

# **DEVELOPMENT OF SWEET POTATO SNACK PRODUCTS IN RURAL AREAS: CASE STUDY OF LIRA DISTRICT, UGANDA.**

By

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## **ABSTRACT**

Product development studies were conducted in phases in Lira district, Uganda, to enhance the role of sweet potato for income generation. Results of the study showed that it is feasible to substitute either 40-60% fresh grated/boiled sweet potato or 30% sweet potato flour for wheat flour in fried and baked snack products. Products made with these levels of sweet potato were found acceptable to consumers and they had good demand in rural markets, schools and within the municipality. Analysis of costs and returns showed that by using improved sweet potato processing technology, costs of snack product production is reduced by 20 to 64 % depending on the product and form of sweet potato used. Results obtained have demonstrated that sweet potato processing technology can improve the income generating potential of small-scale snack product enterprises. The conclusions highlight the importance of expanding the income generating opportunities by targeting major urban markets with promising sweet potato products.

## INTRODUCTION

Sweet potato (*Ipomoea batatas* L.) is an important staple food crop in Uganda, where it plays a major role in the food security system of the country (Bashaasha et al., 1995). Although Uganda is the largest sweetpotato producing country in Africa and the fourth in the world (Woolfe, 1992, FAO, 1991), with an annual production of more than 1.8 millions tonnes (MAAIF, 1992), sweetpotato postharvest use is remarkably narrow and limited to human consumption in a fresh, boiled or roasted form. The small number of ways in which sweetpotato is used, and the limited processing technologies available and adapted to the Ugandan situation, do not permit the potential benefits of the crop to reach consumers and farmers.

Sweetpotato is grown everywhere in Uganda. It provides a good part of the dietary starch throughout the year. Fresh boiled or steamed sweetpotato is mostly consumed with sauces containing beans, cowpeas, or vegetables.

Fresh sweetpotato roots are bulky and highly perishable, and in Uganda, they are not stored. The only storage regularly practised is in-ground storage whereby unharvested mature sweetpotatoes are left in the field until they are needed for home consumption or local sale (Smit and Ocitti p'Obwoya, 1994). In semi-arid areas of the country with a long, hot dry season, in-ground storage is limited by attacks from sweetpotato weevils (*Cylas* spp.). Farmers have traditionally chipped or crushed sweetpotato roots, sun-dried, and stored them from November through March. The dried sweetpotato is then boiled and consumed with sauces or tea, or milled into flour and mixed with millet or sorghum to process the local porridge called *atapa*.

Limited methods of utilisation, lack of industrial or village-level processing of the crop, and low levels of commercialisation are major constraints to increased production of sweetpotatoes.

Myriad products can be made using sweetpotato as an ingredient (Omosa, 1997; Gakonyo, 1993; Collado and Corke, 1996). Sweetpotato, either fresh, grated, cooked and mashed, or made into flour, could, with high potential for success, replace the expensive wheat flour in making buns, chapatis (flat unleavened bread) and mandazis (doughnuts) (Hagenimana et al., 1998). Sweetpotato-based products are of high quality and could compete with existing products on the market (Hagenimana and Owori, 1997). Already in western Kenya and Lira, Uganda, such fried, processed sweetpotato products are being produced by informal micro-enterprises on a small scale.

This paper reports the different steps and research involved in the sweetpotato product development, assessment of the postharvest of the crop for income generation, and promotion of micro-enterprises based on sweetpotato snack products. The case study was conducted primarily within the community together with women's groups and individuals in Lira District, Uganda, and, with the main objectives of diversifying the utilisation of sweet potatoes, reducing processing costs for snack food products, and developing alternative markets for sweet potato.

## **METHODOLOGY**

Methods described by Wheatley et al. (1995) were used to collect information reported here and consisted mainly in a combination of analysis of available secondary data on raw material involved in the processing of snack products, informal interviews and formal questionnaires to assess the needs, new product processing and adaptation of equipment and utensils available, taste testing by users of the products, technical advice to micro-enterprises from extension agricultural agency, and link with local development projects for investment and financial advice.

## **RESULTS AND DISCUSSION**

Four main and distinct phases emerged in the development of products from sweetpotato:

1. Phase 1: Market and consumer studies;
2. Phase 2: Technical experimentation on a pilot scale and in collusion with users;
3. Phase 3: Development of appropriate technologies through adaptive research;
4. Phase 4: Commercialization of sweet potato processed products.

### **Phase 1. Market studies**

*Food Production and Consumption in Lira.* Agriculture is the main economic activity in Lira District. Cotton once dominated as a cash crop, but poor producer incentives and inadequate supplies of cotton seeds have caused a big slump in cotton production. Consequently, farmers are shifting their attention to other, new cash crop opportunities.

As a staple food, finger millet ranks first followed by cassava, sorghum, and sweetpotato. Cassava, which was an important cash crop and famine reserve in the past, has been facing the incidence of the African cassava mosaic virus for

the last 10 years. Its price has increased, and sweetpotato is becoming an important cheap food in the district mainly because of the cassava virus problems and the poor yield and other uses of finger millet and sorghum (District Agricultural Officers from Lira, Soroti, and Kumi, 1995, Personal information).

*Food Preference.* Finger millet along with sorghum, cassava, and sweetpotato are the staple foods of the area. In Lira, breakfast food is usually a light porridge made from a flour mixture of finger millet, sorghum, or cassava. Bread is not a breakfast item, but a rare and expensive snack food. It is usually taken with tea in the evening. Its consumption is as important as that of mandazis. Chapati is not considered a snack; it is eaten for lunch or dinner as a main food of the meal. Kabalagala, a type of pancake made from deep fried dough of cassava flour and soft ripe sweet banana, is found to be an important snack product in the area.

From the ranking exercise for preference of available foods on the market, sweetpotato and bread ranked first, followed by cassava, whereas chapatis and mandazis were fourth. Kabalagala was the last. Irish potato crisps were less known in the area.

*Availability of Fried Snack Products in Lira.* Table 1 lists the snack products and bread sold daily in different markets of Lira Municipality. The activity of trading mandazis, chapatis, kabalagala, cake, and bread involves an exchange of about US\$700/day, and the activity employs more than 100 people. Half of the trade is in bread and a third in mandazis. Women were the major players in selling fried and baked products.

*Feasibility and Acceptability Trials for Baked Sweetpotato Products.* Bread-baking, chapati, mandazi, and kabalagala processing trials were conducted under local commercial conditions using a mixture containing various proportions of wheat flour, sweetpotato flour, or cooked and mashed sweetpotato roots. The recipes used have been reported (Hagenimana et al., 1998), and they were mainly made with 30 % substitution of wheat flour with sweetpotato flour and 50% substitution of wheat flour with boiled and mashed sweetpotato.

A test for preference ranking was used to evaluate the products for colour, taste, oilness, freshness and product price. A short questionnaire was also used to assess consumer preferences for different snack foods compared to sweet potatoes and the awareness of sweet potato processed products. Quantitative responses from a cross section of 155 individuals were obtained to get an appreciation of the potential take up of the sweet potato based snack products.

Acceptability was evaluated by comparing sweetpotato bread, chapatis, mandazis and kabalagala with similar products the consumer has just bought from the market or had ever tasted. Attributes such as overall taste, texture, freshness, appearance, sweetness, and color were judged subjectively by bread, chapati, mandazi, and kabalagala consumers. Consumers were informed that our products contained sweetpotato as an ingredient. The results (Fig. 1) show that products containing cooked and mashed sweetpotato were preferred by consumers for taste, texture, freshness, appearance, sweetness, and color. Consumers expressed a willingness to pay the same price for sweetpotato products as for similar products they had been buying.

The data collected during the study indicated that it was cheaper to produce sweetpotato buns, chapatis, mandazis, and kabalagala than to produce similar products using 100% wheat flour. Table 2 compares net revenue for chaspatis, mandazis, buns, and bread made using only wheat flour and sweetpotato, and shows a significant profit increase when sweetpotato is used.

## **Phase 2: Piloting and Technical Experimentation**

*Piloting Experimentation.* The above sweet potato processing technology was introduced to three women groups, three individual processors and one bread bakery through hands on training. Substitution levels of wheat flour with sweet potato flour and boiled mashed sweet potatoes were 30 % and 50 % respectively in all products. The processors were encouraged to embark on trial productions and trial sales for purposes of practising the processing techniques and for our technical experimentation. Regular follow-up visits with the processors were carried out to assess the status and constraints to technology adoption. An estimated cost and returns to the different sweet potato products was made. Based on the results of the market and consumer studies which showed potential demand for sweet potato-based products, technical and experimental feasibility of substituting fresh sweet potato and sweet potato flour for wheat in fried and baked products was undertaken mainly for maximizing and standardizing the use of sweetpotato in products under study.

*Technical observations by users.* All the processors involved in the trial productions of sweet potato based snack products reported not being aware of the utilisation of sweet potatoes in snack food processing. However, they expressed interest in the processing technology because sweet potatoes were abundantly available. They reported that sweet potato product processes utilising boiled and mashed sweet potatoes were time consuming and the dough was difficult to mix. They, however, said that product quality was good although there were many queries about the shelf life of the products made from boiled and mashed sweet potato. The processes utilising sweet potato flour

were reported to be faster and more convenient to use. Brown discoloration making the products unattractive was however observed on these products.

*Technical constraints to sweet potato processing technology.* During the frequent follow up visits, the following technical constraints were identified:

- Proportion of fresh sweet potato and sweet potato flour incorporated in the mixtures for a particular product varied among processors. As a result, there was great variation in product quality.
- Seasonal availability of both fresh roots and sweet potato flour hindered continued processing of sweet potato products.
- 90 % of the processors found problems with making quality sweet potato flour
- 90 % of the processors making bakery products used local ovens that were inefficient in heat utilisation
- There was lack of a slicer for slicing sweet potatoes for making crisps. Processors who were involved in this product were using kitchen knives to slice uneven thickness of sweet potatoes slices. This affected the quality of the product.

*Trial sales.* 70 % of the processors reported that when they first conducted trial sales of the sweet potato flour-based products, they were rejected by consumers because of the changed appearance of the product. The processors indicated that initially great losses were incurred and they were reluctant to continue with the sweet potato processing technology. Later on, however, when consumers were encouraged to taste the sweet potato products, they found that they had a good taste and they started purchasing them in limited quantities. 5 % of the processors indicated that as they continued making products especially from sweet potato flour, they made improvements in the quality sweet potato flour and they varied the proportions of flour incorporated in mixtures in order to make products more acceptable to consumers. By the end of the phase, the bread bakery reported having got a contract to supply on a daily basis 100 loaves of sweet potato flour based bread to road constructors working 50 km away from the town. One of the women's groups also reported having acquired regular customers for sweet potato flour based buns. Other processors who participated in the feasibility trials did not fair well due to some technical constraints encountered and lack of entrepreneurship.

### **Phase 3: Development of Appropriate Technologies**

During our visits to piloting groups, above identified constraints to the adoption of the sweet potato processing technology were technically addressed through

research and development at the Station of Kawanda Postharvest Programme and in the field.

- Laboratory studies were conducted to standardise and determine the optimum substitution levels of sweet potato which provide a balance between quality and production costs in above mentioned products. In-house panellists and consumer representatives in Lira were involved in acceptability tests during the recipe development. A recipe book (manual) was developed and circulated to processors;
- Improved processing equipment including hand sweetpotato slicers for crisp making, three designs of improved local ovens, manual sweet potato slicer for processing dried chips and then flour were developed at the research station, and furthermore tested with processors in Lira. These equipments were developed to enhance the processing efficiency of sweet potatoes and improve the quality of sweet potato products.
- Cost-benefit analysis was conducted on the developed technologies to determine their potential for reducing processing costs.

#### **Phase 4: Commercialization of Sweet potato Processed Products**

During this phase, a package of improved sweet potato processing technologies were disseminated to enterprising processors through a series of demonstrations and training.

- A total of 250 people including members of women groups, individual processors and potential processors were trained in improved processing methods of sweet potato flour and sweet potato products;
- Improved fresh sweet potato storage methods (in pits and clamps), and dried chips in polythene bags were demonstrated to 55 processors to enable them have a continuous supply of sweet potatoes;
- 5 hand slicers for sweet potato crisps were distributed to individual processors;
- Improved local ovens were demonstrated to 30 processors;
- A manual sweet potato slicer was demonstrated to 40 farmers/processors;
- A local development project provided loans to six enterprising groups in six sub-counties to acquire the improved local ovens and start business with sweetpotato processed products;
- A local based machinery workshop is involved in manufacturing of sweetpotato slicers and selling them to farmers and other users of the product.
- 25 individual processors and six women groups are currently involved in sweetpotato processing activities in Lira District.

#### **CONCLUSION**

Baked and fried products having sweetpotato as an ingredient are highly acceptable to the community. Cooked and mashed sweetpotato as an ingredient improves the taste, texture, freshness, appearance, sweetness, and color of buns, chapatis, and mandazis. Sweetpotato flour is easy to store and process, and is highly profitable, when it is used in processing snack products. This study is a demonstration that at least four steps are required in food product and rural based enterprises: 1) market and consumer evaluation of the product, 2) technical evaluation at the piloting scale, 3) adjustment of the technology to the users' needs, and 4) invitation of enterprises to use the developed technologies through technical (sweetpotato related) and financial (loans and book keeping) training.

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**Table 1: Fried and baked products sold in different markets of Lira Municipality, March 1995<sup>a</sup>**

Market	Mandazis			Chapatis			Kabalagala		
	Sellers (no)	Quantity Sold (no)	Price/unit <sup>b</sup> (US\$)	Sellers (no.)	Quantity Sold	Price/unit (US\$)	Sellers (no)	Quantity Sold	Price/unit (US\$)
<b>Cuk-Alok</b>	<b>3</b>	<b>1,000</b>	<b>0.05</b>	<b>0</b>	<b>0</b>	<b>0.10</b>	<b>0</b>	<b>0</b>	<b>0.01</b>
<b>Junior Quarter</b>	<b>3</b>	<b>250</b>	<b>0.05</b>	<b>0</b>	<b>0</b>	<b>0.10</b>	<b>0</b>	<b>0</b>	<b>0.01</b>
<b>Main Market</b>	<b>7</b>	<b>1,200</b>	<b>0.05</b>	<b>3</b>	<b>600</b>	<b>0.10</b>	<b>2</b>	<b>500</b>	<b>0.01</b>
<b>Obang</b>	<b>4</b>	<b>350</b>	<b>0.05</b>	<b>0</b>	<b>0</b>	<b>0.10</b>	<b>4</b>	<b>350</b>	<b>0.01</b>
<b>Apewany</b>									
<b>Kakoge</b>	<b>2</b>	<b>100</b>	<b>0.05</b>	<b>0</b>	<b>0</b>	<b>0.10</b>	<b>4</b>	<b>550</b>	<b>0.01</b>
<b>Soroti Road</b>	<b>4</b>	<b>350</b>	<b>0.05</b>	<b>0</b>	<b>0</b>	<b>0.10</b>	<b>2</b>	<b>250</b>	<b>0.01</b>
<b>Barogole</b>	<b>6</b>	<b>500</b>	<b>0.05</b>	<b>1</b>	<b>60</b>	<b>0.10</b>	<b>3</b>	<b>700</b>	<b>0.01</b>
<b>Kitgum Road</b>	<b>3</b>	<b>550</b>	<b>0.05</b>	<b>0</b>	<b>0</b>	<b>0.10</b>	<b>0</b>	<b>0</b>	<b>0.01</b>
<b>Aduku Road</b>	<b>4</b>	<b>500</b>	<b>0.05</b>	<b>2</b>	<b>50</b>	<b>0.10</b>	<b>1</b>	<b>250</b>	<b>0.01</b>
<b>Total</b>	<b>36</b>	<b>4,800</b>		<b>6</b>	<b>710</b>		<b>16</b>	<b>2,600</b>	
<b>Total (US\$)</b>		<b>240</b>			<b>71</b>			<b>26</b>	

a. Bread was sold only at one place near the bus station of Lira Municipality. It was traded as a 500-g loaf or as a 12-bun packet. The cost of a loaf of bread varied between US\$0.60 and US\$0.80 while that of a 12-bun packet was US\$0.60.

About 100 loaves of bread and 450 packets of buns were sold daily. Other baked products at the market were cakes worth US\$20.00. Each was sold at US\$0.10.

b. US\$1.00=1,000 Uganda shillings.

**Table 2. Comparative gross margins of sweetpotato products and wheat flour products, Lira, Uganda.**

<b>Product</b>	<b>Net revenue per product (US\$)</b>		
	<b>Wheat flour</b>	<b>Sweetpotato Cooked &amp; mashed</b>	<b>Sweetpotato flour</b>
<b>Chapatis (1 piece)</b>	0.032	0.045	0.047
<b>Mandazi (1 piece)</b>	0.014	0.023	0.023
<b>Buns (1 piece)</b>	0.007	0.014	0.015
<b>Bread (1 loaf of 500g)</b>	0.058	0.065	0.069