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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 fresh form. The limited range of ways and availability of adapted processing technologies in which sweetpotato is utilized in the region seriously undermine 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 puree) 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. Gatumbi 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). Gakonyo (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 stor-

age 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. Kapinga, 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 Dokolo 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 Manufactures 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.

Sweetpotato 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 oily 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 Soxhlet extraction conducted using petroleum ether. Data were analyzed using the MSTAT-C program (MSTAT-C, 1991).

Results and Discussion

Oil content in chapatis incorporating sweetpotato

Figure 2 shows the oil content of chapatis containing sweetpotato. The effect of incorporating boiled and mashed, raw and grated sweetpotato in a quantity of 50% or sweetpotato 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 "Elianto" 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 sweetpotato frying, especially when there as many as 39 different brands of oils and fats in Nairobi supermarkets (Hagenimana and Oyunga, 1995).

Consumer acceptability

Acceptability was evaluated by comparing sweetpotato chapatis (substituting wheat flour for sweetpotato flour or cooked and mashed sweetpotato) 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.

Figure 3 gives the characteristics of acceptability for 3 different types of chapatis

at the Lira main market. In total 47 chapatis consumers were interviewed to comment on different characteristics of the product. Chapatis with cooked and mashed sweetpotato ranked as the first choice for the most of the consumers. It had the best taste and filling (Fig. 3); its freshness and oiliness were adequate, and the colour was good. Its taste was sweet although the sweetness in chapatis is not a characteristic usually desired in the product. The consumers liked it as it was and indicated that it was a new choice in the market. Chapatis with sweetpotato flour was classified as the third choice for most of characteristics especially for its colour, appearance and taste. Consumers indicated that the sweetness was too high in sweetpotato flour chapatis. The product was generally acceptable, however, the texture of sweetpotato flour chapati was hard and the colour was of a rough brown on the surface.

Limited research has been conducted on sweetpotato flour (Jones and Bouwkamp, 1992) and the local flour used in the trial was made out from white-fleshed sweetpotato mostly sensitive to the enzymatic browning. The use of orange fleshed sweetpotato 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 sweetpotato as for chapatis usually bought (Figure 4), 15% would pay more and the rest would pay less. For the chapatis with sweetpotato 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

sweetpotato. Cost and labour inputs for chapatis were collected from KADUNA Adong Women's Group, Lira, Uganda and were readjusted with the data collected 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 sweetpotato or flour increased the net revenue per price of chapati by 13.3 Ushs (42%) and by 15.3 Ushs (49.3%) respectively. There was an increase of 43.9% in the % net revenue cost ratio of the product by using cooked and mashed sweetpotato and 48% increase by using sweetpotato flour.

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

Conclusion

The technology of sweetpotato 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 sweetpotato as an ingredient are highly acceptable by the community from Lira Municipality, and the cost of production indicates that the use of sweetpotato in chapati is profitable. Cooked and mashed sweetpotato as an ingredient improves the taste, freshness, appearance, sweetness and colour of chapatis. It is recommendable to use orange and yellow fleshed sweetpotato which are rich in pro-vitamin A to replace food colour currently used in the same product.

Acknowledgment

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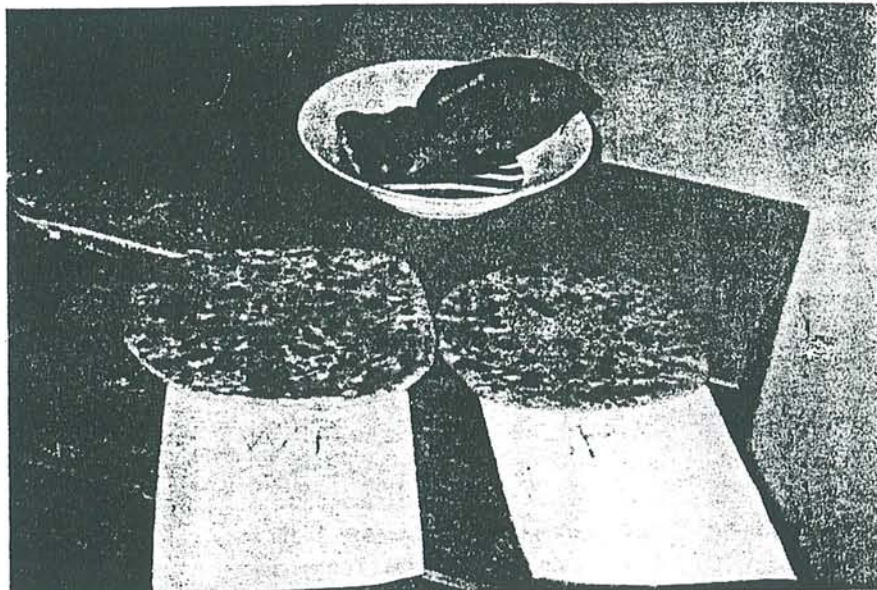


Figure 1. Sweetpotato (50% substitution) and pure wheat flour chapatis

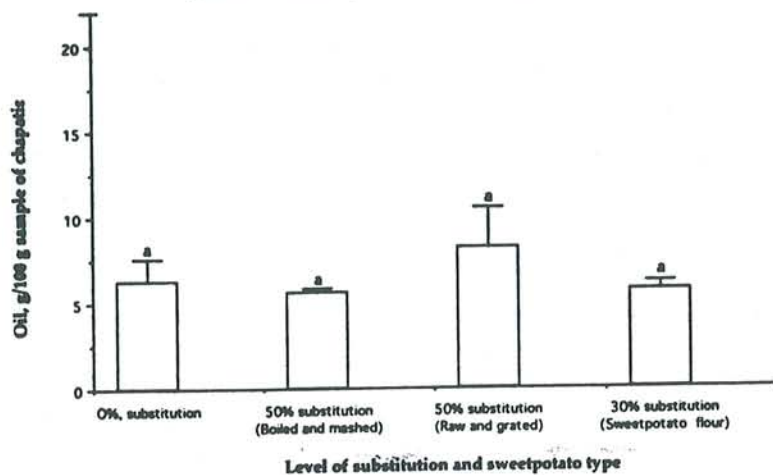


Figure 2. Oil content in chapatis.

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

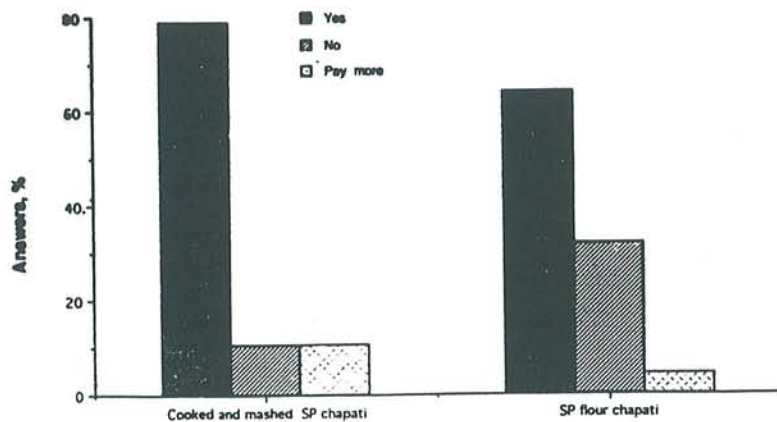


Figure 4. Willingness of consumers to pay the same price as for chapatis just bought at the Lira main market (sample = 47).

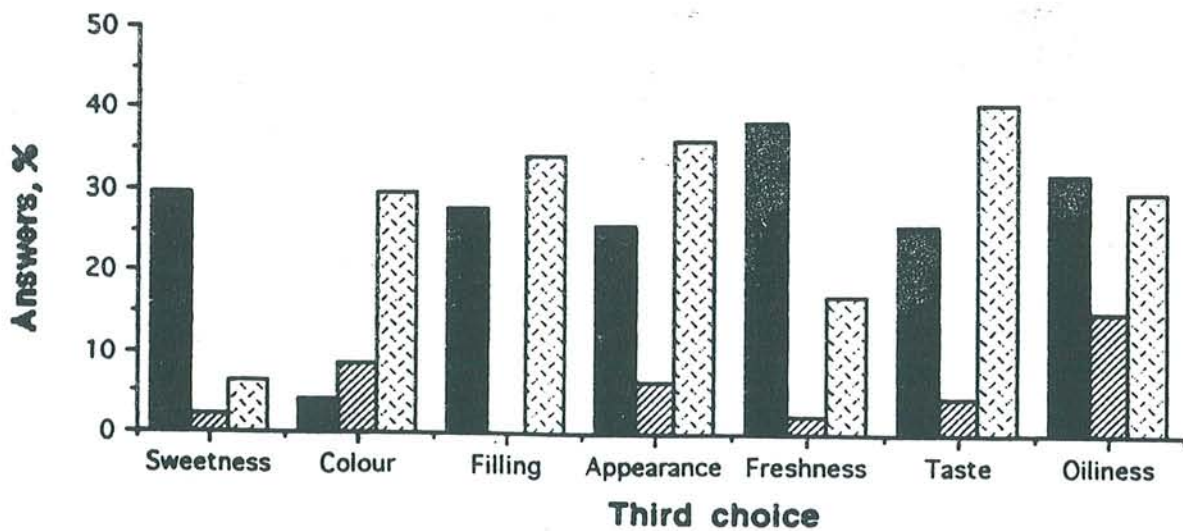
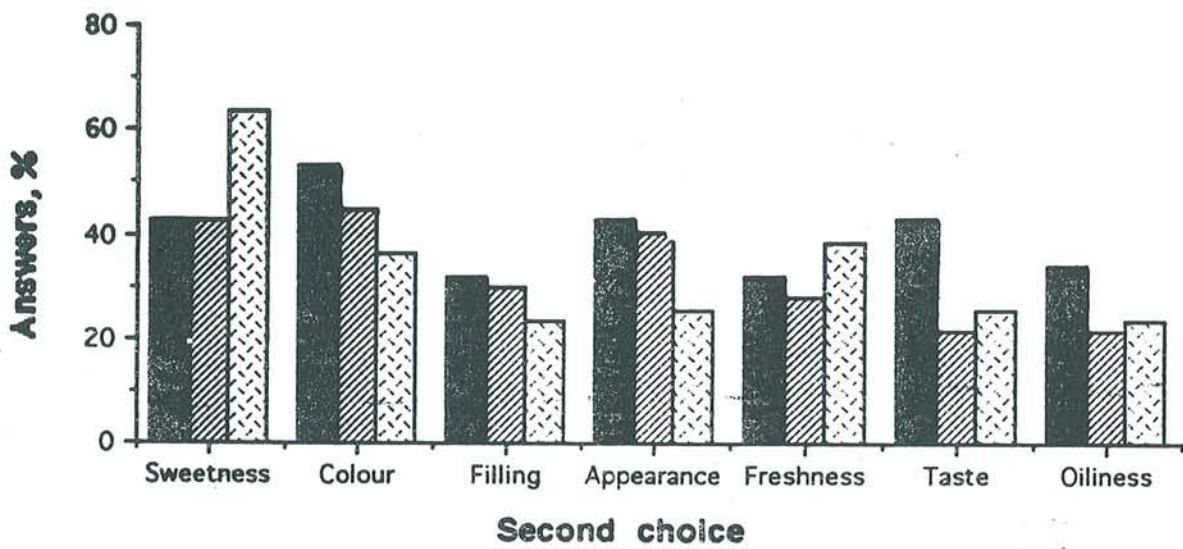
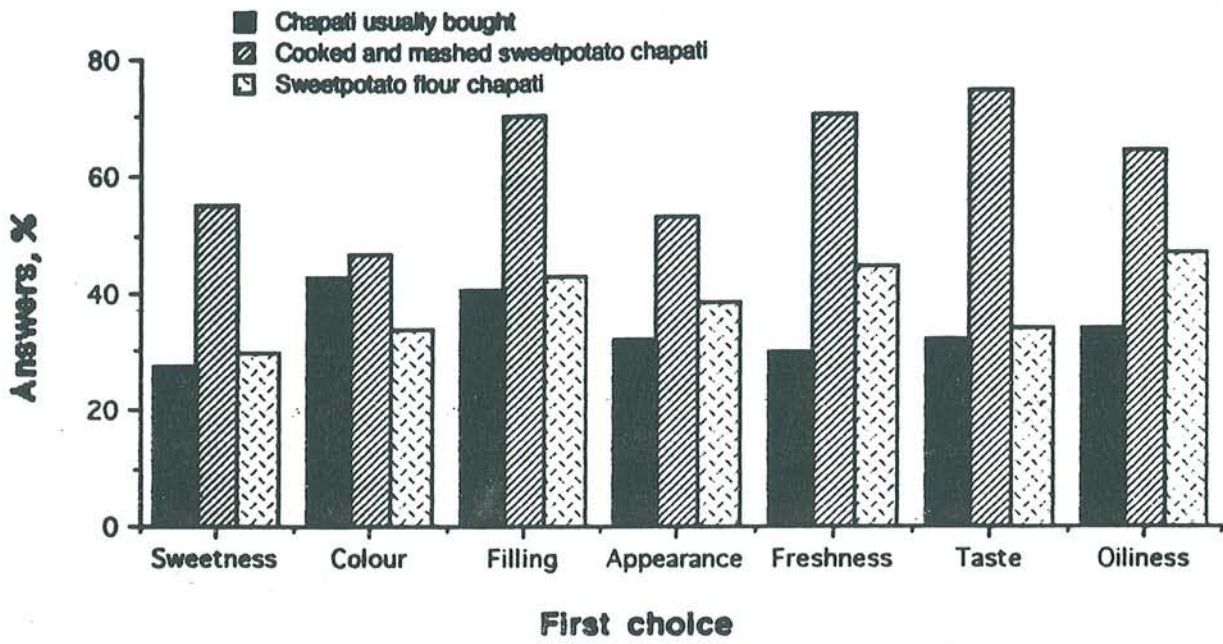


Figure 3. Chapati characteristic acceptability at Lira main market (sample = 47).

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

Items	Wheat flour			Cooked & Mashed SP			SP flour		
	Price per unit	Units	Total	Price per unit	Units	Total	Price per unit	Units	Total
Wheat flour(Kg)	750	0.5	375	750	0.25	187.5	750	0.35	262.5
Sweetpotato(Kg)	20	0	0	20	0.25	5	20	0	0
SP flour	150	0	0	150	0	0	150	0.15	22.5
Salt (Kg)	400	0.002	0.8	400	0.002	0.8	400	0.002	0.8
B. powder(Kg)	3000	0.0015	4.5	3000	0.0015	4.5	3000	0.0015	4.5
Water (L)	2.5	0.035	0.09	2.5	0.030	0.075	2.5	0.04	0.1
Oil (L)	1500	0.065	97.5	1500	0.065	97.5	1500	0.065	97.5
Charcoal(Tin)	100	0.1	10	100	0.2	20	100	0.1	10
Labour(Ind/day)	500	0.11	55	500	0.1	50	500	0.11	55
Depreciation	0.17	8	1.36	0.17	7	1.96	0.17	9	1.53
Market dues	2.5	8	20	2.5	7	17.5	2.5	9	22.5
Total costs			546.25			384.84			476.93
Revenue	100	8	800	100	7	700	100	9	900
Net Revenue			253.75			315.16			423.07
N.R (Chapati)			31.7			45.02			47.01
N.R cost ratio			0.46			0.82			0.89
% change in N.R cost ratio		0			43.9			48	

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 50 Ushs/Kg. Total cost was 150 Ushs/kg flour.
6. Depreciation. The cost of equipment for standard chapatis production was 12500 Ushs. Depreciation was estimated @ 20% p.a., 14400 chapatis per year equivalent to 0.17 Ushs/1 chapati
7. Market dues. 3000 Ushs per month, 1200 chapatis per month, and 2.5 Ushs per chapati.
8. Additional labour for sweetpotato. Labour 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

Bashasha, B., Mwangi, R. O. M., and Ocitti p'Obwoya, C. N., and Ewell, P. T.. 1995. Sweetpotato in the farming and food systems of Uganda. A farm survey report. NARO and CIP, Kampala, Uganda.

Collins, J. L., and N. A. Abdul Aziz. 1982. Sweetpotato as an ingredient of yeast raise doughnuts. *J. Food Sci.* 47: 1133-1139.

Ewell, P. T.. 1993. Sweetpotato in Africa: Research priorities in to stimulate increased marketing. Paper presented at the *International Workshop on Methods for Agricultural Marketing Research*, 16-20 March J. FOOD TECH. IN AFRICA 2 (1): 4 - 8 JAN- MAR, 1997

1993, IARI campus, New Delhi, India

Gakonyo, N. 1993. Processed sweetpotato : responding to Kenya's urban needs. Working papers in *Agricultural Economics*. Cornell University, Ithaca, New York.

Gatumbi, R. W. and Hagenimana, V. 1996. Women's role in local sweetpotato crisps processing in Nairobi-Kenya. Paper presented at the *Stah Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch (ISTR-AB)*, Lilongwe, Malawi, 22-28 October 1995.

Ge, L. W., Xiuqin, W., Huiyi, C., Rong, D. 1992. Sweetpotato in China, pp. 41-50. In Scott, G., Wiersema, S., and Ferguson, P. I. (Eds). *Product Development for Root and Tuber Crops. Vol. 1 -Asia*. Proceedings of the International Workshop, held April 22-May 1, 1991, at Visayas State College of Agriculture (VISCA), Baybay, Leyte, Philippines. CIP, Lima, Peru.

Hagenimana, V. 1996. Sweetpotatoes in processing of doughnuts; Feasibility and acceptability in rural areas. Paper presented at the *3rd KIFST Conference of Food Science and Technology*, Oct. 30-Nov. 1, 1996, Nairobi, Kenya.

Hagenimana, V., Hall, A., and Low, J. n.d. *Sweetpotato processed products in Kampala, Uganda*. (report in preparation). NRI and CIP, Nairobi, Kenya.

Hagenimana, V. and Owori, C. 1996. *Feasibility, acceptability, and production costs of sweetpotato baked products in Lira Municipality, Uganda. A study report*. NARO and CIP, Nairobi, Kenya.

Hagenimana, V., Karuri, E.G., and Oyunga, M. A. Oil content in fried sweetpotato processed products. *Journal of Food Processing and Preservation* (Submitted).

Hagenimana, V. and Oyunga, M. A. 1995. *Brands of oils and fats available on Nairobi market. A survey report*. International Potato Center, Nairobi, Kenya.

Jones, A. and Bouwkamp, J. C. 1992. Fifty years of cooperative sweetpotato research 1939-1989. Southern Cooperative Series, Bulletin No. 369.

Lulal, E.G. and Orr, P. H. 1979. Influence of potato specific gravity on yield and oil content of chips. *Amer. Potato J.* 56, 379-390.

MSTAT-C Program. 1991. *A software program for the design, management, and analysis of agronomic research experiments*. Michigan State University

Omosa, M. 1994. Current and potential demand for fresh and processed sweetpotato products in Nairobi and Kisumu, Kenya. International Potato Center, Nairobi, Kenya.

Oyunga, M. A. 1994. Sweetpotato product development course outline. In : seminar to promote processed sweetpotato products in Uganda. held Sept. 100-17, 1994, Mukono, Uganda. KARI, Kenya.