AFRICAN JOURNAL OF APPLIED RESEARCH (AJAR)
www.ajaronline.com Vol.2, No.2 (Pages 1-5) ISSN 2408-7920 (October 2015)

EFFECT OF HARVESTING PERIOD ON THE SUGAR CONTENTS OF TRIFOLIATE YAM FLOUR

[1]Abiodun, O. A., [2]Akinoso, R., [3]Oladapo, A. S. and [4]Odedeji, J. O.

[1,3&4] Department of Food Science and Technology, Osun State Polytechnic, P.M.B. 301 Iree, Osun State, Nigeria.
[2]Department of Food Technology, University of Ibadan, Oyo State, Nigeria.
funmiabiodun2003@yahoo.com

ABSTRACT
Trifoliate yam is one of the under-exploited yam species cultivated in Nigeria. Utilization of the tuber is limited due to the hardening process which occurs few hours after harvesting. The tubers are kept in the soil after maturity until they are needed as food. Sugar concentration is one of the major parameter that affects the textural quality of food. Therefore, this work studied the effect of harvesting period on the sugar contents of trifoliate yam flour. Trifoliate yam tubers (white and yellow cultivars) were harvested at seven, eight, nine, ten and eleven months after planting. The tubers were made into flours and subjected to sugar analysis. Sucrose, fructose and glucose were the major sugars in the two trifoliate yam cultivars. Highest value (1071.65 mg/100g) of sucrose was at 9 month in the white cultivar while the highest level in the yellow cultivar was at 10 months (983.12 mg/100g). The highest total sugar level was at 11 months (1377.49 mg/100g) in white cultivar and the least value in yellow cultivar at 7 months (1042.86 mg/100g). Total sugar levels in both cultivars increased with harvesting periods. The flour produced at different harvesting periods had variations in sugar concentration as this provides information on the usefulness of the flour for household and industrial use.

Keywords: Cultivars, Harvesting periods, Sucrose, Sugar, Trifoliate yam flour

INTRODUCTION

Yam (*Dioscorea*spp.) is an important source of calories for many people in West Africa and the two economically important species are *D. cayenensis-rotundata* and *D. alata* (Doumbia, 1998; Konan *et al.*, 2014). It constitutes a major staple food for the majority of inhabitants of Nigeria (Liberty *et al.*, 2013). Yam is starchy and contains low amounts of proteins, fat and ash, ranging between 3.0-11.0%, 0.05-2.5% and 3.0-9.0% respectively (Tortoe*et al.*, 2014). Yam flour production enhances the utilization and storability of yam (Badmus*et al.*, 2012).They can be processed into flours for porridge, *fufu,* pastries and bread etc (Glover-Amengor*et al*., 2013). It has potential for livestock feed and industrial starch manufacture (Liberty *et al.*, 2013).

Yam species have been found to contain rhamnose, galactose, arabinose and xylose. The sugars most commonly found are maltose, glucose, fructose and sucrose, in increasing order of importance (Ketiku and Oyenuga, 1973). Moreover, the amount has been found to develop differently with age of each species. Other carbohydrate-related components, like heterosides, have a direct major effect on the food (value) either in the taste or colour of the flesh (Degras, 1993). The content of sugars in the yam tuber is influenced by variety, age, location and cultural treatment (Ketiku and Oyenuga, 1973; Osagie, 1992). A few varieties of *D. alata* were indicated to get slightly sweetened with storage as starches are broken down. Pentose sugars were also identified in *D. alata and D. rotundata* tubers at the end of the dormant period (Degras, 1993). Trifoliate yam (*Dioscoreadumetorum)* is cultivated in West Africa, mainly Southern and Eastern Nigeria (Ogbuagu, 2008). The tubers are eaten during the time of famine or scarcity and are usually boiled with peel and eaten as boiled yam. Postharvest hardening limits their production

and commercialization outside production zones, thereby hampering their economic and nutritious value as food (Afoakwa and Sefa-Dedeh, 2001). The tubers are not harvested like other yam species but are left in the soil and harvested when needed for food. Therefore, this work determined the effect of harvesting periods on the sugar contents of trifoliate yam flour.

RESEARCH METHODS

Materials

Trifoliate yam (white and yellow cultivars) tubers were harvested monthly on a farm at Osogbo, Osun State, Nigeria.

Methods

Preparation of trifoliate yam flour

The freshly harvested yam tuber was washed, drained and peeled. The peeled tuber was sliced and dried in the hot air oven at 60^{o} C for 48 hrs. The dried chips were milled into flour with hammer mill and sieved with 600µm sieve size. The flour samples were sealed in polythene bag.

Sugar Profile Determination

Fifty milligram of sample was extracted by ethanol. The ethanol-extracted sample was dried overnight at 8^{o} C and then re-suspended in a 50 mm sodium acetate buffer (pH = 5.2). Starch in the sample was then digested to glucose by incubating the pellets for 12h at 57^{o} C with 400 units/ml a-amylase and 2 units/ml amyloglucosidase in 50 mm sodium acetate buffer. After centrifugation at 4,000× g for 5 min., triplicate aliquots of 200 ml of supernatant from each sample was brought to a final volume of 1 ml and was quantified with glucose Trinder reagent (Sigma Chemical Co.). Qualitative analysis of ethanol-extracted sugars was accomplished by methods described by Ashworth *et al.* (1993). Ethanol was evaporated from 0.5 ml extract of each sample. Sugars were re-dissolved in 1 ml deionized water and filtered through a 0.45-µm nylon membrane and were separated into their component peaks by injecting 25 µl each sample into the gas chromatography equipment.

RESULTS AND DISCUSSION

Effect of harvesting period on the sugar contents of trifoliate yam flour

Table 1: Effect of harvesting periods on the sugar contents (mg/100g) of white trifoliate yam flour

Harvesting periods	Sucrose	Glucose	Fructose
7	1062.05±0.12	106.15±0.22	114.17±0.15
8	1069.12±0.37	111.29±0.27	114.33±0.17
9	1071.65±0.24	118.36±0.17	125.24±0.23
10	1070.88±0.20	133.65±0.11	146.66±0.36
11	1068.4±0.19	150.99±0.32	158.10±0.20

Table 2: Effect of harvesting periods on the sugar contents (mg/100g) of yellow trifoliate yam flour

Harvesting periods	Sucrose	Glucose	Fructose
7	840.71±0.19	91.77±0.19	110.38±0.13
8	901.66±0.20	91.86±0.21	113.71±0.10
9	966.10±0.27	97.01±0.10	120.62±0.18
10	983.12±0.15	101.94±0.14	127.29±0.25
11	956.36±0.11	126.53±0.28	141.35±0.18

Table 3: Effect of harvesting periods on the total sugar contents (mg/100g) of trifoliate yam flour

Harvesting periods	White	Yellow
7	1292.42±0.20	1042.86±0.11
8	1295.73±0.15	1108.37±0.18
9	1314.60±0.17	1185.31±0.14
10	1354.59±0.11	1214.35±0.17
11	1377.51±0.10	1226.36±0.12

The sugar profiles of trifoliate yam flours are presented in Table 1-3. The major sugar in the yam was sucrose, fructose and glucose in decreasing order. Sucrose had the highest value at 9 month (1071.65 mg/100g) in the white cultivar while the highest level in the yellow cultivar was at 10 months (983.12 mg/100g). The sucrose value decreased slightly till 11 months while the fructose and glucose increased with harvesting periods in both cultivars. The sugar level in white cultivar was greater than yellow cultivar and it increased with harvesting periods. This report agrees with the observation of Degras (1993) that sucrose was the major sugar in yam. Hariprakash and Nambisan (1996) reported the presence of free sugars which consist mainly of sucrose and glucose, with the former predominating in yam. Likewise, fructose and maltose have been detected during dormancy/sprouting periods. The sugar content is influenced by variety, location and cultural treatment.

The total sugars in white trifoliate yam flour at different harvesting periods were higher than the yellow cultivar. The highest sugar level was at 11 months (1377.49 mg/100g) in white cultivar and the least value in yellow cultivar at 7 months (1042.86 mg/100g). The total sugar levels in both cultivars increased with harvesting periods. Total sugars of bulbils of *Dioscoreabulbifera* cultivars was reported to increase during the growth time and ranged from 211 to 455 mg/100g (Libra *et al*., 2011). Increase in the sugar contents with harvesting periods may be as a result of the sprouting which caused hydrolysis of starch and conversion of sucrose into smaller molecules. Afoakwa and Sefa-Dedeh (2002) reported increase in the levels of sugars and cell wall polysaccharides constituents and increases in texture during storage of trifoliate yam tubers, with substantial decreases in moisture and starch contents. High sugar concentrations decrease the rate of starch gelatinization, the peak viscosity and gel strength. Sugars decrease gel strength by exerting a plasticizing action and interfering with the formation of junction zones (Roy and James, 1985).

CONCLUSION

White trifoliate yam flour had higher sugar contents than the yellow cultivar. The sugar contents increased with harvesting periods. Sucrose, glucose and fructose were the major sugars in the trifoliate yam. Reduction in the sucrose content of the yam was noticed at 10 months while there were slight increases in the fructose and glucose contents of the yam. This showed that sugar contents depend on the time of harvesting. Harvesting at the early stage (7-8 months) will produce flour with low sugar contents which may have insignificant effect on the textural qualities of the yam flour.

REFERENCES

Afoakwa, E.O. and Sefa-Dedeh, S. (2001). Chemical Composition and Quality Changes Occurring in *Dioscoreadumetorum*pax Tubers after Harvest. *Food Chemistry* 75(1): 85-91

Afoakwa, E.O. and Sefa-Dedeh, S. (2002). Changes in Rheological Properties and Amylase Activities of Trifoliate Yam, *Dioscoreadumetorum*, Starch after Harvest. *Food Chemistry* 77(3): 285-291

Ashworth, E. N., et al (1993). Seasonal Variation in Soluble Sugars and Starch Within Woody Stems of *Cornussericeal*. *Tree Physiology* 13:379–388.

Badmus A.A., Akinoso R. and Abdulganiy O.R. (2012). Optimization of Yam Milling-A Response Surface Approach. *Advance Journal of Food Science and Technology* 4(4): 189-194.

Degras, L. (1993). The Yam. *A Tropical Root Crop*. 2nd edition. Macmillan Press, London. Pp 121-138.

Doumbia, S. (1998).Quelques Aspects Actuels de la Commercialisation de L'igname en Côte d'Ivoire. In L'igname, Planteséculaireet Culture d'Avenir. Actes du Séminaire International (J. Berthaud, N. Bricas and J.-L.Marchand, Eds.) pp. 285-290, Montpellier, France.

Glover-Amengor M, Quansah J., and Peget F.M. (2013). Performance and Acceptability of Legume-Fortified Yam Flours. *Food Science and Quality Management,* 17: 14-18

Hariprakash C. S. and B. Nambisan (1996). Carbohydrate Metabolism during Dormancy and Sprouting in Yam (Dioscorea) Tubers: Changes in Carbohydrate Constituents in Yam (Dioscorea) Tubers During Dormancy and Sprouting. *Journal of Agricultural and Food Chemistry*, 44: 3066-3069.

Ketiku, A.O. and Oyenuga, V.A. (1973). Changes in the Carbohydrate Constituents of Yam Tuber (*Dioscorearotundata)* During Growth. J*ournal of Science of Food and Agriculture* 24.4: 367-373.

Konan, A.G., Brunnschweiler-Beez, J., Nuessli-Guth, J., Escher, F. and Conde-Petit, B.(2014). Texture and Microstructure Characterization of Pastes Reconstituted from Drum-dried Flakes of Yam (*Dioscorea*Spp.). *European Scientific Journal,* 10 (3): 558-570

Liberty, J.T., Odo, C.E. and Ngabea, S.A. (2013). Performance Evaluation of a Small-Medium Scale Yam Chips Dryer. *International Journal of Inventive Engineering and Sciences,* 1(7): 1-4

Libra, M.A., Gonnety, J.T.,Ahi, A.P., Dabonne, S., Ahipo, E.D., and Kouame, L.P. (2011).Physicochemical changes in bulbils of two cultivars of *Dioscoreabulbifera*during the ripening period. *Advance Journal of Food Science and Technology* 3(5): 327-331.

Ogbuagu, M. N. (2008). Nutritive and Anti-Nutritive Composition of the Wild (Inedible) Species of *Dioscoreabulbifera* (Potato yam) and *Dioscoreadumentorum* (Bitter yam). *Pacific Journal of Science and Technology*. 9(1):203-207.

Osagie, A.U. (1992). The Yam Tuber in Storage. An Up-to-date Review of the Biochemical Composition and Storage of Yam tuber. Postharvest Research Unit. Department of Biochemistry, University of Benin, Nigeria, p 247.

Osunde Z. D. (2008). Minimizing Postharvest Losses in Yam(*Dioscorea spp.*): Treatments and Techniques. Food Science and Technology to Improve Nutrition and Promote National Development, Robertson, G.L. and Lupien, J.R. (Eds), International Union of Food Science and Technology Pp 1-12

Roy, L.W. and James, R.D. (1985). Carbohydrate. In: Fennema , O. (ed) Food Chemistry. (2^{nd}ed.) Marcel Dekker, New York. P 80.

Tortoe, C., Akonor, P.T., Nketia, S., Owusu, M., Glover-Amengor, M., Hagan, L. and Padi, A. (2014). Assessing the Sensory Characteristics and Consumer Preferences of Yam-Cowpea-Soybean Porridge in the Accra Metropolitan Area. *InternationalJournal of Nutrition and Food Sciences,* 3(2): 127-132