RUFORUM Working Document Series (ISSN 1607-9345) No. 14 (2) : 923 - 929.
Available from *http://repository.ruforum.org*

Research Application Summary

Effect of pre-treatments and drying on nutrient content of orange fleshed sweet potatoes in Maswa District, Tanzania

Nicanuru, C.,[1] Laswai, H.S.[2] & Sila, D. N.[1]
[1]Jomo Kenyatta University of Agriculture and Technology, P.O. Box 62,000 – 00200 Nairobi, Kenya
[2] Sokoine University of Agriculture, P. O. Box 3000, Chuo Kikuu, Morogoro, Tanzania
Corresponding author: swaichriss@ymail.com or swaichriste@gmail.com

Abstract

Rural communities in Tanzania are increasingly suffering from food shortage and malnutrition. A household survey was conducted to determine the baseline situation in Maswa district, regarding production, processing and storage of orange fleshed sweetpotato roots and cowpea leaves. Chemical analysis was carried out on four sweetpotato varieties (Jewel, Karoti dar, Kabode and Ejumula) possessing different intensities of orange-flesh colour to establish levels of nutrients in fresh and processed products using standard methods of analysis (AOAC). Beta carotene was determined by the spectrophotometric method. Sweetpotato varieties were subjected to pre-treatments including blanching and boiling. Results of the baseline survey indicated that there was limited knowledge regarding nutritional excellence and blanching of orange fleshed sweetpotato. Michembe (fresh dried) was more preferred than matobolwa (boiled and then dried) sweetpotato. Fresh samples of sweetpotatoes had significantly low proximate composition (protein, fat, fiber and carbohydrate) compared to dried samples due to the fact that during drying food loses a significant amount of moisture resulting into concentrating other nutrients. There was a three-fold reduction in β-carotene content when fresh samples were dried. Boiled chips had more retention of beta carotene content compared to blanched chips. Results further showed that michembe had significantly low β-carotene content and low retention on storage compared to boiled and blanched chips after six months storage at room temperature. It is therefore recommended that blanching be introduced to rural communities during processing of orange fleshed sweetpotatoes to protect nutrients loss. Education on processing and nutritional excellence of orange fleshed sweetpotatoes should also be provided so as to reduce incidences of community malnutrition in and Tanzania .

Key words: Blanched solar dried chips, Matobolwa, Michembe, nutritional value, β-carotene

Résumé

Les communautés rurales de la Tanzanie souffrent de plus en plus de pénurie alimentaire et de malnutrition. Une enquête a été menée dans des ménages afin de déterminer la situation de référence dans le district de Maswa concernant la production, le traitement et le stockage de tubercules de patate douce écharnée d'orange et de feuilles de niébé. Des analyses chimiques ont été effectuées sur quatre variétés de patate douce (Jewel, Karotidar, Kabode et Ejumula) possédant différentes intensités de couleur chair d'orange pour établir les niveaux de nutriments dans les produits frais et transformés en utilisant des méthodes d'analyse standards. Le bêta-carotène a été déterminé par la méthode spectrophotométrique. Les variétés de patates douces ont été soumises à des traitements préalables, y compris le blanchissement et l'ébullition. Les résultats de l'enquête de référence ont indiqué qu'il y avait des connaissances limitées concernant l'excellence nutritionnelle et le blanchissement des patates douces à chair orange la variété. Michembe était plus préféré que la patate douce de matobolwa séchée. Les échantillons frais de patates douces présentaient une composition immédiate significativement faible (protéines, graisses, fibres et glucides) comparativement aux échantillons secs, du fait que pendant le séchage, les aliments perdent une quantité importante d'humidité résultant de la concentration d'autres nutriments. Il y a eu une réduction de trois fois de la teneur en β-carotène lorsque les échantillons frais ont été séchés. Les patates bouillis présentaient plus de retenue de la teneur en bêta-carotène par rapport aux patates blanchies. Les résultats ont en outre montré que michembe avait une teneur en ß-carotène significativement faible et une faible rétention lors du stockage par rapport aux patates bouillies et blanchies après six mois de conservation à la température ambiante. Par conséquent, le blanchissement devrait être introduit dans les communautés rurales lors de la transformation des patates douces à chair orange afin de protéger la perte de nutriments. L'éducation sur la transformation et l'excellence nutritionnelle des patates douces à chair orange devrait également être fournie afin de réduire les incidences de la malnutrition communautaire dans le district de Maswa et en Tanzanie en général.

Mots clés: Copeaux séchés et blanchis, Matobolwa, Michembe, valeur nutritive, patates douces à chair orange

---

Background

Sweetpotato (*Ipomoea batatas* (L.) Lam.) is a very important crop in developing world. In Tanzania, sweetpotato is a major staple food and income source in several regions of the country, and elsewhere in East Africa (Ndunguru, 2003). It is one of the most important food security crops, especially in those regions prone to drought and with poor soils, like Shinyanga and Kagera in Tanzania (FAO, 2004). Sweetpotato roots are bulky and perishable unless cured. Sweetpotatoes are mainly boiled or roasted This limits the distance over which sweetpotato can be transported economically (FAO, 1990). Moreover, production is highly seasonal in most countries, leading to marked variation in the quantity and quality of tubers in markets and associated price swings (Oke and Workneh, 2013). Very little attempt has been done to preserve the crop into flour or crisps (Ndunguru, 2003).

Food preservation has been practiced in many parts of the world for thousands of years. Methods of preservation include: canning, freezing, pickling, curing (smoking or salting), and drying. Food spoilage can either be microbial, chemical or of enzymatic origin and in some cases physical contaminants such as insects, stones, and chaff among others can be a deterrent. Preservation by drying is based on moisture removal to inhibit microbial, chemical and enzymatic activity. (Babagana *et al.,* 2012). Drying of agricultural products is an essential process in their preservation, which normally provides longer shelf-lighter weight for easy transportation and small space for storage. This food preservation technique can reduce wastage of harvest surplus, allow storage to combat food shortages and in some cases, facilitate export to high-value markets (Matthew and Schwarz, 2001).

Direct sun drying has been practiced since ancient times and it is still being practiced widely in developing countries (Dhote and Thombre, 2012). Although this method of drying is cheap, it is associated with problems like contamination by foreign materials, dirt, dust and wind blown debris and insect infestation as well as uneven drying. During rainy seasons, the food cannot be dried to desired safe storage moisture and also may get wet. The poor quality of the dried product cannot be accepted in the world market (Nahar, 2009). Mechanical results into decreased drying time because the hot air is trapped inside the drying cabinet. There is possibility to preheat air before it enters the cabinet, allows better circulation of dry, hot air around the products. Mechanical driers have higher dryihg efficiency due to decreased drying time and higher capacity (Sharma *et al.,* 2009; Strøm, 2011). The hygienic conditions are much better, since the system is closed. The fast drying time decreases microbial growth and production of toxic compounds from bacteria and fungi. Degradation of nutrients sensitive to light and high temperature is lower, because of shorter time of heat and light exposure, and no direct sunlight. (Sharma *et al.,* 2009; Strøm, 2011).

Mechanical dryers usually run by fossil fuel or electricity. Mechanical dryers exist in three types namely natural, forced convection and mixed mode types (Nahar, 2009). However, in many rural areas, electricity is either not available or too expensive for drying of vegetables (Nahar, 2009). Solar drying, which taps on the freely available sun energy, can be utilized while ensuring good product quality via judicious control of the radiative heat (Akarslan, 2012). Therefore, solar dryers can become good substitutes for direct sun drying and mechanical dryers. The objective of this study was to obtain baseline information and the nutrient content of fresh and dried orange fleshed sweet potato varieties in Maswa District, Tanzania.

Study description

The study was conducted in Maswa District which is amoung five districts in Simiyu region in Tanzania. Main food crops grown in the area include maize, paddy rice, sweetpotato, cowpeas and millet and the main cash crops are cotton and paddy rice. The study started with a baseline survey to access use of fresh and dried sweetpotato. Subsquently, four varieties of orange fleshed sweetpotato (Kabode, Jewel, Ejumula and Karoti dar) which are widely grown in Maswa were used in the laboratory study. The harvested potato roots were collected from Ukiliguru Research Centre in Mwanza. The drying process was done to prepare blanched chips, Matobolwa (Boiled then dried) and michembe (fresh dried) chips of sweetpotatoes. Both dried and fresh samples were subjected to beta carotene and proximate analysis at Sokoine University of Agriculture (SUA), laboratory .

Results

Baseline survey results showed that both local and improved sweetpotatoes are dried for future use as food. The main dried products produced were michembe (fresh dried) and matobolwa (boiled dried). Michembe are shelf stable for 3-5 months while matobolwa are shelf stable for more than a year. In some cases, insecticides are used to preserve michembe to prolong shelf-life. The respondents were not aware of the nutritional benefits of orange fleshed sweetpotatoes and blanching procedures were not known.

The varieties studied varied significantly between both fresh and dried samples in terms of protein, fat, fiber, ash and beta carotene content (Table 1 and Fig. 1). After drying boiled samples (matobolwa) were observed to have higher beta carotene levels than michembe and blanched chips. Matobolwa and blanched solar dried chips retained more β- carotene than michembe. However, michembe started getting infested with insects after four months of storage. Blanched solar dried chips and matobolwa were not infested even at six months of storage at room temperature.

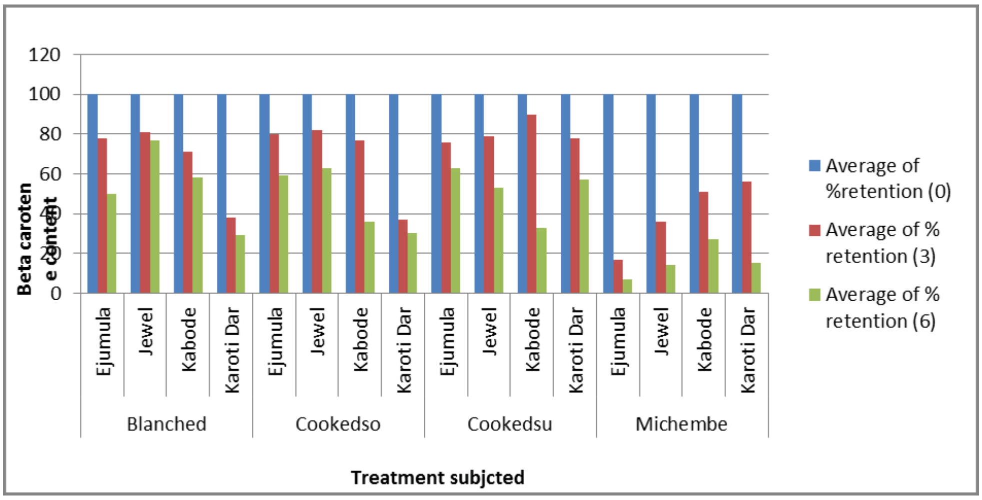

Figure 1. Percentage beta carotene retention after six month storage

Table 1. Proximate results of fresh, balanaced and solar dried sweet potatoes

Variety/ Treatment	Moisture (%)	Fat (%)	Fibre (%)	Protein (%)	Ash (%)	CHO (%)
Jewel						
Fresh	70.37±0.17^{d}	1.67± 0.08^{d}	3.6±0.08^{a}	1.87 ±0.08^{a}	4.18±0.07^{d}	18.31±0.07^{a}
Blanched solar dried	12.1±0.45c	0.98±0.08^{ab}	4.65±0.05^{c}	6.78±0.52^{b}	2.56±0.05^{b}	72.93±0.58^{b}
Matobolwa solar dried	11.32±0.16^{b}	1.004±0.12^{bc}	5.53±0.19^{d}	6.96±0.73^{b}	2.12±0.19^{a}	73.07±0.44^{b}
Matobolwa sun dried	10.70±0.21^{b}	0.82±0 .001^{a}	6.07±0.20^{e}	5.76±0.84^{b}	1.95±0.07^{a}	74.69±0.58^{c}
Michembe	9.29±0.33^{a}	1.18±0.02^{c}	4.01±0.01^{b}	5.88±0.26^{b}	3.26±0.22^{c}	76.39±0.38^{d}
Karoti dar						
Fresh	65.06±0.15^{d}	1.6±0.07^{c}	3.25±0.01^{a}	2.7±0.41^{a}	3.54±0.12^{c}	23.81±0.37^{a}
Blanched solar dried	11.78±0.20^{c}	0.56±0.01^{a}	3.22±0.02a	5.08±0.69^{b}	2.52±0.11^{ab}	76.84±0.61^{b}
Matobolwa solar dried	10.90±0.38^{b}	0.78±0.06^{ab}	4.27±0.24^{c}	5.65±0.16^{bc}	2.53±0.13^{ab}	75.86±0.3^{b}
Matobolwa sun dried	10.40±0.16^{b}	1.05±0.16^{b}	3.74±0.11^{b}	6.24± 0.33^{b}	2.29±0.03^{a}	76.27±0.36^{b}
Michembe	6.23±0.09^{a}	1.83±0.18^{c}	3.33±0.13^{a}	6.88±0.44^{cd}	2.58±0.08^{b}	79.15±0.42^{c}
Kabode						
Fresh	65.39±0.10^{d}	1.14±0.02^{a}	2.98±0.05^{a}	2.2± 0.05^{a}	3.54± 0.11^{c}	24.80±0.11^{a}
Blanched solar dried	9.64± 0.23^{c}	1.92± 0.02^{b}	4.66±0.09^{c}	9.29± 0.88^{d}	2.13±0.07^{a}	72.36±0.85^{b}
Matobolwa solar dried	8.33 ±0.04^{ab}	1.93± 0.07^{b}	4.76±0.0^{4c}	8.01±0.31^{c}	2.02± 0.09^{a}	74.94±0.33^{c}
Matobolwa sun dried	8.84± 0.24^{b}	1.73±0.03^{b}	4.12±0.18^{b}	7.58±0.47^{c}	2.10±0.10^{a}	75.62±0.29^{c}
Michembe	8.10± 0.32^{a}	1.61± 0.28^{b}	3.19±0.18^{a}	5.48± 0.06^{b}	3.23± 0.02^{b}	78.39±0.50^{d}
Ejumula						
Fresh	64.53±0.32^{c}	1.11±0.06^{a}	3.41±0.02^{a}	2.09±0.05^{a}	2.77±0.01^{d}	26.08±0.04^{a}
Blanched solar dried	10.73±1.38a^{b}	1.48±0.31^{a}	4.39±0.13^{c}	5.37±0.22^{b}	2.42±0.03^{b}	75.61±0.34^{c}
Matobolwa solar dried	12.01±2.17^{b}	1.40± 0.28^{a}	4.74±0.25^{d}	6.94±0.27^{c}	2.13± 0.04^{a}	72.79±0.65^{b}
Matobolwa solar dried	10.37±1.49^{ab}	1.82± 0.47^{a}	4.82±0.04^{d}	5.96±1.02^{bc}	2.20±0.03^{a}	74.84±1.47^{bc}
Michembe	6.99±1.97^{a}	1.26± 0.03^{a}	3.77±0.03^{b}	4.89±0.49^{b}	2.69±0.02^{c}	80.33±0.53^{d}

Values are means ± SD. Means in the same column bearing different superscripts are significantly different ($p<0.05$).

Table 2. Beta carotene content of fresh and solar dried orange fleshed sweet potato varieties in mg/100g

Variety/ Treatment	Jewel	Karoti Dar	Kabode	Ejumula
Fresh	73.92±5.84^{d} (100)	32.11±0.52^{c} (100)	24.21±1.52^{b}(100)	31.35±0.07^{d} (100)
Blanched solar dried	52.38±0.51^{b} (71)	19.77±0.06^{b} (62)	22.37± 0.01^{b} (92	21.02 ±0.08b (67)
Matobolwa solar dried	59.77±0.04^{c} (81)	19.20±0.04^{b} (60)	28.03±0.68^{c} (116)	31.51±0.47^{d} (101)
Matobolwa solar dried	59.60±0.05^{c} (81)	18.42± 0.55^{b} (57)	23.09± 0.64^{b} (95)	28.69±0.69^{c} (92)
Michembe	39.88±0.99^{a} (54)	14.78± 1.58^{a} (46)	8.21 ±0.52^{a} (34)	18.07±0.75^{a} (58)

Values are means ± SD. Means in the same column bearing different superscripts are significantly different ($p<0.05$). Values in brackets are percentage retentions.

Discussion

The moisture content of varieties studied showed positive relationship with the flesh colour. The higher the moisture content, the higher the β-carotene content (Jones, 1977; Vimala *et al*., 2011). As expected dried samples had significant higher value due to the fact that during drying food loses a significant amount of moisture nutrient content resulting into concentrating other nutrients (protein, fat, fiber and ash content). Based on these preliminary results it is recommended that senstization activities be undertaken to promote cultivation of orange fleshed sweetpotato varieties and to promote post-harvest processing to improve shelf -life and nutrient concentration.

Aknowledgement

We thank iAGRI, RUFORUM and USAID for funding this study. This paper is a contribution to the 2016 Fifth African Higher Education Week and RUFORUM Biennial Conference.

References

Akarslan, F. 2012. Solar-energy drying Systems, Modeling and Optimization of Renewable Energy (ed) Arzu Şenca, INTECH, Open Access Publisher.

Babagana, G., Silas, K. and Ahmed, M. M. 2012, Solar dryer - an effective tool for agricultural products preservation, *Journal of Applied Technology in Environmental Sanitation* 2 (1): 31-38.

Dhote, C. Y. and Thombre, S. B. 2012. Parametric study on the thermal performance of the solar air heater with energy storage, *International Journal of Mechanical Engineering and Technology* 3 (1): 90-99.

Food and Agriculture Organization (FAO). 1990. Roots Tubers, Plantains and Bananas in Human Nutrition. Rome: FAO.

Food and Agriculture Organization (FAO). 2004. Food and Agriculture Organization Statistics. Rome: FAO.

Jones, A. 1977. Heritability of seven sweetpotato root traits. *Journal American Society for Horticultural Science* 102:440–442.

Matthew, G. G. and Schwarz, D. 2001. Solar drying technology for food preservation. Germany: GTZ-GATE Eschborn.

Nahar, N. M. 2009. Processing of vegetables in a solar dryer in arid areas Central Arid Zone Research Institute, International Solar Food Processing Conference, Jodhpur, India: Central Arid Zone Research Institute.

Ndunguru, G. T. 2003. Handling of sweetpotato during marketing. In: Cassava and Sweetpotato after Harvesting. Proceedings of a Workshop held at the Lake Zone Agricultural Research and Development Institute, Ukiriguru, Mwanza, Tanzania, 2002.

Oke, M. O. and Workneh, T. S. 2013. A review on sweet potato postharvest processing and preservation technology, *African Journal of Agricultural Research* 8 (40): 4990-5003.

Rodriguez-Amaya, D. B. 2001. A Guide to Carotenoid Analysis in Foods. Washington D.C, ILSI Press.

Sharma, A., Chen, C. R. and Vu Lan, N. 2009. Solar-energy drying systems. *Renewable and Sustainable Energy Reviews* 13 (7): 1185-1210.

Strøm, K. 2011. Product quality in solar dried carrots, tomatoes and onions. MSc. Thesis, Norwegian, University of Life Science.

Vimala, B., Nambisan, B. and Hariprakash, B. 2011. Retention of carotenoids in orange-fleshed sweetpotato during processing *Journal of Food Science and Technology* 48 (4): 520–524.