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PHYSICO-CHEMICAL PROPERTIES OF NIGERIAN TYPED AFRICAN STAR APPLE FRUIT.

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ABSTRACT

In this research work, some physcio-chemical properties of African Star Apple (Chrysophyllum albidun) grown mostly in low land tropical rain forest of Southern Nigeria and also in compounds and outlaying farms in most villages, in parts of South-Western Nigeria. The chemical properties were total soluble solids, 23%; pH 3.40; total solids, 29.5%, Ascorbic Acids, 12mg/100g; total sugar, 8.55%; total acidity, 1.11%; and moisture, 70.50%. The average yield of the fruit was 47.74%, viscosity, 12.20cp while colour was 2.00. The physico-chemical properties of the fruit with the exception of ascorbic acid were within acceptable standard.

Keywords: ***African Star Apple, Physico-chemical properties, nutritional properties, Average yield.***

INTRODUCTION

Many fruits have been cultivated since ancient times (Waderiboldaji *et al*, 2008). There are many indigenous species of fruits such as the cherries, which originated from Anatolia. Conventional fruits such as papaya, lemon, apple, oranges, mango, pineapple, just to mention a few have been cultivated and enjoyed by the populace.

African Star Apple (*Chrysophyllum albidum*), an indigenous plant is an edible tropical fruit, which is classified as a wild plant, and belong to the family *sapotaceae*. The fruit which is known as "Agbalumo" by the Yorubas and the Igbos call it "Udara" (Keay, 1964) is seasonal and glaborous when ripe, ovoid to subglobose, pointed at the apex and up to 6cm long and 5cm in diameter. The skin or peel is orange to golden yellow when ripe and pulp within the peel may be orange, pinkish, bricked or light yellow.

The fruit grows naturally in the forest habitat of parts of Africa extending from Sierra-Leone through Guinea, Sudan to East African Countries such as Kenya, Uganda. It is distributed in all forest types (low and tropical rain forest) in Southern Nigerian and also in compounds and outlaying farms in most villages, in parts of South-Western Nigeria. The tree mostly flowers between the months of April and June and fruits between December and March.

Fruits generally are not only consumed fresh but also used to produce jam, jellies, stewed fruit, marmalade, syrup and several types of soft drinks. It is also used for medical purposes due to properties of stalk and fruits. The leaves and seed of some of these fruits and vegetables are used in pharmaceuticals. Some of the trees are also valuable for ornamentation as an ever green broadleaf plant (Islam, 2002).

Many of the tropical fruits and some other fruits have not been utilized in the area of fruit juices. Indigenous tropical fruits for example, African Star Apple (*Chrysophyllum albidum*) are often left unexploited and are allowed to waste due to their excess supply in their season. Due to this, rural producers are often forced to give produce away or let them rot away due to the fact that the fruits have very short life span after ripening. To prevent this loss, processing into other valued products to be sold in urban areas is of importance. Utilization of the glut from these fruits has received less attention until recently where research work on its suitability for other valued product was being looked into.

Many studies have been done on the physical, chemical, pomological and nutritional properties of fruits such as sweet cherry and some others (Naderiboldaja *et al*, 2008; Radicevic *et al*, 2008; Polat *et al*, 2008, Vursavas *et al*, 2005), plum (Diaz-Mula *et al*, 2008; Ertekin *et al*, 2006), wild

plum (Calisir *et al*, 2005), Malatya apricot (Akin *et al*, 2008), Cornelian Cherry (Tural *et al*, 2008; Demir and Kalyoncu, 2003; Guleryuz *et al*; 1998), Oleaster (Akbolat *et al*, 2008), pomegranate (Al-Said *et al*, 2008), hazelnut (Oliveira *et al*, 2008; Koksal *et al*, 2006; Ozdemir and Akinci, 2004), orange (Topuz *et al*, 2004) and berries (Molina *et al*, 2008; Khazaei and Mann, 2004).

The aim of this study was to determine some physical, chemical and nutritional properties of this local fruit, African Star Apple.

MATERIALS AND METHODS

1.0 **Sampling.** Fresh and mature ripe fruits of African Star Apple were obtained from a local farm at Ibadan, Oyo State.

1.1 **pH.** 10g of the samples was weighed into a clean Erlenmeyer. The pH was determined using electrode and potiometer standardized with buffer solutions of pH 9.18 and 4.01 at temperature of 25^0C.

1.2 **Mass Balance of Fruit.** The pulp, the seeds and peels of African Star Apple were weighted to determine the pulp to peel ratio and the yield of the sample. The peel, the pulp and seeds were weighed. The peel ratio was determined from the weight readings as

$$\frac{\text{Wt of fruit pulp}}{\text{Wt of peel of the sourced fruit}}$$

Yield of fruit was also calculated as

$$\frac{\text{Wt of fruit pulp}}{\text{Wt of whole fruit}} \times 100\%$$

Six different weighing were done.

1.3 **Colour/Browning Index Determination.** The colour/browning effect on samples was determined as the optical densities of the concentrated solutions. 5mls was pipette into a cuvette and measured in a spectrophotometer at 420nm and was carried in triplicates.

1.4 **Total Soluble Solids.** The Total Soluble Solids (TSS) for the juice was determined in Degree Brix using a hand Refractometer (Alago, Tokyo model Leica 10431) with a scale of 0-50 degree Brix.

1.5 **Ash Content Determination.** 10g of the samples was weighed and placed inside muffle furnace with temperature adjusted to between 525 ± 15^0C and was heated for 6hours or more to burn off all the nutrients and fibre present to obtain a white ash in hot plate. Ash Content in percentage was calculated thus (AO AC, 2005)

$$\% \text{ Ash} = \frac{\text{Ash weight}}{\text{Sample weight}} \times 100$$

1.6 **Viscosity.** 100ml of the sample was put in a Baroid Rheometer and rotated for about 15-20 seconds. The reading was taken at 600 and 300 revolutions per minute. The plastic viscosity was obtained from the difference between the figures obtained at 600 and 300 revolutions per minute.

1.7 **Moisture Content (%).** A.O.A.C method of 1975 was used with slight modification. 5-7g of the sample was weighed in duplicate into the cans to be used for drying. The samples were then dried at a temperature of about 76^0C for 6hours. The samples were re-weighed at every 2-hour interval until constant weights were obtained. The losses in weight were consequently reported as moisture content loss. The dried samples were cooled in a desiccator to prevent moisture uptake.

$$\% \text{ MC} = \frac{\text{Moisture Content}}{\text{Original mass of Sample}} \times 100\%$$

1.8 **Total Titratable Acidity (% TTA).** Titratable acidity of the sample was determined by titrating 10ml of the extract with 0.1N Na0H with slight modification. 1ml of the sample was diluted into 100ml volumetric flask and one drop of 1% phenolphthalein was added and shaked properly to give a pink colour. The result was expressed as percentage citric acid and calculated using the formula.

$$\% \text{ TTA} = \frac{\text{Titre Value x MNa0H x Acid equivalent x DF x 10}}{\text{Volume of Aliquot taken}}$$

1.9 **Total Sugar.** The method by Wong *et al*, 2002 was adopted with slight modification. About 0.02 – 0.025g (v/w) of the sample was weighed into a centrifuge tube. The sample was prepared accordingly and read at an absorbance of 490nm wavelength on a spectrophometer. Using a prepared

glucose standard curve to estimate the concentration of total sugar in the sample, percentage total sugar was then calculated thus:

$$\% \text{ Sugar} = \frac{(A-I) \times D.F \times V \times 100}{B \times w \times 10^6}$$

RESULTS AND DISCUSSION

Table 1: Chemical Composition of African Star Apple

Parameters	African Star Apple
Moisture %	70.50
Total Solids (%)	29.50
Total Acidity (%)	1.11
Total Soluble Solids (%)	23.00
pH	3.40
Ash (%)	3.13
Maturity Index	
Brix/Acid ratio	28.79
Ascorbic Acid (mg/100g)	12.00
Total Sugars (%)	8.55

Table 2: Pulp to Peel Ratio and Yield of African Star Apple

Wt of Pulp (g)	Wt of Seeds (g)	Wt of Peel (g)	Yield(%)	Pulp to Peel Ratio
3021.59	2037.64	1056.90	49.94	2.86
3707.62	2642.99	1672.90	46.21	2.22
1162.50	771.88	404.65	49.70	2.87
765.00	559.04	310.58	46.80	2.46
2264.08	1637.03	885.53	47.30	2.56
1007.30	702.72	458.87	46.49	2.20

Average Yield (%) = 47.74

Table 3: Physical Composition of African Star Apple Juice

Parameter	Viscosity	Colour
African Star apple juice	12.20	2.00

2.0 **Nutritional Qualities of African Star Apple.** Table 1 shows some chemical composition of fresh African Star Apple. It was noticed that African Star Apple fruits contained between 20-26% soluble solids and 28-31% total solids. The difference between the total solids and total soluble solids may be due to insoluble pectin and fibers. Radicevic *et al* (2008) reported a range of 13.5% to 18.3% for nine (9) Cherry varieties of fruits in Canada. Radicevic *et al* (2001) equally reported that the best fruit quality with the highest content of soluble solids of some selected cherries had

18.33%. Pirlak and Bolat (2001) reported a range of 12.10 – 16.90%. The values obtained were lower than that recorded for African Star Apple fruit (23%). The total acidity value was 1.11, which was reflected in the taste of the fruit. Ojo (1997) and Asafa (1998) reported 15.6% and 17.2% respectively for total soluble solids of African Star Apple and 18.4% and 21.5% respectively for total solids. The sweetness level of the type of African Star Apple fruits was depicted by the values obtained for the soluble solids.

The ash content value of African Star Apple was 3.13%, which was higher than the values reported for some fruits such as that reported by Purseglove (1968) which says papaya contains about 0.6% ash. The low citric acid of "Agbalumo" (1.11) is responsible for the high pH recorded (3.40). These results agree with the previous publications that tropical fruits such as "Agbalumo", mango, plum, papaya, bush mango (*Alvinger Garbonensis)* are under- utilized. Reports have shown that these fruits possess substantial nutritive value (Okigbo, 1977; Okafor, 1983; Keshinro, 1984).

2.1 **The Pulp to Peel Ratio and Yield of the Fruit.** Table 2 shows the result of the pulp to peel ratio and yield of the African Star Apple. Six batches of fruits were used for the research work. The weight of the pulp ranged from 765g to 3, 707g while the yield was found to range from 46.21% - 49.94% with an average yield of 47.74%. Kalyoncu *et al,* 2009 reported that Sweet Cherry type grown in Konya has an average yield of 66.2% and total soluble solids of 18.33g/100g. The yield was higher than that of African Star Apple but the total soluble solids of African Star Apple was higher than that of Konya's sweet Cherry.

2.2 **Ascorbic Acid.** Ascorbic acid is one of the major nutrients (source of vitamin C) that is obtained mainly from fruits. Apart from the sweet sensation, aroma and flavour of the ripe fruits, the nutritional point of view should also be of importance to consumers. Vitamin C is highly sensitive to a lot of conditions such as heat, light, oxygen, pH. The research shows that the African Star Apple has an average value of 12mg/100g, which is lower than that of some other fruits. Taylor reported 47.6mg/100g for "Agbalumo" pulp, 48mg/100g for papaya (1987), Kennedy *et al*, 1990 reported 62mg/100g for freshly squeezed orange juice, while Lee *et al, 1*999 reported 40.6mg/100ml for Florida citrus (freshly squeezed and unpasteurized). The value obtained for this research could have been affected by factors such as the Cultivar, oxygen, soil and some other environmental factors that lead to loss of ascorbic acid.

2.3 **Physical Composition of African Star Apple.** Table 3 shows the viscosity and colour of African Star Apple used for this research work. It was noticed that samples of "Agbalumo" was stable as depicted by the colour index value read in the spectrophotometer while Viscosity value was 12.20CP.

CONCLUSION

African Star Apple, known as "Agbalumo" in the Yoruba speaking area of Nigeria is an indigenous fruits that possess the qualities required of fruits to be processed into other valued products. Although the vitamin C content was low, fortification with adequate quantity of vitamin C for large scale production will be ideal to forestall the situation of inadequate quantity of ascorbic acid, as this is the major nutrient desired in fruits. The low pH of the fruit could assist in its preservation and its large quantity during its season could be exploited for large scale production into other valued products. The perishable nature of the fruit and its large quantity during its season calls for more research on its utilization and other indigenous fruits in order to forestall its wastage and to increase the economic gains of the farmers of the produce.

REFERENCES

1. Naderiboldaji M, Khadivi Khub A, Tabatabaeefa A, Ghasemi Varmamkhasti M, Zamani Z (2008). Some Physical Properties of Sweet Cherry (*Prunus avium L.*) Fruit, American-Eurasian J. Agric Environ Sci. 3(4): 513-520.
2. Islam A. (2002). "Kiraz" Cherry laurel (*Prunus laurocerasus*) New Zealand J. Crop Horticult. Sci. 30:301- 302.
3. Radicevic S, Cerovic R. Mitrovic O, Glisic I (2008). Pomological Characteristics and biochemical fruit Composition of some Canadian Sweet Cherry Cultivars. Acta Hortic. 795(1): 283-286.
4. Radicevic S., Nikolic M., Cerovic R. (2001). Biological pomological properties of new Sweet Cherry Cultivars. Jugoslovensko Vocarstvo, 34 (3/4): 153-160.
5. Polat AA, Durgac C, Kamiloglu O. (2008). Determination of Fruit Quality Parameters of Sweet Cherries grown in high Elevation Regions in Hatay, Turkey, Acta Hortic 795(2):873-876.
6. Vursavus K, Kelebek H, Selli S. (2006). A Study on some Chemical and Physico-Mechanical Properties of three Sweet Cherry Varieties (*Prunus avium L.*) in Turkey. J. Food Eng. 74(4):568 - 575.
7. Diaz-Mula HM, Javier Zapata, P, Guillen F, Castillo S, Martinez – Romero D, Valero D, Serrano M (2008). Changes in Physico-chemical and Nutritive Parameters and Bioactive Compounds during Development and on-tree Ripening of eight plum Cultivars: a Comparative Study. J. Sci. Food Agric. 88 (14): 2499 - 2507.
8. Ertekin C, Gozlekci S, Kabas O, Sonmez S, Akinci I. (2006). Some Physical, Pomological and Nutritional Properties of two plums (*Prunus domestica L.*) Cultivars. J. Food Eng. 75(4): 508-514.
9. Calisir S, Haciseferogullari H, Ozcan M, Arslan D (2005). Some Nutritional and Technological Properties of Wild Plum (*Prunus spp*) fruits in Turkey, J. Food Eng 66:233-237.
10. Akin EB, Karabulut I, Topcu A (2008). Some Compositional Properties of Main Malatya apricot (*Prunus armeniaca L.*) Varieties. Food Chem. 107(2): 939 - 948.
11. Tural S, Koca I (2008). Physico-Chemical and Antioxidant Properties of Cornelian Cherry Fruits (*Cornus mas L.*) grow in Turkey, Scientia Horticulturae, 116(4): 362-366.
12. Demir F, Kalyoncu IH (2003). Some Nutritional, Pomological and Physical Properties of Cornelian Cherry (*Cornus mas L*) J. Food Eng. 60(3):335-341.
13. Guleryuz M, Bolat I, Pirlak L (1998). Selection of Table Cornelian Cherry (*Cornus mas L*) types in Coruh valley. Turk J. Agric Forestry, 22: 357-364.
14. Akbolat D, Ertekin C, Menges HO, Guzel E, Ekinci K (2008). Physical and Nutritional Properties of Oleaster (*Elaeagnus angustifolia L.*) growing in Turkey, Asian J. Chem. 20(3): 2358 -2366.
15. Al-Said FA, Opara LU, Al-Yahyai RA (2008). Physico-Chemical and Textural Quality attributes of Pomegranate Cultivars (*Punica granatum L.*) grown in the Sultanate of Oman J. Food Eng. 90 (1): 129-134.
16. Oliveira I. Sousa A, Morais JS, Ferreira ICFR, Bento A, Estevinho L, Pereira JA (2008). Chemical Composition and antioxidant and antimicrobial activities of three Hazenut (*Corylus avellana L.*) Cultivars, Food Chem. Toxicol. 46(5): 1801 -1807.
17. Koksal AH, Artik N, Simsek A, Gunes N (2006). Nutrient Composition of Hazenut (*Corylus avellana L.*) varieties cultivated in Turkey. Food Chem., 99(3): 509-515.
18. Ozdemir F, Akinci I (2004). Physical and nutritional properties of four major

commercial Turkish Hazenut varieties, J. Food Eng. 63(3): 341-347.

19. Topuz A, Topakci M, Canakci M, Akinci I, Ozdemur F (2004). Physical and nutritional properties of four orange varieties, J. Food Eng. 66:519-523.

20. Molina JM, Calvo D, Medina JJ, Barrau C, Romero F (2008). Fruit quality parameters of some Southern high bush blueberries (*Vaccinium xcorymbosum L.*) grown in Andalusia (Spain). Spanish J. Agric Res. 6(4): 671-676.

21. Khazaei J, Mann DD (2004). Effect of temperature and loading characteristics on mechanical and stress-relaxation properties of sea buckthorn berries, Part 1, Compression tests. Agricultural Engineering International: The CIGR J. Scientific Res. Development, Manuscript FP 03011.

22. Kalyoncu I H, Ersoy N, Yilmaz M (2009). Some Physico-chemical properties and mineral contents of sweet cherry (*Prunus avium L.*) type grown in Konya. African Journal of Biotechnology Vol. 8(12), pp. 2744-2749.

23. Keay RWJ (1964). Trees of Nigeria pg. 387-397. Clavendor Press Oxford.

24. A.O.A.C. (1975). Official Methods of Analysis. 9th ed. Pg. 875, Washington DC.

25. Asafa OM (1998). Quality Attributes and Consumer Acceptability of Regular Jam made from African Star Apple (*Chrysophyllum albidum*). M.Sc Thesis, UI, Ibadan.

26. Keshinro OO (1984). Ascorbate Values of some Unconventional Fruits. Nutrition Reports International 29:1-9.

27. Lee HS and Coates GA (1999). Vitamin C in frozen, freshly squeezed, unpasteurized, polyethylene bottled orange juice: a Storage study. J. of Food Chem. 65:165-168.

28. Kennedy JF, Rivera ZS, Lloyd LL, Warner FP, Jumel K (1990). Studies on Nonenzymatic Browning in orange juice using a model system based on freshly squeezed orange juice. J. Sci. Food Agric. 52:85-95.

29. Pirlak L, Bolat I (2001). The phenological and pomological characteristics of Sweet Cherry Cultivars under Erzurum Conditons. Ataturk Universitesi, Ziraat Fakultesi Dergisi, 32 (2):129-136.

30. Okafor JC (1983). Horticulturally promising indigenous trees and shrubs of the Nigerian Forest Zone. Acta Horticulture 123, 165-170.

31. Okigbo B (1977). Neglected Plants of Horticultural and Nutritional Importance in Traditional Farming System of Tropical Africa. Fourth African Symposium on Horticultural Crops, Kumasi, Ghana, 12-17 August, 1975 in Acta Horticultural 53:131-150.

32. Pourseglove JW (1968). Tropical Crops Dicotyledons. Longman.

33. Ojo OO (1997). Changes in Physico-Chemical and Sensory Properties of Regular and Dietetic Jam made from African Star Apple (*Chrysophyllum albidum*) during Storage. M.Sc Thesis, Dept. of Food Technology, UI, Ibadan, Nigeria.

34. Taylor OA (1987). "Preservation of Fruits and Vegetables". Paper Presentation of National Home Economics Workshop at Ahmadu Bello University, Zaria, Nigeria.