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Chemical Analysis of Chrysophyllum Albidum as A Potential Source Of Raw Material For Industrialization

Asimi Tajudeen , Adeniyi Bolatito O., Adegbola Mosebolatan V ., Adebayo Masaudat A. Department of Science Laboratory Technology, Federal Polytechnic, Ede Osun State
Author's corresponding E-mail: aderemidemo@gmail.com

Abstract - African Star Apple (Chrysophyllum Albidum) grown mostly in low and Tropical rain forest of Southern Nigeria and also in compounds and outlaying farms in most villages, in parts of Southern-Western Nigeria. The physico-chemical properties of the air, sun and oven dried of each of the epicarp, mesocarp,and endocarp the sample was characterized using standard methods (AOAC 2012), while the mineral contents was analysed using instrumental technique. The results showed the total soluble solids to be 64%, the P^H to be slightly acidic (5.7 – 6.2,) with the exception of sun dried endocarp (7.2), while the total acidity was between the range1.4 -2.2, with 2.5Cs viscosity. The highest potassium and sodium values was observed for oven dried samples (795mg/g, 9.15mg/g), while highest value of magnesium (94.197mg/g) was obtained for sun dried and 83.379mg/g for calcium air dried samples. However, with the results obtained, Africa Star Apple can be good potential sources of raw material for food and allied industries, since it is within acceptable values.

Keywords: African Star Apple, Endocarp, Epicarp, Mesocarp, Mineral, Content, Physico-chemical.

1.0 Introduction

One of the indigenous wild fruit trees with enormous potential for plantation establishment is the African Star Apple *(Chrysophyllum Albidum*). African Star Apple which is known as "Udera" among the Igbos and "Agbalumo" by the Yorubas (Keaya 1964) and botanically called *Chrysophyllum albidum* (Linn), and belonging to the family Sapotaceae and it's natural occurrence has been reported in Nigeria, Uganda, Niger Republic, Cameroon and Cote d'ivore (Adewusi and Bada, 1997). It is a tree with great potentials not only as plantation species, but as an important tree in compound agro-forestry system (Okafor, 1981, Okigbo, 1978). Ecologically, the fruit is distributed in all forest types (low and tropical rain forest) in Southern Nigeria and also in compounds and outlaying farms in most villages. The trees mostly flowers between the month of April and June and fruits between the month of December and March.

The tree has an efficient nutrients cycling and the high rate of mineralization of the leaves improves the quality of the top soil (Adesina 2005). The fruits are not only consumed fresh but also use to produce jams, jellies, stewed fruit, marmalade, syrups and several types of soft drinks. It is also use for medical purpose due to properties of stalk and fruits. The leaves and seeds of these fruits are use in pharmaceuticals (Islam 2002). The increasing rate of child morbidity and mortality in the developing Countries was reported to be a result of concentration on the consumption of synthesised foods. Therefore the need for diversification into the natural products for balance diets availability, which can easily be achieved through sourcing for natural raw materials for food and allied industries. This study hereby aimed at determine the physic-chemical properties of African Star Apple and it's suitability for industrial development.

2.0 Materials and Methods

2.1 Materials

2.1.1 Sample Collection

Fresh fruits of African star apple were purchased from a local market in Ede land, South Western Nigeria in the month of March. The fruits were sorted, washed thoroughly to remove adhering substances.

2.1.2 Sample Preparation

The washed fruits were opened by stripping the epicarp to reveal the mesocarp and the endocarp i.e. flesh, peel and pulp respectively.

2.1.3 Drying of Sample

Drying of samples is very important in sample treatments; it is the process of turning samples into fine powder for easy extraction, because many organic solvents cannot easily penetrate into the samples that contain water and also makes extraction inefficient. The epicarp (peel), which had been separated from the mesocarp(flesh) and the endocarp (pulp) was divided into three, the first portion was air dried, second sun dried and third oven dried.

2.1.4 Particles Size Reduction

The dried samples was finely grounded into smaller size using a clean mortar and pestle to aid easy blending using a blender so as to make the sample more homogenous and to increase the surface area for reactions.

2.2 Methodology

2.2.1 Analytical Procedures

Samples were analysed chemically using the Official Methods of Analyses described by the Association of Official Analytical Chemist (A.O.A.C. 18th edition; 2005). All analyses were carried out in triplicates.

2.2.2 Proximate Analysis

The physico-chemical properties was carried out by the classical techniques to determine the ash content, moisture content, viscosity, total titratable acidity (% TTA), total soluble solid, colour/brown index determination, pH and mass balance of the fruit in various aggregate parts of the African star apple, (AOAC, 2000).

2.2.3 Mineral/Elemental Analysis

Atomic Absorption Spectroscopy (AAS) was used with the principle based on the absorption of UV-visible radiation by free atoms in the gaseous state. The fruit sample to be analysed was normally ash and then dissolved in an aqueous solution. This digested solution was placed in the sample coverture where it was vaporize and atomized the minerals. A beam of radiation was passed through the atomized sample, and the absorption of radiation was measured at specific wavelengths corresponding to the mineral of interest. Information about the type and concentration of minerals present was obtained by measuring the location and intensity of the peaks in the absorption spectra. In this work, determination of Calcium, Potassium, Sodium and magnesium was carried out. (AOAC 1990).

3.0 Results and Discussions

3.1 Results

3.1.1 Proximate Analysis

The following physico-chemical properties were obtained

Table 1: Mass Balance of the Fruit (African Star Apple)

SAMPLES	Weight of the endocarp (pulp) (g)	Weight of the Mesocarp (flesh) (g)	Weight of the epicarp (skin/peel) (g)	percentage Yield (%)	Endocarp (pulp) to mesocarp (skin/peel)ratio
Sun dried (%)	565.00	865.00	306.42	32.54	1.84
Oven dried (%)	379.05	725.51	220.50	28.61	1.72
Air dried (%)	682.10	989.00	377.00	33.30	1.81

Average Yield (%) =31.48

Table 2: Moisture Content of the Fruit

SAMPLES	Mesocarp±SD (Flesh)	Endocarp ± SD (pulp)	Epicarp ± SD (Skin)
Sun dried (%)	49.35 ± 0.72	51.64 ± 4.35	57.85 ± 6.70
Oven dried (%)	49.42 ± 3.15	54.03 ± 2.41	52.67 ± 6.44
Air dried (%)	47.29 ± 5.86	50.17 ± 8.85	56.48 ± 9.96

Table 3: Ash Content of the Fruit

SAMPLES	Mesocarp ± SD (Flesh)	Endocarp SD (pulp)	Epicarp SD (Skin)
Sun dried (%)	4.53 ± 1.33	3.27 ± 0.75	4.49 ± 1.78
Oven dried (%)	5.23 ± 3.07	2.73 ± 0.19	3.27 ± 1.24
Air dried (%)	4.28 ± 0.52	3.34 ± 1.49	3.91 ± 1.33

Table 4: Viscosity

SAMPLES	Mesocarp SD (Flesh)	Endocarp SD (pulp)	Epicarp SD (Skin)
Sun dried (Cs)	1.52±0.000	1.98±0.02	1.43±0.00
Ovendried (Cs)	1.49±0.01	2.20±0.01	1.45±0.07
Air dried (Cs)	1.41±0.02	2.57±0.17	1.42± 0.02

Table 5: Total Titratable Acidity (% TTA)

SAMPLES	Mesocarp ± SD (Flesh)	Endocarp ± SD (pulp)	Epicarp ± SD (Skin)
Sun dried (%)	1.838 ± 0.038	1.725 ± 0.075	2.175 ± 0.075
Oven dried (%)	1.940 ± 0.113	1.675 ± 0.156	1.40 ± 0.115
Air dried (%)	1.725 ± 0.075	1.998 ± 0.219	1.375 ± 0.087

Table 6: Total Soluble Solids (Tss %)

SAMPLES	Mesocarp ± SD (Flesh)	Endocarp ± SD (pulp)	Epicarp ± SD (Skin)
Sun dried (%)	55.110 ± 0.767	64.370 ± 0.520	67.970 ± 4.419
Oven dried (%)	57.860 ± 3.502	51.330 ± 3.281	66.660 ± 4.290
Air dried (%)	66.850 ± 3.881	71.670 ± 1.792	74.800 ± 4.922

Table 7: PH

SAMPLES	Mesocarp SD (Flesh)	Endocarp SD (pulp)	Epicarp SD (Skin)
Sun dried	5.900 ± 0.040	5.74 ± 0.359	6.190 ± 0.015
Oven dried	7.420 ± 0.174	6.250 ± 0.058	6.210 ± 0.012
Air dried	5.71 ± 0.093	6.070 ± 0.032	6.14 ± 0.036

Table 8: Colour/ Browning Index Determination

SAMPLES	Mesocarp ± SD (Flesh)	Endocarp ± SD (pulp)	Epicarp ± SD (Skin)
Sun dried	155.67±8.50	142.00±2.65	199.67± 0.58
Oven dried	126.67± 2.08	118.33 ± 2.12	146.67 ± 6.43
Air dried	96.00 ± 2.00	90.67 ± 1.15	97.67 ± 4.51

3.1.2 Mineral/Elemental Analysis

Table 9: Mineral Analysis

SAMPLE	K (mg/g)	Na (mg/g)	Mg (mg/g)	Ca (mg/g)
SUN DRIED				
Endocarp (pulp) ± SD	830.185 ± 0.013	9.074 ± 0.001	153.148 ± 0.000	82.407 ± 0.006
Mesocarp (flesh) ± SD	648.319 ± 0.023	7.566 ± 0.000	95.310 ± 0.002	48.319 ± 0.006
Epicarp (skin) ± SD	747.333 ± 0.121	6.533 ± 0.000	34.133 ± 0.002	47.600 ± 0.003
OVEN DRIED				
Endocarp (pulp) ± SD	928.235 ± 0.008	13.897 ± 0.000	152.426±0.000	59.338± 0.005
Mesocarp (flesh) ± SD	520.191 ± 0.025	5.267 ± 0.000	33.435±0.004	19.695 ±0.006
Epicarp (skin) ± SD	938.133 ± 0.046	8.313 ± 0.000	46.265 ±0.003	71.928 ± 0.005
AIR DRIED				
Endocarp (pulp) ± SD	759.444 ± 0.034	8.263 ± 0.000	140.479±0.001	51.916±0.012
Mesocarp (flesh) ± SD	722.383 ± 0.019	8.131 ± 0.000	46.402 ±0.000	46.682 ±0.011
Epicarp (skin) ± SD	841.077 ± 0.078	7.846 ± 0.000	49.231 ±0.001	151.538 ± 0.016

3.2 Discussion

Table 1 showed the results of endocarp (pulp) to epicarp (skin/peel) ratio mass balance and yield of African Star Apple. The weight of the endocarp (pulp) ranged from 379g to 682g, while their yield was found to range from 28.61% to 33.30% with an average yield of 31.48%, which is in concordance with the work of kalyoneu et al, 2009.

The tables (2-8) showed the physico-chemical properties content of African Star Apple. It was observed that the epicarp sundried has the highest moisture content (57.85±6.70) and least with air dried mesocarp (47.29±5.86), while highest ash content was observed from ovendried mesocarp (5.23±3.07) and least with oven dried endocarp (2.73±0.19). This is similar to work of Radicevic et al (2008) reported a range for nine cherry varieties of fruits in Canada. The percentage range of air dried samples was greater than both sun dried and oven dried because the effect of oven temperature and sun temperature was higher than the atmospheric air condition. The total titrable acidity was highest with sun dried epicarp 2.175±0.075) and least with air dried epicarp (1.375±0.087), which was reflected in the taste of the fruit. Pirlak et al (2001), Ojo (1997) and Asafa (1998) reported similarly in their works. The sweetness level of the type of African Star Apple Fruits was depicted by the values obtained for the soluble solids, which is highest with air dried epicarp (74.800±4.922) least with oven dried endocarp (51.330±3.281).

The low total acidity value of "Agbalumo" (1.375%-2.175%) was responsible for the high pH recorded (5.71-7.42). The pH of oven dried samples was the highest because it was thoroughly dried under oven temperature more than the rest dried samples. These results agree with the previous publications on the tropical fruits such as ''Agbalumo'', mango, plum, papaya, bush mango (Alvinger gabonensis) are underutilized. Tables 4 and 8 showed the viscosity and color, It was observed that the samples of "Agbalumo" was stable as depicted by the color index value read in the spectrophotometer but the colour of each dried sample varies while the viscosity value varies due to increasing temperature which had adverse effect on the thickening of the fluid of each sample.

Table 9 showed the minerals content of the samples, Oven-dried having highest mineral content followed by the air-dried and then the sun-dried, this similar to the work of Adepoju 2009. But empirically, the order of these minerals content in the sample is K>Mg>Ca>Na with variation due to temperature differences.

All the fruit part contains nutrient and had index of nutritional quality (INQ) values above 1.0, the endocarp was considered to be very nutritious followed by the mesocarp, and the epicarp, and the fruit consumption should be encouraged. (Takruri and Dameh, 1998)

4.0 Conclusion and Recommendation

4.1 Conclusion

It can be concluded that African Star Apple known as 'Agbalumo' in the Yoruba speaking area of Nigeria was an indigenous fruits that possess the qualities required of fruits to be processed into other valued products. Its fleshy fruits are widely consumed. Although the fruits of this species contributed to improve health, nutrition, food security and income of the local communities, the species could be further exploited in the region. 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 valuable products.

4.2 Recommendations

Considering the results obtain from the analysis carried out on *Chrysophyllum albidum* (African Star Apple), the following was therefore recommended:

- 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.
- Preservative techniques should be given adequate attention by necessary authorities, to improve on the shelve life the ripe fruits.
- The government should mobilized Standard Organization of Nigeria (SON) to launch a public enlightenment campaign on the importance of the fruit.

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