

Vino,
output from APA conference?
7/6/00

LOSSES IN SWEET POTATO QUALITY DURING POST-HARVEST HANDLING IN TANZANIA

G. T. Ndunguru¹, A. Westby², A. Gidamis³ and K.I Tomlins²

¹ Tanzania Food and Nutrition Centre (TFNC), P. O. Box 977, Dar es Salaam, Tanzania.

² Natural Resources Institute (NRI), Central Avenue, Chatham, Kent ME4 4TB, UK.

³ Department of Food Science and Technology, Sokoine University of Agriculture, P.O. Box 3006, Morogoro, Tanzania.

ABSTRACT

Commercial consignments of sweet potato (variety Polista) were surveyed from harvest to markets at Mwanza. Losses in quality from breaks and cuts occurred at all stages in the handling and transport system and they accounted for a loss in market value of up to 9%.

The greatest loss in quality occurred when loading and unloading sacks that weighed 100 kg or greater; up to 19.0% and 37.0% of roots suffered from breaks and skinning injury respectively. To a lesser degree, harvesting contributed to losses in quality; 20-35% of sweet potatoes were cut, 3-5% were severely broken and 19-53% had major skinning injury. Filling polypropylene sacks with 100 kg or greater also contributed to losses in quality. Pre-harvest losses in quality caused by weevil infestation were also evident.

The results of the study are discussed in the context of the improvements that could be made in the transport and handling chain.

INTRODUCTION

Sweet potato (*Ipomea batatas* (L) Lam.) is an important staple food in the Lake, Southern Highlands, Northern Highlands, Western and Eastern Zones of Tanzania (Ndunguru *et al.*, 1998). The crop is marketed in fresh form and provides an important source of income for producers. It also offers important sources of food to the rapidly expanding urban population.

Commercially, sweet potatoes are harvested in the morning, packed into polypropylene sacks and transported by road or boat or combinations of both (Ndunguru *et al.*, 2000). Marketing does not currently involve grading and storage (Thomson *et al.*, 1997). Sweet potato tubers have delicate skins and easily succumb to mechanical injuries which take many forms at all stages in the life of the produce from pre-harvest operations through harvesting and handling to marketing (Booth, 1974). A preliminary survey (Tomlins *et al.*, 2000) of the sweet potato marketing chain from the farm to the market, indicated that, substantial losses in quality occur.

The general causes of mechanical injuries are reported to be implements used in harvesting the crop, excessive handling, sun and weevils (Salunkhe and Desai, 1984). Ndunguru *et al.* (1998) described the quality characteristics of sweet potato to be breaks, cuts, skin bruising, shrivelling, rotting and weevil damage. These are similar to those reported by Kapinga *et al.* (1995). Although the quality perceptions of consumers depend on personal, local or regional preferences and eating habits, their influence on the market value of the crop is significant (Thomson *et al.*, 1997). Researchers have shown that consumers are sensitive to quality.

The purpose of this study was to determine the cause of losses in quality of sweet potato during post-harvest handling from the farm to the market in Tanzania and suggest interventions that could be made.

MATERIALS AND METHODS

Commercial consignments of sweet potato (variety Polista) comprising 8 sacks of 100 kg and controls, were surveyed from harvest to market in Mwanza. Replicate samples of forty sweet potato

tubers were randomly taken from a pile of freshly harvested tubers on the farm for assessment on quality losses. Other samples of forty sweet potato tubers were randomly sampled from each sack enroute from the farm to the Mwanza market. Each sack was sampled only once during the journey. All sacks were transported by bicycle from the farm to the port, by ship to Mwanza port, and by light pick-up vehicle to the market. Tubers were assessed for skin bruises, breaks and shrivelling using 0 to 5 scale (0 = none and 5 = severe). Cuts were scored as 0 = none, 1 = minor and 2 = major. Scores for weevil attack were 0 = none and 1 = present. The total score for each type of damage was the sum the individual scores for each of the 40 tubers evaluated. Dataloggers (RS components, UK) used to monitor impact, temperature and humidity were fitted inside a plastic pipe that was approximately the same size as a sweet potato tuber and positioned at the centre of sacks. Analysis of variance (ANOVA) was carried out using SPSS (version 8) statistical software.

RESULTS

Sweet potato tubers to be sold in Mwanza were transported from the farm to the port by bicycle or trolley and then by ship to Mwanza Port. Tubers were transported from the port by a pick-up vehicle to the markets in the town for sale.

Losses in quality during harvesting of sweet potato tubers

Farmers in Mwanza use hoes to harvest tubers from the ground. Some of the tubers are injured during harvesting which reduces the the quality of the crop. Table 1 shows the percentage of tubers damaged during harvesting

Table 1 Percent of sweet potato tubers damaged due to harvesting

Type of damage	Scores for replicate samples (%)			Mean
	1	2	3	
Breaks ^(*)				
Minor	13	24	20	19
Major	3	4	5	4
Skinning ^(*)				
Minor	36	19	53	36
Major	4	0	6	3
Cuts	35	26	20	27
Skin weevil	59	13	26	33
Burrowing weevil	2	1	4	2
Rots	20	2	0	7

^(*) Where: minor breaks and skinning had scores of 0 to 3, major breaks and skinning injury had scores of 4 to 5.

The proportion of sweet potato tubers with cuts following harvest varied from 20% to 35%. Sweet potato tubers that suffered from major breaks and skinning injuries varied between 3% and 5% and 0% and 6% respectively. Pre-harvest losses in quality caused by weevil infestation was also evident.

Effect of stuffing sweet potato tubers in to sacks

Polypropylene sacks are normally filled with between 100 and 200 kg roots. Filling the sacks with tubers requires skill and expertise. In most cases, sacks were overfilled and the tubers at the top of the sack were covered with sweet potato vines and carefully tied down with twine. However, when loading sacks the farmers use considerable force that was observed to scrape the skin and cause breakages of the tubers.

Table 2. Effect on quality of stuffing sweet potato tubers into sacks.

Quality variable	Control
------------------	---------

	Freshly harvested(%)	Stuffed in sacks (%)
Breaks (*)		
Minor	20.0	34.0
Major	4.0	8.0
Skinning injury (*)		
Minor	31.1	49.0
Major	15.0	20.0

(*) Minor and major as defined in Table 1.

Stuffing sweet potato tubers into sacks increased the levels of major breaks (4.0% to 8.0%) and major skinning injury (15.0% to 20.0%) (Table 2). When subjected to statistical analysis (ANOVA), the total scores for major breaks and skinning did not indicate a significant effect at (P=0.05). However, there was a significant increase in the proportion of tubers with minor breaks and skinning injuries.

Effect of transport and handling on tuber quality

The total journey from farm to market varied between 16 and 24 hours. During transportation consignments of tubers are subjected to shock impacts as measured with the shock loggers in the consignments of tubers that reduced quality. Figure 1 shows the profile of shock impacts experienced in consignments monitored from the farm to Mwanza markets.

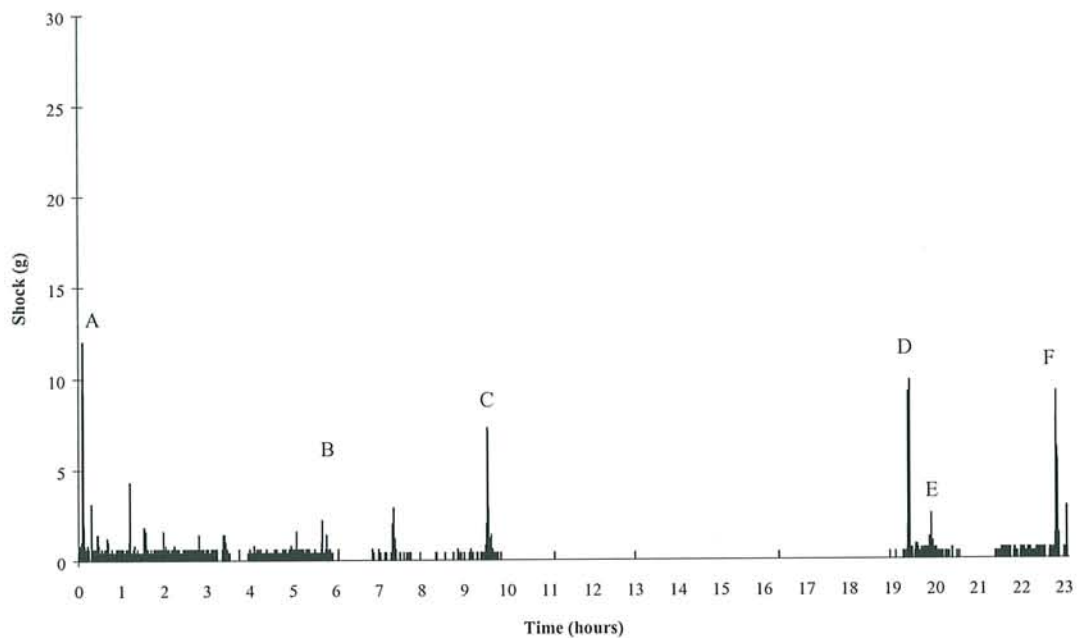


Figure 1: Shock profile (30 second resolution) of sacks of sweet potato tubers transported from a farm at Kahunda, Sengerema to market in Mwanza.

Where A = loading onto a trolley, B = unloading onto sandy beach on the shore of Lake Victoria, C = loading onto the ferry, D = unloading from ferry at

Mwanza port, E = handling at port customs and loading onto a light commercial vehicle, F = transport to market and unloading.

Loading and unloading the sacks on a bicycle or onto a ship or pick-up as indicated in Figure 1 at points A, C, D and F inflicted the largest shock impacts. The damage at different points in the marketing chain are shown in Table 3. Using the relationships between different quality characteristics and market value (Thomson *et al.* 1997), it was calculated that there was reduction

in value of 9% as a consequence of handling on to the ship and in the port in Mwanza.

Table 3: Quality (percent of tubers showing damage) of sweet potato tubers (Polista variety) during transportation from Kahunda to Mwanza markets

Tuber damage	Stage in marketing chain			
	Farm (before transport)	Lake shore at Kahunda	Mwanza port	Mwanza market
Broken tubers	0	1	19	17
Skinning injuries	1	2	28	37
Cuts	2	3	6	4

Note: The total score is the sum of individual score of 40 randomly selected tubers from the sacks.

The loss in quality of sweet potato tubers due to breaks, skinning injuries and cuts were minimal at the farm and lake shore. However breaks and skinning injuries increased from 1% at Kahunda to 19% and 37% at the port and market respectively. This could be due to handling of the sacks at Mwanza port and the market.

DISCUSSION AND RECOMMENDATIONS

Before sweet potato tubers are transported to the market, they are harvested and stuffed in polypropylene sacks for transportation. Harvesting is normally done using hoes, which causes injuries to the tubers. These injuries affect the quality of sweet potato tubers and hence their market value.

When sweet potato tubers are stuffed in sacks and then transported to urban markets in Mwanza they are subjected to friction and shock impacts ~~that~~ which cause substantial losses in quality. Losses that occur are mainly due to cuts and skinning injuries. Pre-harvest losses in quality caused by weevil infestation also contribute to losses in the quality of sweet potato tubers.

Several recommendations are suggested in order to improve the quality of marketed sweet potato tubers. Underground storage organs such of sweet potato tubers have poorly developed cuticles and curing is recommended before they are stored or handled (Booth, 1974; Buescher, 1977; Keleny 1965; Morris 1981; Salunkhe and Desai 1984). Curing is recommended so that a surface layer of protective suberised wound periderm tissue is formed over at the wound site (Wills *et al.*, 1998).

Another approach to reduce damage caused during marketing is to use alternative packaging materials, such as boxes, filled with fewer tubers. During transportation of sweet potato tubers, losses in quality occur due to shock impacts during loading and unloading of sacks. The use of data loggers to monitor shock impact during transportation of sweet potato tubers seems to be useful in identifying stages at which mishandling occurs. The education of those involved in handling could help in improving quality and this is recommended.

ACKNOWLEDGEMENT

This publication is an output from a research project funded by United Kingdom Department for International Development (DFID) for the benefit of developing countries. The views expressed are not necessarily those of DFID [*R6506: Crop Post-Harvest Research Programme*].

REFERENCES

- Booth, R.H. (1974) Post-harvest deterioration of tropical root crops: losses and their control, *Tropical Science*, 61: 49 – 62.
- Buescher, R.W. (1977) **Hordcore?** in Sweet potato roots as influenced by cultivar, curing and ethylene, *Hortscience*, 12: 326 – 327.
- Kapinga, R. E., Rwiza, E. J., Jeremiah, S. C. and Rees, D. (1996) Preference and selection criteria of sweet potato varieties at urban level in the Lake Zone of Tanzania, Tanzania, National Root and Tuber Crops Programme.
- Keleny, G. P. (1965) Sweet potato storage, *Papua New Guinea Agricultural Journal*, 17: 102 – 107.
- Morris, S. C. (1981). Post-harvest storage and handling of sweet potatoes, *CSIRO Food Research Quarterly* 41: 63 – 67.
- Ndunguru, G., Thomson, M., Waida, R., Rwiza, E. and Westby, A. (1998). Methods for examining the relationship between quality characteristics and economic value of marketed fresh sweet potato. *Tropical Agriculture (Trinidad)*, 75: 129 – 133.
- Ndunguru, G. T., Tomlins, K. I.; Rwiza, E. and Westby, A. (2000) Post-harvest handling and transport of sweet potato and their influence on quality in Tanzania, *Postharvest Quality and Technology* [submitted].
- Salunkhe, D. K. and Desai, B. B. (1984) *Post-harvest Biotechnology of Vegetables*, CRS Press, Inc., Boca Raton, Florida.

Thomson, M., Ndunguru, G. T., Waida, T. D. R., Rwiza, E. and Jeremiah, S. (1997). The relationship between quality and economic value of fresh sweet potato and dried cassava products in Mwanza, Tanzania, NRI Report (AO 500). Chatham, U.K. Natural Resources Institute.

Tomlins, K. I., Ndunguru, G. T., Rwiza, E. and Westby, A. (2000). Post-harvest handling, transport and quality of sweet potato in Tanzania. *Journal of Horticultural Science and Biotechnology* [In Press].

Wills, R., McGlasson, B., Graham, D. and Joyce, D. (1998) Post-harvest. An Introduction to the Physiology and Handling Fruit, Vegetable, CAB International Oxon, U.K., 262p.