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Post-harvest Challenges in Sweetpotato: NRI partnership with CIP to support SASHA2

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A new emphasis was introduced into SASHA at stage 2

Improve the utilization pathways for SP consumption and production to boost the economic viability of SP value addition and business activities

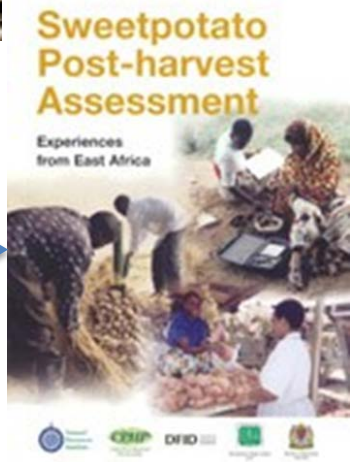
Alleviate vitamin A deficiency through intake of processed products containing OFSP.

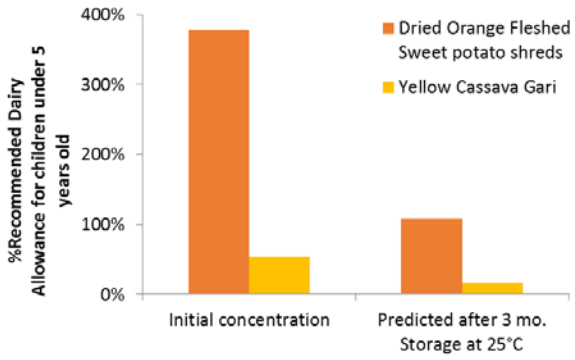
CIP envisaged that storage and handling would be important issues and therefore NRI was brought in join the team

NRI has worked with CIP on postharvest issues of sweetpotato for several decades

Examples:

- Study of simple on-farm storage structures (Uganda)
- Understanding varietal characteristics associated with storability
- Triple S system for storing seed
- Understanding retention of carotenoid during processing and storage





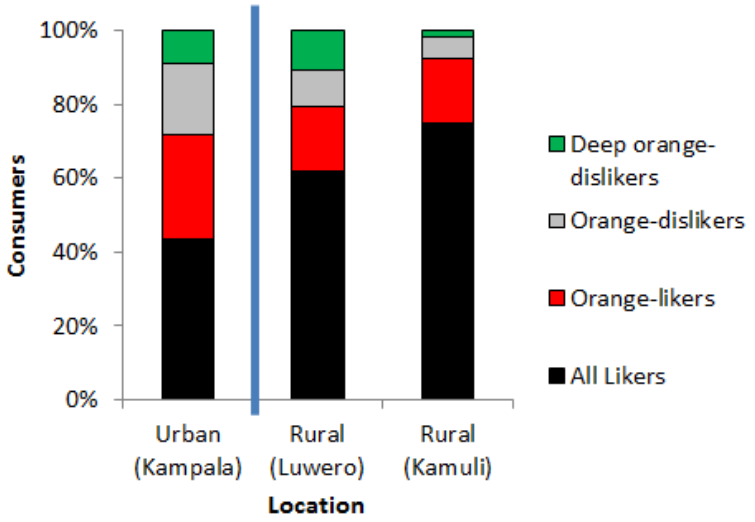
NRI has also worked on consumer acceptance of OFSP which is central to SASHA

Consumer preference is important in the value chain but often neglected regarding poor people. Information about preference and markets can increase the success of a new more nutritious varieties or safer products

NRI has explored preferences and willingness to pay of biofortified sweetpotato and cassava. Language and education were initially a challenge.

For example: new vitamin A orange sweetpotato in Uganda was liked by 82% of consumers but 18% did not. Clear rural / urban differences.

Increasing demand to understand preference. Challenge is diverse varieties and products but lack of knowledge about markets and demand.



NRI inputs to SASHA 2

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- COMMERCIAL SCALE STORAGE To develop cost-effective technologies to enable commercially oriented farmer organizations to supply quality sweetpotato roots year-round to specific agro processors or urban markets (NRI LEAD)
- DOMESTIC SCALE STORAGE To assure year-round supply of orange-fleshed sweetpotato in nutritionally at risk households, develop convenient and low-cost methods for fresh root storage (NRI SUPPORT)
- ANALYTICAL SUPPORT To develop the regional capacity and appropriate protocols for analysis of roots and derived products at reasonable cost to ensure that they have adequate nutritional quality and meet safety standards. (NRI SUPPORT)

SASHA Sweetpotato Action for Security and Health in Africa

Commercial scale storage

In order to identify opportunities to expand marketing of fresh and processed OFSP a value chain analysis and fresh root storage feasibility study was undertaken in Kenya:

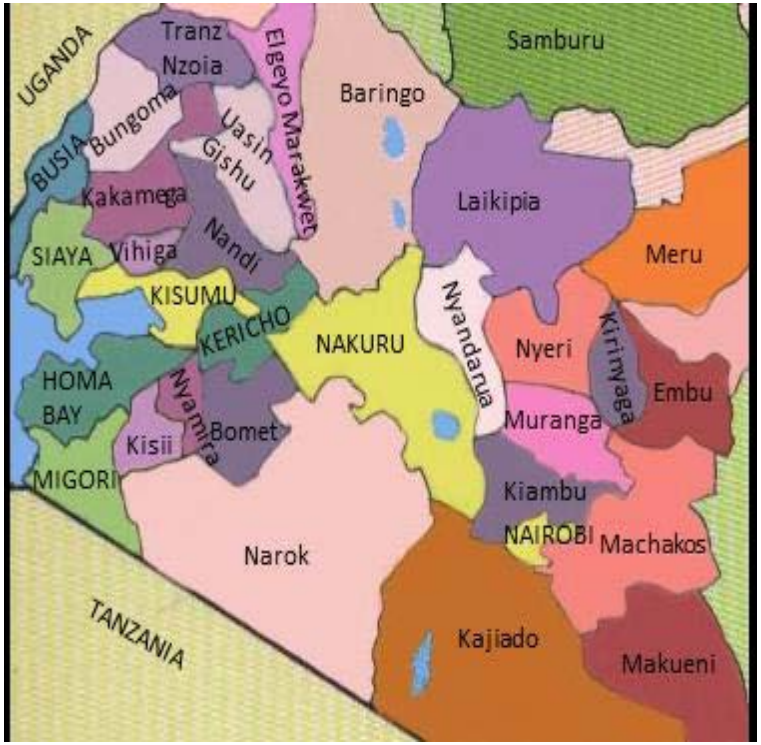
Tanya Stathers, Ilaria Tedesco

- fresh SP root production, availability, trading and service provision in main production areas (Homa Bay, Migori, Siaya, Busia, and Kericho -Green)
- fresh SP root trading, retailing and consumption in major urban markets (Nairobi, Nakuru and Kisumu -Yellow)

Key questions

Is OFSP puree production feasible?

Is storage feasible/advantageous?



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Complex volumetrics of SP value chains

Flat-sized sacks of SP delivered by farmer to roadside, Kabondo

Prim-sized (extended) sack of SP being packed at Kabondo for trade to Nairobi

Tight packing of SP roots

1 punda (donkey) = 2 moets (one each side)

'Tolit' bucket. 4 Tolits = 1 moet, Kericho

Prim-sized (extended) sacks of SP waiting for porterage at Nairobi's Muthurwa market

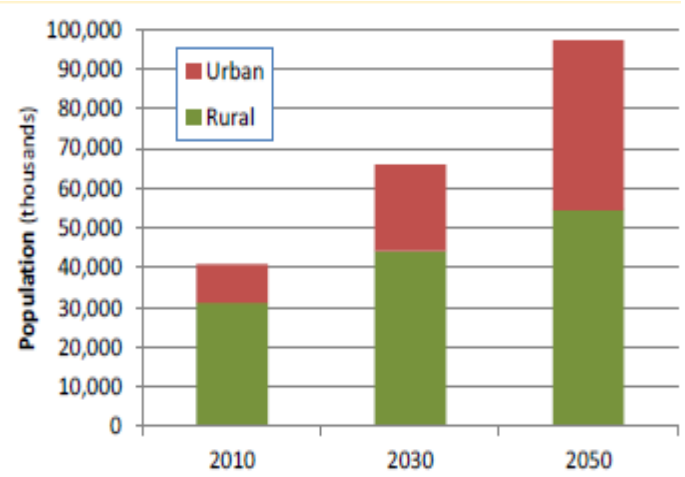
Bao-sized sacks (2 and a bit sack length) of SP at Nairobi's Muthurwa wholesale market

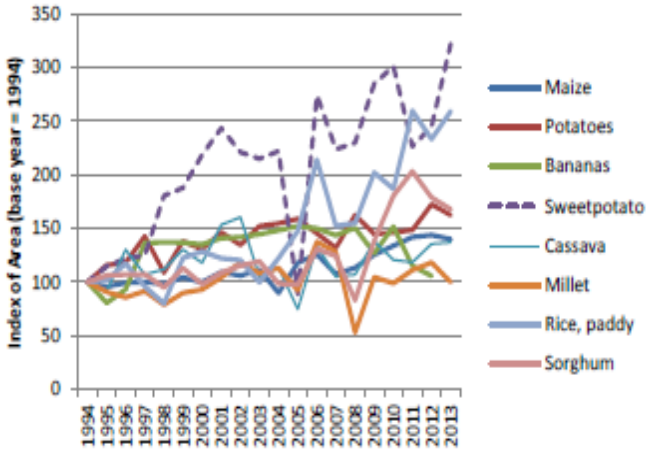
Kiptere trader showing profit margin of resizing the 'moet' volume between purchase and sale

Photos: T Stathers, NRI

Value chain analysis and fresh root storage feasibility study in Kenya

- Kenya's population is growing and becoming increasingly urbanised.
- Sweetpotato is important for urban populations as it is easy to prepare and nutritious
- Area of production for sweetpotato increasing relative to other crops





SASHA
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Value chain analysis and fresh root storage feasibility study in Kenya

- An exciting business opportunity to produce OFSP puree for inclusion in Vitamin A rich bakery products in one of Kenya's large supermarket chains, was identified by CIP in 2014.
  - Analysis within VCA indicated that supply of SP for this could be provided by
    - Well organised scheduling and staggering of OFSP planting (see table below)
    - Use of storage facilities at production site able to store 1 month's supply of OFSP (capacity 20 – 30 tonnes)
  - Investment in appropriate storage facilities cost effective where increase in price in low season by 20% or greater

Table A. Varying supply seasons of fresh SP roots in Busia, Homa Bay, Migori, Siaya and Kericho counties

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Busia	***	***	***	*	*	***	***	**	**	*	*	**
Kabondo	***	***	***	**	*	**	**	**	**	*	*	*
Migori	**	**	***	***	***	*	*	***	***	**	**	**
Siaya	**	**	***	***	***	***	*	*	***	***	***	*
Kericho	***	***	***	*	*	*	***	***	*	**	***	***
Key: *** = Peak supply; **= Medium supply; * = Low supply												

Source: Field visits

To ensure sweetpotato supply for puree production for Kenyan enterprise we focused on three issues

- Improve strategies for sweetpotato handling
- Optimise short term storage
- Optimise long term storage (at least 2 months)

Improve strategies for OFSP handling and short term storage:

August 2015 Trial on strategies for sweetpotato handling for short term storage (up to 14 days)

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Treatments included in trial

- Harvesting method - ox plough, hand
- Methods of soil removal - wet brush, dry manual, wet manual, no removal)
- Packaging - Plastic crate, wooden crate, sack
- Variety - Kabode, Vita

Main findings

Manually wash, air dry, sacks to transport, sort

Sack storage was better than all other treatments due to high humidity

This underlines the importance of curing (maintaining roots at high humidity after harvest to allow healing of wounds)

Further handling trials will be conducted once storage conditions have been optimised.

SASHA Sweetpotato Action for Security and Health in Africa

Tanya Stathers, Penina Muoki, Bethwell Kipkoech, Olivia Wahonya, Jan Low, Tawanda Muzhingi, Andrew Marchant, Debbie Rees

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More information in flyer

SASHA
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The Soft Touch: How postharvest handling affects the quality and shelf-life of sweetpotato roots

SEP 2016

Across Kenya, supermarket customers are now buying delicious golden bread made with vitamin A boosting orange-fleshed sweetpotato (OFSP) purée. To meet this demand, a year-round supply of fresh sweetpotato roots is required, and can be achieved through a combination of staggered production and the storage of fresh OFSP roots to cover periods of low supply. However, careful postharvest handling is required to optimise the quality and shelf-life of these roots.

Fig. 1 NRI researcher Tanya Stathers selects OFSP roots for postharvest handling trial following soil removal with a wet brush and air drying (credit P. Muoki)

What is the problem?

A constant year-round supply of high quality OFSP roots is required to produce the OFSP purée -based nutritious golden bread now being purchased in supermarkets across Kenya. This constant supply of roots can be achieved through a combination of staggered production, purchase from different geographical areas, and the storage of fresh OFSP roots to cover periods of low supply. However, the current practices of rough handling and insufficient sorting of sweetpotato roots can lead to quality degradation and losses during storage.

What do we want to achieve?

Improved shelf-life and quality of fresh sweetpotato roots through avoidance of damage incurred during harvesting and postharvest handling and transport.

How are we going to make it happen, and where are we working?

Understanding of the harvesting and postharvest handling practices of OFSP fresh roots which smallholder farmers and processors could employ to improve root quality and shelf-life was very limited. To address this knowledge gap (Fig 1), we compared the effect of different harvesting, soil removal methods, and packaging containers on the keeping quality of freshly harvested OFSP roots in the Nyanza area of Kenya, where sweetpotato is widely commercialized.

We compared:

- two harvesting methods – a manual hoe and an ox-plough
- four methods for removing the soil from the freshly harvested roots - wet manual (washing roots by hand); wet brush (using a soft shoe brush in water to wash the roots); dry manual (rubbing the soil off manually); and no soil removal.
- three types of packaging container – polypropylene sacks, wooden crates and plastic crates (Fig 2).

In the trial, we used roots from the two main OFSP varieties, Kabode and Vita, being produced in the Homa Bay area of Kenya. Following the different harvest and postharvest handling treatments, the roots were kept in their packaging containers for 3, 7, 10 or 14 days in store rooms at ambient temperatures before sampling.

At sampling, a number of different criteria were assessed, including: weight change of over time; general appearance; root sponginess, shrivelling, rotting and damage; percentage out-turn of roots after peeling; peeling quality and speed (Fig 3).

CIP
INTERNATIONAL POTATO CENTER

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Partners

Natural Resources Institute (NRI), University of Greenwich, UK
International Potato Centre (CIP) - Kenya, Mozambique and Ghana
Organi Ltd., Homa Bay, Kenya

Who are we working with?

These postharvest handling trials were designed and managed by researchers from the Natural Resources Institute (NRI) of the University of Greenwich, UK and the International Potato Centre (CIP) in Kisumu and Nairobi, in conjunction with staff at the Organi Ltd OFSP purée processing facility in Ringa, Kenya.

What have we achieved so far?

This trial has enabled us to start to understand how the different ways farmers harvest and then handle their sweetpotato roots affects their keeping and processing qualities. This knowledge is important for commercial sweetpotato purée processors who purchase OFSP roots from farmers and often need to then store them to secure their constant supply and quality as raw materials for their purée processing unit. Whilst it was anticipated that the washed roots kept in sacks would rot after 4-5 days, this did not happen. In this trial, weight loss over time was less pronounced for all soil removal treatments tested when the roots were kept in sacks, as opposed to in wooden or plastic crates for up to 14 days. At the start, those roots which had not been washed (e.g. those where any soil had been removed using the dry manual method, or those where no soil removal had occurred) were judged as having a better general appearance than the washed roots (i.e. they more closely resembled freshly harvested roots). Packing the roots in sacks as opposed to wooden crates led to a less rapid decline in their general appearance during this trial.

Fig. 2 Postharvest handling effects on rot keeping quality trial in storage room (credit T. Stathers)

Fig. 3 Assessment of peeling quality of OFSP roots during postharvest handling trial (credit T. Stathers)

The results suggest OFSP purée processors should encourage the farmers they source roots from to manually wash the soil off the roots and then air-dry the roots, and sort them carefully to discard those with weevil damage or rotting before marketing them. In addition to enhancing the keeping qualities, there would also be economic benefits to the processor, due to the significant weight of the soil remaining on roots and costs of water and labour associated in washing.

The results also suggest that the washed and air-dried roots can then be packed into sacks for transport to the processing facility to help reduce the weight of packaging containers being transported. However, sacks should not be over-packed, and further study is needed of whether the same results occur when large quantities of fresh roots are being transported in trucks to the processing unit. On arrival at the factory the roots can be further sorted to determine: a) which need to go for immediate peeling and processing, b) which can be kept in sacks for up to 14 days, and c) which will be cured and then placed into long-term storage.

What's next?

Further work is planned to determine the impact of different postharvest handling techniques on fresh sweetpotato roots that will be cured and then stored longer-term (e.g. 2-3 months); and to better understand the practicalities around farmer adoption of improved sweetpotato postharvest handling practices.

SPHI
Sweetpotato for Profit and Health Initiative

The Sweetpotato for Profit and Health Initiative (SPHI), launched in 2000, seeks to improve the lives of 10 million African households in 17 SSA countries by 2020 through providing access to improved varieties of sweetpotato and their diversified use.

Support for the establishment of the Platforms and the holding of CoP meetings is provided by the Sweetpotato Action for Security and Health in Africa (SASHA) Project, led by the International Potato Center with over 20 collaborating partners.

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Visit the Sweetpotato Knowledge Portal www.sweetpotatoknowledge.org

Long- term OFSP storage

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Objectives

- To ensure that puree production is not constrained by root supply, we need cost-effective storage facility, capable of storing for at least one month.
- Requirements
  - Low cost (for construction of store, power supply installation, running costs, including power consumption and maintenance)
  - Reliable independent of the national electricity grid e.g. use solar power
  - Capable of maintaining storage temperatures (ideally 15 - 17°C)
  - Capable of maintaining temperatures for curing at start of storage
  - User friendly to run, and to repair

- To be written up as a case study to inform subsequent ventures, including a set of plans for store construction.

Storage construction led by Andy Marchant,
Trials support from Benard Otieno, Bethwel Keochi, Penina Muoki

SASHA Sweetpotato Action for Security and Health in Africa

Knowledge to feed the world

Long term OFSP storage Progress

- Two storage rooms have been constructed within an existing processing facility
- (In future newly constructed buildings will facilitate the process)

Long term OFSP storage Progress

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- An evaporative cooling system has been developed with low installation costs and low power demand to allow the use of an alternative power supply such as solar power, and using existing 12v components.
- An initial challenge was shortage of meteorological data, especially lack of information on solar radiation through the year. A light meter with data logger has been installed, and number of solar panels increased to provide sufficient power.
- The cooling system is currently working at 70% efficiency, but we are working to increase efficiency and to improve temperature reduction.

Long term OFSP storage
Results of trials on sweetpotato using facilities constructed

Trial 1

- indicated that heating was required to achieve the temperatures necessary for optimum curing (28 - 32 °C)

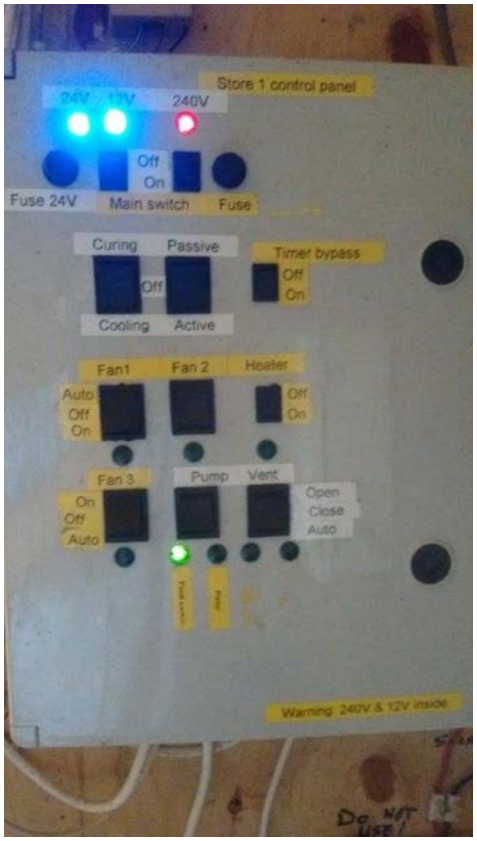
Trial 2

- Two varieties, Kabode and Vita, stored each washed and unwashed.
- Curing (with heating to achieve 28 – 32 °C and high humidity achieved for reducing ventilation) was carried out for 4 days, followed by cooling with the evaporative system.
- Inefficiencies of the evaporative cooling system meant that the storage temperature was above 20°C (typically 20 - 25°C) while 15-17 °C would be optimum
- Despite higher than optimum temperatures after 4 months, >80% original weight of good quality roots that provided good quality puree
- Washing may increase rots, but this needs to be rechecked

Fresh and cooked roots after 4 months storage

Longer term OFSP storage Challenges

- Trial 3 identified two important challenges
- Mechanical breakdowns underlined need for user friendly controls and a problem solving checklist for facility users .
- *A user friendly control system has now been developed, and checklist is in process.*
- Weevil infestation of the stores which was not great in the first trials has become a greater problem than anticipated, as complete control of weevils during production is not feasible.
- *Lower temperature storage should help reduce this problem.*
- *We are recommending that stores are completely emptied at regular intervals and fumigated.*



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Other NRI inputs to SASHA

- Construction of store for puree at Kisumu
- Value Chain analysis in Mozambique
- Advice on potential for storage in Mozambique
- Consultation on methods of vitamin A analysis
- Support for development of protocols for food safety tests on OFSP products

NRI inputs for Year 3

- Final development and testing for two sweetpotato stores at Organi site at Kisumu
- Complete construction of puree store at Kisumu
- Final root storage trial within completed/tested storage facilities
- Follow up Postharvest handling trial in Kenya
- Optimise household/small scale commercial storage facilities in Ghana
- Dissemination material for Triple S storage in Kenya
- Provide support for development of appropriate training in hygenic practices for processors and microbial challenge tests on OFSP puree

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