

Evaluation of Proximate Compositions and Mineral Elements in the Star Apple Peel, Pulp and Seed

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ABSTRACT

African star apple fruit is an edible fruit. Its peel, pulp and seed were analyzed to determine the proximate composition and mineral elements. The results showed that the Pulp contain greater amount of crude fibre, fat, ash and caloric value, while greater amount of moisture was found in the peels. Carbohydrate content and crude protein was higher in the seed. Mineral elements composition revealed that pulp has greater amount of sodium and iron while peel contains greater amount of potassium and zinc. Calcium and magnesium were higher in the seed.

Keywords: Star apple, Proximate compositions, Mineral elements.

INTRODUCTION

The star apple (*Chrysophyllum albidum*) fruit is a forest tree that belong to the family called sapotaceae. It nature occurrence has been reported in diverse ecozones in Nigeria, Uganda, Niger Republic, Cameroon and Coted' Ivorie (Bada, 1997). The plant often grows to a height of 36.5m though it may be smaller (Bada, 1997). The African star apple fruit contains 4 to 5 flattened seeds sometimes fewer due to seed abortion. The plant has in recent time become a crop of commercial value in Nigeria. The freshly pulp of the fruits is eaten especially as snack and relished by both young and old (Cenred, 1999). The fruit has been found to have high content of ascorbic acid with 1000 to 3,300mg of ascorbic acid per 1000gm of edible fruit or about 100 times that of oranges and 10 times of that of guava or cashew (Adisa, 2000). The seeds are also used for local games (Bada 1997). The fruits also contain 90% anacardic acid, which is used industrially in protecting wood and as source of resin, while other components of the tree including the roots and leaves are used for medicinal purposes, (Adewusi, 1997).

Fruits categorization and diagnostic analysis of *Chrysophyllum albidum* (G. Don) in Nigeria has been reported by Oyebade *et al*, (2011). Proximate and Mineral Composition of Seed Shell Pericarp of *Chrysophyllum albidum* was investigated by Ewansiha, *et al*, (2011).

In this century, biological assay methods clarified the significance of mineral elements for human and animal nutrition and modern analytical techniques led to the detection of trace elements as essential nutrients and this is still an active area of current research. These elements are present in fruit such as cashew nuts, sesame seed, sunflower seed, soya beans and star apple etc. Hence the aims of this work is to evaluate the proximate composition and mineral elements in the star apple peel, pulp and seed in order to ascertain its suitability or otherwise for applications in pharmaceutical, food, cosmetics and perfume industries.

MATERIALS AND METHODS

1. Sample Collection and Treatment

Fresh samples of star apple fruits (*Chrysophyllum albidum*) were bought in Ukam Market in Mkpato Enin Local Government Area of Akwa Ibom State, Nigeria. The peel, pulp and seed were removed and kept separately. The hard outer shell of the seed was removed by cracking with a small pestle. The peel, pulp and the cotyledon (inner portion) of the seed were oven dried at the temperature of 60°C for 24 hours. The dried samples were then ground with a manual grinder into powder and sieve to get very fine powder. It was then stored separately in an air tight plastic container pending chemical analysis.

2. Proximate Composition:

Moisture content, ash content, crude protein and crude fat were determined in accordance with Association of Analytical Chemist (AOAC, 1990), while crude fibre was determined using (AOAC, 1995). Carbohydrate content was determined as the difference obtained after subtracting the values in percentage of crude protein, lipid ash, and fibre from the total dry matter.

3. Estimation of Mineral Element

Mineral element in the star apple peel, pulp and seed were determined in accordance with AOAC methods, (1990).

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RESULTS AND DISCUSSION

Table 1: Proximate Compositions

Nutrients	Samples			
	Peel (%)	Pulp (%)	Seed (%)	Average (%)
Moisture content	47.95	32.65	26.55	35.72
Crude protein	6.68	4.73	8.75	6.73
Crude Fat	8.94	10.00	3.45	7.46
Crude Fibre	1.82	3.00	2.42	2.41
Ash	3.15	3.25	2.00	2.80
Carbohydrate	79.39	79.03	83.38	80.60

Table 2: Mineral Element Composition

Elements	Concentration mg/kg			
	Peel	Pulp	Seed	Average (%)
Sodium (Na)	43.86	69.38	37.52	50.25
Potassium (K)	62.26	5.96	41.42	36.56
Calcium (Ca)	8.25	40.99	71.52	40.25
Magnesium (Mg)	6.16	3.52	29.49	13.05
Iron (Fe)	37.34	40.11	6.22	27.89
Zinc (Zn)	13.46	6.83	1.76	7.35

The results of the proximate composition of star apple peel, pulp and seed are presented in Table 1 and illustrated in Fig. 1.

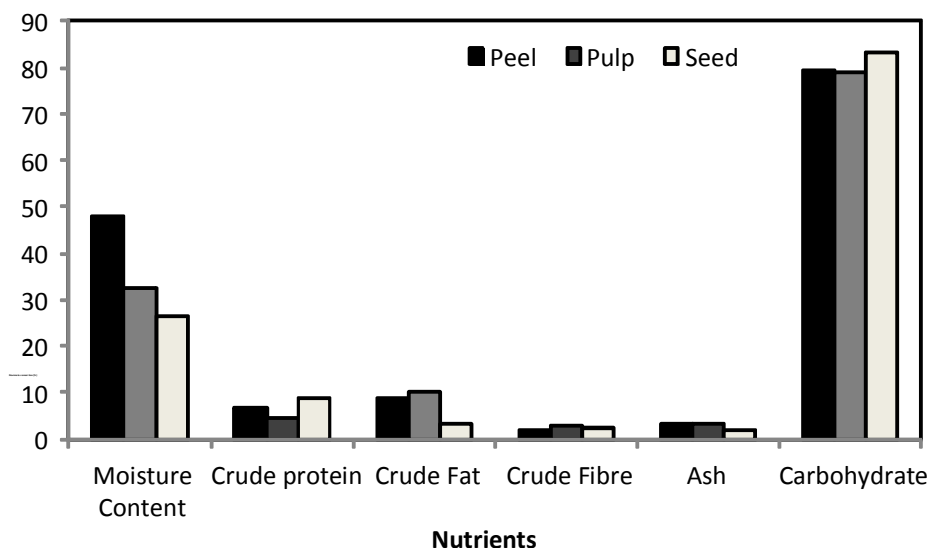


Fig. 1: proximate composition of star apple peel, pulp and seed

Moisture contents: Moisture contents have a great value in the preservation of food materials (Eka, 1984). Moisture contents of the star apple peel, pulp and seed were 47.95%, 32.65% and 26.55% respectively with an average of 35.76%, these clearly shows that peel contain much moisture. Moisture content is one of the most important and most widely used parameter in food processing; hence star apple seed can easily be processed and preserved easily since it contains less moisture.

Crude protein: Crude protein contents of star apple peel, pulp and seed were 6.68%, 4.73% and 8.75% respectively with an average of 6.73%. These are higher than the value of 0.98% reported for the Seed Shell Pericap by Ewansiha, *et al.* (2011). Food and Nutrition Board of Nigeria (1972) recommended 56kg of protein per day in the diet of adult men weighing 70kg and 40kg for women weighing 56kg of body weight.

Crude fat: Fat contents of the star apple peel, pulp and seed were 8.94%, 10.00% and 3.45% respectively with an average of 7.46%. This shows that pulp contain highest amount of fat than peel and seed. The value of pulp and peel is higher than the fat content of other fruits reported by Oyenuga (1960). Fat provide an excellent source of energy, enhance transport of fat soluble vitamins, insulate and protect internal tissues and contribute to vital cell process. However, it is strongly believed that excess of saturated fatty acids are responsible for a tendency to coronary thrombosis and aortic atheroma in men also high level of poly unsaturated fatty acids is important in lowering blood cholesterol level (Lloyd *et al.*, 1997).

Crude fibre: This theoretically referred to material that is indigestible in organisms. The values of 1.83%, 3.0% and 2.42% was obtained for the star apple peel, pulp and seed respectively with an average of 2.41%. Crude fibre content is higher in the pulp and lower in the peel. However the physiological role of fibre is to maintain an intestinal tract (Davidson, *et al.*, 1975). Also client with low fibre have been associated with diseases of the

colon like piles, appendicitis and cancer (Eastwood, 1984). However, low fibre contents are also known to reduce the rate of glucose and fat absorption (Mottram, *et al.*, 1979). Hence the low fibre contents in the star apple peel, pulp and seed are advantageous in absorption of glucose and fat.

Ash Contents: Ash content indicates the amount of inorganic matter and oxides present in the sample. It is the determinant factor of the mineral constituents in the sample. Ash content as presented in Table 1 was 3.15%, 3.25% and 2.00% for peel, pulp and seed respectively. The average ash contents obtained was 2.80%.

Carbohydrate Content: The carbohydrate contents of the star apple were found to be 79.392%, 79.025% and 83.38% for peel, pulp and seed respectively with the average of 80.60%. The major metabolic role of the carbohydrate in the diets is for energy production. There are different types of carbohydrate, but in food only total carbohydrate is considered and it is what is left when protein, fat, moisture and ash of the foodstuff have been removed.

Mineral Element Composition

The results of the mineral element composition in the star apple peel, pulp and seed are presented in Table 2. The mineral elements determined were sodium, potassium, calcium, magnesium, iron and zinc. Their composition is illustrated in Fig.2.

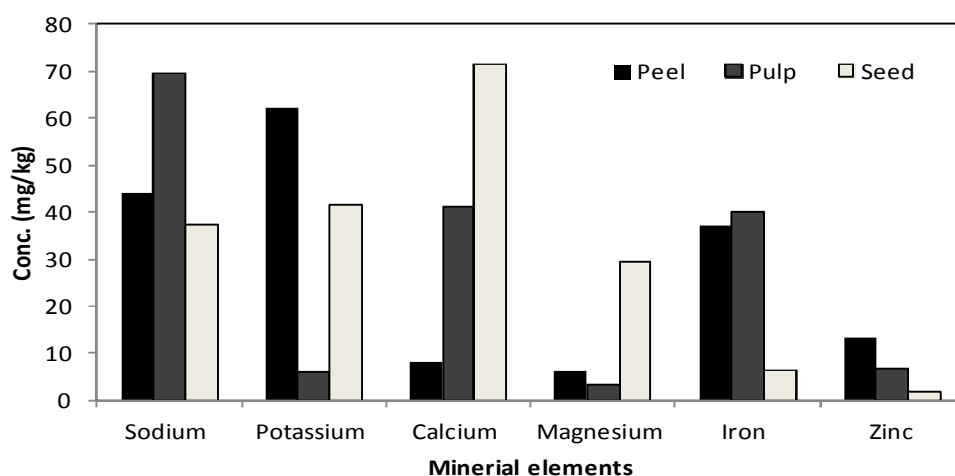


Fig.2: Mineral elements in the star apple peel, pulp and seed

The sodium content of the star apple peel, pulp and seed were 43.858, 69.382 and 37.516 mg/kg respectively with an average of 50.25mg/kg. Sodium is the principle extracellular cation and is used for acid base balance and osmoregulation in inter modular fluid. The recommended daily allowance of sodium is 115-75000mg/kg for infants, 324-975 mg/kg for children and 1100-3300 mg/kg for adults, (Crook, 2006). Hence the value obtained for the star apple peel, pulp and seed are low as compared to the standard value.

Potassium contents were 62.262, 5.965, and 41.416mg/kg for the star apple peel, pulp and seed respectively with an average of 36.72mg/kg. Potassium content of the peel is the highest while that of the pulp is the least. They all have higher potassium content than that of *Acalypha wilkesiana*, *Chromolaena odorata*, and *Tridax procumbens* reported by Ikewuchi and Ikewuchi, (2009). Potassium is the principal cation in intracellular fluid and functions in acid-base balance, regulation of osmotic pressure, conduction of nerve impulse, muscle contraction particularly the cardiac muscle, cell membrane function. Deficiency disease or symptoms occurs secondary to illness, functional and structural abnormalities including impaired neuromuscular functions of skeletal, smooth, and cardiac muscle, muscular weakness, paralysis, mental confusion (Hays and Swenson, 1985; Malhotra, 1998; Murray *et al.*, 2000).

Calcium contents in the star apple peel, pulp and seed were 8.251, 40.996 and 71.522mg/kg respectively with an average of 40.56mg/kg. That of the peel was very low as compared to that of the pulp and seed. Calcium functions as a constituent of bones and teeth, regulation of nerve and muscle function. In blood coagulation, calcium activates the conversion of prothrombin to thrombin and also takes part in milk clotting. It plays a vital role in enzyme activation. Calcium activates large number of enzymes such as adenosine triphosphatase (ATPase), succinic dehydrogenase, lipase etc. It is also required for membrane permeability, involved in muscle contraction, normal transmission of nerve impulses and in neuromuscular excitability. Reduced extracellular blood calcium increases the irritability of nerve tissue, and very low levels may cause spontaneous discharges of nerve impulses leading to convulsions (Hays and Swenson, 1985; Malhotra, 1998; Murray *et al.*, 2000). Calcium

deficiency also affects the dentition of both children and adult. Toxicity symptoms occur with excess absorption due to hypervitaminosis D or hypercalcaemia due to hyperparathyroidism, or idiopathic hypercalcaemia. Excess calcium depresses cardiac activity and leads to respiratory and cardiac failure; it may cause the heart to stop in systole, although, normally, calcium ions increase the strength and duration of cardiac muscle contraction. Excess calcium and phosphorus are excreted by the kidney. Ca and P excreted in faeces are largely the unabsorbed dietary minerals; some comes from the digestive juices, including bile (Hays and Swenson, 1985).

Magnesium content in the star apple peel, pulp and seed were 6.162, 3.518, and 29.494mg/kg respectively with an average of 13.02mg/kg. Magnesium is an active component of several enzyme systems in which thymine pyrophosphate is a cofactor. Oxidative phosphorylation is greatly reduced in the absence of magnesium. It also activates pyruvic acid carboxylase, pyruvic acid oxidase, and the condensing enzyme for the reactions in the citric acid cycle. It is also a constituent of bones, teeth, enzyme cofactor, (Murray *et al.*, 2000). Chronic or excessive vomiting and diarrhea may result in magnesium depletion. Deficiency diseases or symptoms are secondary to malabsorption or diarrhoea, alcoholism. Symptoms of magnesium deficiency in humans include depressed deep tendon reflexes and respiration (Murray *et al.*, 2000). Star apple Seed contain greater amount of magnesium as compared to the peel and pulp.

Iron functions as haemoglobin in the transport of oxygen. The value obtained for star apple peel, pulp and seed were 37.330, 40.110 and 6.22mg/kg respectively with an average of 27.89 mg/kg. In cellular respiration, iron functions as essential component of enzymes involved in biological oxidation such as cytochromes c, c1, a1, etc (Malhotra, 1998). Fe is an important constituent of succinate dehydrogenase as well as a part of the haeme of haemoglobin (Hb), myoglobin and the cytochromes (Chandra, 1990). Iron deficiency anaemia also occurs at birth in other animals like dogs, cats, cattle, etc but it is more pronounced in pigs. Excessive accumulation of iron in the liver, pancreas, heart, lungs and other tissues cause haemosiderosis and when this is accompanied by bronze pigmentation of the skin, the condition is called haemochromatosis (Malhotra, 1998; Murray *et al.*, 2000).

Zinc is distributed widely in plant and animal tissues and occurs in all living cells. The values obtained for the star apple peel, pulp and seed were 13.46, 6.83 and 1.76mg/kg respectively. The average zinc contents was 7.35mg/kg. These values are lower than that of the seed shell pericarp (100.00mg/kg) reported by Ewansiha, *et al.*, (2011). Zn dependent enzymes are involved in macronutrient metabolism and cell replication (Hays and Swenson, 1985; Arinola, 2008). In humans, deficiency disease or symptoms include hypogonadism, growth failure, impaired wound healing, and decreased taste and smell acuity, secondary to acrodermatitis enteropathica, parenteral nutrition (Murray *et al.*, 2000).

Conclusion

The results from the proximate composition showed that star apple peel, pulp and seed have greater amount of carbohydrate contents. Mineral element composition revealed that star apple peel contains greater amount of potassium and zinc while, pulp contains greater amount of sodium and iron, and calcium and magnesium were high in the seed. Hence each these samples (peel, pulp and seed) can act as a source of the mineral supplement in food and allied industries.

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