was posed in view of the fact that in Uganda, and in other parts of Africa, women made decisions about health and nutrition but men still controlled land ownership and use. In her response, the presenter explained that the HSDC project had tried to integrate women in agronomic practices. They had introduced the lead mother project, in which one woman was selected and she moved from household to household to train women, because it was easier than getting permission for these women to attend trainings. The tendency was that during such visits, men would hang around to find out what was being discussed by women, and a survey that had been undertaken showed that men's support was increasing because of the information they got during these visits.

4. EVALUATING THE EFFECTIVENESS OF A NUTRITION-SENSITIVE AGRICULTURAL INTERVENTION IN WESTERN KENYA: DESIGN AND PRELIMINARY FINDINGS OF THE MAMA SASHA PROJECT

DR. FRED K. GRANT - CIP

Dr. Fred Grant made a presentation about a five-year study in Western Kenya (2009). The aim of the study was to establish whether linking OFSP access and nutritional training to existing health services could provide:

- an incentive to pregnant women to increase health service utilization
- increases in consumption of OFSP and other vitamin A rich foods by the women and their young infants in a cost-effective manner

The study was undertaken by CIP in collaboration with PATH (International Health NGO), University of Toronto, Emory University, Community Research in Environment and Development Initiatives (CREADIS) and Appropriate Rural Development Agriculture Program (ARDAP) – two local agricultural NGOs; as well as the Ministries of Agriculture and Health.

The OFSP is a nutrition super food. It is very rich in pro-vitamin A, and one small root (100 g) meets the daily vitamin A needs of a young child. It also has good levels of vitamins C, E, K, several B vitamins, manganese, potassium & dietary fiber.

Figure 4: Mama SASHA Project: testing linking OFSP to health services for pregnant women for increased impact on nutrition in Western Kenya

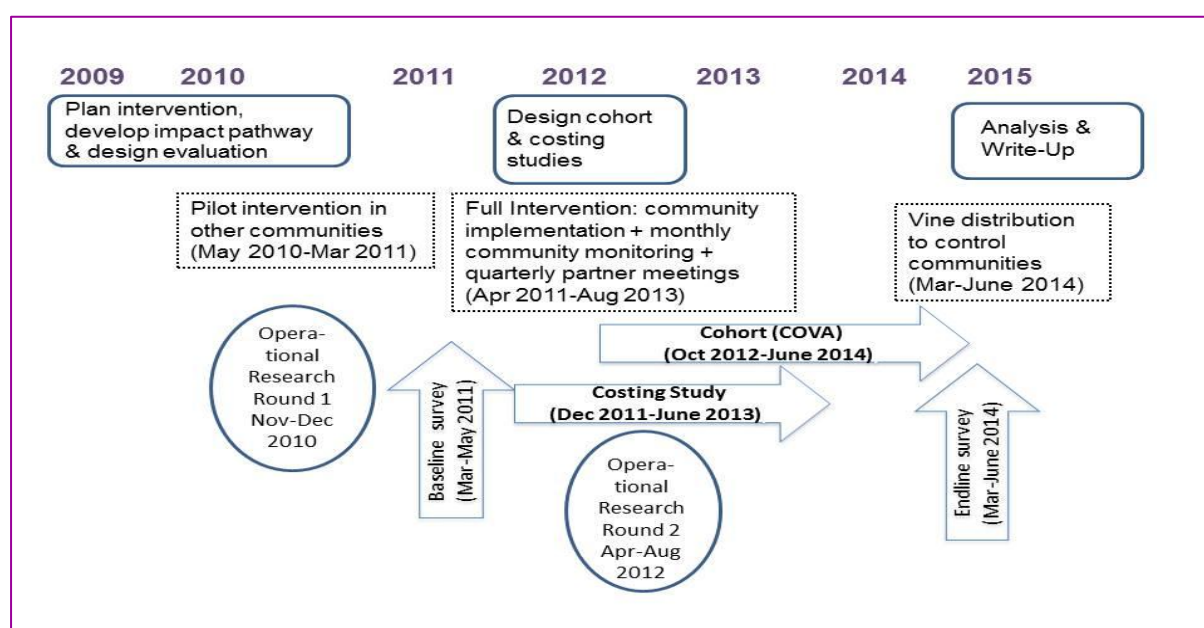


4.1. Evaluation strategy

The evaluation strategy comprised the following components:

1. A cluster randomized at facility level: 4 intervention and 4 comparison facilities across Bungoma and Busia counties
2. Cross sectional baseline and endline surveys (n>2000 / round): The objective was to assess population level impact on child nutrition. Two-stage cluster randomized surveys were carried out in catchment areas of intervention and control facilities between March and May 2011; and between March and May 2014.
3. Detailed costing data for cost-effectiveness analysis
4. Nested Cohort Study (COVA): This study assessed individual level impacts on maternal and child nutrition. It comprised a longitudinal study of 505 women enrolled in pregnancy and followed to 9 months postpartum, from November 2012 until July 2014.

Figure 5: Timeline for major implementation and research activities under Mama SASHA



4.2. Project Reach

The following was achieved during implementation from March 2011 to August 2013:



- 14 DVMs established at 4 intervention sites
- Over 4,600 women reached
- 7,159 voucher pairs issued
- 4,464 redeemed (63%); 3,281 of recipients were women
- Community Health Workers (CHWs) established and run 215 PMCs/LMCs - 2,764 members; 25,141 attendances; 784 mothers participated monthly and 254 newly recruited women monthly

4.3. Preliminary findings: Endline

Finding 1: Production of, and frequency of intake of OFSP and dietary vitamin A were significantly greater among intervention and full participation groups at endline.

Table 2: Endline: Finding 1

| | Catchment Areas at Endline | | | Extent of Participation in Intervention Areas | | | |
|---|----------------------------|-----------|---------|---|-----------|-----------|---------|
| | Intervention | Control | p-value | None | Partial | Full | p-value |
| Sample size | 1164 | 1109 | | 524 | 393 | 220 | |
| Percent growing OFSP | 49.5% | 3.7% | 0.0000 | 22.4% | 66.4% | 91.7% | 0.0000 |
| Frequency of Intake of OFSP (days/week) during hunger period; Mean (SD) | 0.8 (1.5) | 0.1 (0.8) | <0.0001 | 0.4 (1.1) | 1.0 (1.5) | 1.9 (2.0) | <.0001 |
| Frequency of Intake of OFSP (≥3days/week) during hunger period; % | 14.3% | 2.3% | <0.0001 | 6.5% | 16.2% | 33.8% | <.0001 |
| Frequency of Vitamin A Intake Score; Mean (SD) | 2.4 (2.2) | 2.3 (2.0) | 0.1185 | 2.3 (2.1) | 2.3 (2.0) | 3.0 (2.6) | <.0001 |
| Frequency of Vitamin A Intake Score, % >6 (adequate consumption); | 7.1% | 5.1% | 0.0400 | 6.5% | 5.1% | 11.6% | .0080 |

Source: Mama SASHA project, 2014

Finding 2: Percent Household (HH) consuming OFSP; maternal nutrition, health and childcare knowledge and early Antenatal Clinic (ANC) attendance were significantly higher in the intervention and full participating groups at endline.

| | Catchment Areas at Endline | | | Extent of Participation in Intervention Areas | | | |
|---|----------------------------|------------|---------|---|------------|------------|---------|
| | Intervention | Control | p-value | None | Partial | Full | p-value |
| Sample size | 1164 | 1109 | | 524 | 393 | 220 | |
| Nutritional Knowledge Score (max = 24); Mean (SD) | 10.0 (3.5) | 9.6 (3.3) | 0.04 | 9.7 (3.4) | 10.1 (3.3) | 11.1 (3.9) | 0.027 |
| Knowledge of Current Child Care Practices (max= 25); Mean (SD) | 15.5 (3.4) | 14.9 (3.3) | <0.0001 | 14.6 (3.6) | 15.8 (3.0) | 17.1 (3.1) | <0.0001 |
| Attitude Score (max= 20); Mean (SD) | 13.3 (3.2) | 13.0 (3.3) | 0.056 | 13.0 (3.1) | 13.1 (3.4) | 14.2 (2.9) | <0.0001 |
| For previous pregnancy: Number of times received ante-natal care; Mean (SD) | 4.5 (1.6) | 4.4 (1.7) | 0.211 | 4.2 (1.7) | 4.6 (1.6) | 4.7 (1.6) | 0.0002 |
| For previous pregnancy: Months pregnant at time of 1st visit; Mean (SD) | 3.8 (1.6) | 4.0 (1.5) | 0.005 | 4.0 (1.6) | 3.9 (1.5) | 3.4 (1.4) | <0.0001 |

Source: Mama SASHA project, 2014

Finding 3: There were significant differences indicating better status for children in intervention than in control areas for stunting and underweight, however these were not confirmed by extent of participation figures in the intervention.

| | Catchment Areas at Endline | | | Extent of Participation in Intervention Areas | | | |
|---|----------------------------|-----------------|---------|---|-----------------|-----------------|---------|
| | Intervention | Control | p-value | None | Partial | Full | p-value |
| Sample size | 1160 | 1105 | | 515 | 405 | 233 | |
| Stunting (Height for Age (HAZ)), Mean (SD) | -0.77 (1.44) | -0.96 (1.50) | 0.002 | -0.74 (1.47) | -0.79 (1.42) | -0.78 (1.40) | 0.86 |
| Stunting (<-2 HAZ), % | 18.3% | 24.1% | 0.0008 | 18.4% | 19.3% | 15.0% | 0.38 |
| Underweight (Weight for age (WAZ)), Mean (SD) | -0.28 (1.20) | -0.43 (1.21) | 0.004 | 0.19 (1.06) | 0.24 (1.07) | 0.20 (1.11) | 0.85 |
| Underweight (<-2 WAZ) % | 7.1% | 10.3% | 0.0070 | 7.8% | 6.4% | 6.9% | 0.71 |

Source: Mama SASHA project, 2014

Finding 4: The prevalence of inflammation adjusted Vitamin A (i.e. RBP <0.83umol/L) was significantly lower in intervention & participating groups at endline.

| | Catchment Areas at Endline | | | Extent of Participation in Intervention Areas | | | |
|-----------------------------|----------------------------|----------------------|---------|---|----------------------|----------------------|---------|
| | Intervention | Control | p-value | None | Partial | Full | p-value |
| Sample size | 926 | 874 | | 417 | 318 | 191 | |
| RRB, Mean, (95% CI) | 1.58 (1.53, 1.62) | 1.59 (1.54, 1.64) | 0.72 | 1.48 (0.94, 2.09) | 1.63 (1.15, 2.29) | 1.70 (1.21, 2.36) | 0.001 |
| VAD (RBP <0.825 µmol/L), %* | 18.8 | 23.7 | 0.013 | 23.0 | 14.8 | 16.2 | 0.012 |

*RBP <0.825 µmol/L which is biologically equivalent to 0.7 µmol/L of retinol; values have been adjusted for the influence of subclinical inflammation (CRP > 5mg/L).

Values available for VAD were: Intervention (n=926) and control (874).

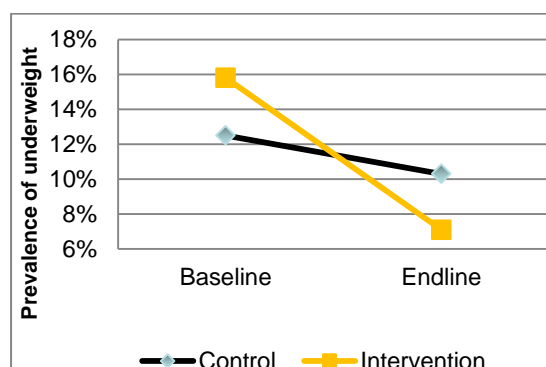
Values available for C-reactive protein (CRP) were: Intervention (n=1135) and control (1077).

DBS analyzed for RBP at Kenya Medical Research Institute (KEMRI)/CDC, Kisumu, Kenya. Quality control done at CSDE Biodemography Lab, University of Washington, Seattle, WA.

Source: Mama SASHA project, 2014

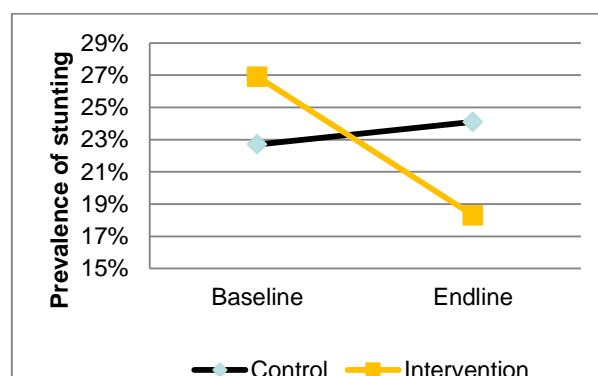
4.4. Preliminary Findings: Outcome

Figure 6: Change in prevalence of underweight among children 6-23 mo of age from baseline to endline¹



Impact estimate = -6.5%**

Figure 7: Change in prevalence of stunting among children 6-23 mo of age from baseline to endline¹

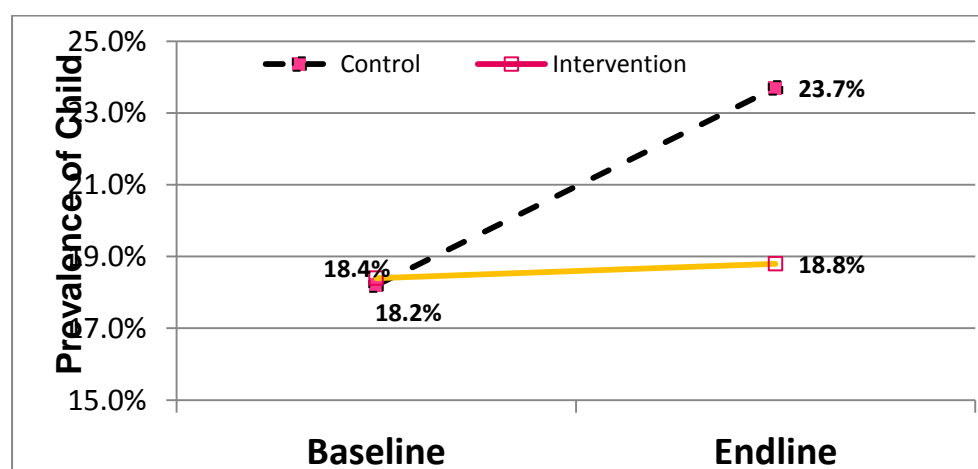


Impact estimate = -10%**

¹Difference-in-difference (DID) impact estimates between control & intervention groups controlled for child sex, clustering. Data from baseline and endline surveys ** p<0.05 for DID estimates.

Source: Mama SASHA project, 2014

Figure 8: Change in prevalence of VAD among children 6-23 mo of age from baseline to endline¹



Impact estimate = -5.1%**

¹Difference-in-difference (DID) impact estimates between control & intervention groups controlled for child sex, clustering. Data from baseline and endline surveys ** p=0.04 for DID estimates.

Source: Mama SASHA project, 2014

Cohort study (early pregnancy till 9 mo postpartum): Intakes of vitamin A significantly higher among both mothers and children in the intervention group at 8-10 months postpartum; Differences in vitamin A intakes were attributed to OFSP consumption.

Cost analysis (financial costs of integrated Mama SASHA project): Over 5,400 women participated in monthly pregnant mother clubs at a cost of USD 63 per woman. There were 18,730 contact points

(in 3 years) at a cost of USD 30 per contact. Of 4,629 women who received vouchers, 3,281 women redeemed vouchers and planted OFSP at a cost of USD 110 for woman and her infant.

Cost-effectiveness (Mama SASHA was cost effective): USD 1882/DALY⁵ averted < WHO Threshold of 3 X GDP of country (USD 994 for Kenya).

4.5. Lessons learned from Mama SASHA project

Agriculture: First, it is essential to select high yielding varieties that produce as well as local ones and that taste good for planting. Secondly, one must assure access to quality planting material, which in drought prone areas could be a challenge requiring the adoption of new technologies like Triple S. Third, efforts must be made to improve knowledge of diseases and pests management among farmers.

Investment in nutrition: Investment in community-level nutrition education should include repetition of consistent messages alongside demonstrations in group based sessions for a year to be sufficient for OFSP uptake and incorporation into the young child diet. Men often control land access and influence diet choices. They should not be excluded from nutritional interventions. Extension personnel need to have quality job aids to perform their jobs well. By using existing farmers and social groups as an entry point, there are opportunities to save costs.

Lessons on integrating agriculture and nutrition into public health service delivery system: The following activities have been found to be useful for training CHWs;

- Health care workers and nurses on instruction on OFSP agronomy;
- Nature of OFSP planting cycle/season;
- Good nutrition and counselling on vitamin A and use of vouchers;
- Involvement of CHWs in counselling at ANC;
- Provision of Information, Education and Communication (IEC) counselling cards, posters, and leaflets and distributed at ANC;
- Joint training of health workers and agricultural extensionists on seed systems and nutrition; and
- Feedback meetings of stakeholders from health and agriculture sectors for integration.

4.6. Summary of question and answer session

During the question and answer session, the following issues were raised and discussed:

Cost of interventions: A participant raised concerns about the apparently high costs of starting up the project, and wondered whether during implementation, the cumulative gain became higher when compared to startup costs. In the subsequent discussions, it was explained that the manpower and labor costs were high.

Challenges of an integrated approach: While the integrated approach encompassing agriculture, nutrition and health is proved to be efficient, it drives implementation costs higher. It was reported that many organizations were reluctant to implement all three components because of these costs.

⁵ Disability-Adjusted Life Year (DALY) is a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death

This is a particular challenge that requires a cost-benefit analysis, and Rwanda which has modified the approach slightly, could be used for lessons and comparisons.

Inclusion of young girls to improve early adoption rates: One participant inquired why the project had not considered including young girls in the project, with the argument that one day they would become mothers and increasing their awareness the importance of vitamin A for young children early could have an impact in future. The response to this was that whereas one could consider including such kind of awareness within a school curriculum, young girls were not considered a core vulnerable target group for the project. Furthermore, this kind of education at too early an age would not be acceptable to some stakeholders, who may see the risks of these young girls considering early motherhood. Another participant highlighted that in previous interventions, they had worked with mothers and children, but not pregnant women, adding that in future, consideration could be made to have a higher involvement of pregnant women in agriculture-nutrition interventions.

5. UNDERSTANDING CONSUMER PREFERENCES AND ESTIMATING WILLINGNESS TO PAY FOR ORANGE-FLESHED SWEETPOTATO JUICE

TEMESGEN BOCHER, SINDI KIRIMI AND JAN LOW - CIP

Rwanda, with total area of 26,000 km² is the smallest landlocked country in Africa. Agriculture is an important sector in the economy. It contributes 34% of GDP, 80% employment and 70% foreign earning (Muhinda 2013).

Micronutrient malnutrition, vitamin A in particular, is one of the major problems that millions of African children face, it results in death and blindness of children (Low et al 2007; De Groote and Kimenju 2008; Magadi 2011; Meenakshi et al 2012; Sindi et al 2013). The joint UNICEF, World Health Organization (WHO) and World Bank report indicated that in 2012 alone, 36%, 29% and 28%, respectively, of the world stunted, underweight and wasted children lived in Africa (WHO; and UNICEF; 2013).

In Rwanda the percentage of the population living below poverty line is about 45%⁶ (NISR 2013). About 43% (CI: 42.7-45.2%), children under five years suffer from chronic malnutrition; and 11% are underweight.⁷

The solution to this problem is (1) Provision of high-dose capsules every six months and (2) Dietary improvement and consumption of foods rich in pro-vitamin A, such as OFSP.⁸ The second approach is found to be the cheaper and more effective alternative but receives less attention.

Sweetpotato production in Rwanda accounts for 7.1% of the land under crop cultivation. The share of crop production for individual crops was highest for sweetpotatoes (18.3%) followed by banana for beer (17.2%).⁹ Sweetpotato is one of the main staple crops in Rwanda.





⁶ National Institute of Statistics of Rwanda (NISR): Seasonal Agricultural Survey Report. Kigali, 2013.

⁷ Rwanda Demographic and Health Survey, 2010

⁸ Groote, Hugo De & Kimenju, Simon S. Comparing consumer preferences for color and nutritional quality in maize: Application of a semi-double-bound logistic model on urban consumers in Kenya. In: Food Policy 33 (2008) 362–370.

5.1. Objectives of the Rwanda Super Foods project

The objectives of the above-mentioned project were to test:

-  Whether it would be possible to develop economically-viable sweetpotato processed products, acceptable to consumers.
-  Whether development of a sweetpotato value chain for processed products, linked to a private sector actor leads to better returns for male and female sweetpotato producers than just accessing the local market
-  Whether men and women farmers benefitted more by being organized in groups and backstopped by NGOs, than by just being linked as individuals to the agro-processor
-  Whether the promotion of OFSP processed products resulted in a change in the image of sweetpotato at local and national levels

5.2. Methodology

This study is based on the survey of 957 individuals selected from seven different markets representing low- to high-income groups in Rwanda. Respondents were asked to show their preferred juice brands from four bottles: buying frequencies and quantity purchased; attributes that influences the decision to buy (taste, aroma, color, consistency, amount of sugar) and knowledge about vitamin A. The tasters were asked to taste each of the juice and rank the attributes one after the other.

Two stage Heckman Selection model was used to identify factors affecting the willingness to pay: choose then decide how much to pay. *Multinomial logit model* was applied on both individual characteristics and juice attributes which influences the decision to choose a particular juice.

5.3. Findings

5.3.1. Analysis result: Overall rating

The table below shows the overall rating of juice made from different varieties and a blend of pineapple.

| Opinion | OFSP | P-Inyange | P-SINA | Blend |
|-------------------------|------|-----------|--------|-------|
| Dislike very much | 19% | 7% | 3% | 18% |
| Dislike slightly | 26% | 9% | 7% | 21% |
| Neither dislike or like | 17% | 12% | 13% | 17% |
| Like slightly | 24% | 36% | 44% | 22% |
| Like very much | 14% | 36% | 33% | 22% |

There was no consumer difference ($p > 0.05$) between the pure OFSP juice and the blended juice. However, when they were told about the nutritional attributes of OFSP juice, these results changed

9 NISR, 2013; Low et al.: A Food-Based Approach Introducing Orange-Fleshed Sweet Potatoes Increased Vitamin A Intake and Serum Retinol Concentrations in Young Children in Rural Mozambique. In: The Journal of Nutrition (2007) vol. 137 no. 5 1320-1327.

drastically, with more people selecting OFSP as a first choice. Putting labels with nutritional information on juice bottles made the OFSP juice more preferable to customers.

5.4. Summary of question and answer session

The discussions after this presentation included the following issues:

Availability of vitamin A: Although the juice seems to be quite acceptable for the consumer, some meeting participants were curious about how much viable vitamin A would be retained over the long period. The response given was that it would be 58-78 (units)/ 100 ml, which is more than a child's daily requirements.

Market segmented preferences: A participant was interested in finding out whether there would be a difference in preferences depending on the market segment. The study team explained that there were seven markets representing three different income categories. In the higher level markets, consumers were more likely to purchase OFSP products because they are more concerned about their health. Another finding is that providing important nutritional information about vitamin A to a community will influence their preferences, but the information does not have an impact on their preferences until they begin to internalize it. For example, in Rwanda, four years of sensitization and mass media campaigns on OFSP and vitamin A have led to a better understanding about the benefits of consuming OFSP, which in turn is increasing preference to its products.

6. VITABREAD: CONSUMER AND BAKER PREFERENCES, ECONOMIC AND NUTRITION POTENTIALS

FRANCIS KWEKU AMAGLOH - UNIVERSITY OF DEVELOPMENT STUDIES, GHANA

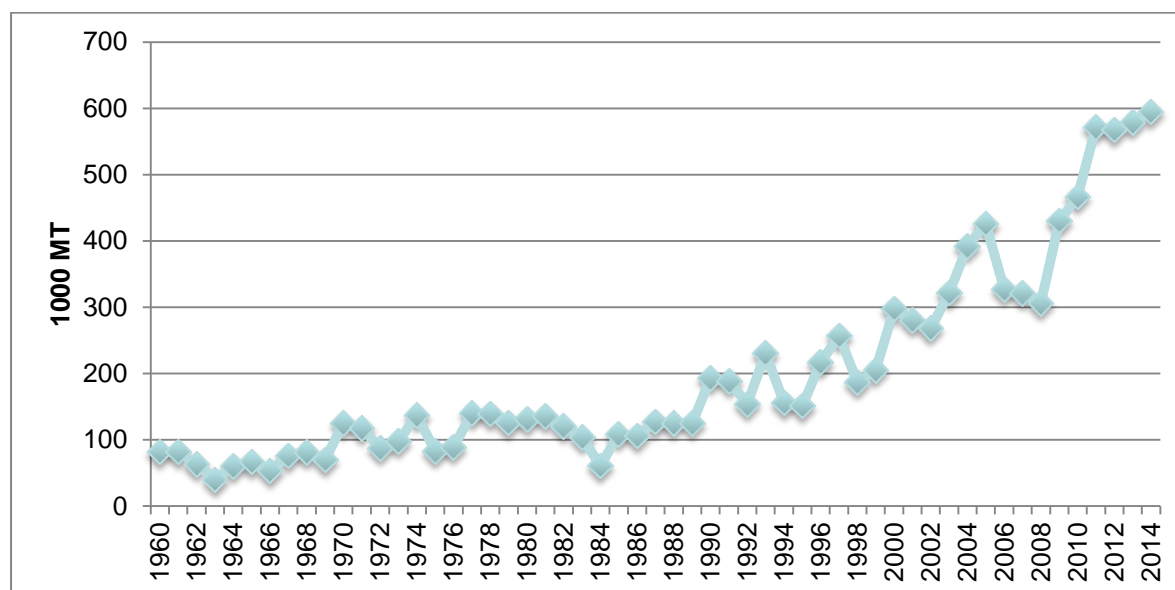
Africa has experienced the highest urban growth during the last two decades at 3.5% per year and this rate of growth is expected to hold into 2050.¹⁰ Urbanization leads to high demand for ready-to-eat food or minimally processed foods. Projections also indicate that between 2010 and 2025, some African cities will account for up to 85% of the population. Sweetpotato has huge processing potential. It can be processed into bakery and fried products, juice, noodles and candies, and is already in use in Asia. It has a short growth period (3 - 5 months), and is a source of starch and micronutrients. OFSP adds significant amounts of vitamin A. This presentation provided an overview of the preferences and potential benefits of vitabread, composite bread containing sweetpotato and wheat flour being developed for the Ghanaian market.

6.1. Economic sense of sweetpotato

Wheat importation costs foreign exchange and is rising. Sweetpotato, which can be grown in wide range of agro-ecologies by all types of farmers can help to meet the increasing demand for minimally processed or ready-to-eat food products using a nutritious food. OFSP puree can substitute 20-50% of wheat flour in baked products for a healthier product. However, OFSP flour not economically viable (4.5 kg to 1kg flour vs 1.3 kg to 1kg for puree).

¹⁰ <http://www.afdb.org/en/blogs/afdb-championing-inclusive-growth-across-africa/post/urbanization-in-africa-10143/>

Figure 9: Wheat flour importation¹¹



The objectives of the study were:

- To assess if consumers and bakers will prefer composite bread containing OFSP (vitabread)
- To refine one of the bread recipes available in Ghana
- To estimate the economic potential of baking vitabread
- To evaluate consumer preference of vitabread
- To determine the vitamin A content of vitabread

The survey was undertaken in four regions in Ghana: Greater Accra, Ashanti, Northern and Upper East and targeted both consumers and bakers.

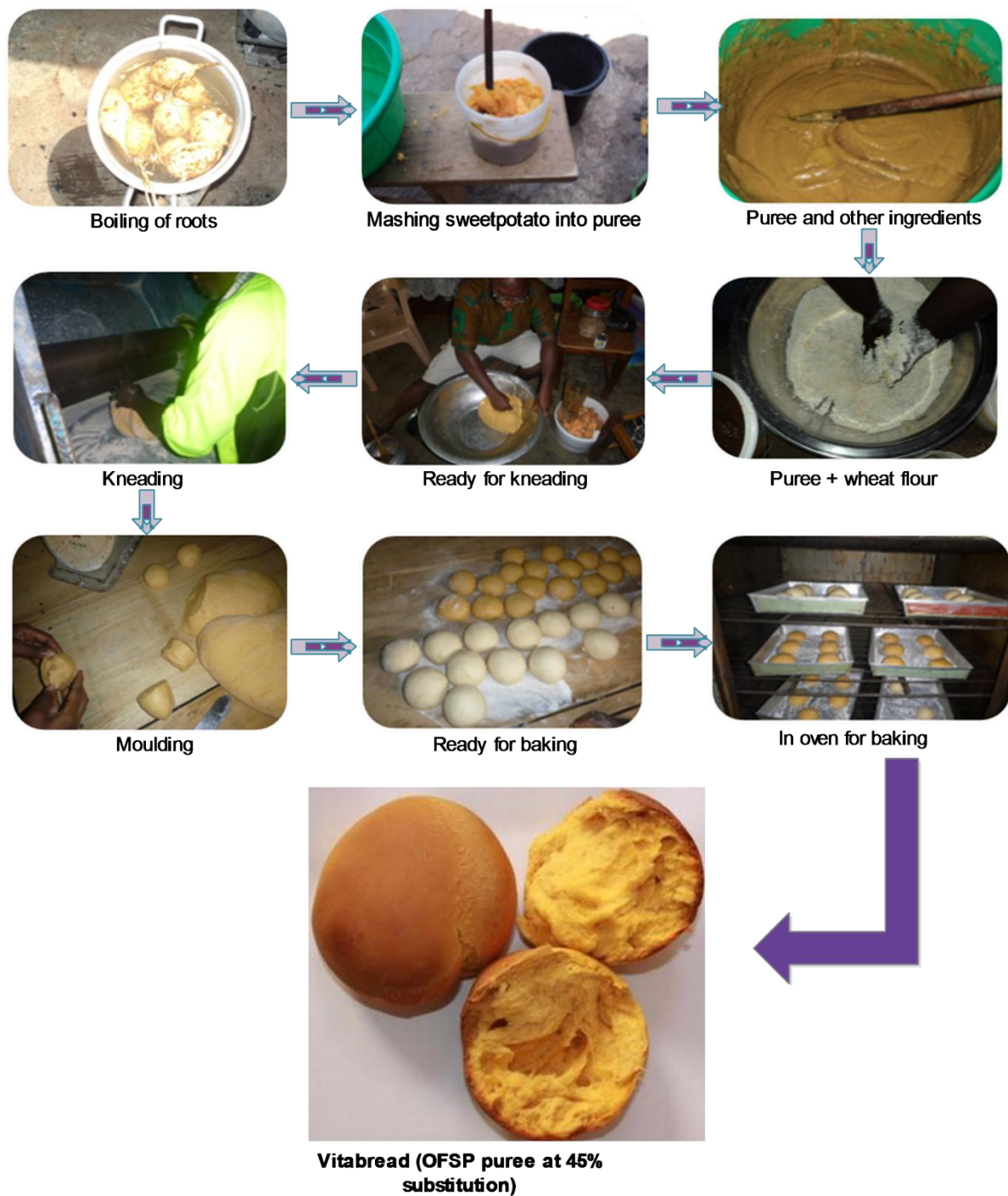
A Benefit-Cost Ratio analysis was undertaken among large-, medium-, and small-scale bread bakers in Tamale. A consumer preference evaluation was done using the 5-point Likert¹² scale with a panel of 100 undergraduate students at the University of Development Studies.

β-carotene assay was undertaken by the Nutrition Department, Noguchi Memorial Institute of Medical Research, on fee-for-service basis.

¹¹ <http://www.indexmundi.com/agriculture/?country=gh&commodity=wheat&graph=imports>

¹² 1=least acceptable/dislike extremely and 5=highly acceptable/like extremely

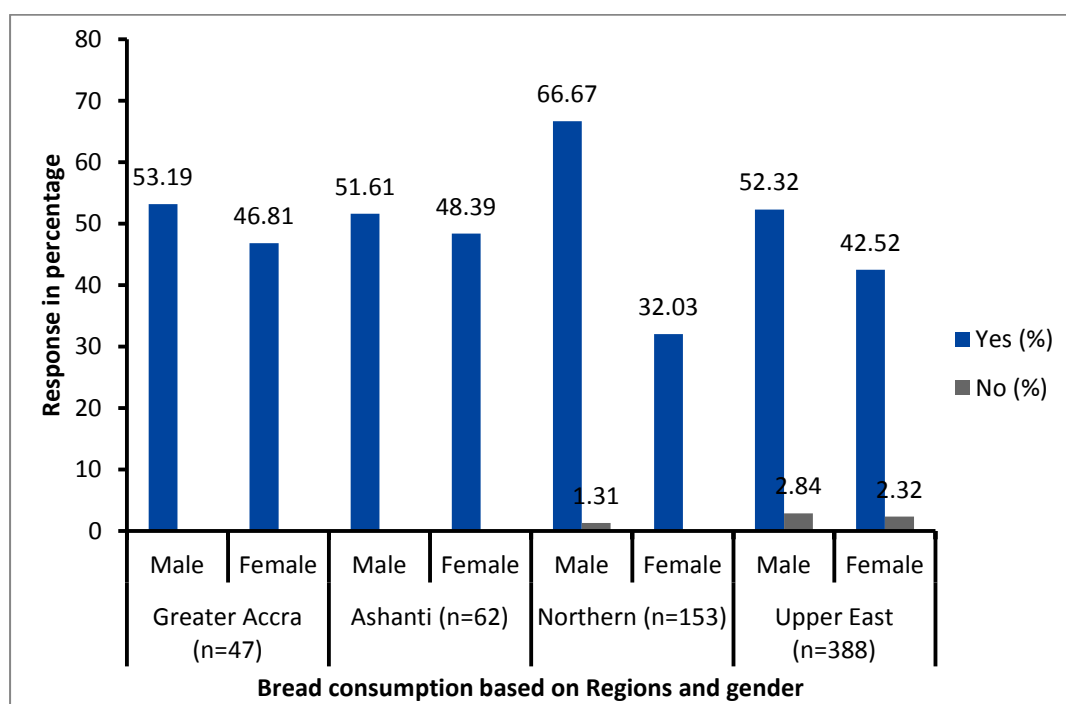
Figure 10: Method of Vitabread production



6.2. Results and discussion

Bread is widely consumed in Ghana as illustrated in Figure 12 below.

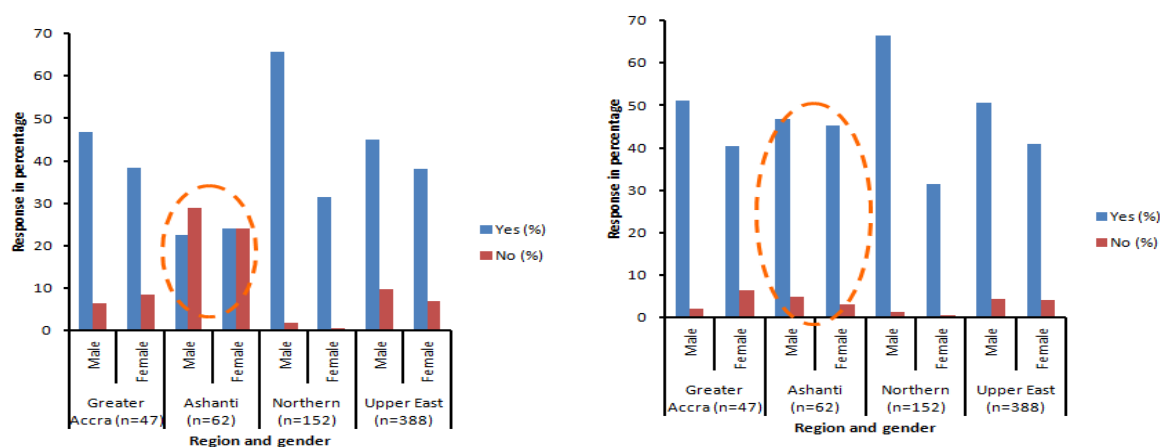
Figure 11: Bread consumption in Ghana based on regions and gender



Source: Field Survey, 2015

Consumers' willingness to buy vitabread: The survey found that awareness about the health benefits of vitabread increased the willingness of consumers to pay for it. This is best illustrated in Figure 13 by the change in responses in the Ashanti region. The graph on the left represents the responses before the surveyed consumers were provided with health advice, while that on the right represents their responses after.

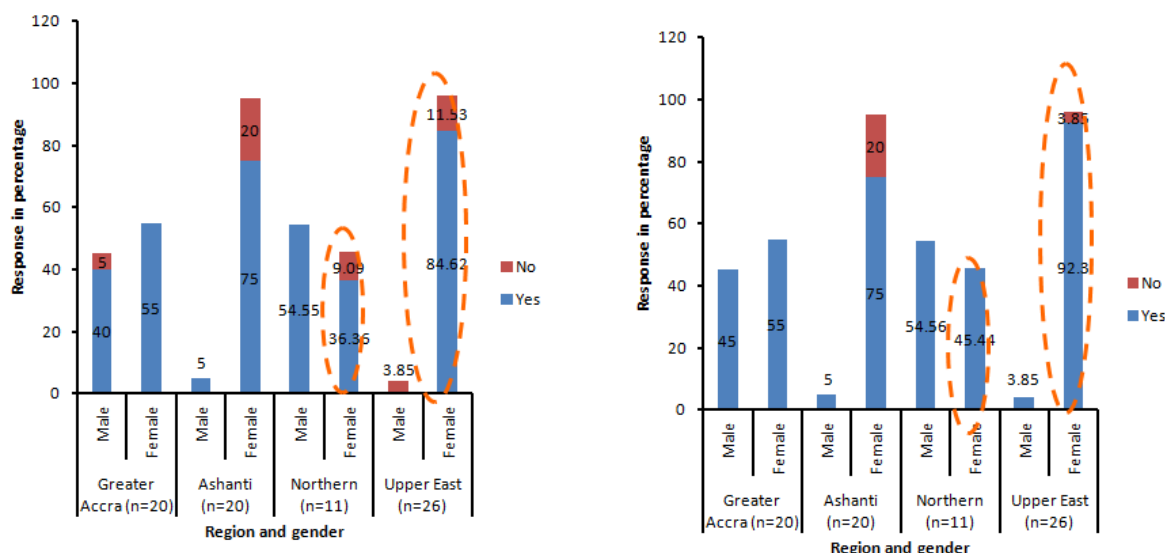
Figure 12: Willingness of consumers to buy vitabread before (left) and after (right) being informed of the health benefits



Source: Field Survey, 2015

Bakers' willingness to bake vitabread: Similarly, increased awareness about the health benefits of vitabread increased the willingness of bakers to bake it, as can be illustrated in the changes in the responses below. The graph on the left represents responses before, and the ones on the right represent responses after health advice was given to the bakers.

Figure 13: Willingness of bakers to bake Vitabread before (left) and after (right) health advice



Source: Field Survey, 2015

Economic analysis on vitabread: The Benefit-Cost Ratio (BCR) analysis was done for bread that is baked with 100% wheat flour; and bread baked with 2.2kg of wheat flour and 1.8kg of OFSP (that is, 45% substitution with OFSP puree). The BCR for the former was 0.99, while that of the latter was 1.18. Therefore, the vitabread that was baked using a mixture of wheat flour and OFSP was found to be more profitable.

Consumer preference: A 5-point Likert scale (1=least acceptable/dislike extremely and 5=highly acceptable/like extremely) was used to measure the consumer preferences for (i) vitabread with sugar; (ii) vitabread with no sugar; and (iii) wheat (white) bread. This data was gender disaggregated. Findings indicate that men liked wheat (white) bread most (4.45), followed by vitabread with sugar (4.35) and the least liked variety was vitabread with no sugar (4.20). vitabread with no sugar as much as the wheat (white) bread (4.46), followed by the vitabread with sugar (4.39).

Nutritional composition: Proximate composition, energy, β -carotene and lutein levels in sweetpotato-based bread (vitabread) and wheat (white) bread were compared. With 35% puree, the vitamin A was 17%, so it is an indication that with the current 45%, the vitamin A content is very good.

6.3. Challenges

OFSP is a potential breakthrough product for the baking industry. However, to assure year-round supply of OFSP, there is need for improved storage and investment in irrigation facilities. Research is underway at CIP-SSA for shelf-storable puree without refrigeration.

7. SUSTAIN MOZAMBIQUE AND ZEBRA FARM INTEGRATE TWO VALUE CHAINS IN JUICE AND BISCUITS

LUCAS MUJUJU¹, ROLAND BROUWER²

1. Leite de Soja, Private Sector Processor, 2. CIP

Soybean production is rapidly expanding in Manica for chicken feed; hardly for humans. Zebra Farm/Só Soja, is a combination of two enterprises producing and processing soy (Só Soja) and sweetpotato (Zebra Farm) in Manica Province of central Mozambique since 2005. Raw material is sourced from their own farm and from outgrowers in the district. Soy milk and yoghurt have been processed and marketed on a small scale in Chimoio. Global Alliance for Improved Nutrition (GAIN) and Africa Agricultural Development Company (AgDevCo) supported up scaling (certification, new equipment, and new production facility). In his report, entrepreneur Lucas Mujuju, explained the experiences of Zebra Farm and Só Soja, who are currently developing OFSP juice and OFSP/soy biscuits for the Mozambican market.

The businesses are different but carried out in the same yard. All the workers have been trained on food handling. The juice is pasteurized at 60°C and soy milk is boiled to 120°C.

7.1. Profitability of the products

According to the product formula and unit cost of ingredients for the juice (ingredients consisting sweetpotato, ascorbic acid, sugar, xanthan gum), the unit cost for a 5 liter bottle would be USD 8.75 and that of a 0.2 liter bottle would cost USD 0.34.

The calculation of production costs of juice excluding labor shows that the juice will generate a gross profit. This is still the case even after including the costs of labor. With regard to biscuits, the summary formula includes flour, sweetpotato, soy, butter, eggs, sugar, salt, and baking powder. It is projected that the production of biscuits will also be profitable (see table below). The observations made are as follows:

- The largest profit is expected from the sales of biscuits.
- Cost calculation depends on how the costs of roots and grains are distributed between juice and yoghurt.
- The business is profitable and can recover the (not included) investments in equipment and infrastructure.

Table 3: Summary of projected results from Zebra Farm / So Soja

| Item | 1 Trimester |
|---------------------------------|-------------|
| Volume roots per day (kg) | 37,50 |
| Volume juice per day (kg) | 30,00 |
| Volume biscuits per day (kg) | 68,36 |
| | |
| Costs | |
| Inputs juice per bottle (MT) | 17,52 |
| Inputs biscuits per 50gram (MT) | 8,00 |
| | |

| | |
|---------------------------------------|----------------|
| Income | |
| Sales juice (USD, 3 months) | 1343,22 |
| Sales biscuits (USD, 3 months) | 5469,12 |
| | |
| Expenditures | |
| Labor and electricity | 2839,58 |
| VAT | 1226,22 |
| Labor tax | 577,20 |
| Profit | 5776,19 |

7.2. Marketability of juice and biscuits

A comparison of consumer appreciation for sweetness, mouth feel and aftertaste between Sumaia (sweetpotato juice) and Santal was done. The 10 respondents were male students aged between 20 and 25 years of age.

Hedonic tests were done using a 9-point Likert scale; and OFSP juice was located between 'like moderately' and 'like very much'. Differences between OFSP and Santal fruit juice were not significant, except for aftertaste which gave OFSP a lower score.

Biscuits are rapidly consumed but people complained that they are too hard. One reason for this could be that it was produced in a sub-optimal oven.

In conclusion, mixing OFSP with soybean enhances the nutrition benefits of soybean for humans. Biscuits made from a combination of these two materials are economically viable. Whereas juice and biscuits seem to have a potential market, improvements will have to be made. A moderately optimistic scenario indicates that the business will be profitable. So far, both products score well on nutrition parameters of iron and vitamin A, but more tests are needed.

7.3. Summary of question and answer session

Participants were interested in getting further information on the following:

Food handling: Concern was raised that cleaning and cutting sweetpotato roots could cause contamination unless there was a good system in place. There was unanimous agreement among participants that this aspect had to be improved on, but that it was not the most influential factor in reducing the viability of the product.

Elimination of aftertaste: As Lucas had presented, some consumers did not like OFSP because of its aftertaste. To address this challenge, Rwanda has blended the OFSP juice with pineapple. However, as Kiriimi Sindi highlighted, this is not the way to go. He stated that when one takes pineapple or mango juice, it is identifiable by its distinct taste, and that should be the case with sweetpotato as well.

8. CAROTENOID RETENTION AND VITAMIN A ACTIVITY IN DRIED ORANGE-FLESHED SWEETPOTATO THAT IS COOKED, FRIED, OR STORED

AURELIE BECHOFF¹, KEITH TOMLINS¹, CLAUDIE DHUIQUE-MAYER² & ANDREW WESTBY¹

1. Natural Resources Institute, UK; 2. CIRAD, France

As you process sweetpotato, there is always a chance of degradation of beta carotene. Currently, there is little information in the literature (i.e. regarding the developing countries situation).

Vitamin A is an essential micronutrient to the diet. VAD is a major public health issue in developing countries, in particular in South Asia and Africa. 127 million children are affected in the world. For instance, in Uganda 38% children are affected¹³ and 71% in Mozambique.¹⁴

High concentrations of pro-vitamin A carotenoids (pVACs) are found in some vegetable, fruit and root crops. OFSP are types of sweetpotato that contain very high contents of pro-vitamin A. Therefore OFSP can be a way of tackling VAD. Some ways of preparing sweetpotato in Africa include drying and subsequent storage. A variety of products can be made from dried products from sweetpotato. The main hypothesis of this research is: can OFSP provide sufficient pro-vitamin A to tackle VAD?

Two studies were undertaken, one on storage and the other on food preparation. The findings were published in the *Journal of Agricultural & Food Chemistry* (2011)¹⁵ and in *Food Chemistry* (2010)¹⁶. The work was also part of Dr. Bechoff's thesis (2006-2010).¹⁷

8.1. Storage under controlled conditions

The study to understand more about the impact of factors on carotenoid degradation is a storage study under controlled conditions of temperature, water activity and oxygen.

Ugandan dried chips (Ejumula variety) were stored under the following conditions: 4 temperatures (10; 20; 30; 40°C) ; 4 aw (0.1; 0.3; 0.5; 0.7) and 4 oxygen levels: 0% (N₂), 2,5 % et 10% O₂, 21% (air).

¹³ Uganda Bureau of Statistics (UBOS) and ORC Macro (2001), Uganda Demographic and Healthy Survey 2000-2001. Calverton, Maryland, USA: UBOS and Opinion Research Corporation (ORC) Macro.

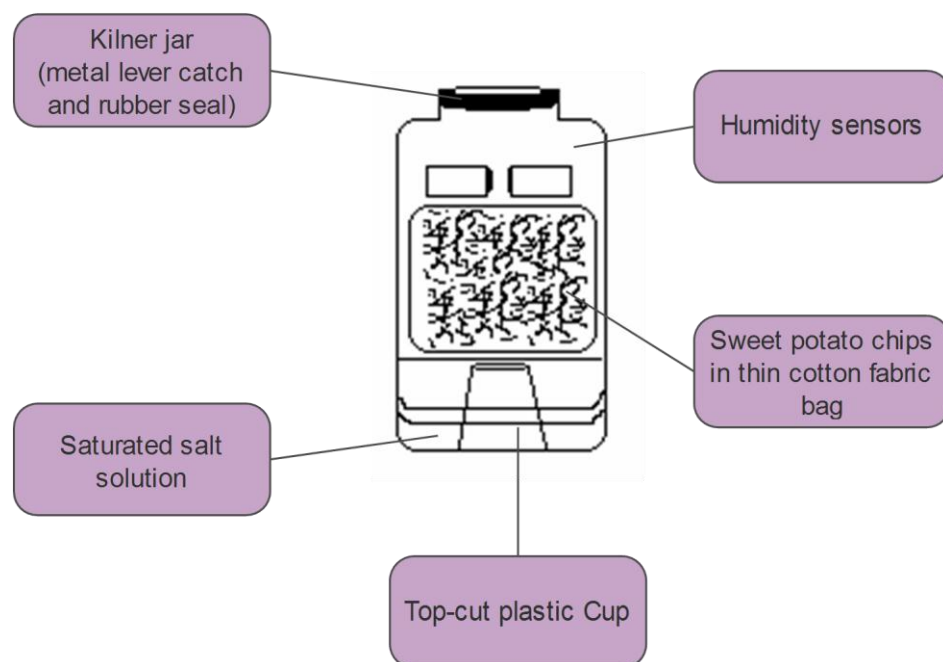
¹⁴ Aguayo, V.M. and Baker, S.K. (2005) Vitamin A deficiency and child survival in sub-Saharan Africa: A reappraisal of challenges and opportunities. *Food and Nutrition Bulletin* 26, 348-355.

¹⁵ Bechoff, A., Poulaert, M., Tomlins, K.I., Westby, A., Menya, G., Young S., and Dhuique-Mayer, C. (2011) Retention and bioaccessibility of β -carotene in blended food from sub-Saharan Africa containing orange-fleshed sweetpotato. *Journal of Agricultural & Food Chemistry*, 59, 10373-10380.

¹⁶ Bechoff, A., Dhuique-Mayer, C., Dornier, M., Tomlins, K., Boulanger, R., Dufour, D. & Westby, A. (2010). Relationship between the kinetics of β -carotene degradation and norisoprenoid formation in the storage of dried sweetpotato chips. *Food Chemistry*, 121, 348-357.

¹⁷ <http://sweetpotatoknowledge.org/use-consumption/nutritional-information/processing-and-nutrition-retention/Aurelie%20Bechoff%20PhD%20thesis-final.pdf/view>

Figure 14: Storage under controlled conditions



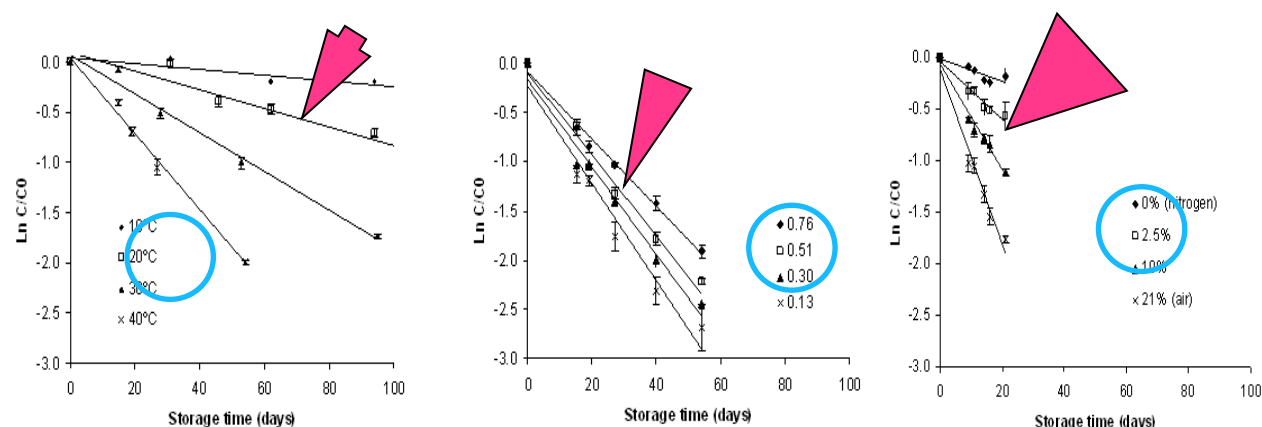
Source: Bechoff, A., Dhuique-Mayer, C., Dornier, M., Tomlins, K., Boulanger, R., Dufour, D. & Westby, A. (2010).

The carotenoid degradation was described due to temperature using an Arrhenius model. The model was successfully validated with experimental data from the laboratory (4.3%) and with data from the field (9.3%).

The findings of the study showed that carotenoid degradation in dried sweetpotato could be predicted. Degradation was fast under ambient conditions (about 70% after 4 months).

As can be discerned from the figure below, degradation was lowest at lowest temperature, highest humidity and lowest oxygen level. This implies that to increase the shelf life, oxygen should be removed from the packaging.

Figure 15: Effect of temperature, a_w and oxygen on storage of sweetpotato



8.2. Food preparation study



Mandazis



Chapati



Porridge

A two-week field study was undertaken between February and March 2010 in Uganda, funded by the National Resources Institute Fellowship (NRIF). 10 chapatti processors and 10 porridge makers (households) were interviewed; and samples made by processors using the same initial ingredients were taken. 30% Ejumula substitution was done for chapatti and mandazi and 40% for porridge. The aim was to explore the variability between processors and influence of cooking parameters on carotenoid retention. Street processors were visited and as they prepared the chapattis, temperature and other factors that could influence retention in real time were recorded. For porridge, the researchers worked with women at household level.

Findings: Whilst the retention of trans-B-carotene varied in the methods of preparation (chapattis or porridge), there was no impact of method on carotenoid retention: 69-93% or 70-97% respectively for chapattis and porridge. Both could provide significant pro-vitamin A to the diet.

8.3. Overall conclusions and recommendations

Losses can be as high as 70% after 4 months of storage but degradation can be predicted based on temperature; humidity and oxygen (air) data. Packaging (i.e. under vacuum) will be critical to limit air into the product.

Losses can be as high as 30% during food preparation. Boiled sweetpotato, or porridge and chapattis made from freshly dried SP flour could provide a significant amount of pro-vitamin A to the diet (1/2 chapatti/day or 2 mugs of porridge/day or 100g of puree = 50% RDA).

Fat (chapatis or mandazis) is good for increasing the absorption of pVACs and therefore the nutritional benefit.

8.4. Summary of question and answer session

The first question was related to the type of fat used in mandazi and chapatti. Aurelie stated that this was not done. Participants contributing to the discussion stated that many studies have found that polyunsaturated fats are better for absorption.

9. EFFECT OF DIFFERENT COOKING TREATMENTS AND AMYLASE ACTIVITY ON SUGARS AND SWEETNESS OF SWEETPOTATO ROOT

ERIC OWUSU MENSAH^{1,2}, I, ODURO², W.O. ELLIS², E.E. CAREY¹

1= International Potato center, 2 = Kwame Nkrumah University of science and Technology, Kumasi, Ghana.

Sweetpotato breeding efforts in Ghana target the development of low-sugar, staple-types preferred by consumers. Sweetpotato can be cooked by different methods: baking, microwaving, steaming etc., which inevitably affect the quality attributes of the cooked products, specifically sugars, sweetness, flavour and other sensory factors. Concentrations are controlled by factors of the cooking method and roots such as temperature, time, initial sugar content and initial amylase activity of the root.

9.1. Problem statement and objectives

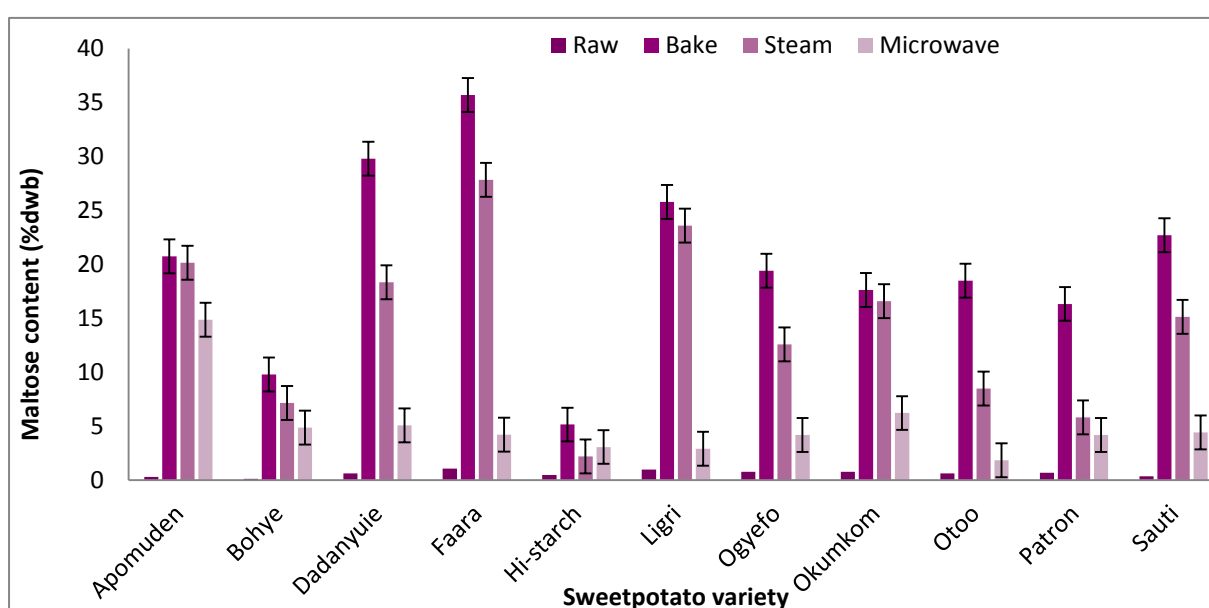
Scientific data on the variability of these factors on sugars and sweetness, which determine its utilization potential, are limited.

The objective of this study was to determine the effect of three cooking methods and β -amylase activity on sugars and sweetness of sweetpotato varieties in Ghana.

9.2. Results and discussion

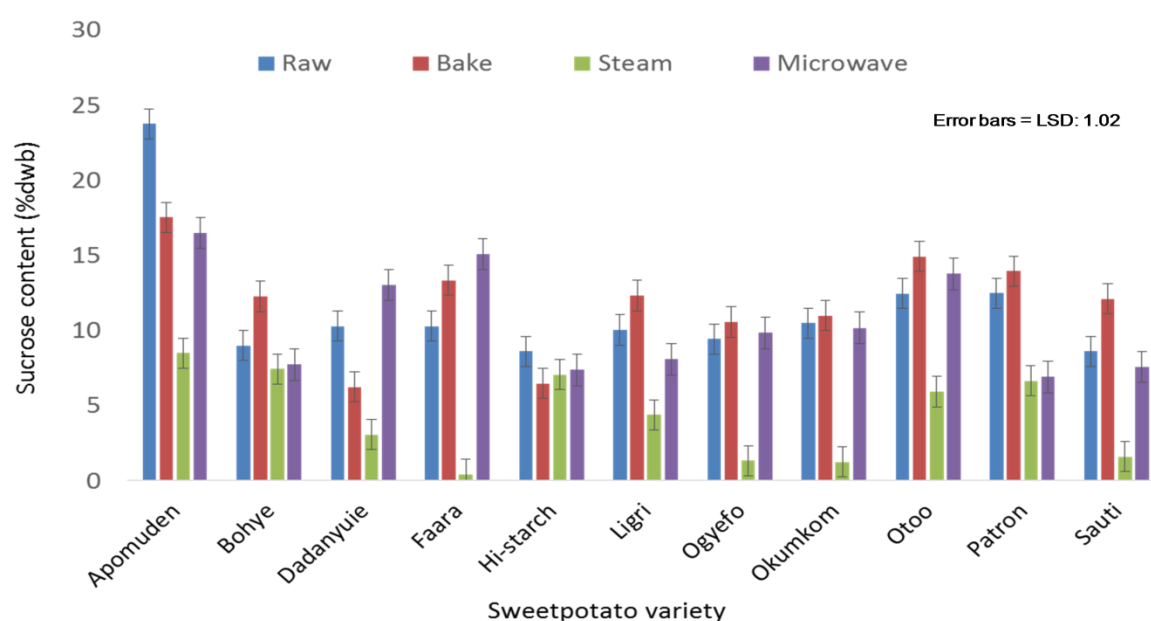
Analysis was done on all the varieties in Ghana. It was found that maltose is very low in raw roots but it rose quite significantly after cooking. Sucrose levels are higher in raw form than maltose. The changes are attributed to the amylase activity in the raw roots. The figures below shows the levels of maltose and sucrose content in raw, baked, steamed and microwaved roots.

Figure 16: Maltose content (%dwb) of raw, baked, steamed and microwaved sweetpotato roots



Source: Owusu, E. (2015): Ongoing PHD research

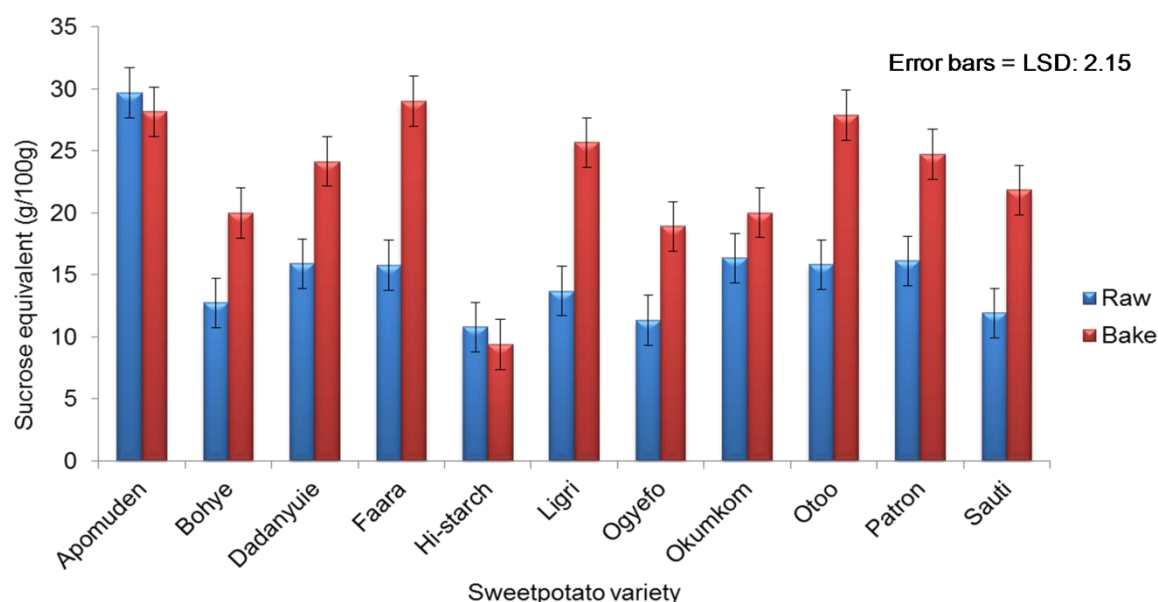
Figure 17: Sucrose content (%dwb) of raw, baked, steamed and microwaved sweetpotatoes



Source: Owusu, E. (2015): Ongoing PHD research

A comparison of sweetness was done between raw and baked sweetpotato roots. If one were to do a classification before cooking, some raw roots would be classified as non-sweet, but the sugar content would rise after cooking, e.g. Faara variety, which was categorized as moderately to high sweet after baking.

Figure 18: Sweetness levels (%) of raw and baked sweetpotato roots



Source: Owusu, E. (2015): Ongoing PHD research

9.3. Conclusion

This study established that sugar contents and sweetness levels in sweetpotato roots are significantly dependent on cooking treatment, and amylase activity of the roots. Baking treatment produced the highest effect; profound on maltose content and sweetness levels. The effect of microwave treatment was minimal, leading to less sweet products. Sucrose is the predominant sugar in uncooked roots while maltose content increases dramatically after cooking. Ultimately, having this kind of analysis is important in helping to select the right variety of roots depending on the purpose for which it is intended.

9.4. Summary of question and answer session

The first question that emerged from this presentation was whether the study considered the length of root storage before it was cooked, as this could affect cooking. The presenter confirmed that storage had an influence on the sugar profile of roots – especially sucrose, but in this study, the roots had been cooked immediately after harvesting.

In the second question, a participant wanted to know why baking increased sweetness of roots yet enzymes are sensitive to, and could be denatured by increased temperatures. In response, a participant explained that when using a microwave, the amylase is denatured quickly while in normal baking in which temperatures increased gradually, the effect was different and sweetness could increase.







10. ORANGE-FLESHED SWEETPOTATO PRODUCT DEVELOPMENT IN MALAWI

JEAN PANKUKU, UNIVERSAL INDUSTRIES

10.1. Background

Malawi is one of the largest sweetpotato producers in Southern Africa. The majority of sweetpotato produced are sold in rural informal markets. Very limited value addition is done at both household- and industrial-level and very little scaling up of commercial production has been done at industrial level despite the nutritional advantages. It is for this reason that Universal Industries, whose work was presented in this report, has stepped up to formally buy OFSP and process them into nutritional products.

The objectives of the project are as follows:

-  To provide a ready market to OFSP farmers that will lead to increased productivity;
-  To produce ready to eat and ready to cook instant nutritious foods;
-  Increased incomes for farmers;
-  Greater accessibility of vita-rich foods to both rural farmers and urban populations;
-  Improved access of disease-free OFSP vines to farmers through screen house construction; and
-  Target market—commercial market stream and institutional/feeding programs.

10.2. Progress of OFSP product development by Universal Industries

OFSP puree: Currently, trials have been done with OFSP puree of different varieties as an ingredient. The major differences are as a result of the dry matter content, amount of fibrous material and moisture content.

OFSP Soft Cookies: Trials for substituting wheat flour with OFSP puree have been done successfully. The biscuits tend to be soft and therefore will specifically be called soft cookies and not biscuits. With the use of puree, sugar and fat content in the biscuit is reduced. Nutritional analysis is underway. No food color is used and different flavor variants have been proposed. The industries are yet to finalize on the die for the shape and size of the cookies.



OFSP Crisps: The OFSP Crisps trials have been done and product is finalized. Out of the six varieties, four were found suitable for crisps. Factors affecting crisps quality include: color, moisture content, maturity, storage time and processing.

Products in the pipeline: These include OFSP Nutritional Bar, OFSP Flour Mixes, OFSP puree baby food, OFSP porridge flour mixes.

10.3. Observations and challenges

OFSP puree quality parameters vary with season. Since different varieties tend to perform differently in different climatic zones, processing can be affected. Furthermore, the deep orange varieties have been found to be unsuitable for crisps as they tend to give a burnt color which is unattractive to customers.

Universal Industries has experienced some challenges. For example, the company is struggling with methods of storage of OFSP roots for a period of time without big losses in beta-carotene – specialized storage/warehousing facility is a must. Secondly, price variations are very high from one season to another, which could result in wheat substitution.

Universal Industries still needs to establish economic potential and viability – which is pegged on the willingness to pay by consumers and also on the ability to successfully market products based on their nutritional content.

10.4. Summary of questions and answers session

As a private sector player, Universal Industries needs to determine the shelf life. This is yet to be determined. The presenter stated that the shelf life study will take a minimum of one full year. In Rwanda, the Akarabo OFSP biscuit study took 6 – 12 months.

In response to the question on whether there were other companies processing sweetpotato, it was explained that Universal Industries was the first company.

11. THE USE OF SWEETPOTATO RESIDUES AS FEED IN RURAL AND PERI-URBAN SMALLHOLDER PIG SYSTEMS IN UGANDA

D. PEZO, E.A. OUMA, M. DIONE, P. LULE, B. LUKUYU, N. CARTER AND G. KYALO - ILRI

11.1. Background

Uganda has shown the highest growth in pig production in SSA in the last 30 years. In the past three decades increased from 0.19 to 3.2 million pigs (UBOS, 2009; FAO, 2011). It has the highest per capita consumption (3.4 kg/person/year). In Asia, e.g. Vietnam, it is 40 kg/person/year. The majority of the production is in the hands of poor households. The researchers have generated data on the role of pigs for these households.

The pig sector in Uganda is largely informal. It involves >1.1 million households. It is a mostly backyard activity, managed by women and children, as means to diversify risk and increase livelihood security. Tethering and scavenging are dominant in rural settings, while housing more relevant in peri-urban pig production systems.

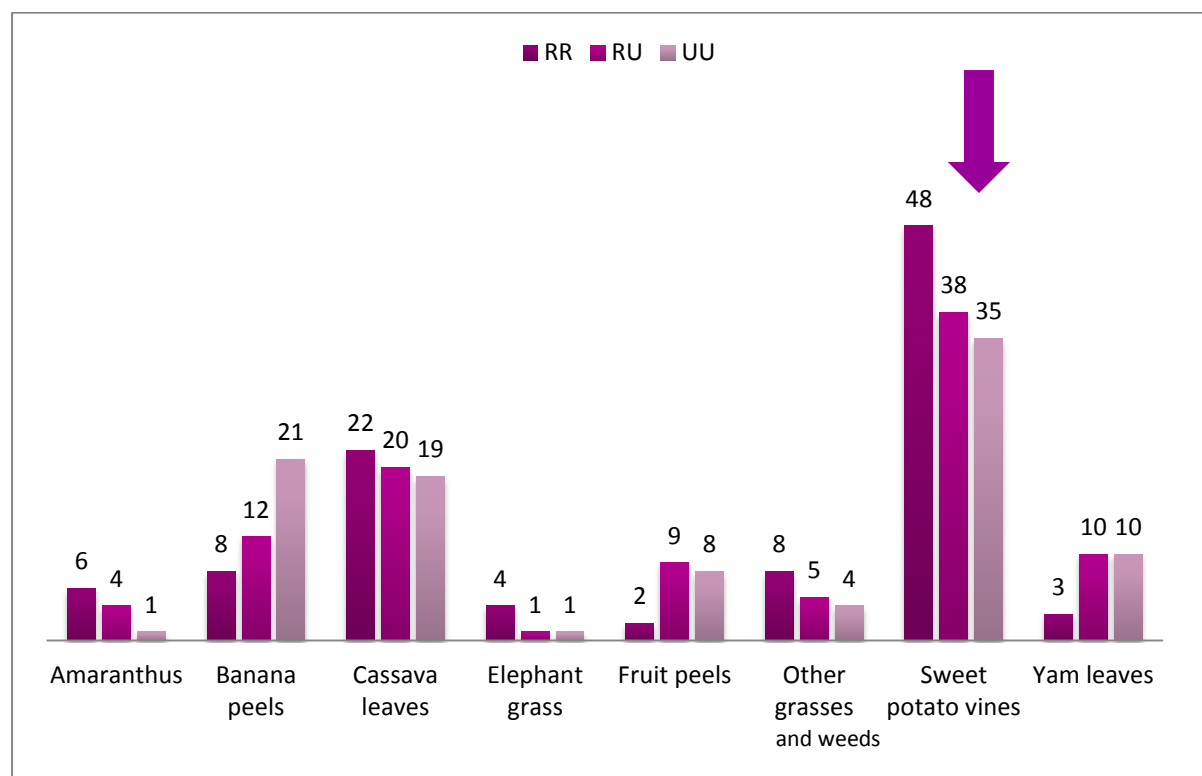
The sector is characterized by poor knowledge on disease control and biosecurity measures, uncoordinated trade and transport, lack of pig farmers' organization for collective action and mostly unsupervised slaughter, with no meat inspection in local markets and a high prevalence of road-side butchers and pork joints.

11.2. Constraints and opportunities of pig feeding in Uganda in smallholder Systems

Feeding consists of 60-75% of total variable costs. Feeds consist of crop residues, forages and kitchen leftovers represent 70-75% of the diet along the year. Grasses and weeds replace crop residues during crop growing periods. Feed collection and feeding is mainly done by women and children; however men and few hired labor participate more in peri-urban settings. The main constraints as identified by farmers include: fodder shortages in the dry season, high cost of commercial feeds, price fluctuations of feed ingredients and poor quality of purchased feeds.

As Figure 20 below shows, sweetpotato vines are the most preferred fodder for pigs, followed by cassava leaves in rural areas and yam leaves in peri-urban settings.

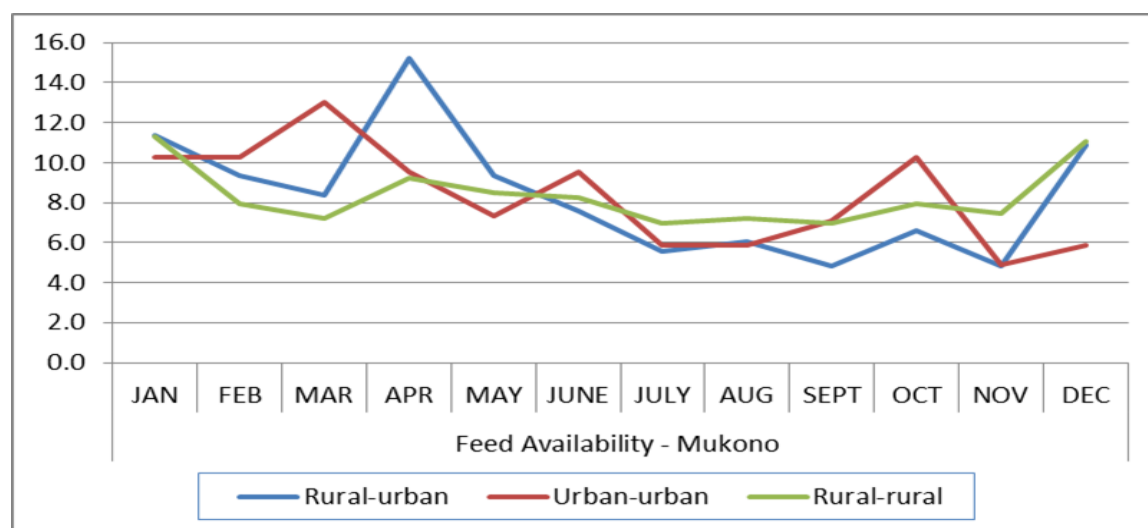
Figure 19: Use of fodder sources in smallholder pig systems in Uganda, as a function of value chain domain



Source: Pezo et al, 2015

Figure 20: Relative availability of feeds along the year in smallholder

The figure below illustrates the seasonality of pig feeding strategies in Uganda.



Source: Ouma et al, 2014

11.3. Importance of sweetpotatoes in Uganda and Eastern Africa

Uganda is the second largest producer of sweetpotatoes in the world, only after China. The area planted with sweetpotato has not changed much in the last 35 years in Uganda but there were significant increases in productivity (FAO, 2014).

Sweetpotato is a widely grown crop and a good source of energy (roots) and protein (vines), but highly perishable. Feed conservation strategies will help to reduce wastage of sweetpotato residues, and extend their use in periods of feed scarcity. Simple silage making technologies are easy and affordable options for conservation of sweetpotato roots and vines; but, new options need to be assessed and shared with farmers. With strategic supplementation farmers can get good biophysical and economic results.

Table 4: LWG (g day⁻¹) in local and crossbred pigs fed on concentrates, SP silage- and fresh local feeds-based diets ¹

| Diet | Crossbred pigs ^a | Local pigs ^a |
|------------------------|-----------------------------|-------------------------|
| Commercial concentrate | 660 ± 105 | 530 ± 93 |
| Local feeds formulated | 310 ± 92 | 210 ± 72 |
| Sweet potato silage | 470 ± 92 | 390 ± 64 |

^a Pigs weighing > ±20 kg at beginning of the trial

¹ Results have been shared with female and male farmers in Masaka, to assess acceptability of these technology innovations.

- Poor results with weaned pigs with lower initial weight

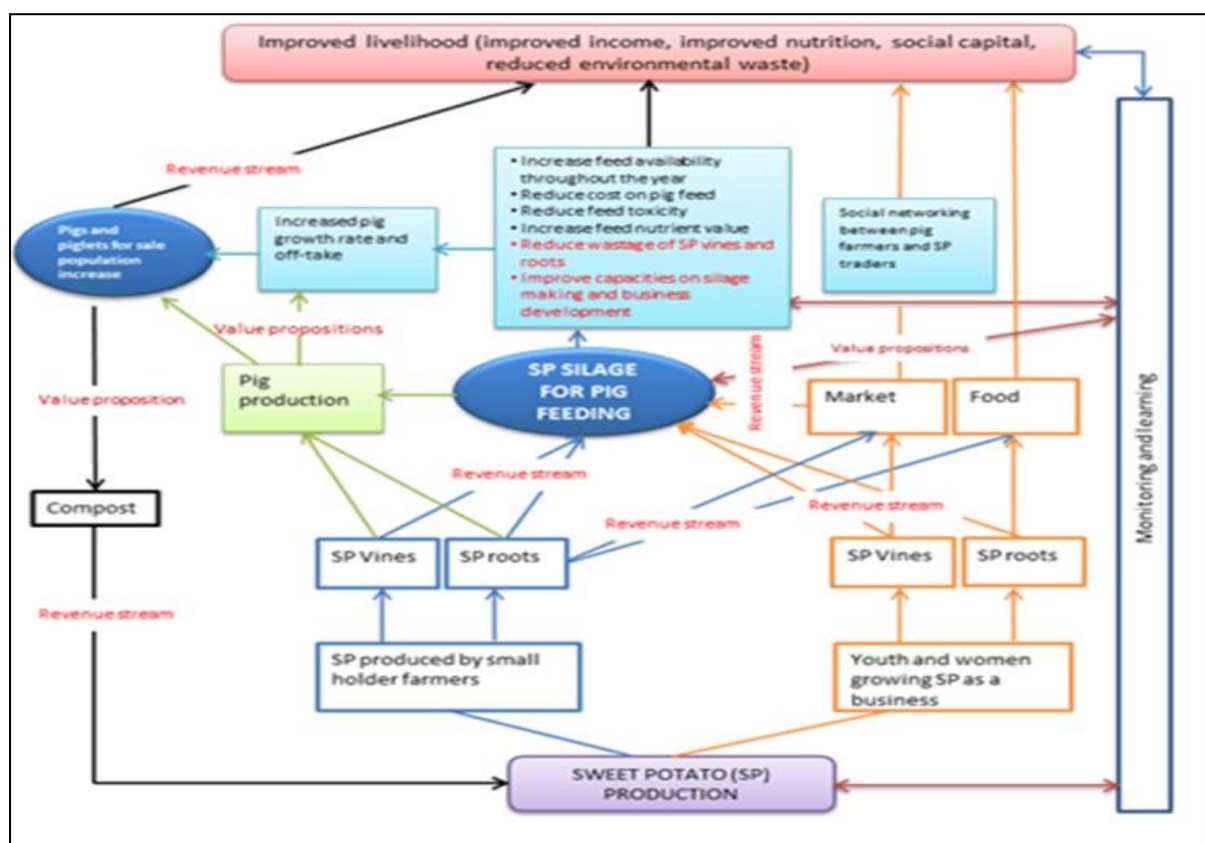
Source: Carter et al, unpublished data

Table 5: LWG, FCR and economic benefits in pigs fed on farmers' diets or sweetpotato silage-based diets + supplements in Sichuan

| Diet | Initial weight, kg | LW gain, g day ⁻¹ | Feed Conversion kg kg ⁻¹ | Economic benefit increase, % |
|---|--------------------|------------------------------|-------------------------------------|------------------------------|
| Farmers' Control | 41.0 | 438 | 4.86 | ----- |
| SP silage + Protein-rich concentrate | 40.9 | 624 | 3.44 | + 33 |
| SP silage + Premix (amino acids and vitamins) | 41.1 | 662 | 3.22 | + 78 |

Source: (Pezo et al, 2004)

Figure 21: A business model promoted under Roots, Tubers and Bananas (RTB)-ENDURE, by ILRI, CIP and partners in Uganda



Based on the results of this work, the use of sweetpotato silage as pig feed results in significant increases in live weight gain and a reduction in feeding costs by partial replacement of commercial concentrates; therefore it could contribute to improve the livelihoods of poor households that raise pigs and grow sweetpotatoes.

12. CAN RADIO GET SWEETPOTATO MARKETS GOING? RADIO AND SWEETPOTATO PROMOTION

SHEILA RAO - FARM RADIO INTERNATIONAL

Farm Radio International (FRI) started in 1979 in Canada, founded by a broadcaster who had the vision to share knowledge and to give farmers a voice. Radio is especially effective because it communicates messages in a language that is understood by the audience, it is accessible, and it is a cost-effective medium for operating on a large scale. Furthermore, it is effective where literacy levels are low and it builds on the oral tradition of African communities.

FRI has the following four areas of intervention: (i) Resources for broadcasters; (ii) broadcaster training; (iii) impact programming and (iv) integrating modern technology.

12.1. FRI's work with OFSP

The following has been done:

- Using serialized radio mini-drama to contribute to increasing knowledge and consumption of OFSP in Uganda
- Using inclusive, demand driven radio and communication strategies to support knowledge sharing and adoption of OFSP

This work was a multi-country initiative that covers Ghana, Burkina Faso, Uganda and Tanzania. Participatory radio campaigns focused on three main areas: Production (vine and tubers); consumption and nutritional knowledge. The goal was to increase the overall adoption of OFSP in targeted region in all four countries. The activities included cooking shows, primary schools partnerships in Tanzania, orange Fridays in Cape Coast, Ghana, establishment of national advisory teams in all countries as well as international advisory meetings.

12.2. Examples of ongoing partnerships



HarvestPlus in Uganda wants to reach 225,000 farming households in three regions and create demand for OFSP throughout the country through their *Developing and Delivering Biofortified Crops* initiative. They need messaging to be consistent, locally relevant and to raise awareness of and create demand for OFSP. As such, the messages had to be in six local languages that are spoken in 13 districts of Uganda. HarvestPlus wanted programs to interact with audiences and gather data. To help achieve these objectives, FRI led the development of an entertaining and educative radio mini-drama series, in close collaboration with HarvestPlus Uganda, and supported with SMS polling (TRAC FM). It is expected that 350,000 households in 13 districts will gain access to a radio mini-series that promotes production and consumption of OFSP, and that the radio mini-series will contribute to

increased knowledge of OFSP nutrition among listeners. The intervention also expects to increase knowledge about the preparation and consumption of OFSP. The target is to ensure that seven radio stations in Uganda promote OFSP through radio mini-drama and complementary radio spots.

Under the **Gates OFSP** initiative, 45 radio station staff in 15 radio stations will undergo training in nutrition and OFSP, and broadcaster training to enable them to continue producing effective farm radio programs. The initiative hopes to reach 4,500 listener group members and to enable 15,000 farmers gain "on demand" access to OFSP information through use of Information and Communication Technology (ICT) such as interactive voice response and recordable radios. The overall goal is for 100,000 households to begin growing and eating OFSP.

12.3. My children

This radio play was implemented by FRI, H+ and TRAC FM. Audience research was done through Focus Group Discussions (FGDs). Broadcasters were trained on OFSP, radio craft and use of ICTs. The next step was participatory drama design, scriptwriting, translation and audio production. During broadcast, SMS polling was done by TRAC FM. Monitoring of the outcomes was one together with HarvestPlus and partners in community groups.



My children was made up of 30 episodes, each 2-4 minutes long which are repeated. Each episode focuses on one key message or piece of information regarding production and nutritional aspects of OFSP. Listeners participated through free SMS polls and quizzes at the end of each episode. Listeners can call and listen to previous episodes for 55 UGX/minute.



The plot: *My Children* is a story about love, domestic strife, money, power, and OFSP. Florence, the heroine of the series, struggles to grow enough nutritious food to feed her family, and knows that her children are not as healthy as they could be. She reluctantly decides to give OFSP a try. But first she has to stop her money-obsessed husband from selling the family farming plot to fund a foolish "business idea." The table below shows the potential reach of the show.

Table 6: Potential listeners of *My Children* radio play in Uganda

| Station | Potential Listeners | Coverage | Disctrict | Language |
|-----------|---------------------|----------|-------------|----------|
| Mega FM | 2,000,000 | 240km | Gulu / Oyam | Luo |
| Radio Waa | 2,000,000 | 200km | Kole / Lira | Luo |

| | | | | |
|----------------------------|--------------|--------|---------------------|-------------|
| Kamuli Broadcasting (KBS) | 3,000,000 | 80km | Kamuli / Buyende | Lusoga |
| Central Broadcasting (CBS) | 7,000,000 | 4200km | Mukono/Rakai/Masaka | Luganda |
| Liberty FM | 3,000,000 | 1000km | Kibaale | Bunyoro |
| Radio West | 1,500,000 | 1000km | Isingiro | Rukiga |
| Voice of Kigezi | 8,000,000 | 800km | Kabale | Rukiga |
| Voice of Kamwenge | 8,000,000 | 750km | Kamwenge | Rukiga |
| Voice of Muhabura | 2,000,000 | 750km | Kisoro | Lufumbira |
| KKCR | 5,000,000 | 500km | Kibaale | Bunyoro |
| 10 radio stations | 25,000,000 + | | 13 Districts | 6 + English |

TRAC FM is an innovative software platform using radio and Short Messaging System (SMS) to enable you to track citizen reports and collect citizen feedback. Based on poll questions, listeners can vote and air their voices through a toll-free SMS line (free of charge) and interact with the radio studio through a real-time visualization. TRAC FM engages citizens in meaningful public debate and changes them from passive listeners to active participants. For example in Radio Waa, there were 50,000 responses.

12.4. Outcomes

Farmers claim to have gained knowledge on the nutrition content of OFSP and its use, vitamin A and effects of VAD. The radio drama has led to a positive change in attitude to OFSP, in turn leading to high demand for OFSP vines. Vines are now moving around Uganda and being shared by farmers. Women want to join groups so as to obtain OFSP vines because they see the benefit by both selling and consuming. Children also ask for OFSP as they are attracted to its color and taste. Those who have vines say they have planted and seen the benefits, while others are still accessing vines and plan to grow.

Nonetheless, there are still some challenges. Demand often exceeded supply of vines. Radio stations broadcasted drama at various times, where some listened more than others. There is also an unmet demand for recipes.

“The radio is where we are not. It eases our work. The drama answers some of the questions that the farmers ask us. It also helps to introduce us to new villages.”

Tadeo Khamala, field extension worker, HOCADERO.

“I now feed OSP to my kids at least three times per week.” Ruth Birungi, OSP farmer from Kitojo-Mbarara village, Isingiro district.

“I learned from the drama that there’s a market for OSP. If I grow more I can make some money.” Yoronim Bishanga, Kitojo-Mbarara, Isingiro district.

12.5. Conclusions

An interactive radio mini-drama series is an efficient means for scaling up awareness and knowledge of OFSP. It is cost-effective, more so when used in concert with other mechanisms such as face-to-face extension where available. Broadcasters can play a large role in gaining trust and buy-in from rural populations. Through good radio, a platform for informed farmer decision-making can be created. From the experiences with My Children, there is need for a better integration of the mini-drama series with other OFSP and nutritional interventions, as well as more discussion on stereotypes and 'hype' needed.

12.6. Summary of question and answer session

The first question was how appropriate program time was determined. The presenter said that FRI carried out formative research to know the peak listening hours, which were found to be in the evenings. FRI then negotiated with the stations to find out which times were both affordable and could guarantee a wide reach. Because radio airtime is very expensive, FRI made additional offers of training and networking that stations may otherwise not have had access to.

The second question was on whether FRI measured impact by checking the uptake of vines before and after broadcasts. The presenter explained that with radio, it is always difficult to determine distribution of vines that can be attributed only to the broadcasts, because radio never works independently of other services and programs. Rather, it is easier to evaluate the specific added value that radio had on targeted listener groups.

The third question was on whether FRI always worked with community radios. The presenter described examples in which they had worked with other stations, such as Radio Maria in Tanzania. The reason for this was that community radios did not always have the resources or infrastructure, even though they had the potential for better reach in the community. That is why sometimes it was more effective to work with private stations that had better established structures.

13. Round Table Discussion & Puree Demonstration: New product development and challenges facing sweetpotato processors

Tawanda Muzhingi (Food Scientist), Penina Muoki (Value Chain Specialist) and Antonio Magnaghi (Euro Ingredients) discussed the experiences in development of new products, and shared challenges faced by sweetpotato processors, such as hygiene and quality assurance, reliability of supplies and access to machinery. They also carried out a demonstration of puree making.

Issues discussed include:

Production costs: The human work and controls required to integrate puree in products is very high, and that is probably why the private sector has until now shied away. Support of puree processors that are willing to supply industries with ready-made puree, tailored to the specifications of the baking, dairy and other industries is likely to increase the uptake of puree. People are becoming specialized in doing puree and they will get further training.

Hygiene: Concerns have been raised with regard to prevention of contamination, especially during washing and cutting of sweetpotato. Hygiene is key to making processing viable and adoptable. Apart from training, hygiene can be guaranteed through establishing good quality controls.

Access to equipment: In some cases, the equipment available in the market may not be appropriate for the purposes intended by processors. In such cases, it is possible to liaise with the equipment suppliers to make the adjustments required. Sometimes, local solutions can be sought to adapt or produce equipment that are well suited to the processors' needs.

14. DEVELOPMENT AND CHARACTERIZATION OF PEANUT BUTTER ENHANCED WITH OFSP

JOSEPH MULINDWA - MAKERERE UNIVERSITY

This presentation explained the work done to develop a product that exploits increased utilization of peanut butter in Uganda and the pro-vitamin A content of OFSP. He reported on the nutritional, sensory and storage studies of the developed product.

14.1. Background

Peanut (groundnut) production in Uganda is 235,000 MT.¹⁸ Peanuts are utilized as peanut butter, sauce, roasted, or confectionary, etc. Peanuts are high in oils and proteins and they can replace animals as source of protein.

Another important crop in Uganda is OFSP with the potential to combat VAD. VAD prevalence is 33% in children 0-59 months and 20% in women 15-50 years.¹⁹ Therefore, OFSP was used to increase the pro-vitamin A content of peanut butter.

Peanut butter was selected because its utilization is on increase in Uganda. Addition of OFSP to oil-rich peanut butter could result into a nutritious product with high bioavailable beta carotene; consequently, enhancing peanut butter with OFSP may reduce the prevailing VAD in children.

14.2. Objectives of the study

This study aimed at the production of shelf stable acceptable pro-vitamin A enriched peanut butter. The specific objectives were:

1. To determine the nutritional composition of the developed pro-vitamin A-rich peanut butter from peanuts and OFSP
2. To determine the acceptability of the pro-vitamin A-rich peanut butter from peanuts and OFSP



¹⁸ FAOSTAT, 2012: FAO (Food and Agricultural Organization) statistics database. <http://www.fao.org>

¹⁹ UBOS, 2010: Uganda Bureau of Statistics (UBOS). (2010). Statistical Abstract. The Republic of Uganda. www.ubos.org/onlinefiles/uploads/ubos/pdf

3. To determine the shelf life of the pro-vitamin A-rich peanut butter from peanuts and OFSP

Hypotheses

1. Addition of OFSP flour into peanut butter can enhance its pro-vitamin A content
2. An acceptable shelf stable pro-vitamin-A rich peanut butter can be produced by combining peanuts and OFSP

14.3. Materials and Methods

- Peanuts (Valencia variety) from the National Semi-Arid Resources Research Institute (NaSRRI).
- OFSP (Naspot 10, 4 months maturity) from Volunteer Efforts for Development Concern (VEDCO) Uganda.
- Chemicals and reagents- from Westford, Kampala, Uganda.

The method adapted was production of peanut butter enhanced with OFSP by Ozcan & Seven²⁰ with modifications to suit the available technology.

Cost analysis: A cost analysis of enhancing peanut butter with OFSP was undertaken. It was determined that the unit production cost is UGX 1727.50 (1 USD = UGX 3281)

Table 7: Cost analysis of enhancing peanut butter with OFSP in Uganda

| Materials/service | Unit cost (UGX) |
|---------------------------|-----------------|
| Ground nuts (1 kg) | 3,500 |
| OFSP roots (0.75 kg) | 300 |
| Drying of OFSP/kg | 10 |
| Roasting of groundnuts/kg | 500 |
| Peanut grinding/kg | 1,000 |
| Packaging 4 tins | 600 |
| Transport costs | 1,000 |
| | 6,910 |

Source: Mulindwa (2013) Makerere University

Chemical analysis: Total pro-vitamin A carotenoid content was analyzed using a procedure described by Rodriguez-Amaya & Kimura.²¹ M.C, protein, dietary fibre, fat/oil and total sugars analysis was done according to AOAC 1999.²²

²⁰ Ozcan & Seven (2003): Ozan, M., & Serap, S. (2003). Physical and chemical analysis and fatty acid composition of peanut, peanut oil and peanut butter from CQM and NC-7 cultivars. *Grasas y Aceites* 54(1), 12-18.

²¹ Rodriguez-Amaya & Kimura (2004): Rodriguez-Amaya B.D & Kimura M. (2004). *Harvestplus Handbook for Carotenoid Analysis*. Harvestplus Technical monograph 2. Harvestplus. Washington DC.

²² AOAC (1999): AOAC. (1999). *Official methods of analysis*. Association of analysis chemistry, Washington, DC.

Sensory evaluation: 50 semi-trained panelists were randomly selected. Four samples of the treatment combinations were presented to each participant. Sensory attributes were scored using the 9-Point Hedonic Scale.

Shelf stability analysis: Acid value and peroxide value was analyzed according to AOAC, 1999. Enumeration of *S. auerus*, yeasts and moulds was done according to the International Standard-ISO 21527-2 method, while enumeration of coliforms was done according to the International Standard-ISO 4832 method.

Data analysis: Data for sensory evaluation was summarized and analyzed using SPSS (version 16). Means were tabulated and subjected to ANOVA using Genstat (13th Edition). Means were separated using LSD ($P \leq 0.05$) to determine significant differences.

14.4. Results and discussions

Shelf stability study of OFSP enhanced peanut butter was studied considering changes in lipid quality: acid value and peroxide value; beta carotene retention; microbial quality and sensory properties.

Table 8: Sensory evaluation of freshly produced OFSP enhanced peanut butter

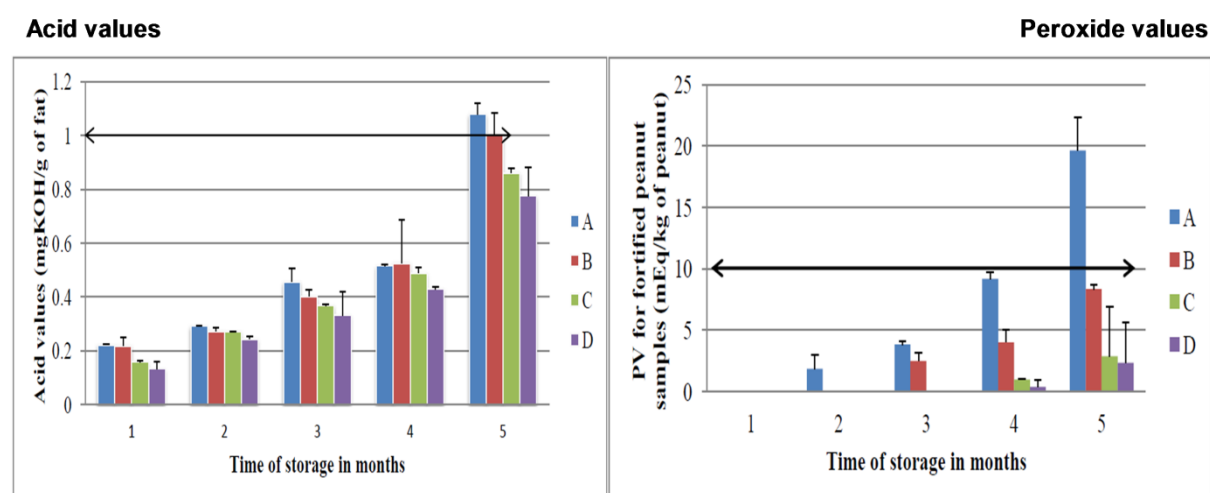
| | Colour | Aroma | Oiliness | Spreadability | Taste | Flavour | Overall acceptability |
|----------------|------------------------|------------------------|------------------------|-------------------------|------------------------|------------------------|-------------------------|
| Control sample | 6.68±1.65 ^a | 6.47±1.51 ^a | 6.08±1.89 ^a | 5.22 ±2.02 ^b | 6.35 ±2.2 ^a | 6.02±1.88 ^b | 6.22±1.82 ^a |
| Treatment B | 7.31±1.29 ^a | 6.89±1.27 ^a | 6.85±1.59 ^a | 6.60 ±1.98 ^a | 6.79±1.55 ^a | 6.58±1.36 ^b | 7.20 ±1.18 ^a |
| Treatment C | 7.41±1.06 ^a | 6.81±1.40 ^a | 6.87±1.24 ^a | 5.77 ±2.07 ^b | 6.89±1.60 ^a | 6.70±1.58 ^a | 7.04±1.58 ^a |
| Treatment D | 6.83±1.98 ^a | 6.25±1.65 ^b | 6.27±1.84 ^a | 6.25 ±2.03 ^a | 6.22±1.83 ^a | 6.06±1.82 ^b | 6.33 ±1.95 ^a |

Values are means ± Standard deviations. Means followed by the same letter in the same column are not significantly different ($P < 0.05$).

Source: Mulindwa (2013) Makerere University

Figure 22 below shows the changes in acid and peroxide values of peanut butter samples with storage time.

Figure 22: Changes in acid and peroxide values of peanut butter samples with storage time

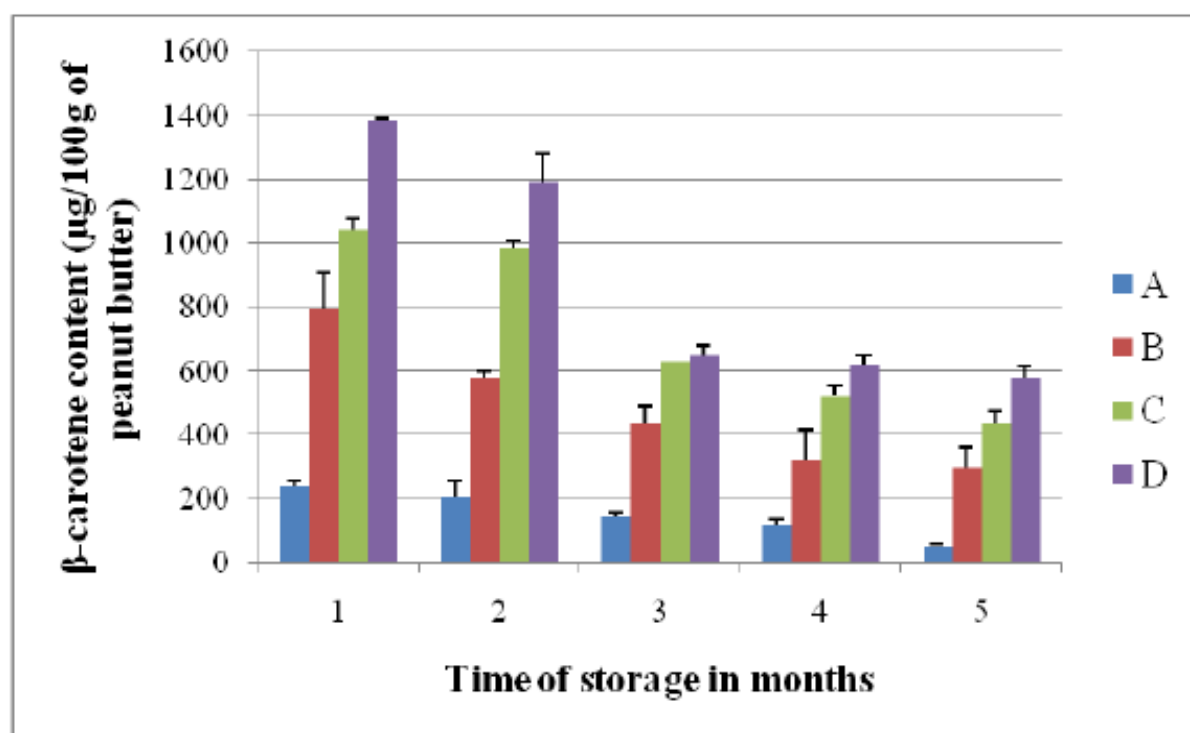


Source: Mulindwa (2013) Makerere University

For the first month there was no peroxide formed but by the fifth month there was a rapid shoot of peroxide.

From the first to fourth months there was a rapid decrease of beta carotene, after which it stabilized. The higher the levels of beta carotene contained, the higher the degradation. Retained beta carotene could still provide the required vitamin A content. With the addition of OFSP, stability of fat in the peanut butter increased.

Figure 23: Beta-carotene retention of OFSP enhanced peanut butter with storage time



Source: Mulindwa (2013) Makerere University

14.5. Conclusion and recommendations

The method used was able to produce an acceptable product. Beta carotene in OFSP enriched peanut butter increased with increased addition of OFSP. The product enriched with 15% OFSP had the highest beta carotene. Shelf stable OFSP enriched peanut butter product contained adequate beta carotene.

More research needs to be done to determine (i) the consumption rate of the OFSP enhanced peanut butter to meet recommended daily vitamin A intake; (ii) effectiveness of OFSP enhanced peanut butter to change vitamin A status of individuals; and (iii) OFSP's potential to reduce the oxidation of oils and levels to use.

14.6. Summary of question and answer session

During the discussion, the following issues were covered:

Substitution ratios: Participants discussed the level of substitution and whether it was possible to go beyond 15% substitution. The presenter said that although acceptability was generally high, he had run out of finances to continue testing. However, it was agreed that if the proportion of OFSP could increase, it would also lead to higher the nutritional value.

Available proportion of vitamin A: In response to a participant who wanted to know whether the product had real potential to provide the required daily vitamin A intake, participants familiar with the eating habits in Uganda discussed that since groundnuts formed an essential part of the daily diet, the peanut butter developed would not only serve as a spread on bread, but as a sauce in many other meals consumed across the day, including on chapattis and cooked bananas. Therefore, consumption of the required amounts of vitamin A was possible.

Food safety, especially with regard to aflatoxin: This question was raised to find out whether consideration of microbial aspects had gone as far as checking for aflatoxin; leading to a debate about appropriate methods for detection of aflatoxin in groundnuts. While the presenter had used a method in which groundnuts are exposed to mild heat for the shortest time possible and then the discolored nuts are removed, some participants argued that the method described was appropriate for mold but not for aflatoxins. However, the discussion concluded when one participant explained that blanching technology had been tested in Kenya and although it involved a lot of work, it was effective in testing and removing groundnuts that are affected with aflatoxin.

Labelling: The question of the level of substitution that one could reach to acceptably still refer to the product as peanut butter was raised. The response to this question was that labeling guidelines exist, and product developers could get them from their local government offices.

Standards for moisture content of puree: This was deemed a particularly important question when getting product certification by the national bureau of standards. Contributing to this discussion, many participants were of the opinion that most African countries would lack such standards, and some of them proposed that this could be an area that the CoP could follow up. However, participants were also informed that product developers are not working in a complete vacuum, as there are specific requirements that they were required to fulfill depending on the product that they wanted to release, and all they had to do was to get these guidelines.

15. ROUND TABLE DISCUSSION AND PUREE DEMONSTRATION: NEW PRODUCT DEVELOPMENT AND CHALLENGES FACING SWEETPOTATO PROCESSORS

The round table discussion was done by Antonio Magnaghi, Penina Muoki and Tamanda Muzighi. The discussion was opened by Antonio who highlighted the following points:

- Organi Limited, which is a local company focused on puree and concentrate production (extraction and processing of raw roots) because it makes more economic sense. It is something that gives an attractive product to the manufacturer because they are providing a product that cuts down on labor and cost of production.
- In Mozambique, Zebra Farm and So Soja are using both OFSP and Soybeans, and have found a way to add value to and monetize sweetpotato and soybean pulp, which one would otherwise consider a reject. Some of the equipment under use by private sector partners has been adapted to local requirements, such as the partner in Rwanda, Sina, is making OFSP juice liaised with the manufacturer in Europe to adjust the machine that they wanted to use.
- Sweetpotato varieties cannot all be handled the same way because they behave differently. One must do a lot of work to ensure that correct instructions are given to manufacturers.

Tawanda then opened up the discussion for questions. Responses were initially made by the panelists, and other participants were free to contribute their own knowledge and experiences to the interactive discussion. In this section, the questions and array of answers is summed up:

How do we retain the volume in the bread considering that OFSP has no gluten and which rates can we go with when replacing wheat with OFSP puree?

- The way to achieve volume is to combine enzymes, yeast and baking powder. There are enzymes that reinforce gluten content in the flour. Another thing is the addition of gums to retain water and gas. Third, the process does not involve resting the dough.

I would like to know the shelf-stability of OFSP puree? You said the data is not ready but can you give us an indication?

- We had two arms: on the one hand we tested a combination of sodium benzoate and potassium sorbate and on the other hand we used an experimental anti-fungal and anti-microbial treatment, and we had a control with nothing at all. The second factor was the packaging: the treatment was done using two different types of packing regular and vacuum packing. The first two work well up to about 2.5 months, but the anti-fungal, anti-microbial treatment can go for a longer period under the vacuum package. We are also going to try reducing the pH level of the puree to 4.6 because at that level most spores and the bacteria and fungi do not survive and we will combine with the sodium benzoate and potassium sorbate to see how the puree behaves.
- Issues that arise are how to retain the beta carotene. If you extract and use when raw, then you are able to retain higher amounts of beta carotene.

How do you calculate the amount of OFSP puree to add in bread?

- Normal standard bread ingredients include flour, water, fat and yeast. When doing calculations to replace wheat flour with OFSP puree, you must understand how much dry matter and moisture content of the. There is a technique to calculating all this. It's also important to note

that the dough is very sticky, which conventional bakers might think is wrong, but this is not the case.

- In Ghana, the experience is that you need to explain to the baker in their language, which is not about the moisture content but about the ingredients and the measurements of these ingredients.
- This means therefore that the bakers should get documentation which shows them exactly how much water to use for different levels of moisture content. For us to ensure that it works at wide scale with private sector, scientists must come up with recommendations that are as simple and straightforward as possible.
- In my experience, you cannot deal with all varieties in the same way. We have to do a lot of work to ensure that we give bakers the correct instructions depending on the variety they use. This especially applies when it comes to moisture content. One can use a moisture content analyzer and place the information on moisture content in the batch of puree being delivered. The baker will adjust their water input accordingly.
- Moisture content will always affect the consistency of the dough, so it is better to document them scientifically. There are equipment such as Farinograph and Consistograph that can be used to do this. I know we put more value for the nutritional value and that is why we are establishing a lab here, but we should consider establishing this lab, which is difficult to get in the private sector.
- In Homabay, the maturity of the roots has been found to make a difference; if they are not mature, the water absorption is higher.
- Cooking method is vital to getting a consistent puree. You need to control the cooking. With the technology available, steaming is recommendable, as it helps to control the timing and amount of water.
- As the researchers continue to document all these things, they should share this information to enable the CoP members to respond to some questions, such as the proportion of wheat replacement per recipe and how much savings are made by this replacement.

Are there standards for the substitution of wheat with OFSP?

- In food, you mostly have to respect microbiology and weight. In East Africa, specialized products are a category. The CoP has an opportunity to influence some things and address gaps in standardization of OFSP products.
- In 2009-2010 standards in East Africa were harmonized, and this included root crops. Puree is not included, but once you have a new process, all you have to do is inform the bureau of standards to organize a stakeholders' meeting and set a standard for it. All five East African countries are under one standard.
- When developing a complementary food; there is a gold standard on which we base our product. When doing the refining work that we are doing, we should use this and not worry too much about the national standards.

This session also involved the demonstration of puree processing. Participants observed the process and discussed the speed of production, the merits and demerits of the processing equipment. They also had an opportunity to taste the baked products that had been produced with OFSP along with the spreads provided by other participants.

16. STORAGE OF SWEETPOTATO ROOTS IN ZERO ENERGY COOL CHAMBER

MADJALIWA NZAMWITA, RWANDA AGRICULTURE BOARD

Madjaliwa Nzamwita presented the research that has been going on to improve storage technologies in Rwanda. He began by asking: “How do you feel when you leave the swimming pool? Those who do swim understand how it feels. This is the phenomenon that would be used to expand the shelf life of the sweetpotato.”

How **EVAPORATIVE COOLING** works

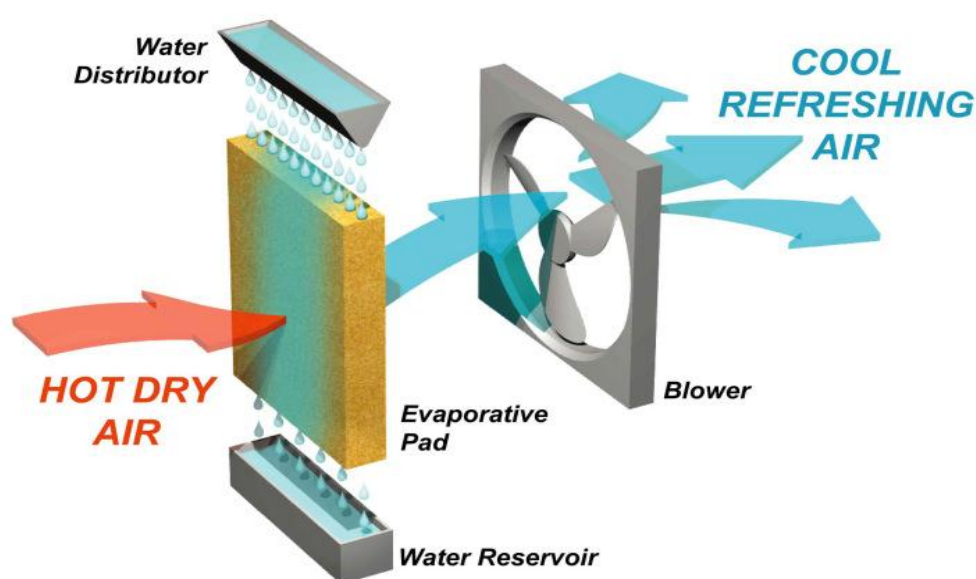
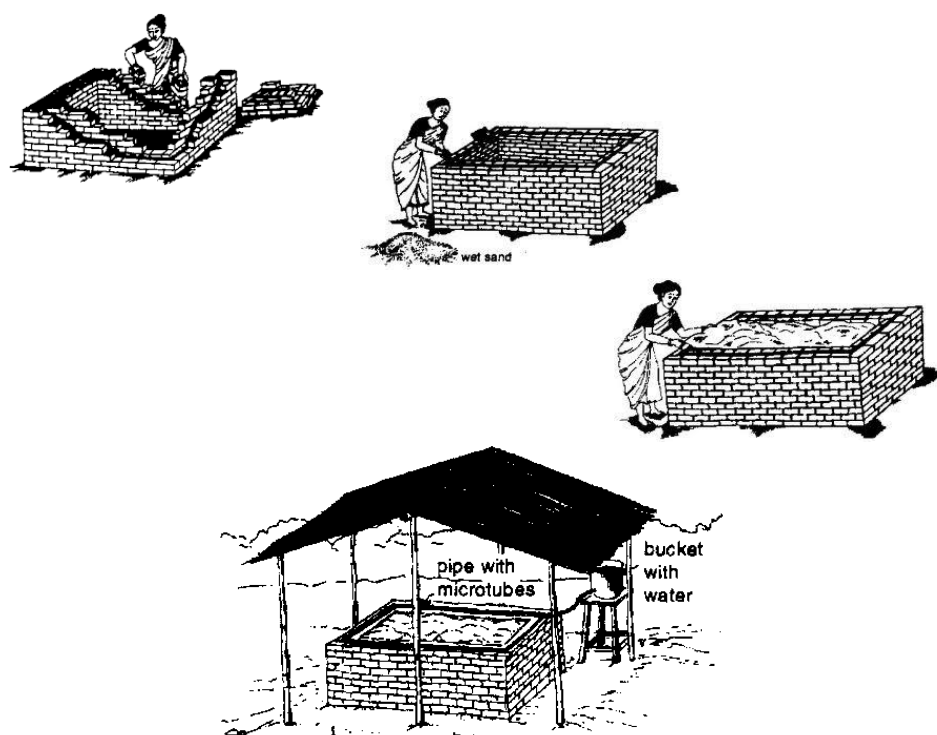


Figure 24: How evaporative cooling works²³

There is a double wall structure with a space in between, in which one can put sand or charcoal. The product is then placed inside the storage container and covered. One should ensure that the sand or charcoal does not come in touch with the product. It is important to ensure steady supply of water to keep the sand or charcoal wet. As the temperatures around it rise, the water evaporates and cools the structure. The design was adapted from a model that is successfully being implemented in India.

²³ <https://muellerdesignlab.wordpress.com/2012/04/20/diy-evaporative-cooler-design/>

Figure 25: Model of the storage structure in use in India



16.1. Methodology

Two structures were tested for storage of different sweetpotato varieties: one was the farmer's house, while the other was the storage structure.



Records of relative humidity in and out of the house were to be recorded; although the sensors went off before all the data was collected, the data that had been collected, along with data from a previous study, was sufficient to analyze and come up with reliable findings.

16.2. Results and findings

The analysis looked at different parameters such as weight loss and sprouting.

Total soluble solids: During storage, sweetpotato roots that contain up to 80% water, also lost a lot of water, which increased its sweetness (see figure below). Madjaliwa referred to the previous presentation by Eric, in which it was found that baking became sweeter. When compared to the findings of this study, it could be deduced that another contributing factor for increased sweetness

was the loss of water during cooking, which causes an increase in the other components. For example, some of the varieties such as Gihingumukungu are classified as non-sweet, but farmers have reported that after storage, they become sweeter.

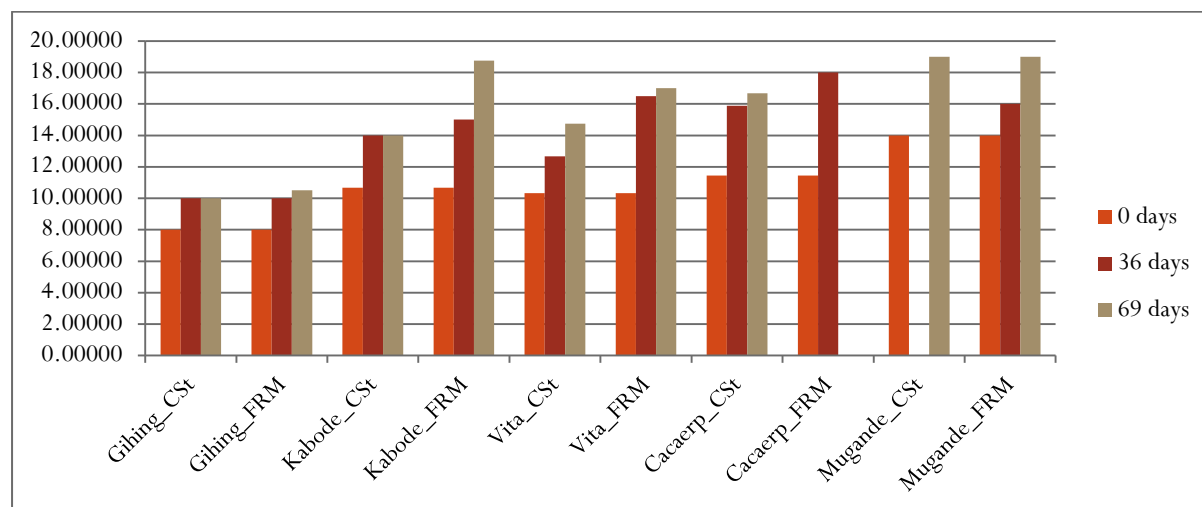


Figure 9: Total soluble solids²⁴

Source: xxxx

Percentage weight loss: The loss of weight of sweetpotato roots stored in the storage structure was less than those that were stored in the farmer storage; however, it was difficult to get sweetpotatoes of a uniform size for accurate comparison. As time went by, the roots reduced in size and appeared smaller (See figure below).

Figure 26: Appearance of sweetpotatoes in farmer storage and storage structure after 0 and 36 days



²⁴ The x axis on table = brix (unit for sugar). Any soluble compound can be detected using the same approach

Rotting: The roots were cut into 4 halves to look at internal appearance. The roots that were stored in the cold storage structure did not rot a lot as compared to those under farmer storage.

16.3. Conclusion and recommendations

The cool storage structure can help to keep the quality of the roots. The shelf life of sweetpotato roots depends on the variety; Gihingumukungu maintained its quality after 69 days of storage. Evaporation of water from the roots led to shrinking thereby affecting their weight and appearance.

There is need to increase the relative humidity inside the storage structure to minimize the rate of evaporation and to conduct chemical analyses on the roots (Starch, sugars, carotenoids, enzymatic activity etc). The presenter concluded by urging participants to recommend the appropriate “curing process” under tropical conditions.

16.4. Summary of question and answer session

The presenter was asked whether considerations were done for the application of the roots before they are exposed to zero energy cool chamber i.e., studying the effect of storage conditions on the quality of the roots and effect on the processing quality: He mentioned that the study is still under way and considerations will be done but at the moment not determined.

In his presentations he mentioned that they did not take the temperature and the relative humidity because of the failure of the sensors due to battery losses. He however mentioned that in the previous studies, temperatures were taken and were in the range of 13-17°C. It was further mentioned that there is full data for 6 months from the previous work.

It was however mentioned that there are challenges with the technology like determining the water drips to inject into the system for example calibrating the duration of release and the time of the day when water drips can be released into the system. There is also a challenge of water supply, so to sustain the system water has to be pumped from distant sources.

Concern was also raised that the structure design does not take into consideration the air/moisture circulation; therefore there may not be evaporative cooling since the structure is covered and no air movement. Further, audience wanted to know why charcoal was opted instead of sand. The response was: Rwanda’s sand is not good yet porosity of the sand has to be considered for the system to work effectively and charcoal has been proved to provide good results. The issue of removing the sand from the structure also is a factor to consider since the structure is tall and removal of sand can be a challenge. So charcoal was opted based on those reasons.

The structure being covered was backed up with the reasoning that thieves could enter and steal the materials if it is left with open loaf. However they noted that, there is space left which can cater for the air circulation.

Advice was given that they can look into using solar panels to facilitate the cooling, however members suggested that cost analysis has to be put into considerations before choosing which technology to go with since something cheap and sustainable is needed.

17. RAINBOW PROJECT IN NIGERIA: PROGRESS ON TECHNICAL AND ADAPTIVE RESEARCH ON FRIED AND BAKED SWEETPOTATO-BASED PRODUCTS –

GANIYAT OLATUNDE - FOOD SCIENCE & TECHNOLOGY DEPARTMENT; FEDERAL UNIVERSITY OF AGRICULTURE, ABEOKUTA, NIGERIA

17.1. About RAINBOW Project

Sweetpotato for Health and Wealth in Nigeria Project, popularly known as the ‘RAINBOW Project’ is sponsored by the Federal Ministry of Agriculture and Rural Development (FMARD). It is managed by CIP Nigeria. A four-year project started in March 2014. The RAINBOW project aims to:

- Transform all varieties of sweetpotato into a major high income generation industrial crop for farmers while playing a big role in food security and malnutrition; and
- Improve market opportunities for sweetpotato beyond the fresh roots market, by exploring processed products value chains, thus creating jobs and wealth.

Orange-fleshed varieties are particularly targeted to improve vitamin A status of consumers. The project works in six states (Osun, Kwara, Nasarawa/FCT, Kaduna, Benue, Ebonyi). The partners are FMARD, ADPs, NRCRI, FUNAAB, FedPoly, Offa, Helen Keller International (HKI).

17.2. Value chains components

1. Nutrition value chains: improved intake of vitamin A and essential nutrients by children
2. Diversified product value chains: link farmers to processors of fried and baked OFSP products

Fried and baked products were identified after a rapid appraisal conducted in selected states in Nigeria in 2011.²⁵ The appraisal found that sweetpotato was popularly consumed as fresh roots, fried products (street fries, French fries, crisps), baked products, glucose syrup, flour for cooked paste (amala) and non-alcoholic beverage (kunnun). Fried and baked products were the most popular.

The project wanted to achieve the following:

- 📋 Identify at least two enterprises in the FCT interested in baked and fried products
- 📋 Develop consumer acceptable baked and fried OFSP-based products and demonstrate its economic viability in addition to high pro-vitamin A potential amongst other nutrients

17.3. Identification of Enterprises

To document existing practices, prospects, and challenges for substitution or replacement in existing wheat- and root-based products, a survey of 81 enterprises and 166 consumers was undertaken using structured questionnaires. The data collected included demography of respondent (gender, age, education status, etc.), characteristics of enterprise (franchised or non-franchised, staff strength, etc.), production (product type, raw materials, quality assurance, prospects, challenges), marketing (patronage, target consumer, consumer health considerations, etc.) sweetpotato

²⁵ Onumah, G., Dipeolu, A. and Fetuga, G. (2012). Sweetpotato Value chain study: Exploring opportunities to promote greater exploitation of the benefits of sweetpotato in representative states in Nigeria. Report submitted to International Potato Center, Lima, Peru. 71pp

utilization (product type, awareness of OFSP), and willingness to use SP/OFSP). The areas sampled were: Bwari, Gwagwala, Abuja Municipal and Kuje.

The results show that the enterprises have very good prospects. To take into consideration the health concerns of their customers – such as diabetes, weight gain, ulcers and hypertension – the enterprises produce products with reduced oil, sugar, salt or pepper.

Table 10: Baked and fried goods produced by enterprises

| Baked | Fried |
|----------------|-------------------------------------|
| Bread* | Doughnuts* |
| Meat/fish pie* | Potato fries/chips (French fries)** |
| Sausage roll* | Plantain chips |
| Cake (Muffin)* | Sweetpotato chips/crisps** |
| Cookie* | |
| Chinchin* | |
| Pizza* | |

*wheat-based





**root & tuber-based

Level of awareness: There is a low level of awareness of OFSP among enterprises (22%) and consumers (41%).

Willingness to pay: 75% of the consumers are willing to pay extra cost for health benefits of OFSP and 72% of enterprises are willing to use OFSP. The motivation for use includes: additional income, demand by consumers, and improved health for consumers.

Although the users (both consumers and enterprises) show a willingness to pay and use OFSP, delivering the raw materials to the enterprises is a challenge. The quality is often inconsistent; there are delays and seasonal fluctuations in supply, which also results in price fluctuations.

Achievements: 5 enterprises were selected to partner for product development/pilot study. The selection was based on the following criteria:

-  Expressed a lot of enthusiasm and readiness to use sweetpotato in their products
-  Expressed readiness to partake in the pilot study by making their facilities available
-  Produce relatively large volume of products
-  Have a large base of customers and retail outlets including urban markets

They had to have the following features: Small scale, semi- mechanized, minimal packaging of products, standard quality control and assurance system in place, etc. Furthermore, year-round availability of OFSP was emphasized.

The enterprises selected are as follows:

1. Royal Best International Trading Ltd. – Bread, doughnut
2. Season 7 Restaurant and Catering Services - Bread, cakes, pies, doughnut, potato fries, etc.
3. Vines Hotel (Bakery Section) - Bread, cakes, pies, doughnut, cookies

4. Heritage Chips - Sweetpotato chips
5. Mac-Chiz & Sons Global - Sweetpotato chips, plantain chips

17.4. Nutritional Analysis of Existing Baked & Fried Products

Information about the nutritional quality of existing baked and fried products, offers a baseline for evaluation of the quality of proposed products to be developed using sweetpotato.

Sampling: 24 samples were taken from 7 enterprises (bread, meat pies, sausage rolls, cookies, muffins, potato fries, plantain chips, doughnuts, sweetpotato chips).

As shown in Table 11 below is the nutrient composition of existing baked and fried products.

Table 11: Nutritional quality of existing baked and fried products

| Product | Moisture (%) | Protein (%) | Fat (%) | Ash (%) | Fibre (%) | Carbohydrate (%) | Total sugar (%) |
|-------------------------|--------------|-------------|---------|---------|-----------|------------------|-----------------|
| Bread (n=6) | 22.58 | 10.23 | 3.14 | 2.58 | 0.98 | 60.50 | 5.85 |
| Meat pie (n=3) | 14.45 | 10.78 | 3.65 | 3.84 | 1.38 | 65.90 | 10.80 |
| Sausage rolls (n=3) | 18.97 | 12.30 | 3.33 | 2.39 | 0.74 | 69.58 | 7.92 |
| Cakes (Muffins) (n=3) | 27.90 | 8.81 | 8.20 | 1.19 | 0.94 | 52.97 | 10.97 |
| Cookies (n=2) | 9.93 | 7.33 | 2.20 | 4.63 | 3.32 | 72.61 | 13.30 |
| Doughnuts (n=4) | 25.93 | 12.39 | 8.15 | 1.83 | 0.69 | 50.93 | 14.26 |
| Potato fries (n=3) | 34.78 | 5.92 | 7.40 | 2.04 | 1.92 | 47.71 | 7.85 |
| Plantain chips (n=2) | 9.02 | 11.26 | 8.36 | 5.24 | 4.23 | 61.89 | 11.81 |
| Sweetpotato chips (n=2) | 8.63 | 5.68 | 5.39 | 2.00 | 1.49 | 76.85 | 12.48 |

Source: Olatunde G. O. (2015) Nutritional composition of existing baked and fried products from selected enterprises in FCT, Nigeria. In: 2014 Progress Report of the Sweetpotato for Health and Wealth in Nigeria (Rainbow Project), January, 2015.

17.5. Technical and adaptive Research

Using the principle of product development, one conducts studies on laboratory scale, followed by scaling up for real time and then adaptation on a pilot/commercial level.

During the technical research, raw material characteristics are evaluated to determine appropriate process and steps for specific products and to establish quality requirements for raw material,

intermediate and product (nutritional, sensory/consumer, packaging, storage and shelf-life). Adaptive research validates outputs from laboratory studies and determines the economic viability.

Technical studies for the fried sweetpotato chips/crisps involved 3 varieties: Farmer variety (yellow-fleshed); Mothers' Delight (orange-fleshed); and King J (orange-fleshed) were compared. They were fired for 2.5-4 minutes at temperatures of 150 – 170 °C using pure, refined vegetable oil in a deep fat glass fryer (BUSH FCO 300-UK). The results showed that slice thickness depends on variety.

Consumer studies were done on sweetpotato crisps, which was a pilot product. The studies involved 300 consumers from 3 locations. In the preliminary evaluation, the technical research stage, overall preference had been highest for Farmer's variety (7.77), followed by Mother's Delight (7.23) and lastly, King J (6.66). The consumer preference at the pilot stage was for Mother's Delight (7.76), Farmer's Variety (7.64) and King J (6.59).

The presenter explained the challenges faced, such as the high cost of transporting roots from the farmers to the technical research center at FUNAAB, and questioned how the supply chain would work in the entrepreneurial context, especially considering the seasonal availability of roots. In addition, currently, the analysis of beta carotene and vitamin A could not be done by the local service provider, whose results had been determined to be unreliable.

In conclusion, potential for baked and fried products to utilize sweetpotato was further confirmed. There is potential for consumer acceptance of products, as well as potential for increased profit. Sustained effort must however be made to make quality roots available year round and at a competitive price; further to this, enterprises need technical support, while the people will require increased awareness of nutritional benefits of OFSP.

18. PANEL DISCUSSION: ECONOMICS VERSUS NUTRITION IMPACT OF SWEETPOTATO PROCESSING

The panel discussion was led by Akoto Osei. The panel discussants were: Robert Ackatia-Armah (Nutritionist), Kirimi Sindi (Agro-Economist), Jean Pankuku and Tawanda Muzhingi (Food Scientists).

In the opening remarks, Akoto mentioned that at continental level there is huge momentum towards agriculture and nutrition. The African regional nutrition strategy has been revised to align with the global one, and it looks at nutrition-centered and –sensitive interventions. A taskforce on nutrition – mandated by heads of states – meets once a year and serves as an advisory board. In addition, 30 October was declared as the African Day of Food and Nutrition Security, and in 2014, African Heads of State recommitted to allocate 10% of the budget to agriculture since one of the main continental goals is to improve agriculture and nutrition. There are also various platforms, including an annual African Nutrition Champion meeting-where someone can be invited to advocate for the nutrition pointing out the OFSP. There is also a drive to have a nutrition ambassador for African to help in the advocacy for the nutrition on the continent. Akoto concluded the introduction by reiterating that the African Union has laid great opportunities to address agriculture and Nutrition.

Concern was raised, why; in spite of all the work, there is no up scaling of the food and nutrition issues in Africa. Members of the discussion panel mentioned that the idea has to be good enough for it to be adopted. Whereas there are many ideas, they could not be conceptualized by the people who are supposed to take up the technology or innovations. There is therefore need to have people

with skills to combine the scientific and business skills to enable scale-up. It was further discussed that more research needs to be done, and a problem-solving approach had to be adopted, especially at the industrial level. It was also noted that agriculture in Africa today still relied on nature's whims, and it would be necessary to innovate scale up of agricultural practices through irrigation and other methods.

The panel also commented on the delay for up scaling- the panelists mentioned that there is always a gap between innovators, policy makers and other stakeholders. It becomes difficult to deliver the message to the government if they are not involved from the word go. Therefore there is need to involve all the stake holders at the start.

Rwanda was asked to share their experience on getting sweetpotato on the policy of Rwanda. They explained that policy decisions consider sustainability of the innovation and technology. The research done in Rwanda gave a drive to the promotion of OFSP to be included in the government policy because of its beta-carotene content. Today, the policy captures sweetpotato as a crop, and does not focus on OFSP. This is because VAD is not a problem in Rwanda and supplementation is adequately sponsored by different organizations. The question researchers and advocates for OFSP asked the policy makers was how they would sustain supplementation if funding was pulled out. They then offered OFSP as a locally grown and effective complementary food. This gave the Ministry of Agriculture a reason to include it in its policy.

The chair of the panel asked what was meant when they said that they have to start from the bottom up and asked the discussants to recommend the direction that should be taken to include all the relevant stakeholders. The discussants explained that for continued cultivation of a crop like OFSP, there would be need to develop systems that ensure continuous use through involving breeders to improve varieties to foster processing and also have nutrition issues in pipeline. Gender issues that affect implementation and adoption of knowledge and consideration of vulnerable groups in nutrition programs were also raised, as these are the ones who could not afford purchased products and could benefit the most from OFSP.

19. SWEETPOTATO VALUE CHAINS IN WESTERN KENYA: CURRENT AND POTENTIAL

TANYA STATHERS & ILARIA TEDESCO - NATURAL RESOURCES INSTITUTE, UNIVERSITY OF GREENWICH, UK

Tanya Stathers presented the above-mentioned study that was undertaken in December 2014. Her presentation covered the aims of the project, the approach and the key findings, which were to describe the existing value chains, discuss the business opportunities for puree processing and the potential role for commercial root storage within this.

19.1. Background

This study investigated (i) sweetpotato root production, availability and service provision in the counties of Homa Bay, Migori, Siaya, Busia, and Kericho in Kenya; (ii) trade of fresh sweetpotato roots to major urban markets in Nairobi, Nakuru and Kisumu; (iii) existing and proposed OFSP processing; and (iv) potential for fresh sweetpotato root storage.

The study area has adequate rainfall and no long dry spells, which allows for roots to be harvested all year round. Sweetpotato is planted twice per year and rotated with maize, beans and groundnuts. The area under sweetpotato was typically between a quarter and a half of the total land area.

In the focal 5 production counties, 33-57% of young children are stunted. Exclusive breastfeeding is done for 1.4 months in Kabondo, 5.2 months in Busia. Nationally, 84% of preschool children were shown to be Vitamin A deficient in 2006, yet only 30% of children had received Vitamin A supplements in past 6 months (KDHS, 2008/9). However, >79.6% of young children had eaten foods rich in Vitamin A in the previous 24 hours.

19.2. Approach

The study's methodology is grounded on:

- i) Analysis of the context where the various value chains are located,
- ii) Accounting of the physical and monetary flows characterizing the agents and activities,
- iii) Preliminary assessment of the OFSP puree processing business requirements, and
- iv) Potential economic viability of fresh root storage facilities, taking into account the SP year-round supply, price variations, transportation issues and storage costs.

59 interviews were done; farmer focus groups were carried out. NGO partners who form part of the OFSP consortium are among the people who were interviewed, as were agriculture extension officers, retailers, sweetpotato transporters and traders in most of the counties. Four groups of OFSP processors were interviewed about their current activities. No yellow or white fleshed sweetpotato processors were found. Some work was done with some urban consumers in the urban markets to get an understanding of the criteria for sweetpotato consumption in the urban areas.

19.3. Findings

Sweetpotato production and trade

Sweetpotato (particularly the yellow and white fleshed varieties) is harvested virtually throughout the year. Yield estimates ranged from location to location and supply of fresh roots also varied from season to season. In Table 12 below, the dark green signifies peak supply periods in the sampled counties. As can be seen, one can sequence the buying of roots to coincide with peak supply seasons in the various counties, hence ensuring year-round supply.

Table 12: Varying supply seasons of fresh SP roots in Busia, Homa Bay, Migori, Siaya and Kericho

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Busia | *** | *** | *** | * | * | *** | *** | ** | ** | * | * | ** |
| Kabondo | *** | *** | *** | ** | * | ** | ** | ** | ** | * | * | * |
| Migori | ** | ** | *** | *** | *** | * | * | *** | *** | ** | ** | ** |
| Siaya | ** | ** | *** | *** | *** | *** | * | * | *** | *** | *** | * |
| Kericho | *** | *** | *** | * | * | * | *** | *** | * | ** | *** | *** |

Key: *** = Peak supply; ** = Medium supply; * = Low supply

Although the focus of the study was Western Kenya, it was found that sweetpotato roots are sourced from as far away as Tanzania. Access to planting material is not a problem, often sourced

from neighbours.

Sweetpotato trade

Large quantities of yellow-fleshed, red skinned sweetpotato roots are traded from Kabondo and Migori (~80% roots sold in all counties except in Siaya). There are limited amounts of OFSP (grown in Busia, Kabondo, Siaya); although promoted for more than 10 years, production is hampered by issues such as market, taste, cooking properties. However, OFSP vines have a strong market.

Highest profits per acre (per cycle) are reported in:

- Busia (Sweetpotato roots Ksh 12,800-54,000; OFSP roots Ksh 32,000-45,000; OFSP vines Ksh22,000-48,000)
 - Kericho (Sweetpotato roots Ksh30,000-40,000)
 - Kabondo (Sweetpotato roots Ksh 10,000-20,000; OFSP roots Ksh 20,000-25,000; OFSP vines Ksh12,000)
- (1USD = Ksh. 97)

There is a very complex volumetric system in the study area. Different types of sacks with different volume and weight, and sometimes with the size changing along the value chain, complicate data collection on the price per sack. In some areas, people measure the price per donkey.

Sweetpotato roots are usually washed before packing in the sacks, and then they are transported by trucks to the main urban markets, where they immediately go on sale. The shelf life needed for these roots is therefore not very long.



Washing and packing of sweetpotato roots in Kabondo

The following diagram shows the breakdown of sweetpotato trader's **expenditure and margin when trading prim sized sacks**.

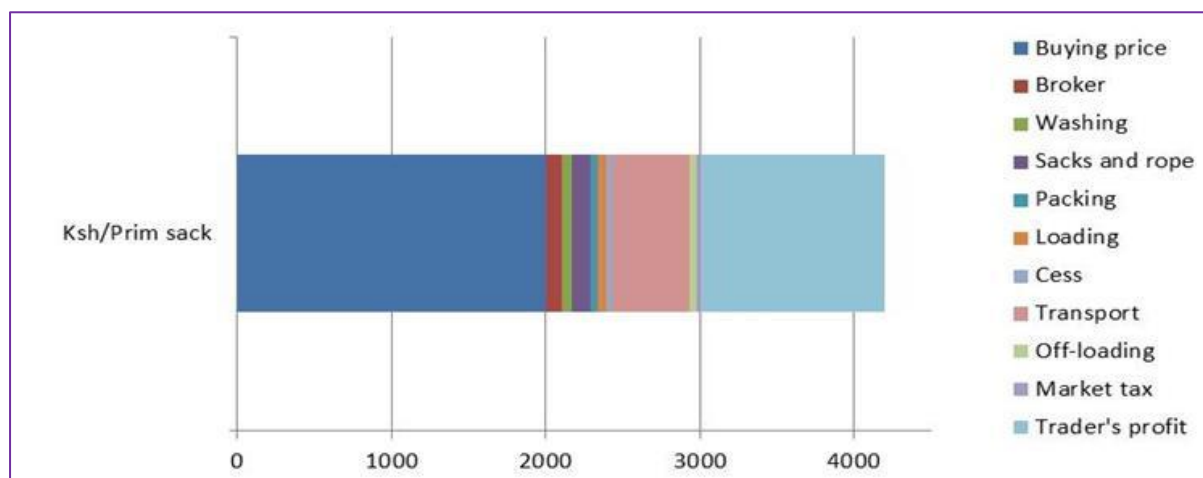


Figure 27: sweetpotato trader's expenditure and margin when trading prim sized sacks.

Sweetpotato value chain actors' margins – Kabondo

The figure below shows how much gross profit different stakeholders make per prim sack, as well as cumulative annual profits. In figure 28, farmers appear to make a lot of profit per sack, however, considering the small number of sacks they are likely to sell throughout the year, one realizes that their profit margin is not as high as the larger-scale traders, who make up to Ksh. 3 million per annum (see figure 29).

Figure 28: Comparison of gross margins/ Prim sack of sweetpotato roots along the value chain

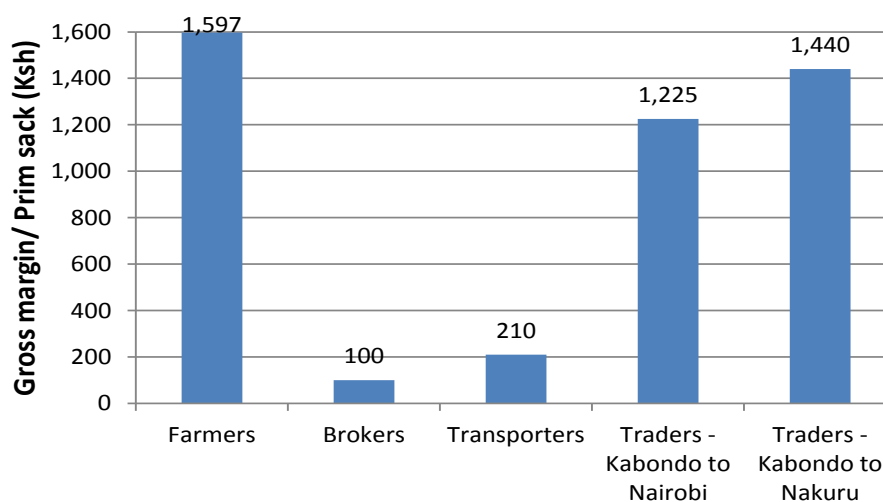
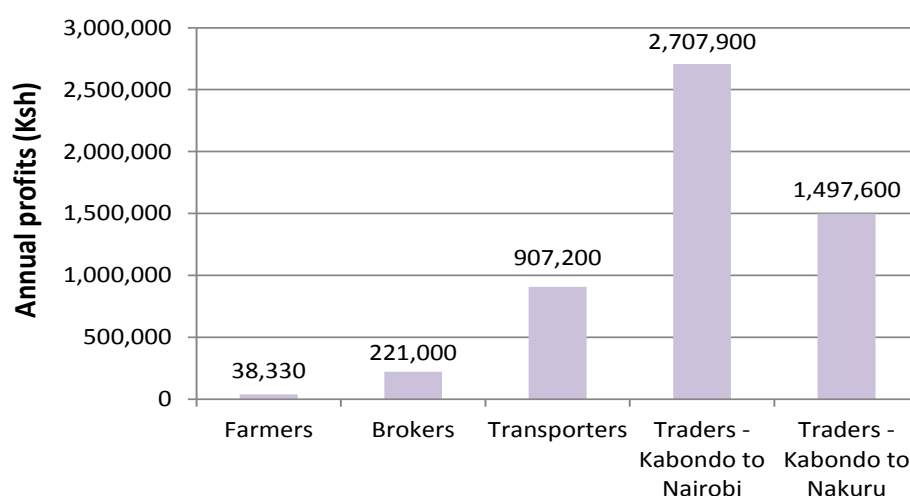


Figure 29: Comparison of annual profits per sweetpotato value chain actor



Sweetpotato processing – Kabondo

The Kabondo cooperative has received funding from USAID and other partners to process flour which is distributed to local supermarkets and traders. Another processor is Organi Ltd, a company that has also invested a lot into OFSP processing. The company started out making dried sweetpotato chippings, but has since diversified into production of puree, with the support of the SUSTAIN project. One other processor in Busia processes roots into dried chips or OFSP flour. The annual profits from these two activities, of which 10 to 12 tonnes are sold annually, is between USD 3,000 and 4,100.

19.3.1. Urban trading



The transportation trucks usually deliver roots overnight to the urban markets, the number of sacks being delivered varies per season. During the study 270 sacks (probably >40 tonnes of SP roots) were delivered to Muthurwa market in Nairobi on 17 Dec 2014. The study found that buying prices by Nairobi traders' fluctuate by 52-78% during the year and selling prices by 42-69%. Other costs stay the same all year. From here, the roots are usually sold to retailers or to

end-consumers.

Both men and women participate in the sweetpotato trade, but women dominate the retail trade. The size of piles is altered during the day and year to maximise profits and although none of the retailers calculated how many piles per sack, they knew their profits. Sweetpotato retailers, mostly women, consider the business to be profitable enabling them to pay their rent, school fees and food.

19.3.2. Urban sweetpotato consumption

Most consumers said they eat sweetpotato roots for breakfast twice or thrice per week, which they had bought the day before. The consumers chose roots based on size, freshness, colour, absence of damage and price. The yellow-fleshed variety was preferred over OFSP which consumers said tasted more like pumpkin. Several felt that unwashed roots last longer, but washed roots make it easier to see if roots are damaged or rotten, and reduce meal preparation time.

19.3.3. Fresh sweetpotato root storage

There is a big risk because OFSP has not been produced large scale. Therefore, there is a high likelihood of a lack of a constant supply of fresh OFSP roots in the early stages of the enterprise. Ensuring the processor is not let down during this critical period could be achieved through:

- Well-organised scheduling and staggering of OFSP planting by producers, and
- Use of an OFSP fresh root storage facility at the processor's site with capacity to hold at least one month's root demand.

A fresh root storage facility could help ensure:

- A continuous supply of raw materials (buffer against poor harvest or transport issues);
- Lessening of the need to pay high root purchasing prices in low seasons;
- Increased control over the quality of fresh roots;
- Improved flexibility to increase or decrease puree production quantities if market demand fluctuates.

Key technical issues include and economic issues have to be taken into consideration.

The storage facility capacity and cost analysis found that it would be advisable to have at least one month's root demand. Two store types with a capacity of ~20-30 tonnes were found to be appropriate. The study also found that while the weekly cost to buy fresh roots in low supply season is higher than the weekly storage costs for both types of facility, the advantage disappears during high season.

19.4. Summary of question and answer session

The following is a summary of the issues that were raised and discussed from this presentation:

Commercial scale storage: There is need to do more detailed work on harvesting, storage and transporting to be sure that high quality roots go into the storage to optimize the process and ensure that the processor gets good quality.

Profit margins: Farmers are only selling a few sacks while traders are selling huge volumes. There are different trading levels, but on average, the traders say one needs at least Ksh. 100,000 to get into the business. At the moment, OFSP has a smaller value chain compared to yellow-fleshed varieties. Chances are that this will change when demand for OFSP increases.

Reliability of data: Using volumetric is an issue because data is not reliable unless the researchers specify the type of sack that was used. There are also huge leaks in the official data that is out there; however, even though it may not be completely reliable, it is done at a large scale that a small survey would not be able to.

20. OFSP Puree Processing in Kenya and building on the Mama SASHA experience

PENINA MUOKI – CIP

Penina started the presentation by outlining the SUSTAIN project context, and explained that the aim is to support scaling up biofortified crops through research and development initiatives. The outputs of the project are (i) Access to improved OFSP varieties by smallholders scaled up reaching at least 1.2 million household having children <5 years old; (ii) Access to improved nutritional knowledge & diversified use of OFSP by both female and male caregivers; and (iii) At least one commercially marketed processed product that uses OFSP as a major ingredient in each target country. The presentation focussed on the achievements made in delivering the third output.

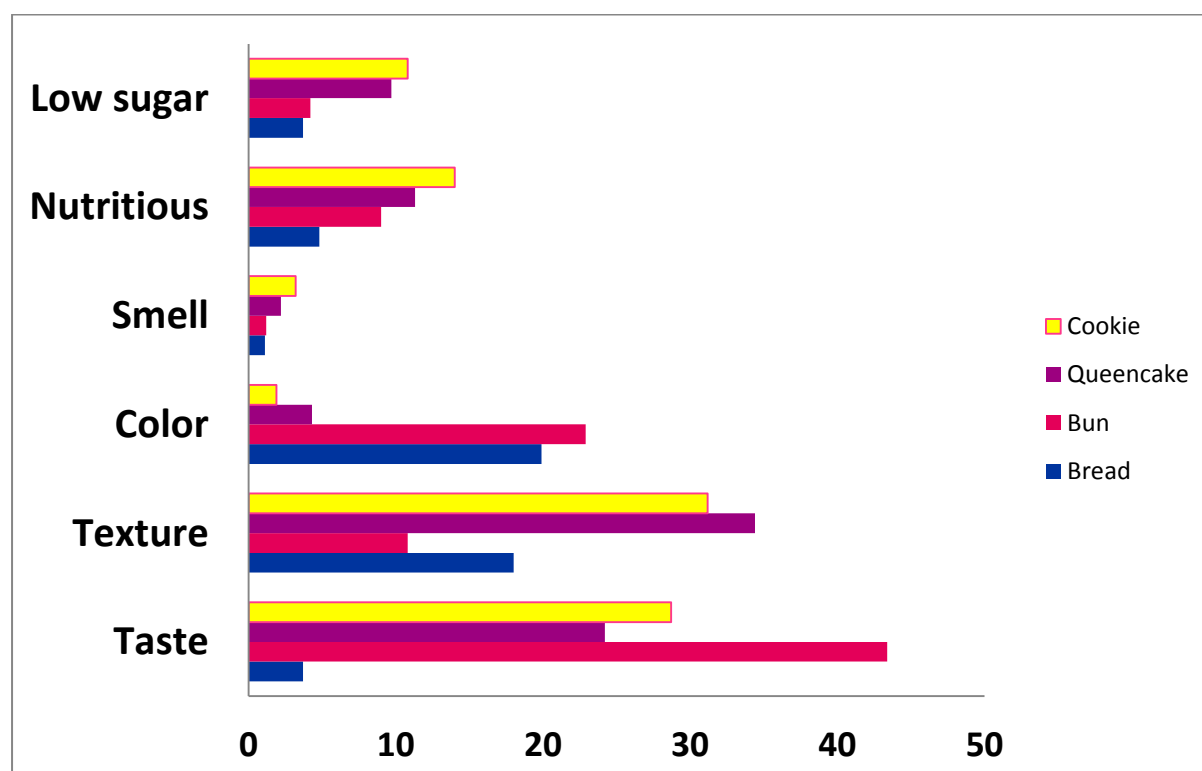
20.1. Consumer survey

A survey was undertaken to determine:

- Consumer sensory acceptability of OFSP-wheat flour baked products (Bread, Queen cake, Buns and Cookies)
- Consumer willingness to pay for OFSP puree -wheat flour baked products (Bread, queen cake, buns and cookies)

The following four stores were involved in the survey: T-MALL (n=213), BEBA BEBA (n=109), EASTLANDS (n=230) and OTC (n=146).

Figure 30: Reasons for OFSP Product Preference



Consumer ratings: Consumer ratings for overall preference of the four OFSP products is higher than the corresponding control products. Consumer ratings for (colour, smell, taste, and texture) are not significantly different between OFSP and control products.

Cost of production: Substituting 50 percent of wheat flour for OFSP puree is estimated to reduce the cost of producing bread and buns by 13 percent. Thus, in-cooperation of OFSP puree in the four baked product provides a cost-cutting avenue while providing consumers with organoleptically acceptable and healthy product (in terms of vitamin A).

20.2. Building working partnerships with Tuskys and other stakeholders

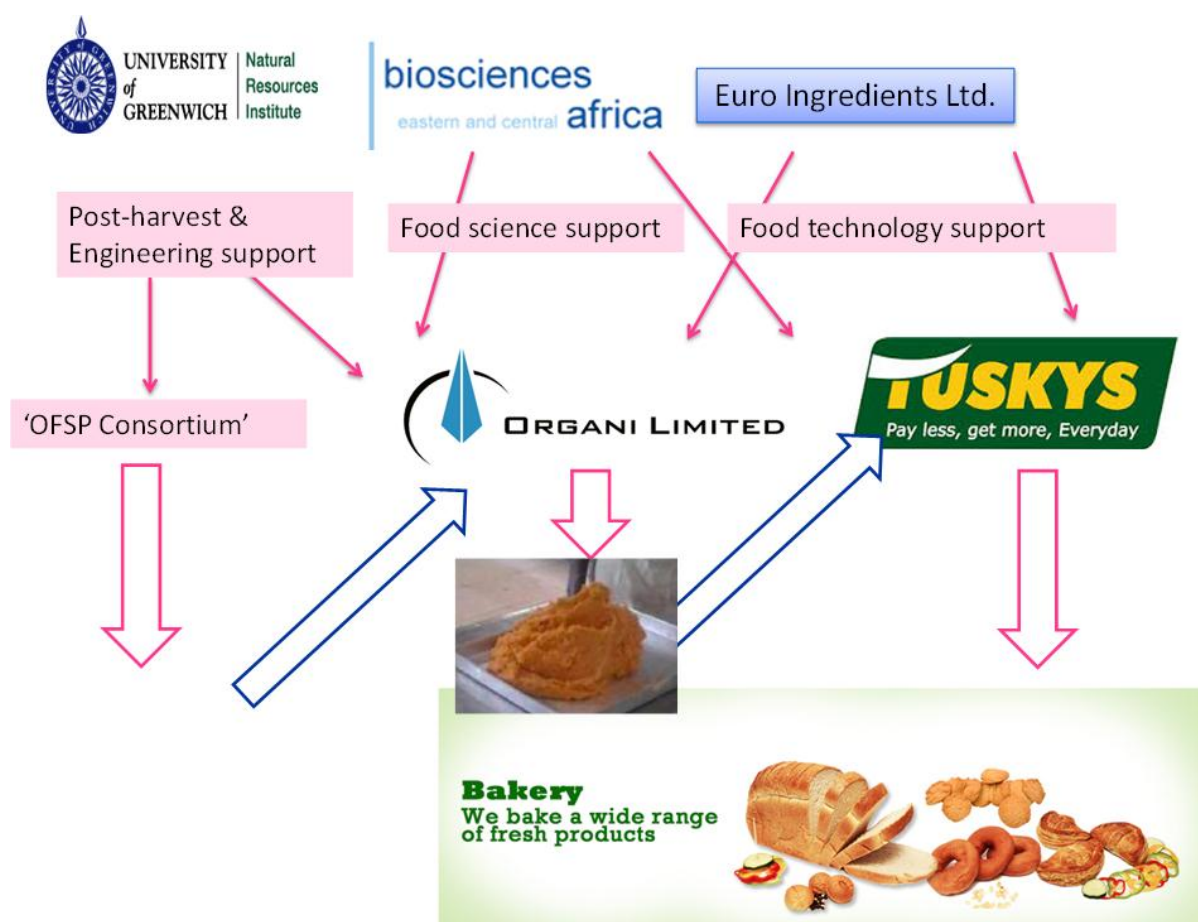
A buying contract was signed between the puree processor and Tuskys Supermarket. To achieve this, there had to be commitment from top management. Throughout the process of establishing the work flow, a consultative process helped each partner to understand their role right from the beginning, and hence to avoid unpleasant surprises as the production - marketing continuum was well evaluated at the onset.



A meeting of the different stakeholders helps to define roles

In order to revamp production, the 'OFSP Consortium' partners that have been promoting OFSP have been brought together to tap into this market. CIP has a lean team- but with capacity to provide technical backstopping along the OFSP value chain. The presenter highlighted that to ensure sustainability, the project not only built in a sustainability and exit strategy at the beginning of the project, but also built on existing structures of farmer organization.

Figure 31: Flow chart of production - marketing continuum



20.3. Conclusion

The preliminary findings of the baseline survey and feasibility study that was undertaken on OFSP production indicates limited production (~ 100 Acres). However, there is already 90 Acres of production that is linked to the puree production. One lesson is that a competitive approach to selecting a puree processor to work with helped to get buy-in from the investor, Organi Ltd, who have made most of the investments required to buy equipment and rehabilitate the processing facility to meet the minimum standards for KEBS. The main financial support from SUSTAIN is –puree filling machine. The launch of OFSP products in the supermarkets is scheduled for June 1, 2015.

21. CHALLENGES FACED IN MARKETING PORRIDGE FLOUR WITH OFSP AS AN INGREDIENT

JEAN ONYAIT - SOROTI SWEETPOTATO PRODUCERS AND PROCESSORS ASSOCIATION (SOSPPA)



Sweetpotato is an important food crop in Uganda, as it plays a prominent and diverse role in the food system. Sweetpotato is a predominant staple as well as a complementary staple food crop that is consumed throughout the year by farmers and low income consumers. OFSP is an excellent source of beta-carotene that provides sufficient vitamin A to meet the required daily allowance in the diet. The crop is mainly consumed in fresh form as boiled/steamed and roasted roots. Boiled roots can also be served as mashed, stewed and fried food; it is also commonly processed into sweetpotato dried chips and flour at household levels during the dry season.

Dried sweetpotato chips are consumed boiled as “Amukeke”, while the flour is used as an ingredient for preparation of traditional Dishes “Atap” The flour was occasionally used for making porridge compared to maize Flour. Currently more women and children consume OFSP porridge compared to men.

The introduction of OFSP flour has seen families start consuming sweetpotato flour for porridge.

21.1. Challenges faced



Acceptability of OFSP porridge has faced a couple of challenges just like any other OFSP products. Most or all consumers derive their interest towards consuming OFSP Porridge based on the following:

-  Available information: the choice to purchase or consume OFSP porridge is based on the information the consumer has about OFSP. Most importantly the packaging of the information plays a key role that is to consume.
-  The quality of Packaging and branding of OFSP: The visual impression of OFSP to the consumer will make the consumer purchase or consume.

However, lack of certification, has limited the supply of OFSP to the middle class who usually buy it in the supermarkets. In addition, there is high competition from other substitutes and consumers have various options to choose from including the local sweetpotato that is still available. Furthermore, the level of income of the consumers who should consume more of the OFSP porridge does not have disposable income to purchase the OFSP flour.

21.2. Current Initiatives Recommendations

Adoption of initiatives geared towards promoting OFSP usage will go a long way in making OFSP acceptable in both rural and urban areas. SOSPPA is currently conducting farmer mobilization, facilitating linkages and supply of fresh and processed commodities. The organization also conducts awareness campaigns of sweetpotato value added products and trains farmer communities. In order to have OFSP play a major role the following actions are should also be undertaken:

-  Spur the production of the roots by creating demand for OFSP through extensive marketing of the value in OFSP;
-  Blend OFSP in already existing consumer products;

- Technology transfer and adoption of OFSP for sweetpotato beverage production in commercial quantities. Build the capacity of local processors to produce for commercial;
- Partner with health marketing agencies to market the health benefits and values of OFSP
- Conduct workshops and trainings with the producers, middle men, suppliers, transporters and traders of sweetpotato in urban areas with the intention to move them into introducing OFSP into the market; and
- Adopt different post-harvest technologies.

22. FUTURE RESEARCH TOPICS: PLENARY DISCUSSION

Participants were put into five groups to discuss areas of interest for future research based on the following topics.

1. Group 1: Sweetpotato fresh root marketing and storage
2. Group 2: OFSP product development including puree
1. Group 3: Understanding the distribution of revenue along the value chain – including: costing out product development, gender issues
2. Group 4: Note to breeders. What do we need to tell them about product-linked characteristics?
3. Group 5: Integrating crops, livestock and nutrition: Can households improve their systems?

This section captures a summary of the plenary presentations from the groups.

22.1. Group 1: sweetpotato fresh root marketing and storage

The group members: Kirimi, Sheila, Christine, Madjaliwa, Tanya and Philip

During the discussion, the group members covered a brief description of the fresh root marketing and storage situation; major issues with roots when it comes to the market, harvesting, technology, handling before and after harvesting e.g. do you wash after harvesting or not, and do you cure before or after harvesting; styles of harvesting; how sweetpotato is delivered to the market challenges of high demand and reputation of sweetpotato, among others.

With regard to post-harvest handling, the group identified the following questions:

- What are the incentives for producing OFSP and for adhering to specific processing interest?? in production, harvesting and marketing;
- What kinds of storage strategies would work best at what scales;
- Do you cure then harvest, or vice-versa; and
- What are the appropriate messaging required for increasing incentives

Whereas all the issues identified were felt to be important research questions that should be followed up on, the group summed up the priority question as:

- **What are the incentives for producing OFSP and for adhering to specific process needs in production, harvesting and marketing?**
- **What are the appropriate, relevant policies that can be put in place?**
- **What are communications needs that will help support?**

22.2. Group 2: OFSP product development including puree storage

Group members: Aurelie, Francis, Olatunde, Antonio, Joseph, Jean, Gabriel

They first identified the **current products** as:

- Products based on puree currently available: bread, cake, cookies; doughnut, chapatti; baby food
- Fresh roots: juice, grates,
- Products from leaves and by-products such as animal feeds

The group then identified the **research gaps** as follows:

- Baked products: need to make it more attractive and more nutritious by adding sesame seeds; consider dough improvement like enzymes
- Fried products: reduce amount of oil absorb by products – forms of processing
- Beverages: need to mix with the other juices and depends on the starch contents of the juice
- Puree: waiting on the current trials
- Need to consider OFSP spread with pea-nut butter but how do we call it?

In addition, they said there was need to consider processing of flour when the need arises and to send it to areas that need it. The also suggested that varieties be categorized depending on the products that they can be processed into. The group proposed new products as development of bakery filling and ketchup (sweetpotato puree with food color).

Prioritization: in order of preference based on presumed consumption for development are:

1. bread
2. doughnuts
3. juice blend
4. crisp
5. spread

22.3. Group 3: Understanding the distribution of revenue along the value chain – including costing out product development and gender issues

The group arranged the research topics in order of priority

1. Documenting income and revenue distribution
 - Who is getting what and profit margins (profit calculation along the chain....farmers, processors, etc)
 - Intra-HH distribution of income (between men and women.....farmers)
2. Link between increased income and nutrition
3. Affordability of final product
4. Willingness to pay for values generated
5. Assessment of costs of setting up business
 - Implications of NGO involvement on sustainability and the real cost of setting up business
6. Estimates of what savings at private sector and regional levels in country
7. What are the income implications of scaling up production

- ☐ Guaranteeing of profit margins when prices increase
- ☐ Price stability
- ☐ Role of government in price regulation

22.4. Group 4: Note to breeders. What do we need to tell them about product linked characteristics?

The group concluded that there is need to start considering more nutritional attributes affecting processing and include in the catalog with traits

1. Fried foods
 - ☐ Starch content
 - ☐ Reduce sugar content
 - ☐ Amino acids
 - ☐ Moisture content
2. Puree
 - ☐ Sugar content
 - ☐ Dry matter
 - ☐ Amylase activity
 - ☐ Fiber
3. Flour
 - ☐ Ability to retain beta-carotene after heating
4. Starch as thickening component
5. Dry matter content

The group also had a note to the breeders: They requested the breeders to consider the need to breed more for shape (oblong) and form (no bumps) and size (200-300 g) and how to better capture odor in breeding, since this seemed to be an issue especially with OFSP.

22.5. Group 5: Integrating crops, livestock and nutrition can households improve their systems?

Crop-livestock integration already exists. The group identified the following questions:

1. How can we promote enhancing interactions for improving productivity and the livelihoods of poor HHs in rural and peri-urban settings?
 - ☐ Understanding the decision making process at the HH level (gender dimensions)
 - ☐ How different service providers tackle integrated production as well as HH health and nutrition?
 - ☐ Does the foliage from OFSP varieties have a different feeding value than from other SP varieties? Any differences in foliage production?
 - ☐ How manure can contribute to improved yields of SP (OFSP and others)
 - ☐ Urban agriculture: How integrated systems could help improving income, health and nutrition in urban and peri-urban settings?
2. Other topics related to other groups
 - ☐ SP processing generates by-products (i.e. peelings) : need to assess the value of these by-products

- How proper SP root off-farm conservation helps to improve the livelihoods of rural families producing sweetpotato?
- 3. Documenting income and revenue distribution
 - Who is getting what and profit margins calculation along the chain... farmers, processors etc.
 - Intra-hh distribution of income between men and women and also who controls the income

Following the presentations, there was a brief plenary discussion that is captured by the following points:

- Research should be in terms of products. People eat food, not crops, and it is critical to integrate sweetpotato in the diets of households.
- Look at the food systems of the country to determine what foods are dominant and what OFSP will contribute to the food system?
- Some of the notes that presenters made to the breeders' group could also be important for food scientists.
- There should be an integrated approach for both the breeders and food scientists
- OFSP cannot compromise the food diversity and security of households. With the income they make from selling sweetpotato, they could purchase other foodstuff.
- Another question we must answer is whether sweetpotato boosts overall household income or just the commodity being sold
- No research questions were proposed on animal feeds especially because there are lots of peelings from different components of the value chain,
- Product development should involve actors from other sectors such as the wheat and beans industry
- With regard to OFSP porridge, as it forms less viscous porridge, more flour can be added, and this could increase the nutrient densities.
- Why are we not having scaling up or adoptions? The main reason is that there are insufficient incentives to allow for adoption of the technologies from the research components. This needs to change.
- Farmers have many needs: social, economics, food security, nutrition. All these will have to be included when we are considering research topics. There should be a holistic approach.
- Before breeders begin breeding they should have some information before they begin work.

23. THE FUTURE OF THE CoP

In the last session, participants discussed the future of the CoP. This section sums up the discussions.

Virtual discussions: There have been problems with follow through of virtual discussions. Suggestions were made that topics should rotate and be coordinated by different people. Two options were given: the first was to have interest groups within the CoP, and the second was to hold discussions as an entire group, as people were bound to be active only if a topic is of interest to them.








Online forum: The online forum will enable CoP members to share information with other CoP groups. The Sweetpotato Knowledge Portal is being redesigned to allow for creation of private

spaces for online forum discussions, and it allows for members to select parts of their discussions that they would like to make public. Before the portal is launched however, the members have the opportunity to hold Google group discussions.

Google group discussions: With this option, there is no need to log in to have the discussion, because it comes as an email that one can respond to by sending an email to the group. The advantages of Google groups were shared with members e.g., the ability to opt out of the emails through the unsubscribe email, and selection of the schedule for delivery of messages if one prefers not to receive an email every time there is a contribution. Participants discussed factors that influenced discussions e.g., the way a question was framed, the need for leaders to take ownership to drive up the discussions.

On-line panel discussions: This is an approach whereby people are selected to hold online discussions and respond to questions on a specific date, which is announced earlier to allow for people to confirm attendance. Participants suggested that the plans be made and announced at least two weeks in advance and where possible, questions should be solicited before the online panel discussion. Already, Antonio made commitments for a monthly Skype link for technical advice on product development and processing. Another suggestion was to use Webex, which requires registration and advance confirmation by participants.

The following suggestions were made:

-  Add area of expertise to participants' list to improve networking
-  Share existing and upcoming publications - for example the investment and implementation guides are expected to be published by next month. There are also some joint publications across countries.
-  CoP group leaders should summarize these discussions.
-  Ease access to previous discussions
-  Share the outcomes of discussions with a wider audience and ensure that the work reaches beyond the sweetpotato knowledge portal
-  Write articles and share updates on what CoP members are doing
-  Discuss and share strategies to reach policy makers

At the end of the meeting, group leaders were tasked with coming up with four topics that would guide upcoming discussions. The meeting was closed by one of the leaders, Madjaliwa, who thanked all the organizers and the team that supported the administrative and logistic arrangements that made it possible to hold the meeting.

24. Evaluation

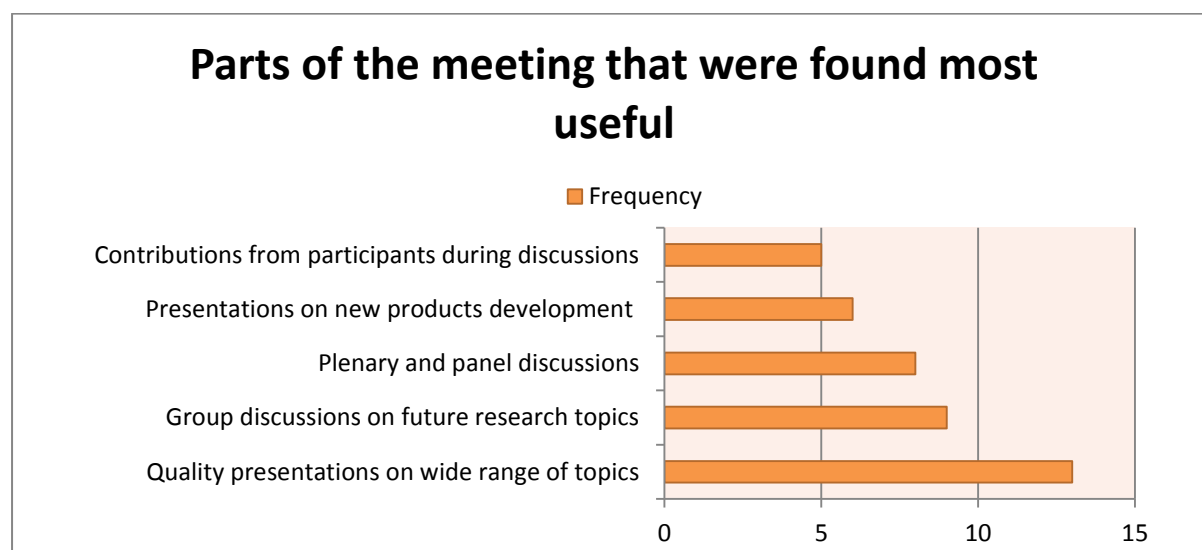
At the end of the meeting, participants were asked to fill out questionnaires to provide feedback that would help improve the usefulness of future meetings. The meeting evaluation was completed by 25 respondents (15 male and 9 female). The mean age of respondents was 41 years.

Meeting expectations: 48 percent of the respondents felt that the meeting had met most of their expectations while 52 percent felt it had met all of their expectations. The quality was rated as either very good (44 percent) or good (56 percent).

Usefulness of the meeting: Participants mentioned 28 parts of the meeting which they thought were useful. In the following chart, we highlight the five most useful parts of the meeting. The

sessions that received the most positive feedback were: sweetpotato value chains in Western Kenya, panel discussion on economics versus nutrition impact of sweetpotato processing; demonstrations on how to make puree and product sampling. Participants also appreciated the fact that there was literature available for them to take away. A breakdown of the responses is attached in Annex 1 of the report.

Figure 32: Parts of the meeting that were found to be most useful



Areas that need improvement: Participants were also requested to suggest three areas that they thought could be improved, as well as topics that they would like to address during the next meeting. Over 25 items were mentioned (See Annex 1). The suggestions advanced by most respondents were:

- ❏ Involve more policy makers, government officials, and private sector and CGIAR centers
- ❏ Include more breeders
- ❏ Include presentations on other OFSP utilization
- ❏ Give adequate time for presentations and ensure good time keeping

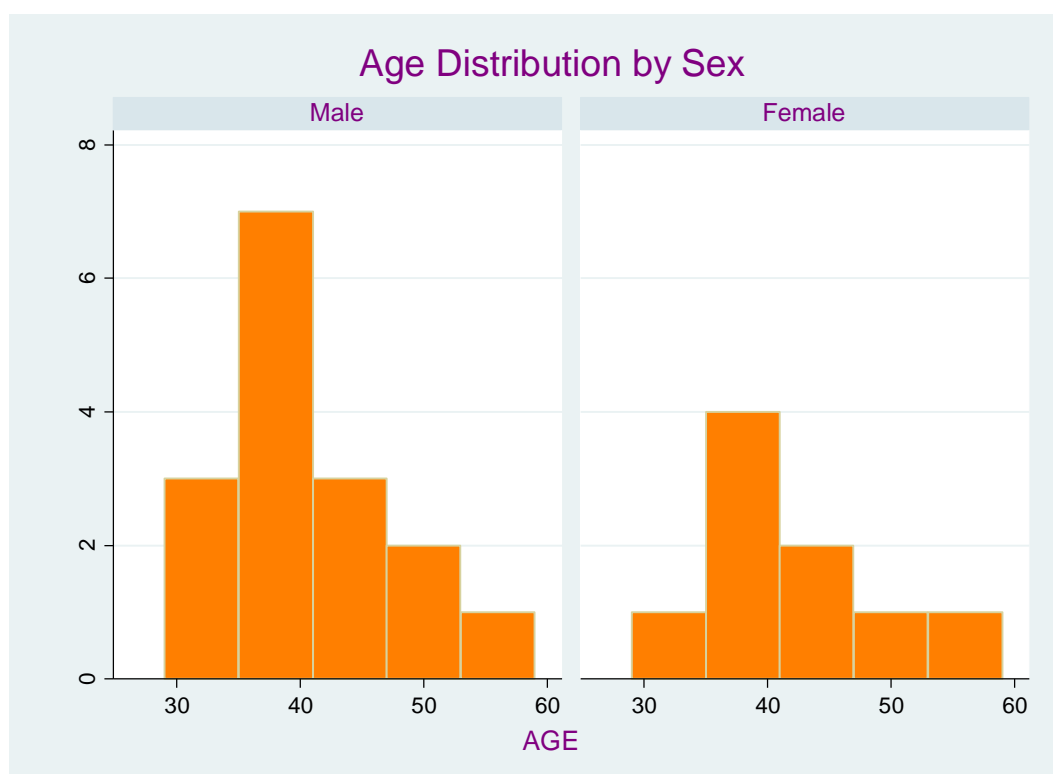
Organization and administration: Through qualitative feedback, respondents communicated their opinion that the conference was well packaged organized. However some felt that the logistics could be improved, and that more time should have been allowed for participants to network. There were also suggestions that the publication of the proceedings be published in the public domain.

25. ANNEXES

Annex 1: Meeting evaluation results

Introduction

The meeting evaluation was completed by 25 respondents, 15 male and 9 female. The mean age was 40.72 years



Other responses are as listed below:

| Evaluation Item | Response (%) | |
|--|--------------|----|
| 1.) Did meeting matching expectations | Most | 48 |
| | Completely | 52 |
| 2.) Rating of the Quality in terms of content | Good | 56 |
| | Very good | 44 |
| 3.) Rating of the meeting in terms of organization(Logistics, communication) | Alright | 8 |
| | Good | 36 |
| | Very good | 56 |

4.) Parts of the meeting that were found most useful to participants

| Most Useful Parts of the Meeting | Frequency | Percent of responses | Percent of cases |
|---|-----------|----------------------|------------------|
| 1 Quality presentations with wide range of topics. | 13 | 16.88 | 52.00 |
| 2 Participation of private sector | 2 | 2.60 | 8.00 |
| 3 Plenary and panel discussions. | 8 | 10.39 | 32.00 |
| 4 knowledge and experience in OFSP production | 2 | 2.60 | 8.00 |
| 5 status and need for communication | 1 | 1.30 | 4.00 |
| 6 Sweet potato value chain in Western Kenya | 3 | 3.90 | 12.00 |
| 7 Sweet potato products acceptability by consumers | 1 | 1.30 | 4.00 |
| 8 New innovations and technologies | 2 | 2.60 | 8.00 |
| 9 Group discussions on future research topics | 9 | 11.69 | 36.00 |
| 10 Plenary discussion on Economics vs Nutrition | 3 | 3.90 | 12.00 |
| 11 Presentations on new products development | 6 | 7.79 | 24.00 |
| 12 Sweet potato storage | 2 | 2.60 | 8.00 |
| 13 Provision of literature | 2 | 2.60 | 8.00 |
| 14 Networking with other participants | 3 | 3.90 | 12.00 |
| 15 Questions and Answers session | 1 | 1.30 | 4.00 |
| 16 Presentations on findings and ongoing projects | 1 | 1.30 | 4.00 |
| 17 COP operation during the year | 1 | 1.30 | 4.00 |
| 18 Contributions from diverse participants | 5 | 6.49 | 20.00 |
| 19 Adequate time | 1 | 1.30 | 4.00 |
| 20 Policy intergration and gender issue in project management | 1 | 1.30 | 4.00 |
| 21 Advocacy for OFSP nutrition and utilization | 1 | 1.30 | 4.00 |
| 22 Nutrition focus in Rwanda | 1 | 1.30 | 4.00 |
| 23 Disseminating OFSP through District health in Uganda | 1 | 1.30 | 4.00 |
| 24 Logistics | 1 | 1.30 | 4.00 |
| 25 MaMa SASHA experience | 1 | 1.30 | 4.00 |
| 27 Working with enterprises | 2 | 2.60 | 8.00 |
| 28 Puree demonstrations and product sampling | 3 | 3.90 | 12.00 |

5.) Areas for Improvement for the next meeting

| | Least Useful Parts of the Meeting | Frequency | Percent of responses | Percent of cases |
|----|---|-----------|----------------------|------------------|
| 3 | Panel on Economics vs Nutrition | 2 | 11.11 | 20.00 |
| 4 | Presentations by private sectors | 1 | 5.56 | 10.00 |
| 5 | Recipes | 1 | 5.56 | 10.00 |
| 6 | Future research topics | 2 | 11.11 | 20.00 |
| 7 | Networking | 1 | 5.56 | 10.00 |
| 8 | Plenary discussions | 1 | 5.56 | 10.00 |
| 9 | Community of practice discussion groups | 1 | 5.56 | 10.00 |
| 10 | Puree processing | 2 | 11.11 | 20.00 |
| 11 | Root storage | 1 | 5.56 | 10.00 |
| 12 | Discussion on new products development | 1 | 5.56 | 10.00 |
| 13 | Diversity of session facilitation | 1 | 5.56 | 10.00 |
| 14 | Effects of different cooling treatments | 1 | 5.56 | 10.00 |
| 15 | Diversity of participants and speakers | 1 | 5.56 | 10.00 |
| 16 | Experience on OFSP products | 1 | 5.56 | 10.00 |
| 17 | Poor travelling arrangements | 1 | 5.56 | 10.00 |

6.) Please suggest 3 areas for improvement or topics you would like to see in the next meeting

| Improvement Areas for Next Meeting | Frequency | Percent of responses | Percent of cases |
|--|-----------|----------------------|------------------|
| 1 Involve more policy makers, government officials, private sectors, CGIAR centres | 8 | 21.62 | 38.10 |
| 2 Discussion on markets | 1 | 2.70 | 4.76 |
| 3 Challenges related to processing | 1 | 2.70 | 4.76 |
| 4 Adequate time for presentations and time keeping | 3 | 8.11 | 14.29 |
| 5 More panel discussions | 1 | 2.70 | 4.76 |
| 6 Income distribution | 1 | 2.70 | 4.76 |
| 7 COP dealing with other crops of interest | 1 | 2.70 | 4.76 |
| 8 Include more breeders | 3 | 8.11 | 14.29 |
| 9 Submitting challenges earlier | 1 | 2.70 | 4.76 |
| 10 Field visits during meetings | 1 | 2.70 | 4.76 |
| 11 More impacts on community | 1 | 2.70 | 4.76 |
| 12 More work on animal feed processing | 1 | 2.70 | 4.76 |
| 13 OFSP improvenent varieties | 1 | 2.70 | 4.76 |
| 14 Polish-up perree processing | 1 | 2.70 | 4.76 |
| 15 More presentations on product development | 1 | 2.70 | 4.76 |
| 16 Successful experiences | 1 | 2.70 | 4.76 |
| 17 More nutritional studies | 1 | 2.70 | 4.76 |
| 18 More storage studies | 1 | 2.70 | 4.76 |
| 19 Other OFSP utilizations | 2 | 5.41 | 9.52 |
| 20 More work on cooking and preparation inpacts | 1 | 2.70 | 4.76 |
| 21 Curing in ground and vs out of ground | 1 | 2.70 | 4.76 |
| 22 Sweet potato transport system | 1 | 2.70 | 4.76 |
| 23 Shelf-storage panel | 1 | 2.70 | 4.76 |
| 24 Abstracts presentation | 1 | 2.70 | 4.76 |
| 25 Policy influencing becoming part of Communitu of Practice | 1 | 2.70 | 4.76 |

7.) Other comments

- Good job. Am new to this but was very impressed. Am glad I participated. keep it up.
- I really enjoyed the conference and being part of the COP. Hope to keep in touch with ever..
- Great efforts. Keep it up.
- Excellent meeting.
- There is limited networking time available.
- Excellent prior organization.
- Well done to the organising team.
- We need publication of the proceeding published in public domain.
- Stick to the time allocated for each session.
- Been well organized. I feel the logistics were lacking, need to look at it.
- Great networking. Keep it up during the year.
- It has been a well packaged meeting. Congrats and welldone to the team that put this meetin..
- There is need to include other key stakeholders in the deliberation.

Annex 2: Meeting programme

| | | |
|--|--|--|
| 19 th May 2015 | Arrival of participants | |
| 20th May, 2015 | | |
| Session 1 | Chair / Rapporteur | Jan Low (Chairperson) Daniel Mbogo |
| 8:00-8:30 | Registration | Emily Ndoho & Daniel Mbogo, CIP |
| 8:30-8:45 | Introductions | |
| 8:45-8:55 | Welcome Address | Francis K. Amagloh, University of Development Studies, co-leader of CoP |
| 9:00-9:15 | 1. Expectations from CoP on Marketing, Processing and Utilization & Post-Harvest Research in SASHA Phase 2 | Jan Low, CIP |
| 9:15-10:30 Presentations: 15 min each; 15 minutes for discussion | 2. Where we are, and what we expect to achieve with Orange-fleshed Sweetpotatoes (OFSP) in Rwanda: Nutrition focus | Robert Ackatia-Armah, CIP |
| | 3. Disseminating Orange Sweetpotatoes through District Health Systems in Western Uganda | Angela Atero, HarvestPlus |
| | 4. Evaluating the effectiveness of a Nutrition-Sensitive Agricultural Intervention in Western Kenya: Design and Preliminary Findings of the Mama SASHA project | Fred K. Grant, CIP |
| | 5. Understanding Consumer Preferences and Estimating Willingness to Pay for Orange-fleshed Sweetpotato Juice | Temesgen Bocher, CIP |
| 10:30-11:00 | Coffee Break | |
| Session 2 | Chair/Rapporteur | Kirimi Sindi (Chairperson) Fetuga Ganiyat (Rapporteur) |
| 11:00-12:30 15 min presentations & 15 min discussion | 6. Vitabread: Consumer and baker preferences, economic and nutrition potentials | F K. Amagloh, Univeristy of Development Studies, Ghana |
| | 7. SUSTAIN Mozambique & ZEBRA FARM integrate two value chains in juice and biscuits | Lucas Mujuju, Leite de Soja, private sector processor & Roland Brouwer (CIP) |
| | 8. Carotenoid retention and vitamin A activity in dried orange-fleshed sweetpotato that is cooked, fried, or stored | Aurelie Bechoff, Natural Resources Institute |
| | 9. Effect of different cooking treatments and amylase activity on sugars and sweetness of sweetpotato root | Eric Owusu-Mensah, CIP |
| 12:30-14:15 | Lunch & Sweetpotato Recipe Contest! | |
| 14:15-15:30 15 min presentations & 15 min discussion | 10. Orange-fleshed sweetpotato product development in Malawi | Jean Pankuku, Universal Industries |
| | 11. The use of Sweetpotato Residues as Feed in Rural and Peri-urban Smallholder Pig Systems in Uganda | Danilo Pezo, International Livestock Research Institute |
| | 12. Can Radio Get Sweetpotato Markets Going? Radio and Sweetpotato promotion | Sheila Rao, Farm Radio International |

| | | |
|--|--|--|
| | 13. Development and Characterization of Peanut Butter Enhanced with OFSP | Joseph Mulindwa, Makerere University |
| 15:30-17:00 | Round Table Discussion & Puree Demonstration: New product development and challenges facing sweetpotato processors | Antonio Magnaghi, Euro Ingredients (Leader) Sheila Rao & Eric Owusu-Mensah (Rapporteurs) |
| 21st May, 2015 | | |
| Session 1 | Chair | Maurice Mbololo (Chairperson) Godfred Kalembera (Rapporteur) |
| 9:00-9:40 | 14. Storage of sweetpotato roots in zero energy cool chamber | Madjaliwa Nzamwita, Rwanda Agriculture Board |
| 15 min presentations, 10 min discussion | 15. Technical and adaptive research on baked and fried sweetpotato-based products on the RAINBOW project, Nigeria | Fetuga Ganiyat, Federal University of Nigeria at Abeokuta |
| 9:40-10:30 | Panel Discussion: Economics Vs Nutrition impact of sweetpotato processing | Akoto Osei, African Union (Leader), Panel Discussants: Robert Ackatia-Armah (Nutritionist), Kiriti Sindi (Ag Economist), Jean Pankuku (Food Scientist), Tawanda Muzhingi (Food Scientist) |
| 10:30-11:00 | Coffee Break | |
| Session 2 | Chair | Maurice Mbololo, Scinnovent Centre (Chairperson) Kiriti Sindi, CIP (Rapporteur) |
| 11:00-11:45 | 16. Sweetpotato Value Chains in Western Kenya: current and potential | Tanya Stathers |
| 11:45-12:15 | 17. OFSP Puree Processing in Kenya & Building on the Mama SASHA Experience | Penina Muoki |
| 12:15-12:30 | 18. Challenges Faced in Marketing Porridge Flour with OFSP as an Ingredient | Jean Onyait, Soroti Sweetpotato Producers and Processors Association (SOSPPA) |
| 12:30-14:00 | Lunch | |
| 14:00-15:30 | Plenary discussions Future research topics | Tanya Stathers (Chairperson) Rapporteurs: Fred Grant & George Ooko Abong, |
| 15:30-16:30 | How CoP should operate in the future | Francis K. Amagloh & Jan Low |
| 16:30-17:00 | Closing Remarks | Madjaliwa Nzamwita, CoP co-leader |
| 17:00 | Begin departures from airport | Emily Ndoho |

Annex 3: List of Abstracts

| | |
|---|-----|
| Abstract 1: Expectations from CoP on Marketing, Processing and Utilization & Post-Harvest Research in SASHA Phase 2- <i>Jan Low</i> | 93 |
| Abstract 2: Where We Are, and What We Expect to Achieve with Orange-fleshed Sweetpotato (OFSP) in Rwanda: Nutrition Focus - <i>Robert Ackatia-Armah</i> | 93 |
| Abstract 3: Dissemination of Orange Sweetpotatoes through District Health Services Delivery Systems in Western Uganda: A Case Study of Health Child Uganda - <i>Angela Atero</i> | 94 |
| Abstract 4 - Evaluating the Effectiveness of a Nutrition-Sensitive Agriculture Intervention in Western Kenya: Design and Preliminary Findings of the Mama SASHA project - <i>Fred Grant, Amy Webb Girard, Haile Okuku, Carol Levin, Donald Cole, and Jan Low</i> | 95 |
| Abstract 5: Understanding Consumer Preferences and Estimating Willingness-to-Pay for Orange-fleshed Sweetpotato Juice: Does Nutrition information Matter? - <i>Temesgen Bocher, Kiriimi Sindi and Jan Low</i> | 96 |
| Abstract 6: Vitabread: Consumer and baker preferences, economic and nutrition potentials - <i>Francis Kweku Amagloh</i> | 97 |
| Abstract 7: SUSTAIN Mozambique and Zebra Farm Integrate Two value Chains in Juice and Biscuits using Orange-fleshed Sweetpotato and Soya - <i>Roland Brouwer (CIP) & Lucas Mujuju (Zebra Farm)</i> | 98 |
| Abstract 8: Carotenoid Retention and Vitamin A Activity in Dried Orange-fleshed Sweetpotato that is Cooked, Fried, or Stored - <i>Bechoff, A.^{1*}, Tomlins, K.I.¹, Dhuique-Mayer, C.² and Westby A.¹</i> | 99 |
| Abstract 9: Effect of Different Cooking Treatments and Amylase Activity on Sugars and Sweetness of Sweetpotato Root - <i>Owusu-Mensah, E.^{1,2}, Odoro, I.¹, Ellis, W.O.¹, and Carey, E.E.²</i> | 99 |
| Abstract 10: Orange-fleshed Sweetpotato Product Development at Universal Industries in Malawi - <i>Jean Pankuku</i> | 100 |
| Abstract 11: The Use of Sweetpotato Residues as Feed in Rural and Peri-urban Smallholder Pig Systems in Uganda - <i>D. Pezo, E.A. Ouma, M. Dione, P. Lule, B. Lukuyu, N. Carter and G. Kyalo</i> | 101 |
| Abstract 12: Can Radio Get Sweetpotato Markets Going? Radio and Sweetpotato promotion - <i>Sheila Rao & Karen Hampson</i> | 102 |
| Abstract 13: Development and Characterization of Peanut Better Enhanced with Orange-fleshed Sweetpotatoes - <i>Joseph Mulindwa</i> | 103 |
| Abstract 14: Evaluation of the evaporative cooling system (zero energy cool chamber) for sweetpotato roots storage - <i>Madjaliwa Nzamwita*, Jean Claude Nshimiyimana, Nyirahabimana Christine, Nyirahanganyamunsi Gerardine and Kiriimi Sindi</i> | 104 |
| Abstract 15: Technical and adaptive research on baked and fried sweetpotato-based products: progress with the 'rainbow project'/federal university of agriculture, Abeokuta (FUNAAB), Nigeria - <i>Ganiyat Olatunde</i> | 104 |
| Abstract 16: Sweetpotato Value Chains in Western Kenya: Current and Potential - <i>Tanya Stathers and Ilaria Tedesco</i> | 105 |
| Abstract 17: OFSP Puree Processing in Kenya & Building on the Mama SASHA Experience - <i>Penina Muoki</i> | 106 |
| Abstract 19: Development and Marketing of Sweetpotato Processed Products by SOSPPA in Uganda - <i>Jean Anthony Onyait</i> | 107 |
| Abstract 20: Orange Fleshed Sweetpotato Post-harvest Value Addition for Improved Food and Nutrition Security in Kenya – <i>Abong', GO^{1*}, Kaaya, A², Shibairo, SI³, Lamuka, PO¹, Okoth, MW¹, Odongo, NO¹, Sopade, PA⁴</i> | 108 |

Abstract 1: Expectations from CoP on Marketing, Processing and Utilization & Post-Harvest Research in SASHA Phase 2- Jan Low

International Potato Center

Sweetpotato for Profit and Health Initiative Leader and SASHA Project Manager

The five year SASHA Phase 2 project (2014-2019) will build on the successes realized during SASHA Phase 1, with a strategic focus on adaptive research to break the remaining bottlenecks to unleashing the potential of sweetpotato for reducing undernutrition and food insecurity. The overall objective continues to be ***to develop the essential capacities, products, and methods to reposition sweetpotato in food economies to alleviate poverty and undernutrition in Africa***. CIP leads a diverse set of partner organizations in research for development activities in Uganda, Kenya, Ethiopia, Tanzania, Mozambique and Ghana. SASHA Phase 2 continues to receive the support of the Bill & Melinda Gates Foundation.

In Phase 2, SASHA is addressing remaining challenges in breeding, seed systems, post-harvest and nutritional quality, as well as continuing its commitment to building a strong sweetpotato community of practice (CoP). The Regional Technical Support Platform (see figure) envisions four technical CoP working groups meeting annually and communicating virtually throughout the year: 1) Breeding and Genomics, 2) Seed Systems & Crop Management, 3) Markets, Processing & Utilization, and 4) Advocacy, Monitoring, Learning and Evaluation. We envision that the same core set of scientists and practitioners will learn from each other, thus speeding up the transfer of new ideas. Each Community of Practice will actively engage with the Sweetpotato Knowledge Portal, with access to technical assistance to set up relevant discussion groups.

For sweetpotato agro-processing to truly take off on a commercial scale, and to enhance household level food security, the SASHA project will seek to develop and refine tools to significantly reduce seasonality in supply, in close collaboration with scientists from the Natural Resources Institute and other national research organizations in specific countries as well as sweetpotato dissemination projects. This will be achieved by investing in cost-effective gender-sensitive storage techniques for fresh roots and processed puree and postharvest management practices for different end users of sweetpotato, assuring adequate safety and quality standards by establishing a reference nutrition laboratory in collaboration with Biosciences for eastern and central Africa (BecA) in Nairobi.

Abstract 2: Where We Are, and What We Expect to Achieve with Orange-fleshed Sweetpotato (OFSP) in Rwanda: Nutrition Focus - Robert Ackatia-Armah

International Potato Center

Regional Nutritionist –SSA

Sweetpotato is widely consumed in Rwanda and regarded as a poor man's food. Over the past five years, great progress in accepting and adopting newly introduced orange-fleshed sweetpotato (OFSP) varieties. With universal coverage of vitamin supplementation in Rwanda, OFSP promotion as a major contributor to Vitamin A deficiency reduction faced some push back. However, based on advocacy work started under the SASHA-Rwanda Super Foods project and now being continued under the SUSTAIN project, OFSP is gradually being accepted as an import crop for its nutritional, health and income benefits. It is now mentioned in key policy documents of the Social Cluster Ministries (SCM) and is encouraged and promoted as a strategy for fighting micronutrient malnutrition and an important contributor to meeting caloric needs of rural households with children under 5 years. Going forward, CIP will play a pivotal role in ensuring that OFSP becomes a part of the new nutrition agenda in Rwanda to complement other efforts being promoted in the fight against malnutrition. Several NGO's are increasingly including OFSP as part of their nutrition

programing working with rural farmers. As a result, CIP is playing a coordinating role in this effort to ensure that material that goes out to farmers is clean, well-accepted and comes with nutritional information. We are also coordinating the training and sharing of nutrition information related to OFSP through consistent messaging around its use alone or as an ingredient for foods fed to children under 5 years. A special emphasis is being placed on the first 1000 days of life program promoted by the SCM. This program creates an environment for CIP to promote OFSP consumption during pregnancy and also during the period of complementary feeding. CIP also continues to invest in product development with private sector to promote the incorporation of OFSP puree into commonly consumed bakery products. With these efforts, CIP hopes to strengthen the adoption of OFSP as a key staple and expand coverage of the crop nationwide.

Abstract 3: Dissemination of Orange Sweetpotatoes through District Health Services Delivery Systems in Western Uganda: A Case Study of Health Child Uganda - Angela Atero

HarvestPlus

Vitamin A deficiency is a public health problem in Uganda; in 2011 about 33% of children (6-59 months) were categorized as having vitamin A deficiency (UBOS & Micro International 2011). In 2005, UNICEF estimated the deaths resulting from vitamin A deficiency (VAD) at 29,000 and the percentage of children less than 6 years of age with sub-clinical Vitamin A deficiency to be 66%. If the deficiency remained unchecked, it is estimated to have caused 160,000 child deaths between 2006 and 2015 (FANTA 2010). Against this background, HarvestPlus Uganda embarked on developing and disseminating vitamin A rich orange sweet potatoes to improve nutrition and public health in different parts of the country through partner NGOs. A number of models were adopted in the dissemination process including; Extension system Model, Value Chain Approach Model and, Health Services Delivery System (HSDS) model. This presentation will concentrate on the HSDS model which was implemented by Health Child Uganda (HCU), an NGO partner of HarvestPlus to disseminate the orange sweet potatoes in Mbarara district in Western Uganda. We will elucidate the application of the model, its achievements, challenges, and lessons learnt. The HSDS model engages village health teams (VHTs). Each VHT has a catchment area for which they are responsible. Their work is to deliver and promote health programs in their catchment areas. These VHTs are in turn supervised by Health Centre Supervisors. HCU applied the HSDS model in Mbarara district to promote the cultivation and consumption of the OSP. Three sub-counties of Ruganda, Ndeija and Mwizi were selected and from which twelve parishes were identified. In each Parish, one health centre was included in the project. The field extension workers of HCU trained 12 Health Centre supervisors who in turn trained 216 Village Health Teams (VHTs) in the six parishes. Each of the village health teams was responsible for 30 households in their catchment areas. The VHTs sensitized households on the consumption and agronomic practices of the OSP. With the HSDS model we managed to reach out to 6,480 beneficiaries in just six months. The major advantage with this model is that it is much easier to pass on the nutrition related messages since the VHTs have previous training in nutrition and health. The major challenge faced was varying VHT performance due to different levels of education. The major lesson learnt was that there is need for continuous sensitization and refresher trainings in agronomy of the OSP for VHTs since they are not well conversant with agriculture-related issues.

Abstract 4 - Evaluating the Effectiveness of a Nutrition-Sensitive Agriculture Intervention in Western Kenya: Design and Preliminary Findings of the Mama SASHA project - Fred Grant, Amy Webb Girard, Haile Okuku, Carol Levin, Donald Cole, and Jan Low

Background / Rationale: Rigorous evaluations of nutrition-sensitive agricultural interventions are a research priority. The Mama SASHA project integrated agriculture and nutrition interventions into antenatal health care services to maximize the potential benefits of orange-fleshed sweetpotato (OFSP) on the nutritional status of mothers and children less than 2 years of age.

Methodology: The evaluation strategy was developed iteratively using participatory impact pathway analysis and included 2 cross-sectional surveys of pregnant women and mother-child (6-23 months-old) pairs at baseline and endline, a nested longitudinal cohort study following mother-infant pairs from early/mid- pregnancy through 9 months postpartum, two rounds of operations research and monthly monitoring. Data collection for the baseline (n=2,742) and endline (n=2,505) surveys included anthropometry and vitamin A (VA) status on children as well as information on dietary diversity (household and individual), knowledge and attitudes (related to nutrition, VA and health services), health services uptake, program participation, socio-demographics, agricultural practices, and agricultural knowledge. Data collection for the cohort study (n=505 women and their infants) included food security, dietary intakes, uptake of health services, program participation, knowledge and attitudes; agricultural practices and sociodemographics; anthropometry, maternal hemoglobin, VA and iron status of women; infant VA and iron status, infant anemia, and breast milk vitamin A and carotenoids, and infant morbidity. Extensive monitoring data and project expense reports were used to estimate the financial costs as well as cost-effectiveness of the intervention.

Results: At baseline, no significant differences were observed between intervention and control on household socio-demographics or maternal or child diet, nutrition or knowledge, child anthropometry or VA deficiency (VAD). At endline, significantly ($P<0.05$) greater proportion of intervention households: produced and consumed OFSP; had higher household, maternal and child dietary diversity, consumption of VA rich foods and dietary adequacy for VA; increased utilization of antenatal services; and had higher maternal nutrition, health and childcare knowledge and had lower child VAD. From baseline to endline, we observed significant reductions in prevalence of stunting (difference-in-difference impact estimate, DID: -10%; $P<0.001$), underweight (DID: -6.5%; $P<0.01$) and VAD (DID: -5.1%; $P=0.04$) among children from intervention areas compared to those from control areas. However, further analysis is required as only approximated 50% of households in the endline actually participated in the intervention. Among those participating in the cohort study, intake of VA was significantly higher among both mothers and children in the intervention group at 8-10 months postpartum, with these differences attributed to OFSP consumption. The intervention was cost-effective: \$1882 per DALY averted [$<$ WHO Threshold of 3 X GDP of country (\$994 for Kenya)].

Conclusion: Preliminary findings from the Mama SASHA intervention indicate that an integrated agriculture-nutrition-health intervention had a positive impact on maternal and child health and nutrition through improved use of health services and OFSP production and consumption.

Acknowledgement: Bill & Melinda Gates Foundation funded this study under the Sweetpotato Action for Security and Health in Africa project.

Abstract 5: Understanding Consumer Preferences and Estimating Willingness-to-Pay for Orange-fleshed Sweetpotato Juice: Does Nutrition information Matter? - Temesgen Bocher, Kirimi Sindi and Jan Low

International Potato Center

This study applies the Heckman two stage probit model to analyze willingness-to-pay for different juices types and a multinomial logit model to analyze the determinants of juice choices for orange-fleshed-sweetpotato (OFSP)-based juice products in Rwanda. The objective the study was to test the possibility of producing OFSP juice, understanding consumer preferences and studying willingness-to-pay among consumers. The study is based on a structured survey and taste test administered to 980 randomly selected juice tasters (384 female and 562 male) from seven different representative markets in Rwanda (serving low to high income consumers). Four juices were tested: two popular brands of 100% pineapple juice (made by Inyange and SINA Enterprises), one 100% OFSP juice; and one 85% OFSP-15% SINA pineapple juice blend. During the taste testing, there was no information provided as to what the type or brand of the juice was. Each of the respondents was asked to give his or her opinion concerning different juice attributes by rating aroma, taste, color, “right” amount of sugar, and aftertaste using a Likert scale (1 to 5, with five being the most preferred).

Descriptive results are provided in Table 1. Model results suggest that both individual consumer characteristics and juice attributes play role in willingness-to-pay for the juice, particularly the sex of the consumer, the consumer’s juice buying frequency and the aroma, right amount of sugar, and taste of the juice were positively associated with willingness-to-pay and juice choice.

The study compared the consumer’s willingness-to-pay for OFSP-based juices versus other non-OFSP juices (the most popular brands on the market) when information on the nutritional quality of the OFSP juice was provided compared to when it was not provided. Without nutritional information the willingness-to-pay for the other juices compared with OFSP-based juices was statistically higher; but with nutritional information the opposite held true.

Moreover, there is no significant differences in consumer preferences for major juice attributes or willingness-to-pay between OFSP-pineapple juice and the two 100% pineapple juices. This suggests that it is possible to develop OFSP based juice that can be accepted by consumers. Furthermore, providing nutrition information of OFSP juice, particularly about the role vitamin A plays in health is important for how the juice is perceived and consumer willingness to pay.

Table 1. Average Consumer Likert Scores (range 1-5) for Attributes of Four Juices and Consumer Willingness-to-Pay for those Juices.

| Juice type* | Color | Aroma | Taste | After taste | Consistency | WTP |
|---|----------|-----------|-----------|-------------|-------------|------------|
| 1. Mean scores without nutritional information | | | | | | |
| OFSP-Juice | 3.96 | 2.88 | 2.98 | 2.97 | 3.22 | 397 |
| P-Inyange | 3.18 | 3.86 | 3.65 | 3.48 | 3.21 | 453 |
| P-SINA | 3.08 | 3.99 | 4.00 | 3.80 | 3.62 | 466 |
| Blend | 3.82 | 3.10 | 3.48 | 3.36 | 3.59 | 451 |
| T-statistics difference in means without nutritional information of the juice | | | | | | |
| OFSP vs P-Inyange | 11.34*** | -15.26*** | -10.80*** | -7.47*** | 0.08 | -9.00*** |

| | | | | | | |
|--|----------|-----------|-----------|-----------|----------|------------|
| OFSP vs P-SINA | 13.85*** | -19.02*** | -17.04*** | -13.07*** | -6.34*** | -6.54*** |
| Blend vs P-Inyange | 9.31*** | -10.91*** | -2.46* | -1.56 | 5.29*** | -0.14 |
| Blend vs P-SINA | 12.14*** | 0.34 | -8.40*** | -6.59*** | -0.51 | -1.02 |
| 2. Mean scores with nutritional information | | | | | | |
| OFSP-Juice | 4.16 | 3.87 | 4.02 | 3.89 | 4.00 | 449 |
| P-Inyange | 2.78 | 3.55 | 3.39 | 3.24 | 2.93 | 417 |
| P-SINA | 3.05 | 3.80 | 3.68 | 3.59 | 3.44 | 406 |
| Blend | 3.87 | 3.84 | 3.76 | 4.36 | 4.27 | 540 |
| T-statistics difference in means with nutritional information of the juice | | | | | | |
| OFSP vs P-Inyange | 7.16*** | 1.77* | 3.62*** | 3.36*** | 5.84*** | 2.02** |
| OFSP vs P-SINA | 6.58*** | 0.40 | 1.99* | 1.63 | 3.20** | 2.56** |
| Blend vs P-Inyange | 9.76*** | 3.33*** | 14.90*** | 14.65*** | 15.12*** | 5.39*** |
| Blend vs P-SINA | 4.85*** | 6.61*** | 9.03*** | 10.21*** | 9.55*** | 4.80*** |

Standard errors in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$

*100% Pineapple juices: P-Inyange and P-SINA. OFSP-Juice is 100% OFSP; Blend is 85% OFSP, 15% Pineapple juice.

Abstract 6: Vitabread: Consumer and baker preferences, economic and nutrition potentials - Francis Kweku Amagloh

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With increasing urbanisation rate of 3.5% in Africa, there would be high demand for bakery products including bread. Sweetpotato, particularly the orange-fleshed cultivars (OFSP), has huge processing potential because of their short growth period (3-5 months), powerhouse for vitamin A, and combining properties of cereals, fruits and vegetables. The objectives of this study were to: (1) refine one of the bread recipes available in Ghana; (2) conduct a survey to assess if consumers and bakers will prefer composite bread containing OFSP (vitabread); (3) estimate the economic potential of baking vitabread; (4) evaluate the consumer preference for vitabread; and (5) determine the vitamin A content of vitabread. Surveys were conducted in four regions in Ghana: Greater Accra, Ashanti, Northern and Upper East. The benefit-cost ratio (BCR) was used to calculate cost of processing vitabread with 45% OFSP puree substitution with wheat flour. A quarter the amount of sugar added to traditional wheat (white) bread was used for the vitabread. A consumer sensory evaluation by 100 undergraduate students was used to assess the acceptance of no-sugar vitabread, vitabread (OFSP composite breads) compared with traditional wheat (white) bread that was refined. A 5-point Likert scale (1=least acceptable/dislike extremely and 5=highly acceptable/like extremely) was used to score for appearance, aroma and overall degree of liking. β -carotene is being analysed by the Nutrition Department, Noguchi Memorial Institute of Medical Research, on fee-for-service basis. All the respondents interviewed in Greater Accra (n=47), in Ashanti (n=62); and 99% and 95%, respectively in Northern (n=153) and Upper East (n=388) Regions consumed bread. Except in the Ashanti Region, where only 47% of the respondents indicated that they would purchase the vitabread, in all the other regions, about 89% of the respondents indicated that they would buy the vitabread if it is available on the Ghanaian market. All the bakers interviewed in Greater Accra (n=20)

and Northern Regions (n=11) expressed their willingness to bake the vitabread. For bakers in Ashanti (n=20) and Upper East Regions (n=26), 80% and 96%, respectively indicated that they would bake the sweetpotato composite bread. Based on the BCR calculation, it is more profitable to bake the vitabread than the traditional wheat (white) bread (1.18 and 0.99, respectively). BCR value of 1.00 means a breakeven venture. The vitabread as well as wheat (white) was ranked highly for preference for appearance, aroma and overall degree of liking, score ranged from 4.15 to 4.65. The sensory panellist (90% of the responses per each sample) strongly indicated that they would like to see the vitabread samples on the Ghanaian market. The vitabread (previous formulation at 32% OFSP puree substitution) could meet 17% of the daily adequate intake of vitamin A for a 1-3 year old child consuming about 50 g of this bread. Therefore, incorporation of OFSP puree would have double advantage by making bread baking more profitable and also the vitabread will be a good source of dietary vitamin A.

Funding: *The Jumpstarting of OFSP in West Africa through diversified markets funded this project through a sub grant agreement (SGA 7823-000-00-UDS-01).*

Abstract 7: SUSTAIN Mozambique and Zebra Farm Integrate Two value Chains in Juice and Biscuits using Orange-fleshed Sweetpotato and Soya - Roland Brouwer (CIP) & Lucas Mujuju (Zebra Farm)

In collaboration with Euro-Ingredients Ltd., the International Potato Center (CIP) in sub-Saharan Africa (SSA) has been developing several orange-fleshed sweetpotato (OFSP)-based products. One of these products is juice made from milled fresh roots. The raw juice is mixed with ascorbic and citric acid, gum and inverted sugar and pasteurized to attain the right taste, viscosity, mouthfeel and enhance shelf-life. Tests suggest a shelf life of at least 4 weeks in cool storage. OFSP juice is also being explored in Rwanda and in Mozambique. In Mozambique, CIP partners under its SUSTAIN project with Zebra Farm, a small agro-processing company in Chimoio in the center of the country, which will produce the juice commercially.

The partnership with Zebra Farm creates a unique opportunity as today the company's main business is the production of soymilk and yoghurt. The production of the soymilk and yoghurt produces a pulp residue. Milling sweetpotato roots also produces pulp. Both pulps combined with flour, butter and egg make biscuits that are rich in Vitamin A and protein. The combination increases the feasibility of *both* value chains, OFSP and soy. Business scenarios show that the operation can be profitable even under unfavorable market prices for roots.

Zebra Farm owns land where it produces soybean and, since early 2015, also the OFSP variety Tio Joe. In addition to its own production, it buys soy from outgrowers. Under the partnership agreement with CIP it will buy roots from at least 10 farmers.

Until today only the soy milk and yoghurt have been produced at a commercial scale. The OFSP products are waiting for the arrival of the necessary equipment. Hence, all available information is still based on tests and simulations. A taste test with 10 male twenty-year old university students indicated that the current formula is only slightly less appreciated than fruit juice. This suggests that the product would have a viable market. Moreover, addition of fruits such as mango, banana and pineapple results in an even better tasting product which taste-wise can easily compete against other juices. Samples of juice and biscuits have been analyzed for Vitamin A and C content as well as for protein, fats, sugar and key minerals. Results show varietal choice heavily influences nutritional composition.

The juice/biscuits combination offers interesting opportunities but there are also challenges. One is the need for imported equipment, which has delayed implementation. The other is an unexpected change in Chimoio's municipal policy, which has forced Zebra Farm to abandon its installations downtown and construct new ones on the outskirts of town. In addition to these incidental obstacles there are more structural difficulties: citric and ascorbic acid and gum are also imported

products. The same is valid for packaging and labeling materials. Importing increasing expenses and is cumbersome and hence important obstacles on the road to a sustainable and profitable operation.

Abstract 8: Carotenoid Retention and Vitamin A Activity in Dried Orange-fleshed Sweetpotato that is Cooked, Fried, or Stored - Bechoff, A.^{1*}, Tomlins, K.I.¹, Dhuque-Mayer, C.² and Westby A.¹

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Biofortified orange-fleshed sweetpotato (OFSP) is being promoted to tackle vitamin A deficiency, a serious public health problem affecting children and pregnant/lactating women in sub-Saharan Africa. The retention of β -carotene (BC) in blended foods made with part OFSP flour (from dried OFSP) (30%) was examined. Chapatis and porridges were prepared by local processors in Uganda (n=10). While the retention of all-trans-BC in porridges (69 to 93%) and chapatis (70 to 97%) varied between the processors, there was no overall difference between the two products and this was probably because of the variability in field conditions. BC retention in mandazis was similar to that of chapatis and porridges. Processing into FC significantly increased the amount of cis-isomers, in particular 13-cis-BC. The bioaccessibility of the BC as measured by their transfer into micelles was evaluated using an *in vitro digestion* procedure in various OFSP-derived products: after *in vitro* digestion, the percentage of micellarized all-trans-BC was greater in products cooked with oil: chapati (73%), mandazi (49%), as compared with the boiled ones: porridge (16%) and puréed from boiled root (10%). In all the products, the incorporation into micelles for 13-cis-BC was significantly higher to that of all-trans-BC. When taking in account the bioaccessibility of all-trans-BC and 13-cis-BC isomer, an edible portion of porridge (one mug), boiled root (half a root), mandazis (two) or chapati (one) could provide a significant part of the daily vitamin A requirements of a child under 6 years (respectively 20, 46, 75 or 100%). These data support the promotion/consumption of locally cooked OFSP food products to tackle vitamin A deficiency in sub-Saharan Africa.

In contrast, storage of dried OFSP at room temperature in Uganda for four months resulted in high losses of pro-vitamin A (70%) and therefore, there was little vitamin A activity left in the dried product. To understand the cause of the losses, dried sweetpotato was stored under controlled conditions of temperature (10; 20; 30; or 40°C), aw (0.1; 0.3; 0.5 or 0.7) and oxygen (0 [under nitrogen]; 2.5; 10 or 21% [air]). Losses in provitamin A were the least during storage at the lowest temperature and oxygen level and at the highest humidity level. The effects of storage temperature (10; 20; 30; 40 °C), water activity (0.13; 0.30; 0.51; 0.76) and oxygen level (0%; 2.5%; 10%; 21%) on the degradation of carotenoids and formation of volatile compounds during storage of dried sweetpotato were evaluated. A kinetic model was developed for degradation of trans-BC and it showed that breakdown followed first order kinetics with an activation energy of 64.2 kJ.mol⁻¹. The difference between experimental data under laboratory or field conditions fitted and data predicted by the model was less than 10% for trans-BC, or for total carotenoids. It is also suggested that carotenoid degradation in dried sweetpotato was by autoxidation because of the trend in β -carotene degradation rate in relation to water activity or oxygen level.

Abstract 9: Effect of Different Cooking Treatments and Amylase Activity on Sugars and Sweetness of Sweetpotato Root - Owusu-Mensah, E.^{1,2}, Oduro, I.¹, Ellis, W.O.¹, and Carey, E.E.²

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Sugar content of sweetpotato roots can be significantly affected by cooking. Eleven sweetpotato varieties were cooked using baking, microwaving and steaming, with the aim of investigating the effects of these methods on sugar profile and sweetness levels. The roots were harvested at four months after planting and stored for a week at ambient condition prior to experiment. Following cooking treatments, sucrose, glucose, fructose and maltose contents were determined. Individual sugar values were also converted to relative sweetness per sucrose equivalent. Initial sugars and amylase activity of the raw uncooked roots were also determined. The study indicated that baking treatment was most pronounced, producing 60% and 80% more sugars than steaming and microwaving, respectively. The effect of the microwave treatment was not significantly different from the raw in most of the varieties. Whilst sucrose was the predominant in the raw form, maltose increased dramatically and became the principal sugar after cooking. Increased sugar concentration was highly correlated with amylase activity in the raw roots. Sweetness level increased substantially upon cooking in most of the varieties, and was highly dependent on initial sugar content, amylase activity and cooking treatment. Thus, evaluation of sweetness levels in sweetpotato clones should not only be on the uncooked samples but should take into account the cooking methods used.

Abstract 10: Orange-fleshed Sweetpotato Product Development at Universal Industries in Malawi - Jean Pankuku

Universal Industries Limited - Group Food Technologist

Malawi is the largest producer of sweetpotatoes in southern Africa, but very minimal value addition is done at household level and no processing at industrial level. The project of developing and commercialization of sweetpotato based products by Universal Industries is meant to scale up the utilization of the bio-fortified orange-fleshed sweetpotatoes by both the rural and urban communities through the value added products. The value added products that are being developed include OFSP puree, OFSP flour, OFSP Crisps, Porridge flour mixes, baby foods, and juices. By creating the local and international market for the value added products, a pull/demand for more sweetpotatoes roots as the main raw materials will be created increasing productivity and at the same time providing a sure stable market to the farmers. The project also aims at producing ready to eat and ready to cook instant foods that are not only convenient but also nutritious, meeting the needs for such consumer market segment. The products are therefore targeted at two market streams, the normal commercial selling with existing customers (wholesalers and retailers) and feeding programs supported by the governments, NGOs and different other institutions.

Progress on product development Universal has so far tested the six OFSP varieties for crisps. Initial findings showed that the deep orange color was not good as the crisps color looked burnt and therefore unattractive for crisps. One of the challenges with OFSP crisps was high breakages during the frying process. The challenge then is to find an OFSP variety that does not break too much during frying, but also make modify the processing specifications such as frying time, temperature and slice thickness. The other product that has been developed is biscuits with OFSP puree as a wheat flour substitution. Again, a special OFSP biscuit has been developed which is so promising following consumer acceptability studies conducted so far. Trials are still underway to find a suitable Malawian variety for OFSP puree processing to use in the biscuit processing. One observation is that puree made from roots harvested during the rainy season differs compared to puree from roots harvested during the dry season. This variation in moisture content affects the processing quality. OFSP puree was used to make biscuit cream but has for not been successful as it increases the moisture content of the cream which affects the texture/crispness of the biscuit and the shelf life as well. Some of the products yet to be developed include puree baby food, a Nutri-Bar and OFSP flour mixes. The main challenges so far include that some adjustment will have to be made during processing to accommodate for the changes with different varieties and seasons. Also, different

varieties tend to perform differently in different climatic zones which as well affect the physiochemical characteristics of the roots. The major challenge at the moment is the storage of the OFSP roots for a period without losing the beta-carotene.

Abstract 11: The Use of Sweetpotato Residues as Feed in Rural and Peri-urban Smallholder Pig Systems in Uganda - D. Pezo²⁶, E.A. Ouma, M. Dione, P. Lule, B. Lukuyu, N. Carter and G. Kyalo

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In the last 30 years, Uganda has had a massive growth in pig population, from 190,000 in the late 90's to 3.2 million pigs in 2008, and currently has the highest per capita consumption of pork in East Africa (3.4 kg/year). The majority of pig farmers are smallholders (1.2 million households raise pigs), practicing low input/ low output systems. On addition, Uganda has the highest production of sweetpotatoes in Africa, and is the second largest producer of sweetpotatoes in the world. Focus group discussions (FGDs) conducted in 35 Ugandan villages (covering Kamuli, Masaka and Mukono districts) showed that in rural and urban settings smallholder pig farming is practiced in crop-livestock systems, with high dependence on crop residues and sweetpotato vines being the most preferred crop residue by smallholder farmers as pig feed. However, the relative contribution of sweetpotato residues to pig diets, as well as other crop residues and forages, is strongly affected by rainfall seasonality that influences crop patterns.

More than 95% of the crop residues used for feeding pigs is produced on farm. Trading of crop residues is minimal (comprises <2%). Women and children are mostly responsible for pig feeding and management, as well as for collecting crop residues for pigs (86 and 79% of farms in rural and peri-urban settings, respectively). Other feeds used are kitchen leftovers, including banana peelings, which provide 18-20% of the total ration; whereas forages and "weeds" represent 20-28%, and compounded feeds (commercial and home-mixed) 25-27%, with maize bran as the main ingredient.

The main feeding constraints identified by farmers in FGDs are: dry season fodder shortages (60%); risk of parasite infestation through forages (26%). In the case of concentrates, constraints include high cost of commercial feeds (80%), and poor quality of purchased feeds (46%). There is need for enhancing knowledge on feeding strategies and fodder conservation among farmers in order to overcome the feed availability fluctuations, but also on proper feed formulation for both farmers and feed stockists. In addition, quality control of feeds available in the market is urgently needed.

An alternative to overcome seasonality in the use of sweetpotato residues is silage making. Simple technologies have been tested in South East Asia, China, and more recently in Kenya and Uganda. A study conducted in Masaka district, Uganda showed that crossbred and local pigs eating complete diets made of 30-40% sweetpotato silage (70% vines: 30% tubers) plus other local feeds (i.e., fruit, forages, and others) gained 470 and 390 g/day, respectively; whereas the daily gains for pigs fed on concentrates were 660 and 530 g/day, respectively. Studies in Sichuan (China) showed that pigs fed on sweetpotato silage supplemented with a protein rich concentrate could gain up to 620g/day, with an increase in the economic benefit of 33.5%. In conclusion, the use of sweetpotato silage as pig feed results in significant increases in live weight gain and a reduction in feeding costs by partial replacement of commercial concentrates.

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Abstract 12: Can Radio Get Sweetpotato Markets Going? Radio and Sweetpotato promotion - Sheila Rao & Karen Hampson

Farm Radio International

Since 2012, Farm Radio International implemented two projects that focused on the promotion of bio-fortified sweetpotato. Each project used a number of different radio communication strategies and worked with a variety of radio stations, scientists, health specialists, nutritionists, farmers groups and private sector interests to engage in a dialogue around the production and consumption of sweetpotato, and the relevant nutritional value of vitamin A. Both projects facilitated on-air discussions of sweetpotato and nutrition, and the potential market for processed products. Through a HarvestPlus funded project in Uganda, a 52-episode mini-drama aired on 9 different radio stations in 6 vernacular languages. 'My Children' or *Abaana Bange* in Luganda, focused on the challenges faced by a rural farming household, and how one family learned the value of growing and eating orange sweetpotato. An interactive mobile phone service allowed listeners to call-in, and participate in the programs, vote for their favourite character, and anticipate certain outcomes in the story. The service allowed the radio stations to track where the listeners were based. The evaluation of the project revealed that the drama contributed to an increase in knowledge of nutritional value of sweetpotato and an increase in interest in selling the roots and processed products. The drama presented a forum for listeners to engage with key challenges in production, while also exploring household gender dynamics. The scripts for the drama were translated and adapted for audiences in Tanzania and Ghana, using local writers and radio production companies in each country.

A second multi-country project beginning in 2012 took place in Tanzania, Uganda, Ghana and Burkina Faso. Funded by the Bill & Melinda Gates Foundation, this three-year project provided an opportunity to expand the networks surrounding sweetpotato promotion between agricultural scientists and breeders, health specialists, communication specialists, farmers, and private sectors interests in marketing and processing. Participatory radio campaigns (PRCs) were used to support three main themes: accessing and cultivating vines to increase production in targeted regions; preparing and consuming sweetpotato roots and leaves using locally available ingredients and resources and increasing the shared nutritional information and knowledge around eating healthy foods with specific micronutrients. All three themes considered the market interests for both men and women and factors affecting influencing a successful entry into local and regional markets. The results and focus of each of the programs varied, based the specific local and regional context. The use of different radio strategies responded to specific challenges with sweetpotato adoption. For example, *beep to vine*, connected listeners who were interested in beginning sweetpotato production with vine suppliers in their district, through a free messaging system. Call-in shows allowed farmers to ask questions regarding harvesting, and recipes, and opportunities for selling products. Live cooking shows, and distribution of vines through schools were also used in conjunction with the radio shows. Radio has the potential to support market interests for sweetpotato products through the use of more interactive services. These two projects served as an initial strategy to increase production, to raise awareness of the diverse ways in which to prepare sweetpotato and to explore the market potential. A more focused approach on using interactive radio strategies that specifically looks at the integrated value chain for sweetpotato or on marketing nutritious staple crops could leverage the impact from this initial strategy, and boost the overall availability of sweetpotato and sweetpotato products.

Abstract 13: Development and Characterization of Peanut Butter Enhanced with Orange-fleshed Sweetpotatoes - Joseph Mulindwa

Makerere University

Although peanuts are an excellent source of nutrients such as fats and proteins, they are inadequate in essential vitamins, especially vitamin A which leads to Vitamin A deficiency (VAD). This study was designed to produce pro-vitamin A enhanced peanut butter using locally available sources, to make it available to children between the age of 6-15 years in Uganda.

Peanut butter was produced from peanuts free from moulds and aflatoxins and stabilized with triglycerides and enhanced using 5%, 10%, and 15% Orange Fleshed Sweetpotatoes flour (OFSP). All samples were stored for five months at room temperature and continuously monitored for changes in β -carotene, fat stability, microbial quality, and sensory properties. Addition of OFSP flour to peanut butter increased β -carotene significantly ($P \leq 0.05$), $1388 \pm 7 \mu\text{g}/100\text{g}$ in sample with 15% OFSP flour, followed by sample with 10% OFSP flour ($1041 \pm 36.8 \mu\text{g}/100\text{g}$), sample with 5% OFSP and control sample had the least β -carotene of $795 \pm 111.5 \mu\text{g}/100\text{g}$ and $244 \pm 11.6 \mu\text{g}/100\text{g}$, respectively. β -carotene retention of sample with 15% OFSP at the end of the fifth month had significant amount of β -carotene that can contribute to the required vitamin A intake for boys and girls between age of 6-15 years whose WHO recommended levels are in the range of 350-500 $\mu\text{g}/\text{day}$.

Fat analyses of the stored peanut butter showed that control sample had reduced flavor due to high acid value and peroxide value. The control sample had highest acid value (AV) (0.22 mg KOH/g of fat) in the first month of storage, sample with 5% OFSP had AV of (0.21 mg KOH/g of fat), sample with 10% and 15% OFSP had least AV of (0.15 mg KOH/g of fat) and (0.13 mg KOH/g of fat), respectively. Acid Value increased with storage time and at the end of 5th month, acid value of control sample was 109%, while sample with 15% OFSP had the least. For the peroxide values (PV), all samples did not show any peroxides in the first month of storage, during the 5th month of storage, PV of control sample had increased to 19.62 meq/kg; followed by sample with 5% OFSP with value of 8.35 meq/kg; followed by sample with 10% OFSP (2.89 meq/kg) while sample with 15% OFSP had the lowest PV of 2.34 meq/kg. All the peanut butter samples tested negative for *E.coli*, yeasts and moulds. Over the period of five months, control sample tested negative for *S. aureus* but was present in other samples, sample with 15% OFSP having the highest count of $4 \times 10^1 \text{ cfu/g}$ but considering the USDA commodity micro requirements for peanut butter, it was found that the peanut butter was safe for consumption.

The study showed that there was a significant amount of β -carotene retained in sample with 15% OFSP at the end of the five months of storage which can contribute to the vitamin A requirements for children between the ages of 6-15 years who RDI is 350-500 $\mu\text{g}/\text{day}$.

Abstract 14: Evaluation of the evaporative cooling system (zero energy cool chamber) for sweetpotato roots storage - Madjaliwa Nzamwita*, Jean Claude Nshimiyimana, Nyirahabimana Christine, Nyirahanganyamunsi Gerardine and Kirimi Sindi

Rwanda Agriculture Board and International Potato centre

Five sweetpotato varieties notably Gihingumukungu (orange-fleshed), Kabode (orange-fleshed), Vita (orange-fleshed), Cacearpedo (orange-fleshed), and Mugande (white-fleshed) were stored under cool and farmer storage conditions to evaluate the effect of low temperature and high relative humidity on the shelf-life of sweetpotato roots. The rotting, sprouting, total soluble solids, weight loss and appearance of the roots were evaluated during the course of the experiment. Samples stored under cool storage conditions had the lowest rate of rotting, weight loss and good appearance when compared with samples stored under farmer's storage conditions. Gihingumukungu had the highest moisture content but it maintained the highest quality for all parameters investigated except sprouting as it produced more sprouts compared to other varieties. The weight loss in samples stored under cool storage conditions ranged from 0-9.0%, 25-43%, 16-30%, 26-44% and 29-50% for Gihingumukungu, Kabode, Vita, Cacearpedo and Mugande respectively. In contrast, the weight loss in samples stored under farmers conditions ranged from 32-45%, 39-66%, 34-56%, 60-71% and 47-59% for Gihingumukungu, Kabode, Vita, Cacearpedo and Mugande respectively. However, we may not draw conclusions at this stage since the experiment is still underway and samples have been stored for about two and a half months only.

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Abstract 15: Technical and adaptive research on baked and fried sweetpotato-based products: progress with the 'rainbow project'/federal university of agriculture, Abeokuta (FUNAAB), Nigeria - Ganiyat Olatunde

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The product development aspect of the 'Sweetpotato for Health and Wealth in Nigeria' tagged 'Rainbow Project' seeks to improve market opportunities for sweetpotato beyond the fresh roots market, by considering processed products value chains, thus creating jobs and wealth. The orange-fleshed variety is particularly targeted to improve the vitamin A status of consumers. Surveys had identified fried and baked products as having the potential to utilize sweetpotato roots. The objectives of the product development aspect handled by FUNAAB were; (i) to identify enterprises involved in baked and fried products and characterize existing products with respect to nutritional quality and (ii) to conduct technical and adaptive research with enterprises. A survey of 81 enterprises and 166 consumers were conducted in the Federal Capital Territory (FCT). Existing baked and fried products within the FCT were analysed. Baked and fried products were developed in the laboratory at FUNAAB. Pilot study of fried product was conducted at an enterprise in FCT, while sensory and consumer studies of the fried product were conducted with 300 consumers across three locations in FCT. The enterprises were generally small scale with respect to staff strength, equipment and production. These enterprises were generally willing to use sweetpotato in their products on the basis of customer demand and profit. Although more than 70% of the enterprises have never heard about orange-fleshed sweetpotato (OFSP), nor aware of its health benefits, they were willing to use OFSP in their products. The enterprises emphasized the need to make OFSP available in abundance in order to encourage its utilization. 94% of the 166 consumers eat sweetpotato. Although 41% were aware of OFSP, only 35% were aware of its nutritional benefits, however, 75% were willing to pay an extra cost for the health benefits of OFSP. Three varieties of sweetpotato roots used for frying studies in the laboratory were Farmer's variety (yellow-fleshed), King J (orange-fleshed) and Mother's Delight (orange-fleshed). It was observed that each variety gave different slice thickness

with the same domestic slicer due to the difference in texture of the roots. Generally, the harder the texture of the root, the thinner the slice thickness. It was also observed that each variety required different frying temperature and time for acceptable crisps. The conditions that worked during the pilot study were different from the laboratory conditions due to the different type of slicer, type of fryer and quantity fried per batch. The roots gave varying range of thickness as required by each variety based on preliminary trials. The slices were fried in batches at about 140 °C for between 6 – 9 min depending on the variety. On a scale of 1 to 9, consumers scored crisps from Farmer's variety highest in colour (7.91) and crispiness (7.48), Mothers' Delight had the highest scores in taste (7.70) and aroma (7.37) while King J scored the lowest (6.17-6.70) in all the attributes. Crisps from Mothers' Delight were the most acceptable overall (7.76) followed by Farmer's variety (7.64) and King J (6.59). For the baked products it was observed that the type of baking equipment particularly oven determines the baking temperature and time. Some quality attributes of bread from wheat flour substituted with Mothers' Delight flour (10-30%) and puree (10-30%) were determined. Consumer acceptability showed that on a scale of 1 to 9, bread from 100% baking flour scored 6.3, bread substituted with flour scored 6.2-6.6, while bread substituted with puree scored (7.1-7.5). Pilot study on bread is yet to be conducted. Progress so far has further confirmed the potential for baked and fried products to utilize sweetpotato. There is also great potential for consumer acceptance of such products and increased profit for enterprises. However there is need for sustained effort in terms of availability of quality roots at a competitive price, technical support to enterprises and awareness creation of the

Abstract 16: Sweetpotato Value Chains in Western Kenya: Current and Potential - Tanya Stathers and Ilaria Tedesco

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To boost the economic viability of sweetpotato value addition opportunities and use them to address vitamin A deficiency amongst vulnerable communities, it is necessary to understand the operations, scales and challenges of existing sweetpotato value chains.

Kenya is rapidly urbanizing. By 2050, 44% of Kenya's 97 million people are expected to live in urban centres and sweetpotato roots are an important part of the urban food system. Vitamin A deficiency amongst pre-school children in Kenya, and across Sub-Saharan Africa, is however high. Sustainable food-based approaches where locally produced foods rich in vitamin A are actively consumed as part of a balanced and diverse diet can help address this. Many vitamin A rich foods such as orange-fleshed sweetpotato, mangoes, papaya, pumpkin, dark green leafy vegetables, eggs, liver and milk are available. Along with nutritional awareness raising, these foods can be incorporated into the diet in sufficient quantities to help prevent vitamin A deficiency in children and adults. This improves their immunity to diseases, reducing the incidence of disease-related death and burden on overstretched health care systems, and improving national productivity and economic development.

This presentation describes a recent investigation into sweetpotato root production, availability, trading and service provision in the counties of Homa Bay, Migori, Siaya, Busia, and Kericho in Kenya; and the trading, retailing and consumption of fresh sweetpotato roots in major urban markets in Nairobi, Nakuru and Kisumu. The data were mainly obtained from 59 focus-group and individual interviews with key value chain agents (e.g. farmers, traders, transporters, retailers, processors, and service providers) in December 2014.

Our findings describe the current production, trading and processing systems of yellow-, white- and orange-fleshed sweetpotato varieties across the eight focal counties. Sweetpotato roots are harvested almost all year round in the producing counties, where the crop is typically planted twice per year. Large quantities of yellow-fleshed sweetpotato roots are traded from Kabondo and Migori. The peak and low sweetpotato supply seasons occur sequentially in different locations making it

fairly straightforward for traders to access fresh sweetpotato roots throughout the year. The price variation between the peak and low supply season changes by agents and counties considered, with seasonal variation in buying price ranging from a minimum of 9% amongst Kisumu traders to a maximum of 67% amongst Kabondo and Nairobi traders. The trading system in Nairobi appeared the most complex, considering the numerous different sack dimensions and root types, and the various different geographical sources of sweetpotato used.

Boiled sweetpotato roots are generally viewed as a comparatively cheap, easy to prepare, filling and healthy food. The yellow or white-fleshed sweetpotato roots are currently the most popular. Orange-fleshed sweetpotato roots can be eaten boiled or roasted, or mashed into puree for use in a range of products including breads, chapatis, cakes, juices, porridge. However, for this to happen at scale, coordination and changes along the sweetpotato value chain are required. The information collected in the study was used to assess the feasibility of orange-fleshed sweetpotato puree processing activities including insights into the need for and opportunities of establishing fresh sweetpotato root storage facilities.

Abstract 17: OFSP Puree Processing in Kenya & Building on the Mama SASHA Experience - *Penina Muoki*

Background: The Scaling up Sweetpotato Through Agriculture and Nutrition t (SUSTAIN) project aims to enhance the efficiency with which farmers participate in the orange fleshed Sweetpotato value chain for health and wealth creation. It builds on the experience of Mama SASHA project that aimed to provide solid evidence of the effectiveness of an innovative approach to integrate OFSP promotion and production with public health care services. The expected impacts include significant increases in both the consumption of Vitamin A-rich foods and use of antenatal care services.

The major difference in the approach of SUSTAIN from Mama SASHA is that the former includes a marketing component. One of the complaints in the final year of the Mama SASHA project was that as OFSP production expanded, market opportunities were limited. In the SUSTAIN –Kenya project, Public-Private partnership with Tusky's supermarket, which is interested in using OFSP puree as a partial substitute for wheat flour in its bakery products have been pursued to enhance marketing component of the OFSP value chain.

Description of the activity: The overall aim of OFSP puree processing is to facilitate commercialization of widely marketed products that use substantial amounts of sweetpotato. The A 'top-bottom approach', which involves market identification prior to massive production of agricultural commodity, has been applied following the step-wise process below:

1. Consumer acceptability and willingness to pay for the proposed bakery products was established.
2. Buy-in from the private sector was sort using the data from the consumer study. These included processors of the final bakery products and the processor of the intermediary product; the puree
3. Revamping of OFSP production through formation of a consortium of Organizations participating in promotion of OFSP.
4. Technical backstopping of puree processor for set up of processing facility.
5. Investment in R4D for storage of roots and puree.

Achievement: While this is an initiative of the international Potato Centre, a collaborative effort among public and private players has led to a number of achievements as follows:

1. Buying contract has been facilitated between the puree processor and Tuskys, one of Kenya's leading retail supermarket.

2. Puree facility has been set up and staff trained in production and handling of the puree.
3. Tuskys has standardized recipes of 4 OFSP products (Loaf bread, Gallet bread, Buns and scones). These products will be formally launched in 6 Tuskys stores on June 1, 2015.
4. Over 90 Acres of OFSP root producers (Minimum acreage of 0.5 per farmer) are linked to the puree value chain.
5. About 25 commercial decentralized vine multipliers have been trained to support provision of clean planting materials towards the puree value chain.
6. Storage study to support cost effectiveness of the puree value chain ongoing.

Challenges: Unavailability of clean planting material in a timely manner is a key constraint. This is being handled by increasing the number of decentralized vine multipliers with capacity to produce vines commercially.

Abstract 19: Development and Marketing of Sweetpotato Processed Products by SOSPPA in Uganda - Jean Anthony Onyait

Soroti Sweetpotato Producers and Processors Association (SOSPPA)

Sweetpotato is widely grown as a staple food in many parts of Uganda, with the most supply coming from Teso region & specifically Kumi & Ngora Districts. The traditional varieties still override the presence of the orange-fleshed sweetpotato (OFSP) in the market. SOSPPA has supplied more than 50,000 metric tons of OFSP vines to different regions, especially Northern Uganda. With little more effort, the OFSP should be seen in the market, especially if the concentration is shifted from production of more vines for sale to production of roots. SOSPPA has been creatively engaged in marketing OFSP through the promotion of health benefits from confectionary products made out of OFSP.

Using OFSP to Combat Vitamin A Deficiency. OFSP contains large quantities of a precursor of vitamin A known as beta-carotene. Vitamin A deficiency is a particular problem for children under five and for pregnant and lactating women.

We have distributed porridge flour from OFSP to a number of hospitals. However, the challenge faced is that of perception by the consumers. They look at the flour as if was ordinary porridge flour which they can produce at home. The use of Oscan be extended to attach a medicinal value. We performed an experiment late in 2014 at Kyere hospital, where we processed OFSP juice & identified 2 children of the same age who had signs & symptoms of VAD such as dry or inflamed eyes, hair loss, loss of appetite, night blindness, recurring infections, skin rashes. We introduced juice to one of child as medicine (Child A) and the other (Child B) we introduced it as juice. Child A responded with in a week because he was psychologically meant to take it as medicine, while the child who consumed it as juice took a longer time of over 2 weeks to respond. Blood samples were taken from both children to assess their serum retinol status.

Current Form of Consumption. Currently, sweetpotato is being utilized in various forms including fresh tubers (Achok), roasted (Emukaru), boiled, dried (Amukeke or Inginyo) and processed as juice, porridge flour, and confectionaries. These uses can be scaled throughout the country to boost production and consumption of the crop. To make this possible, a commercial approach towards boosting production & consumption is needed.

Recommended initiatives.

1. Spur the production of the roots by creating demand for OFSP through extensive marketing of the nutritional value of OFSP;
2. Technology transfer and adaptation of OFSP for sweetpotato beverage production in commercial quantities is an important initiative to be taken;

3. Partner with Health Marketing Agencies to market the health benefits & values of OFSP;
4. Conduct workshops and trainings with the producers, middle men, suppliers, transporters & traders of sweetpotatoes in urban areas with the intention to move them into introducing OFSP into the market.

Abstract 20: Orange Fleshed Sweetpotato Post-harvest Value Addition for Improved Food and Nutrition Security in Kenya – Abong¹, GO^{1*}, Kaaya, A², Shibairo, SI³, Lamuka, PO¹, Okoth, MW¹, Odongo, NO¹, Sopade, PA⁴

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Project Summary

Orange fleshed sweetpotato (OFSP) is one of the new crops that have been introduced in developing countries due to its high beta-carotene levels. It is both an excellent source of energy and important nutritive substances that can contribute towards improving nutrient status of the community. Sweetpotato roots and leaves are good sources of vitamins, antioxidants, fiber and minerals. This has led to the promotion of the (OFSP) varieties by various initiatives in Sub-Saharan Africa such as the Sweetpotato Action for Security and Health in Africa (SASHA) and worldwide through the Sweetpotato Initiative for Profit and Health (SPHI). Despite these efforts, the local farmers especially in Kenya have not adopted large-scale production of OFSP, with some citing its low dry matter and problems of cookability.

The current project seeks to develop innovative appropriate processing technologies that will add variety to the form in which OFSP is taken and hence, provide additional means of consumption as well as develop market-oriented products together with small to medium scale producers (SMEs) in order to enhance the market base and hence, increase income of the actors along the value chain. The current project goal is to improve food security and incomes for communities in Western and Nyanza regions of Kenya and Uganda where the crop is widely grown. This will be achieved through the following objectives: Assessing the current post-harvest practices, constraints and opportunities in major OFSP growing areas of Western Kenya region; Characterizing physico-chemical and nutritional quality traits of OFSP varieties bred and grown in Kenya/Uganda; Identifying sweetpotato varieties suitable for processing into value added products; Developing, evaluating and validating post-harvest value addition and appropriate technologies for food and industrial applications of OFSP in Kenya; Enhancing OFSP utilization through increased uptake and commercialization of newly developed technologies and OFSP products through capacity building and technology transfer.

Key words: value addition, appropriate technologies, nutritional security, sweetpotato

Annex 4: List of participants

Markets, Processing, and Utilization Community of Practice platform
May 20-21, 2015 Nairobi - Kenya

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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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