AMERICAN JOURNAL OF FOOD AND NUTRITION
Print: ISSN 2157-0167, Online: ISSN 2157-1317, doi:10.5251/ajfn.2011.1.1.34.38
© 2011, ScienceHuβ, http://www.scihub.org/AJFN

Comparison of the Nutrient composition of four sweet potato varieties cultivated in Rwanda

Ingabire Marie Rose[1] and Hilda Vasanthakaalam[2]

[1]Department of Food Science & Technology, Kigali Institute of Science & Technology, BP: 3900, Kigali, Rwanda.
[2]Senior Lecturer, Department of Food Science & Technology, Kigali Institute of Science & Technology, BP: 3900, Kigali, Rwanda. hfst@kist.ac.rw, hildajeya@hotmail.com; mobile: +250 – 788530367 / + 250 - 727111028

ABSTRACT

Sweet potatoes (*Ipomea batatas*) are important nutritious staple crop in Rwanda. The aim of the study was to compare the nutritional composition of selected yellow and white sweet potato varieties cultivated in Rwanda. Two yellow varieties (Kwizekumwe, 440170) and two white varieties (Mugande and Rutambira 4-160) were used for the study. Estimation of moisture, ash, protein, crude fibre was conducted using standard AOAC procedures. Total reducing sugars and **β** carotene was determined by UV Spectrophotometric method. The study revealed that the moisture content in the sweet potato varieties was quite high and ranged between 62.58 ± 0.42 to 64.34 ± 0.42 .The crude protein (0.91 ± 0.05) and total reducing sugar (2.50 ± 0.12) content was high in Kwizekumwe and were the least in 440170 variety with 0.7 ±0.03 and 1.74 ± 0.07 respectively. However, the 440170 variety recorded the highest in crude fibre (0.14 ± 0.00) and the least was observed in Rutambira 4-160 variety (0.11 ± 0.00). Crude ash was high in Kwizekumwe (0.44±0.07) while Mugande had the least ash content (0.40±0.02). **β** carotene content was present only in the yellow varieties but was found to be high in Kwizekumwe (1.85±0.00). Thus, Kwizekumwe was found to be more nutritious when compared to the other varieties.

Keywords: *sweet potatoes; proximate analysis; reducing sugars; yellow varieties; Rwanda.*

INTRODUCTION

Sweet potatoes (*Ipomea batatas*) are an extremely important crop in many parts of the world, being cultivated in more than 100 countries. Sweet potatoes are an important food crop of the tropical and subtropical areas and therefore have nutritional advantage for the rural and urban dwellers of these regions by increase in its production and consumption (Woolfe, A. J.,1992; Ferris *et al, 2002*). They are important food crop in many countries of sub- Saharan Africa (FAO, 2000) and is a versatile crop for African farming systems. They are highly consumed in Rwanda and it is estimated that sweet potato consumption is about 130Kg / person per year (Ferris *et al,* 2002). In Africa, Uganda is the leading producer of sweet potato followed by Rwanda and Burundi. The actual per capita consumption varies between 90 - 100Kg and 100 - 300Kg in Uganda and Rwanda respectively (Ewell, P.T., 1991). They are nutritious staple crop in Rwanda and are widely consumed as boiled or fried. They are cultivated by the farmers in the region of Butare, Gikongoro, Gitarama, Kigali and Lake Kivu border of Rwanda (ATDT, 2002). The nutritional composition of the sweet potatoes cultivated in Rwanda has not been investigated. Many of the advanced materials which were at different stages of selection and investigation were lost during the 1994 genocide. The "Seed of Hope" project, PRAPACE and CIP have assisted to introduce true seeds and cuttings of sweet potato in the country. Of the 212 varieties cultivated in Rwanda, four varieties were taken for the study viz., Kwizekumwe, 440170, Mugande and Rutambira 4-160. In comparison with other tubers, sweet potatoes contain an average amount of proteins and carbohydrates mainly starch. They also contain some free sugars which give the tuber its sweet taste. Vitamin A and B are also present in significant amounts and the tubers are rich in vitamin C. Orange flesh sweet potatoes are high in carotenoids and β carotene (Jakahata *et al* ,1993). Consumption of orange flesh sweet potato roots can provide

sustainable vitamin A, which plays a major role in preventing night blindness (Ndirigue, J., 2004). The aim of the study was to compare selected nutritional content of four varieties of sweet potatoes cultivated in Rwanda.

MATERIALS AND METHODS:

Four sweet potato varieties comprising of both the yellow and white variety grown in Rwanda were taken for the study viz., Kwizekumwe, 440170, Mugande and 4160. The former two being the yellow variety while the latter two being the white variety. The proximate analysis viz., estimation of moisture, ash, protein, fat carbohydrate, fibre along with total reducing sugars and β carotene content were carried out according to the stipulated procedures laid down for analysis (AOAC,2005). All experimental procedures were carried out at JKUAT laboratory except for total reducing sugars that was carried out at ISAR laboratory.

Determination of moisture was carried out by oven method, while ash content was determined by the dry ash method in a muffle furnace while protein determination was by Kjeldahl method. Total reducing sugars and β carotene was determined by UV Spectrophotometric method, crude fibre was determined by calcination method. The results thus obtained were statistically analyzed using standard deviation.

RESULTS & DISCUSSION:

The proximate analysis, total reducing sugars and β Carotene were analyzed in the yellow and white varieties of sweet potatoes, the results of which are indicated in table 1.

Table 1: Selected nutrients in four varieties of sweet potatoes (%)*

S. No	Chemical constituents	Sweet potato varieties			
		Yellow variety		White variety	
		440170 (Mean SD)	Kwizekumwe (Mean SD)	Rutambira 4-160 (Mean SD)	Mugande (Mean SD)
1.	Moisture	64.03 ± 0.84	62.78 ± 0.70	62.58 ± 0.42	64.34±0.42
2.	Crude protein	0.71 ± 0.03	0.91 ± 0.05	0.80 ± 0.02	0.81 ± 0.09
3.	Total reducing sugars	1.74 ± 0.07	2.50 ± 0.12	1.94 ± 0.02	2.04 ± 0.01
4.	Crude fibres	0.14 ± 0.00	0.12 ± 0.01	0.11 ± 0.00	0.12 ± 0.01
5.	Crude ash	0.43 ± 0.09	0.44 ± 0.07	0.42 ± 0.07	0.40 ± 0.02
6.	β Carotene	1.68 ± 0.00	1.85 ± 0.00	-	-

*fwb - fresh weight basis

Colour and appearance: Sweet potatoes have white, yellow or orange flesh, and their thin skin may either be white, yellow, orange, red or purple. The nature, isolation and chemical structure of the different chloroplast pigments responsible for the different colours in fruits and vegetables were studied several decades ago (Schertz, F. M., 1928). Kwizekumwe and 440170 were the yellow sweet potato varieties while Mugande and Rutambira 4-160 were the white sweet potato varieties. The white colour was due to the presence of lycopene and yellow orange colour was due to the presence of **β** carotene (Dauty, 1995). Yellow sweet potatoes contain β carotene while the orange flesh sweet potatoes contain appreciable amounts of β carotene. Simon. P. W., (1997) quoted Steenbock who reported in 1991 that yellow corn (*Zea mays* L.) and "yellow" vegetables [carrots (*Daucus carota* L.) and sweet potato (*Ipomoea batatas* L.)] eliminated the symptoms of vitamin A deficiency in rats while white corn and "white" vegetables [parsnip (*Pastinoca sativa* L.), potato (*Solanum tuberosum* L.)], and beets (*Beta vulgaris* L.) did not. Yellow flesh cultivars contain higher amounts of β carotene than white types and the roots of red sweet potatoes contain anthocyanin pigment (Salunke and Kadam, 1998).

Moisture content: The moisture content in the sweet potato varieties taken for the study was quite high and ranged between 62.58 ± 0.42 to 64.34± 0.42. The differences in the moisture content among the sweet potato varieties can be attributed to the difference in the genetic composition and also the agro cultural practices. In common with other roots and tubers the sweet potato has a high moisture content resulting in relatively low dry matter content. The average dry matter content is approximately 30% but varies widely depending on factors such as

cultivar, location, climate, day length, soil pest diseases, and cultivation practices (Woolfe, A. J., 1992).

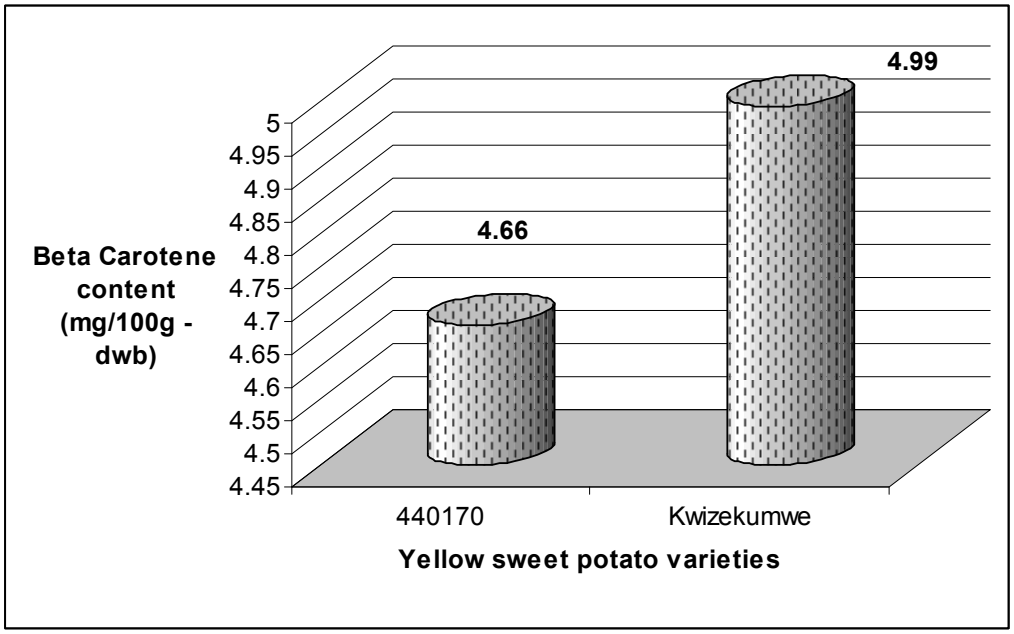
Crude protein content: The crude protein content among the selected varieties ranged between 0.71 % ± 0.03 to 0.91 % ± 0.05 irrespective of the colours of the sweet potato varieties. The crude protein content was high in the yellow Kwizekumwe (0.91 ± 0.05) while protein was least in the yellow 440170 variety with 0.7 ±0.03. Protein content in the diets of low income groups in developing countries like Rwanda is derived mostly from foods of vegetable origin. The average total protein content of sweet potato is low as 1.5% (fwb) and 5% (dwb), however it is superior to other roots and tubers such as cassava, plantains, taro and inferior to potato, yams and cereals even those cooked as porridges (Woolfe, A. J.,1992). The protein content of these tubers varied from 1.0% to 2.5 % (about 5% dwb) (Salunke and Kadam, 1998; Montreka and Benjamin, 2003). This indicated that the sweet potatoes selected for the study, cultivated in Rwanda, had lesser than 1% protein content.

Total reducing sugars: Sucrose is the most abundant sugar in raw sweet potatoes with smaller amounts of glucose and fructose (Bouwkamp, J. C., 1985). During storage of the tubers some starch were converted into reducing sugars and subsequently into sucrose (Salunke and Kadam, 1998). In the present study the total reducing sugars were found to be high in the yellow Kwizekumwe variety with 2.50 ± 0.12. While it was 1.74 % ± 0.07 in yellow 440170 variety and 1.94 ± 0.02 in white Rutambira variety and 2.04 ± 0.01in white Mugande variety. Cultivars from the South Pacific region were found to have total sugars from 0.38% to 5.64% (fwb) and from 2.9% to 5.5% (fwb) in American cultivars and the time of harvest had a significant effect on total sugar content (Woolfe, A. J., 1992). The reducing sugar content in the present study was within the ranges quoted by the above mentioned authors.

Crude fibres: Pectin, cellulose, hemicelluloses together with lignin are classified as dietary fibre (Robinson and Lawler, 1980). Dietary fibre has recently gained much importance as it is said to reduce the incidences of colon cancer, diabetes, heart disease and certain digestive diseases. In the present study, dietary fibre ranged from 0.11±0.00 in the 4160 variety to the highest (0.14 ± 0.00) in the 440170 variety. It must however be noted that Kwizekumwe and Mugande exhibited the same values of 0.12 ± 0.01. Total fibre content in eighteen varieties of sweet potatoes in Hawaii had a range of 2.01–3.87 g/100 g fresh weight (Huang A. S**.** *et al***,** 1999). Tropical fruits and vegetables contribute to dietary fibres and found to be 1.4% from cellulose, 0.4% from lignin and 0.9% from hemicellulose of the peel of sweet potatoes (Lund and Smooth, 1982). This study recorded lesser amount than the above quoted literature and therefore indicate to be a poor source of dietary fibre.

Crude ash: The ash content among the different varieties revealed that the highest content was in Kwizekumwe variety with 0.44 ± 0.07 while the lowest value of 0.40 ± 0.02 was identified in the Mugande. The other varieties Rutambira 4-160 and 440170 had 0.42 ± 0.07 and 0.43 ± 0.09 respectively. The amount of minerals furnished in 100g is small for all the minerals, with the possible exception of potassium that furnished about 11.4% or 18% of the RDA, (Huang *et al*, 1999).

β carotene content:
Fruits and vegetables contain different types (over 600) of carotenoids in different quantities (Fesco and Boudion, 2002). As discussed under colour and appearance, since Mugande and Rutambira 4-160 were the white varieties β carotene content were totally absent while Kwizekumwe and 440170 being the yellow varieties contained β carotene. The former yellow variety had a higher content of 1.85±0.00 (fwb) when compared to the 440170 variety that had 1.68 ± 0.00 (fwb). Eighteen varieties of sweet potatoes in Hawaii were found to have 13.1mg/100g (fwb) of β carotene in orange fleshed varieties. The beta-carotene content in light yellow and purple fleshed ones were in the range of 0.1–0.6 mg/100 g, fresh weight (Lund and Smooth, 1982). Since Mugande and Rutambira 4-160 were the white varieties β carotene content were totally absent while Kwizekumwe and 440170 being the yellow varieties contained β carotene. The former yellow variety had a higher content of 1.85±0.00 when compared to the 440170 variety that had 1.68 ± 0.00. The β carotene content on dry weight basis (dwb) is indicated in figure 1. There is a potential for orange fleshed sweet potatoes for raising the vitamin A intake in Africa and processing of orange flesh sweet potatoes results in 25 to 30% loss of β-carotene content (Hagenimana and Low, 1982). Carrots, sweet potatoes and leafy vegetables contain high levels of β-carotene, usually exceeding 8000 I.U. per 100g and can therefore cover the recommended daily intakes (5000 to 25000 I. U.) (Fesco and Boudion, 2002).



dwb – dry weight basis

Fig 1: β carotene content in selected yellow sweet potato varieties

CONCLUSION

Sweet potatoes (*Ipomea batatas* L) are important nutritious staple crop in Rwanda. Four varieties were used to study their nutrient composition viz., Kwizekumwe, 440170 that were the yellow variety while, Mugande and Rutambira 4-160 were the white variety. In Rwanda sweet potatoes are widely consumed by the rural poor and urban dwellers that depend on it for their livelihood. Many of the land races and scientific data were lost during the war. The aim of the study was to compare the nutritional composition of selected yellow and white sweet potato varieties cultivated in Rwanda. Standard methods and materials were used to estimate moisture, proximate components, total reducing sugars and **β** carotene. The difference in colour and appearance in the varieties selected for the study was due to the presence of pigments. Kwizekumwe, 440170 were the yellow varieties while Mugande and Rutambira 4-160 were the white varieties. The white colour was due to the presence of lycopene and yellow orange colour was due to the presence of β carotene. The moisture content in the sweet potato varieties taken for the study was quite high and ranged between 62.58 ± 0.42 to 64.34 ± 0.42. The differences in the moisture content among the sweet potato varieties can be attributed to the difference in the genetic composition and also the agro cultural practices. The sweet potatoes selected for the study, cultivated in Rwanda, had lesser than 1% protein content. The reducing sugar content in the present study (1.74 % ± 0.07 to 2.50 ± 0.12) was within the ranges quoted in the literature. Dietary fibre ranged from 0.11±0.00 to 0.14 ± 0.00 and was less compared to literature sources. The amount of minerals furnished was quite less from 0.40 ± 0.02 to 0.44 ± 0.07. Mugande and Rutambira 4-160 were the white varieties β carotene content were totally absent while Kwizekumwe and 440170 being the yellow varieties contained β carotene.

ACKNOWLEDGEMENT

The authors extend their thanks to MINEDUC, Government of Rwanda for financially supporting the project and also the institutions of ISAR, Rubona and JKUAT, Nairobi for assisting in the analysis of the nutrient composition.

REFERENCES

ATDT (2002) Agricultural Transfer of Development Technologies Project in Rwanda, 9th progress report, December 2001- March 2002, ISAR/ ATDT.

AOAC (2005) Official Method of Analysis, 16th edition Association of Official Analytical Chemist, Washington DC.

Bouwkamp, J. C., (1985). Sweet potato products: a natural resource for the tropics. CRC Press, Inc., Boca Raton, FL.

Dauthy Mircea Enachescu, (1995). Fruit and Vegetable Processing. FAO Agricultural Services Bulletin No.119. Food and Agriculture Organization of the United Nations, Rome.

Ewell, P. T., (1991). Sweet potato in the food systems of Eastern and Southern Africa. In: Proceeding of the 9th symposium of the International Society for Tropical Root Crops, 20-22 October 1991, Accra Ghana.

Fesco O. Louise and Boudion O. Wilfried (2002). Food and nutrition security for human security, International Conference on Vegetables, On the occasion of the WFS-fyl (World Food Summit - five years later), convened in Rome on 11-13 June 2002

Hagenimana Vital and Jan Low, (2000). Potential of orange-fleshed sweet potatoes for raising vitamin A intake in Africa. Food and Nutrition Bulletin. The United Nations University. 21(4): 414 – 418.

Huang, A. S., Tanudjaja, L. and Lum, D (1999). Content of Alpha-, Beta-Carotene, and Dietary Fibre in 18 Sweet potato Varieties Grown in Hawaii. Journal of Food Composition and Analysis. 12 (2):147-151.

Jakahata, Y., Noda, T., and Nagata, T (1993). HPLC determination of β carotene content in sweet potato cultivars and its relationship with colour value. Japan Jrl of Breed. 43: 421-427

Lund D. Eric and John M. Smoot, (1982). Dietary Fibre Content of Some Tropical Fruits and Vegetables. J. Agric. Food Chem. 30: 1123-1127.

Mircea Enachescu Dauthy (1995). Fruit and Vegetable Processing. FAO Agricultural Services Bulletin No.119, Food and Agriculture Organization of the United Nations, Rome.

Montreka Y.Dansby and Adelia C. Bovell-Benjamin (2003). Production and Proximate Composition of hydroponic sweet potato flour during extended storage. Journal of Food Processing and Preservation. 27(2)153–164.

Ndirigue, J., (2004). Adaptability and acceptability of orange and yellow fleshed sweet potato genotypes in Rwanda BSc (Agri) Hons IFA Yagambi, DRC.

Robinson C. H, and Lawler, M., (1980). Normal and therapeutic Nutrition. Macmillan Co Ltd., New York.

Salunkhe and Kadam (1998). Handbook of Vegetable Science & Technology. CRC Press, New York, USA.

Schertz, F. M., (1928). The chloroplast pigments, their functions, and the probable relation of the chlorophyll to the vitamins. The Quarterly Review of Biology. December 3 (4): 459 to 485

Simon W. Phillip (1997). Plant Pigments for Colour and Nutrition. HortScience. 32(1) : 12 – 13

Woolfe A Jennifer (1992). Sweet Potato: An Untapped Food Resource, Cambridge University Press. UK