Sweetpotatoes in Chapatis Processing:
Feasibility and Acceptability in Rural Areas.

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Abstract

Sweetpotatoes (Ipomea batatas) storage roots with a high dry matter content, either in steamed and smashed, raw and grated or flour form, were used to partially substitute wheat flour in processing of chapatis. The feasibility, consumer acceptability, and cost production for the product in Lira Municipality, Uganda, have been studied. It has been found that chapatis containing sweetpotato are highly acceptable and competitive, and small-scale businesses of such fried processed products incorporating sweetpotato are starting in the area.

Introduction

Sweetpotato (ipomea batatas) is an important subsistence crop in East Africa, and it plays a major role as a famine reserve for many rural and urban households because of its tolerance to drought, short growth period, and high yield with limited inputs on relatively marginal soils (Bashaasa et al., 1995; Ewell, 1993). Its utilization is very narrow; it is essentially consumed boiled in boiled form. The limited range of ways and availability of adapted processing technologies in which sweetpotato is utilized in the region seriously undermining the potential benefits of the crop to farmers and consumers.

However, there are myriad of products that can be made using sweetpotato as a major ingredient (Ge et al., 1992). Hagenimana (1996) has shown how sweetpotato storage roots with a high dry matter content, either in steamed and smashed, raw and grated or flour form could substitute wheat flour processing of mandazis (doughnuts). Collins and Abdul (1982) tested the effect of sweetpotato flour (and purée) as an ingredient of quality of yeast-raised doughnut. Several chemical and physical properties and six organoleptic attributes of the doughnuts were tested, but overall quality was not significantly lowered by addition of sweetpotato. Gaturubi and Hagenimana (1995) have shown that sweetpotato roots are starchy and are quite suited to deep-frying during the production of crisps (called “chips” in the United States). Galonyo (1993), Omosa (1994), and Hagenimana et al. (n.d.) have shown that sweetpotato either in fresh grated, boiled and mashed, or flour form could, with high potential of success, partially replace wheat flour in processing of fried and baked products. Furthermore, Hagenimana and Owori (1996) have reported that wheat flour is too expensive in such a manner that the cost of a 2-kg pack is equivalent to a 3-day salary of a casual worker in Lira Municipality, Uganda.

Small-scale businesses of such fried processed sweetpotato products, especially chapatis (flat bread) constitute an important economic activity in small restaurants called “hotel” of East Africa. However, little has been done up to now to improve the quality and cost of the production of this important food product. The purpose of this work is to determine the feasibility and acceptability of processing chapatis where wheat flour has been partially substituted by sweetpotato.

Materials and Methods

Plant material

Fresh sweetpotato roots (a mixture of local varieties) were bought from Lira Municipal market.

Sweetpotato flour

Sweetpotato flour used in this study was processed out of dried sweetpotato slices purchased from a farmer in Lira, Uganda. They were from a mixture of white-fleshed varieties and processed according to the general schema early described (Hagenimana, 1996). After harvesting, sweetpotato storage roots are usually kept in the sun for 2-3 days, hand-peeled, sliced, and sun-dried. After peeling, they are often crushed instead of being sliced and dried. Sun-dried sweetpotato slices are reportedly very sensitive to attack by storage weevils. To prevent such damage, some farmers in Tanzania parboil or blanch the slices at the temperature of water for 2-3 min and then dry them for 2-3 days before storage (Dr. Kapinge, personal communication). After parboiling, a hard protective layer forms during the sun-drying period because of gelatinized starch at the surface of the slices. This hard layer seems to prevent storage weevils from penetrating into the slices.

Sweetpotato slices used in this experiment were ground in a posho mill at Dokoto International Inc. in Lira.

Wheat flour

The wheat flour used was that generally used for chapati making at Lira market. It was milled by UNGA Limited, Commercial street, P.O.Box 30386, Nairobi, Kenya.

Chapatis Processing

Chapatis were made from the following recipe: 1.0 kg of boiled and mashed or raw and grated sweetpotato roots (Variety called “Tanzania” in the area), 1.0 kg of wheat flour from UNGA Limited, Nairobi, Kenya (when sweetpotato flour was used the ratio was 3.7 sweetpotato flour to wheat flour), 1 teaspoon (about 1.7 g) of salt (Salt Manufacturers Kenya Ltd., P.O. Box 81665, Mombasa, Kenya), 3 teaspoons (about 5 mL) of baking powder1 (Kapa Oil Refineries Ltd., P.O. Box 18492, Nairobi, Kenya) 1/4 cup (about 100 mL) of vegetable oil (Mukwano Industries Ltd., P.O. Box 2671, Kampala, Uganda) and 2 cups of water.

1 Some Chapatis processors in Kenya and Uganda do not use baking powder.
Sweet potato and dry ingredients were mixed together. Water was added and the mixture hand-kneaded to make a soft, smooth dough. The resulting dough was divided into approximately equal portions and formed into balls. These were rolled into circular shapes of about 10-12 cm in diameter and about 2-3 mm thick using a floured pastry board, and grilled on a hot and oiled griddle iron for about 1 minute each (about 30 sec for each side) (Figure 1).

The oil content of samples was determined in triplicate as described by Lulai and Orr (1979). Samples were finely ground in a blender, a 5-g mixture sample was put into a thimble, and a 6-h Soxlet extraction conducted using petroleum ether. Data were analyzed using the MSTAT-C program (MSTAT-C, 1991).

Results and Discussion

Oil content in chapatis incorporating sweet potato

Figure 2 shows the oil content of chapatis containing sweet potato. The effect of incorporating boiled and mashed, raw and grated sweet potato in a quantity of 50% or sweet potato flour (30%) in the mixture of chapatis was not significant at the 5% level. We recently reported that the oil content in such products fried in “Elaito” brand (oil) and those in “Kasuku” brand (fat) was not significantly different (Hagenimana et al., 1996) which is particularly relevant in the choice of oil type for use in sweet potato frying, especially when there as many as 39 different brands of oils and fats in Nairobi supermarkets (Hagenimana and Oyungu, 1995).

Consumer acceptability

Acceptability was evaluated by comparing sweet potato chapatis (substituting wheat flour for sweet potato flour or cooked and mashed sweet potato) with the chapatis the consumer has just bought from the restaurant or usually buys. Attributes such as sweetness or sugary taste, colour, filling, appearance (grain, texture, crust and crumb colour), apparent freshness, taste, and oiliness were judged subjectively by chapatis consumers.

Limited research has been conducted on sweet potato flour (Jones and Bouwkamp, 1992) and the local flour used in the trial was made out from white-fleshed sweet potato mostly sensitive to the enzymatic browning. The use of orange fleshed sweet potato in flour processing and baking goods may improve the colour and the pro-vitamin A content of the product (results not shown). However, more research work is still needed to improve the flour quality and keep the nutritional characteristics of the raw material.

Price

Some 80% of consumers interviewed at the main market in Lira said that they would pay the same price for the chapatis made from ingredients including cooked and mashed sweet potato as for chapatis usually bought (Figure 4). 15% would pay more and the rest would pay less. For the chapatis with sweet potato flour, 63% of the consumers expressed their willingness to pay the same price as for chapatis usually bought, while 37% said they would not pay.

Cost of production for chapatis

The production costs illustrated in Table 1 use the cost of ingredients and other inputs of the chapatis recipe as a comparison with the product incorporating sweet potato. Cost and labour inputs for chapatis were collected from Kapeka Adong Women’s Group, Lira, Uganda, and were reestimated when we were processing chapatis for our trials at New Lira Restaurant, Lira, Uganda.

The comparison of the production costs shown in Table 1 indicated that the use of cooked and mashed sweet potato or flour increased the net revenue per price of a chapati by 13.0% (42%) and by 15.3% (49.3%) respectively. There was a 43.9% increase in the net revenue cost ratio of the product by using cooked and mashed sweet potato and 48% increase by using sweet potato flour.

Apart from wheat flour, the other expensive ingredient was oil. The data clearly indicated that it was cheaper to produce sweet potato chapatis which was mainly due to the reduction in wheat cost. The cost related to water and firewood in case of washing and cooking sweet potato has been found to be very minor.

Conclusion

The technology of sweet potato use (either in cooked and mashed, or flour form) in processing chapatis has been refined and the feasibility adapted to the level of the small processor conditions with no major change in equipments and materials. The activity of trading chapatis in Lira Municipality involves more than 40 people. Fried products having sweet potato as an ingredient are highly acceptable by the community from Lira Municipality, and the cost of production indicates that the use of sweet potato in chapatti is profitable. Cooked and mashed sweet potato as an ingredient improves the taste, freshness, appearance, sweetness and colour of chapatis. It is recommendable to use orange and yellow fleshed sweet potato which are rich in pro-vitamin A to replace food colour currently used in the same product.

Acknowledgment

The authors are grateful to Rose Nasaka and Isaac Njaci for chapatis processing and oil content determinations. The study was financially supported by CIP and the Overseas Development Administration’s Crop postharvest Research programme.
Figure 1. Sweetpotato (50% substitution) and pure wheat flour chapatis

![Image](image1.png)

Figure 2. Oil content in chapatis.
(Means followed by common letters for the same processed product are not significantly different at 5% level using LSD test.)

![Image](image2.png)

Figure 4. Willingness of consumers to pay the same price as for chapatis just bought at the Lira main market (sample n = 47).

![Image](image4.png)
Figure 3. Chapati characteristic acceptability at Lira main market (sample = 47).

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### Table 1. Production cost for sweetpotato and pure wheat chapatis in Lira municipality (Ushs)

<table>
<thead>
<tr>
<th>Items</th>
<th>Wheat flour</th>
<th>Cooked &amp; Mashed SP</th>
<th>SP flour</th>
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<tr>
<td></td>
<td>Price (Ushs)</td>
<td>Units</td>
<td>Total</td>
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<tr>
<td>Wheat flour (Kg)</td>
<td>750</td>
<td>0.5</td>
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<td>Sweetpotato (Kg)</td>
<td>20</td>
<td>0</td>
<td>0</td>
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<td>SP flour</td>
<td>150</td>
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<td>0</td>
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<tr>
<td>Salt (Kg)</td>
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<td>B. powder (Kg)</td>
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<td>0.015</td>
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<td>Water (L)</td>
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<tr>
<td>Oil (L)</td>
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<td>0.065</td>
<td>97.5</td>
</tr>
<tr>
<td>Charcoal (Tin)</td>
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<td>0.1</td>
<td>50</td>
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<tr>
<td>Labour (labor/day)</td>
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<td>0.1</td>
<td>10</td>
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<tr>
<td>Depreciation</td>
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<td>8</td>
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<td>Market dues</td>
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<td>84.4</td>
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<tr>
<td>Total costs</td>
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<td>Revenue</td>
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<td>Net Revenue</td>
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<td>N.R (Chapati)</td>
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<td>N.R cost ratio</td>
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</table>

### Assumptions

1. The processing of sweetpotatoes requires the same amount of oil as wheat flour chapatis.
2. The cost of sweetpotato was calculated from the quantity of unpeeled roots and prices in Lira markets for March 1995.
3. Cost of charcoal: We assumed that a tenth of a tin will cook sweetpotato for 30 min and that the frying of 10 chapatis requires a tenth of a tin. Charcoal is used in fresh sweetpotato cooking and shallow frying.
4. Cost of oil: We assumed that about 10% is absorbed by the chapati during the process of frying. Oil is used in dough mixture and shallow frying.
5. Cost of sweetpotato flour: We assumed that the price of dry sweetpotato chips was 100 Ushs/Kg, and the milling cost was 20 Ushs/Kg. Total cost was 150 Ushs/kg.
6. Depreciation: The cost of equipment for standard chapatis production was 125,000 Ushs. Depreciation was estimated at 20% p.a., 14,000 chapatis per year equivalent to 0.17 Ushs/1 chapati.
7. Market dues: 3,000 Ushs per month, 1,200 chapatis per month, and 2.5 Ushs per chapati.
8. Additional labor for sweetpotato. Labor for peeling, washing, mashing, mixing, rolling, cutting, and frying chapatis made with cooked and mashed sweetpotato takes 49.2 min. Labour cost is 500 Ushs/8h (480 min); equivalent of 49.2 min is 0.10 person/day.

### References

