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CHEMICAL COMPOSITION AND PHYSICAL PROPERTIES OF AFRICAN STAR APPLE (*CHRYSOPHYLLUM ALBIDUM*)

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ABSTRACT

The proximate composition, mineral contents and chemical characteristics of different parts (the peel, pulp and juice) of the African star apple were determined by standard methods. Also, as a first step in developing processing for the fruits, some physical properties were studied. Result of the proximate composition showed that the juice component contained 69.9% moisture, 2.5% protein, 7.4% fat, 19.4% carbohydrate, 3.8% crude fibre, 15.6% Nitrogen free extract and 2.7% ash. The pulp and peel have higher protein contents 8.2 and 6.4%, fat contents14.3 and 12.1%, carbohydrate contents 68.2 and 64.1%, crude fibre 5.0 and 14.2%, respectively. The vitamin C of the juice was 49.4mg/100L and reducing sugar of 13.4%. The pH of juice was 3.3. The mineral contents of the fruit showed higher values in the peel than either in the pulp or juice. Mn and Fe are the main minerals in the juice and pulp. The physical characteristics of the fruits have values as follows: weight per fruit 31.1-57.1g; volume 25.0-48.0cm$^{3;}$ diameter of the base of fruit 4.2-5.2cm; height 4.3-5.2cm; surface area 58.9-72.7cm^{2}. The seed constituted 24.1-27.8% of the weight of fruit while the pulp, peel and juice 52.5-55.5%, 19.7-22.5% and 3.8-5.3%, respectively.

keywords: Chrysophyllum albidum, minerals, physical characteristics, proximate composition.

INTRODUCTION

The African star apple (agbalumo in Yoruba) is a native of many parts of tropical African. The tree grows as a wild plant and belongs to the family *Sapotaceae* (Hutchinson and Dalziel, 1963). It is an evergreen tree that can grow up to 40 meters high and about 2 meters in girth. It has a straight and long fluted bole with small buttress at the base. The bark is thin and light brown and when incised exudes a gummy latex.

The African star apple in Nigeria has a very wide geographical spread but its ideal habitat is lowland tropical rain forest. The fruits usually appear in July, ripen between December and March. The fruit contain three to five shiny seeds, which are not eaten. The fruit has been shown to have tremendous economic value by Okafor (1975) and Inoh et al. (1977) who reported that jams comparable to raspberry jams and jellies could be made from it. Its high pectin content (Inoh et al., 1977) is also suggestive of its vast medicinal benefits, which include plasma cholesterol level reduction, rate of sugar uptake as well as its detoxifying action and effectiveness in diarrhea therapy (Hulme, 1970). However,

up till now, only the juice component of the fruit is consumed to a large extent, while a few people relish the gummy, tasty pulp as well. The fruit, as is the situation with most tropical fruits, is seasonal and highly perishable. These factors militate against its large scale production. Nwadinigwe (1982), however, reported effective cold storage preservation of the fruit up to a period of 12months with 2,4 dichlorophenoxy-acetic acid. Adoption of this approach could serve as impetus for massive cultivation and large scale processing of the fruits. As a prelude to processing of the fruits, some important physical properties need to be determined. Therefore, the essence of this study was to determine the proximate composition and mineral contents of the different parts of the fruit namely the peel, pulp or (fibre) and the juice as well as the physical properties, such as the weight of the fruit, weight of the peel, juice and pulp, the characteristic surface area and the bulk density.

MATERIALS AND METHODS

Sample collection and preparation

Fresh fruit of *C. albidum* were purchased from some local markets at Ile-Ife and environs in the Southwestern state Nigeria, since the fruits vary in size from locality to locality somewhat. They were pooled together and then divided into two lots. Fresh samples of one lot were washed and then analyzed for moisture, carbohydrate, oil, protein, crude fibre, ash, reducing sugar, ascorbic acid and minerals. The second lot was used for the physical properties determination.

Chemical analyses

The chemical properties highlighted above were determined using methods of AOAC (1980). For mineral contents` determination, fresh fruit were washed, air-dried and fractionated into the peel, pulp and juice and analyzed for mineral content using atomic absorption spectrophotometry (AOAC, 1980). The phosphovanademolybdate method was used for the estimation of phosphorus (AOAC, 1980) while Potassium and Sodium were determined by flame photometry. The reducing sugars were determined after extraction with tungstic acid and estimating colorimetrically at 540nm, using dinitrosalicylic acid reagent. In determining the vitamin C, about 50ml of the juice was homogenized with 50ml of 20% trichloroacetic acid. The vitamin C was determined by titrating the extract with 2, 6-dichlorophenol Indolphenol. pH of the extracted juice was determined using pH meter (Pye Model 290) at 27^0C.

Measurement of physical properties

The shape of the fruit is ovoid with pointed apex, therefore its height in its natural resting position as well as the diameter at the base were measured with vernier calipers. The weight and the volume were determined using electronic weighing balance and water displacement method respectively. The two data were then used in evaluating the densities. The surface area was determined by first coating the surface with paint and contact printing on a light sensitive flexible paper (Oje and Ugbor, 1991). The surface edges traces on the paper were then pencil-traced on graph paper. The surface area was measured by counting the squares within the traced marks.

Statistical analysis

All experiments were done at least in du-

plicate. Data are reported as mean ± standard deviation. When appropriate, data were subjected to statistical analysis of variance (ANOVA) and means were separated using Duncan`s multiple range test (Duncan, 1955) at 5% level of significance.

RESULTS

Results of proximate chemical composition, ascorbic acid content, reducing sugar and pH of the different parts of *C albidum* are presented in Table 1. The moisture content values range from 69.9±0.09 to 57.2±0.34%. The peel showed the lowest moisture content value (57.2±0.34%) which was significantly different from those of the juice (69.9±0.09%) and pulp (69.2±0.04%). The protein content was highest in the pulp (8.2±0.61%) and least in the juice (2.5±0.22%). Just like the protein content, fat and carbohydrate contents of the different components of *C. albidum* followed similar trend with the juice showing the lowest values. Crude fibre is however highest in the peel (14.2±0.02%) and least in the juice but with no significant difference between the juice and the pulp ($p \geq 0.05$). All the three components of *C. albidum* showed almost equal amount of nitrogen free extract while the ash value was least in the juice. The ascorbic acid and reducing sugar of the juice were found to be 49.4mg/100ml and 1.34±0.12%, respectively. The juice was found to be acidic showing a pH value of 3.3.

Table 2 shows the results of mineral contents of the juice, pulp and peel. The juice was found to contain some mineral elements that were not found either in the pulp or the peel. These include Na, K, Ca and phosphorous. These elements were present in high concentrations (61.9 – 160.5mg/100g). Manganese was the major element present in the pulp and the peel in appreciable concentrations. Iron was found mainly in the juice(12.0mg/100g)and peel (13.1mg/100g). Lead was not detected in any of the components.

The results of the physical properties of the fruits are as shown in Table 3. The weight of the fruits ranged between 31.5 and 57.1g. The seed about five constituted between 24.1 and 27.8% of the fruit while the pulp, peel and juice constituted between 52.5 and 55.2%, 19.7 and 22.5% and3.8 and5.3%, respectively. The volume of the fruit was found to be between 25.0 and 48.0cm^3. The range of values of the diameter, height and surface area of the fruits were 4.2-5.2cm, 4.3-5.2cm and 58.9-72.7cm^2, respectively.

DISCUSSION

The moisture content of the juice although high is still low compared to some other tropical fruits such as orange 85%, tomato 95%, banana 75% (Bollard, 1970). The fruits ripen normally between December and March, which is dry season period in Nigeria. Moisture content of fruits varies with season (Aina, 1990). The protein content of 2.30% is low but it is in fair amount to its fat content of 9.3%. The fruit juice is a very stable milky and pinkish emulsion. The formation of such emulsion requires proportionate amounts of water, oil and an emulsifying agent such as protein, lecithin etc. The protein and carbohydrate contents of the pulp showed inverse variation and the values were higher than that of the peels. This trend agreed favorably with what is obtainable in some other fruits like breadfruits, cashew, orange, etc (Edet et

al.,1984; Fetuga et al., 1974) However, the crude fibre in the peel was much higher than in the pulp. This may be attributed to its high contents of carbohydrate. Only the juice was analyzed for ascorbic acid and reducing sugars. Result showed that the ascorbic acid contents of the *C.albidum* was high (49.4mg/100L) and comparable to some exotic fruits such as grape fruit (56mg/100L) and pawpaw (53mg/100g) and higher than many others such as sweet orange (31mg/100g), mango (34.7mg/100g and tomato (27mg/100g) (Aina, 1990; Mortensen and bullard, 1966). The sugar content (1.34%) was moderate. The low reducing sugar content of the juice indicates that most of the sugars present are polysaccharides in nature. The pH (3.3) was low and implied high acidity, a condition that is responsible for the tartness of the fruit juice.

The result of mineral analysis showed that 100g of the samples of the pulp and juice would provide more than Recommended Dietary Allowance (RDA) value for adult of Manganese (596%) and iron (137.8%) as earlier reported (Underwood, 1971; Wilson et al., 1975). The minerals were concentrated in general in the peel than in the pulp or in the juice. This observation is consistent with the report of Nwadinigwe, (1982). Also 100g of raw pulp together with the juice contained about 67.9% of the RDA value for magnesium while juice alone contained up to 32, 16.28 and 5.8% of the RDA values for Na, K and Ca, respectively. Lead was not detected but Mercury level was high. The high level of mercury will not constitute health hazard since the fruit is not consumed frequently.

Some ecological factors might be responsible for the varying figures obtained for the physical properties of *C. albidum* fruits and these include plant location, variety, stage of maturity of fruits and season. The above parameters are of great importance in the design and fabrication of processing equipment for C *albidum* fruits.

REFERENCES

Aina, J.O. 1990. Physico-chemical changes in African mango (*Irvingia gabonensis*) during normal storage ripening. Food Chemistry. 36:205-212.

AOAV 1980. Official Methods of Analysis of the Association of Official Analytical Chemists. 11th edition. P. Washington, D.C. Association of Official Analytical Chemists.

Bollard, J. 1970. Plant Biochemistry. 61 -68pp, Academic Press, New York.

Duncan, D.B. 1955. Multiple range and F-tests. Biometrics. 11: pp 1-42.

Edet, E.E., Eka, O.A., Ifon, E.T. 1984, Chemical evaluation of nutritive value of seeds of African breadfruit (*Trecula Africana)* Food Chemistry 17: 41-7

Fetuga, B., Babatunde, G., Oyenuga, V. 1974. Composition and nutritive value of cashew nut to the rat. J. Agric Food Chemistry 22:678-682

Hulme, A.C. 1970. *The Biochemistry of fruits and their product*. A.C. Hulme(ed) Academic Press, London.

Hutchinson, J., Dalziel, J. M. 1963. *Flora of West Tropical Africa*. Crown Agent for Oversea Governments and Administration, London. 278pp

Inoh, P.G. Balogh, E., Ngoddy, P.O. 1977. Agbalumo pectin extraction properties. Nigerian Institute of Food Science and Technology. Proceedings of the launching and first annual conference. Volume 5-7, pp 61-67.

Mortensen, E, Bullard, E.T. 1966. *Hand book of Tropical and Sub-tropical Horticulture Agency for Internal Dev.* Washington, D.C. pp 23-30.

Nwadinigwe, C.A. 1982. Nutritional value and mineral contents of *Chrysophyllumalbidum* fruit. *J. Sci Food Agric* 33: 283-286.

Oje, K., Ugbor, E.C. 1991. Some physical properties of oil bean seed. *Journals of Agric. Engineering Research* 50:305-313.

Okafor, J.C. 1975. The place of wild (uncultivated) fruits and vegetables in the Nigerian diet. Proceedings, recommendations and papers of first national seminars on fruit and vegetables.

Ojehomon, O.O. Town, P.A and McLean, K. (Eds) pp 153-154. Ibadan, Nigeria.

Underwood, E.J. 1971. *Trace elements in human and animal nutrition*. 574pp. Academic Press, New York.

Wilson, E.D. Fisher, K.H., Fuqua, M.E. 1975. *Principles of Nutrition*. 167pp. John Wiley & Sons Inc, New York.

Table1: Proximate composition, ascorbic acid content, reducing sugar and pH of the different parts of *C. albidum* fruit

Composition	Juice	Pulp	Peel
Moisture content, %	69.9±0.09[a]	69.2±0.04[a]	57.2±0.34[b]
Protein, %	2.5±0.22[a]	8.2±0.61[b]	6.4±0.09[c]
Fat, %	7.4±0.46[e]	14.3±0.08[d]	12.1±0.11[d]
Carbohydrate, %	19.4±0.31[c]	68.2±0.34[f]	64.1±0.61[f]
Crude fibre, %	3.8±0.04[a]	5.0±0.09[b]	14.2±0.02[c]
Nitrogen free extract, %	15.6±0.22[a]	15.3±0.07[a]	15.2±0.15[a]
Ash,%	2.7±0.03[e]	3.2±0.13[c]	5.1±0.61[d]
Ascorbic acid, mg/100ml	49.4±0.09	-	-
Reducing sugar, %	1.34±0.12	-	-
pH	3.3	-	-

Values are means of triplicate determinations
Values in the same row having different superscripts are significantly different ($p \leq 0.05$)

Table 2: Mineral contents of different parts of *C.albidum* fruit

Minerals	Amounts in different parts of fruit (mg/100g) Juice	Pulp	Peel	Juice+ Pulp
Na	160.5± 0.23	-	-	-
K	325.7± 0.16	-	-	-
Ca	57.9±0.07	-	-	-
P	61.9±0.19	-	-	-
Mn	5.5±0.01	8.2±0.49	23.7±0.38	13.7±0.67
Pb	ND	ND	ND	-
Cr	0.6±0.11	ND	1.9±0.22	0.6±0.33
Fe	12.0±0.09	ND	131.0±0.31	12.0±0.42
Co	0.1±0.03	ND	1.2±0.10	0.1±0.09
Ni	ND	ND	5.0±0.03	-
Cu	28.9±0.17	37.3±0.06	100.0±0.14	66.2±0.23
Zn	0.3±0.07	0.2±0.36	0.4±0.41	0.5±0.15
As	4.0±0.54	2.0±0.17	-	6.0±0.35
Cd	47.0±0.19	18.6±0.23	28.2±0.47	65.7±0.07
Mg	128.4±0.38	88.5±0.62	251.7±0.36	216±0.29
Se	5.0±0.03	-	5.4±0.07	5.0±0.18
Hg	25.8±0.41	10.4±0.53	43.2±0.25	36.2±0.51

ND =Not detectable

Table 3: Physical characteristics of *C.albidum* fruit

Characteristics	Range values
Weight (g)	31.5-57.1
No of seed per fruit	3-5
Weight of the seed (%)	24.1-27.8
Weight of pulp (%)	52.5-55.2
Weight of peel (%)	19.7-22.5
Weight of juice (%)	3.8-5.3
Volume of the fruit (cm^3)	25.0-48.0
Bulk density (g/cm^{-3})	1.6-2.0
Diameter at the base, i.e., using the largest Subscribing Circle (cm)	4.2-5.2
Height at natural rest position (cm)	4.3-5.2
Surface area (cm^2)	58.9-72.7