



Determination of biochemical composition of *Saba senegalensis* (Saba fruit)

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ABSTRACT

Saba senegalensis is an indigenous tree crop found in the northern regions of Ghana and parts of Africa; it is used as dessert or as condiment for dishes. This study was carried out to analyze the nutritional value of *Saba senegalensis* by determining proximate and biochemical composition using Association of Official Analytical Chemist (AOAC) standard methods of food analysis. The fruit recorded vitamin C content of 16.41mg/100g, and 47.2 mg/100 g of malic. It was discovered that the fruit was slightly acidic with pH of 2.24 and had a brix level of 14.1 %. Crude protein content was 8.75 % and 0.53 % for the seed and pulp respectively. The crude fat was higher in the pulp (8.92 %) than in the seed (2.14 %). The moisture content of the juice was 41.43 %, the ash content of the seed and pulp were 6.7 % and 2.8% respectively and a crude fibre of 13.52 %. The result indicated a nutritive value of 379.32 kcal/100 g with 74.23 % available carbohydrates. Calcium, phosphorus and magnesium concentrations were 810 ppm, 357.5 ppm and 47.5 ppm respectively. The nutritional and mineral composition of *Saba senegalensis* from northern Ghana is higher than some commercial fruits and is very much comparable with various wild and non-wild tropical fruits reported in literature.

Key words: *Saba senegalensis*, proximate composition, minerals, vitamin C, tree crop

INTRODUCTION

Saba senegalensis is an indigenous climbing plant that belongs to the family Apocynaceae; it is found in the wild of Africa and distributed across Burkina Faso, Gambia, Guinea, Mali, Niger, Guinea Bissau, Senegal, Cote d'ivoire, Tanzania and Ghana [1] In Ghana, the plant is found in some parts of Northern, Brong Ahafo, and Upper West regions [2]. The generic name was adapted from Midinka, name of the plant, the specific name refer to Senegal in West Africa where the plant was first found and collected for identification [3].

Saba senegalensis is a medicinal food plants and has the potential of contributing to soil and water conservation. The fruit is tasty, sweet-sour with yellow pulp when ripe [1]. It can be mashed and used for porridge and "Tuozaaafi" [2]. *Saba senegalensis* pulp is used for jam and juice production in Senegal and Burkina Faso. The latex is used to treat pulmonary diseases and tuberculosis; the leaves can cure chronic headache, wounds, food-poisoning and vomiting. Fula of Senegal use the leaves in preparation of sauces and condiments [4].

In Ghana, there is little documented information on all aspects of the *Saba senegalensis*. Therefore, research on the biochemical composition would be useful in the food industries and in medicine. It would also be useful to breeding and conservation programmes. The objectives of the study were to determine the proximate composition of the *Saba senegalensis* fruit, to calculate the titratable acidity of the fruit, to determine the vitamin C content of the fruit, to quantify the malic acid content of the fruit and to determine calcium, magnesium and phosphorus content of the fruit.

MATERIALS AND METHODS

Collection and preparation of Sample: Fully ripe *Saba* fruits were harvested from the same tree at Tumu in the Upper West Region of Ghana. Fruits of similar sizes, maturity and stage of ripening were selected for the study. The fruits were packaged in a well-padded ventilated paper box and transported within 6 hours to the Spanish laboratory, Nyankpala campus of the Faculty of Agriculture, University for Development Studies, Tamale-Ghana and the Savanna Agricultural Research Institute (SARI) laboratory, of the Council for Scientific and Industry Research (CSIR).

Determination of Proximate and mineral composition: Proximate and mineral determination was carried out at the Spanish laboratory of UDS. Proximate composition and mineral analysis were carried out as recommended by [5]. The parameters determined were moisture, protein, crude fat, crude fibre, ash, carbohydrate, P, Ca, Mg and contents. Phosphorus was estimated using a spectrophotometer (Model - Jenway 7305A). Calcium and magnesium were estimated by using Atomic absorption spectrophotometer (Perkin-Elmer, 4000 A).

RESULTS

Proximate Composition

The proximate composition of the fruit gave a crude protein of 8.75 % from the seed and 0.53 % from the pulp, crude fat of 2.14 % and 8.92 % from the seeds and pulp respectively and a crude fiber of 13.52 %. The moisture content was analyzed on both the juice and the whole fruit which showed relatively low moisture content in the juice, 41.43 % as compared the whole fruit that gave moisture of 70.90 % indicating that the fruit contains relatively high moisture content. Table 1 below gives a clear picture of ash content seed, pod and pulp as 6.7 %, 1.6 % and 2.8 % respectively and it gives an indication of the total mineral content in the fruit. The results also showed that the *Saba* fruit contains 74.23 % of available carbohydrates.

Table 1: Proximate composition of the *Saba* fruit

Parameter	Percentage composition (%)	
	Pulp	Seed
Ash	2.80	6.70
Crude protein	0.53	8.75
Crude fat	8.92	2.14
Crude fibre	13.52	nd
Available carbohydrates	74.23	nd

nd means not determined.

Table 2: Vitamin C, malic acid, titratable acidity, brix level, pH and juice content of *Saba senegalensis*

Variable	Composition per 100 g of edible portion
Vitamin C	16.41 mg
Malic acid	47.20 mg
Brix level (soluble solids)	14.10 %
Titratable acidity	30.44 g/L
The sugar acid ratio	4.60
Fruit juice content	26.35 %
pH of pulp	2.24
Nutritive value (energy)	379.32 kcal

Chemical Composition of fruit

Analysis for the various compositions was made based on 100 g of edible portion. The results show that the *Saba* fruit contains vitamin C of 16.41 mg and high malic acid of 47.2 mg. Analysis was also carried out to ascertain the

juice potential in percentage an average fruit can give, and it showed 26.35 %. The results also showed that the fruit contains 14.1 % of brix and the titratable acidity gave 30.44 g/l. The fruit contains 3.04 % of total acid with 46:100 as the sugar acid ratio which is an important parameter in measuring the sugar balance which is an indicator of the fruit flavor. A pH value of 2.24 showed that it is relatively acidic with high nutritive value of 379.32 kcal/100 g (table 2)

Mineral content: 810 ppm, 357.5 ppm and 47.5 ppm were recorded for calcium, phosphorus and magnesium respectively.

DISCUSSION

Proximate Composition

Determination of food composition is fundamental to theoretical and applied investigations in food science and technology, and is often the basis for establishing the nutritional value and overall acceptance by consumers. The moisture content was 41.43% ; this value is lower than the 80% recoded by [6] but appreciably higher than moisture in almond (5.20%) and cashew nut (5.90%) [7] and bush cane (33.6 %) [8].

The moisture content was relatively high in both the pulp and the entire fruit when compared to moisture content of other fruit(s). Moisture determination is one of the most important and most widely used measurements in processing and testing of food [9]. Moisture content is importance to both the stability and quality of foods. Fruits that contain high amount of water are subject to rapid deterioration from mold growth and insect damage. Moisture content determination is important in determining the nutritive value of a food sample, in expressing results of analytical determinations on uniform basis, and in meeting standards as to how much moisture foods, especially processed foods should contain.

Ash in fresh fruits range from 0.2 to 0.8 and is generally inversely related to the moisture content [9]. The ash content of the seeds, pod and pulp of the Saba fruit were 6.7 %, 1.6 % and 2.8 % respectively, which implies that the fruit contains high levels of minerals. This result is in line with a report that the Saba fruit contains 58 % calcium, 28 % phosphorus and 1 % iron [6]. Minerals are of prime importance in determining the fruit nutritional value.

Fats and oils are a concentrated source of energy with each gram giving 9 calories [10]. Fats make certain vitamins available for use in the body, they cushion vital organs, help to maintain body temperature, and make up part of all body cells. Most fruits have fat content <0.5 g/100 g edible portion [11]. However, [12] reported that crude fat content of pear seeds within the range of 2.06 ± 0.75 % while the pulp recorded 5.60 ± 0.57 % which is similar to the fat content in Saba fruit. The pulp of Saba fruit contained 8.92 % which was also higher than that in the seed 2.14 %. The vast difference in crude fat content between the seeds and pulp of Saba fruit could be attributed to the fact that Saba fruit pulp has a high fat content therefore the amount of energy the fruit contains is high since fat gives more energy.

Saba fruit contained a high amount of crude fibre (13.52 %) as compared to commercial fruits like apple (3.4 %) [13] but was slightly lower than that of bush cane, *Costus afer* (15.55 %) [8]. Adequate intake of dietary fibre can lower the serum cholesterol level, risk of coronary heart disease, hypertension, constipation, diabetes, colon and breast cancer [14]. The Recommended Dietary Allowance (RDA) of fibre for children, adults, pregnant and lactating mothers are 19-25, 21-38, 28 and 29 g, respectively [15]. These suggest that a daily intake of Saba fruits may help fight against diseases and limit the chances of infections. The nutritive value of the Saba fruit was 379.32 kcal/100 g. The calorific value of this fruit can be compared to the commercial and wild edible fruits. It indicates that this fruit could be an important source of dietary energy. The high calorific content of the fruit could be attributed to the high carbohydrate and the pulp fat contents of the fruits.

Chemical Composition of fruit

Vitamin C

The fruit contains about 16.41 mg/ 100 g of vitamin C which makes it a good source of the vitamin. Fruits which are excellent sources of vitamin C can provide 180-600 mg of vitamin C per 100 g edible portion [16]. Vitamin C is an antiscorbutic substance which prevents and cures scurvy. Vitamin C has also been implicated in the hydroxylation of proline to form the hydroxyproline required in the formation of collagen which helps in the healing of wounds, fractures, bruises and bleeding gums, and reduces the liability to infections [17]. Ascorbic acid is involved in the

metabolism of some amino acids, such as tyrosine, in drug and folic acid metabolism, and in the synthesis of anti-inflammatory steroids in the adrenal glands [17]. The absorption of iron is increased by dietary ascorbic acid when the two nutrients are ingested simultaneously and takes place when the ascorbic acid content of a meal is 25-75 mg or more; edible portion the Saba fruit can enhance iron absorption. The daily human requirements for vitamin C recommended by some various international and national agencies are as follows, 40 mg/day (United Kingdom's Food Standards Agency); 45 mg/day for children (World Health Organization); 90 mg/day (males) and 75 mg/day (females): Health Canada 2007; 60-95 mg/day and additional 20 mg/day and additional 40 mg/day for pregnant and lactating women respectively: United States' National Academy of Science [17].

Considering daily human requirement for vitamin C, one can comfortably say that the Saba fruit stands a better position in providing enough vitamin C to the rural people especially in the northern part of Ghana. One may only need to consume about 300 g of Saba fruit edible part to get the requirement for both the World Health Organization and the UK standards.

Minerals

Calcium was present at a high concentration of 810 ppm followed by phosphorus with 357.5 ppm and magnesium 47.5ppm. The calcium content of the Saba fruit was also reported to be 58 % [6]. Analysis of mineral composition of the wild fruit, *Mordii whytii* showed that calcium recorded 300.0 ppm and phosphorus, 170.0 ppm [18]. Wild plum analysed by [19] contained higher amount of Ca (920.2 ppm) and Mg (916.68ppm). The wild fruit, *Piper guineense*, was indicated to be a rich source of calcium (311.5ppm) [20]. The mineral content (in ppm) of some wild edible fruits are; *Grewia tiliifolia* - P: 25.2, Ca: 1094, Mg: 4022; *Cordia dichotoma* - P: 22.0, Ca: 6154, Mg: 12360; *Meyna laxiflora* - P: 15, Ca: 3251, Mg: 995 [21]. The phosphorus content in Saba fruit is considerably higher than these wild edible fruits and that of bush cane (*Costus afer*) which was found to be 60.2ppm [8]. Mineral content of other wild edible plants [22] using Atomic Absorption Spectrophotometer was significantly higher: phosphorus in *Caryota urens* L (2700ppm), calcium in *Bauhinia recemosa* Lam. (22630ppm) and magnesium in *Oroxylum indicum* (L.) Vent (3160ppm) than that of the Saba fruit with - 357.5 (P), 810 (Ca) and 47.5ppm(Mg) respectively.

Calcium constitutes a large proportion of the bone and is important in human blood and other extracellular fluid [23]. Intake of the Saba fruit would be helpful for the normal functioning of the cardiac muscles, blood coagulation, milk clotting and the regulation of cell permeability. Phosphorus combines with calcium to form a relatively insoluble compound calcium phosphate, which gives strength and rigidity to bones and teeth. Phosphorus like calcium is needed not only for the growth of skeleton but also for its maintenance. The phosphorus-containing lipoprotein facilitates the transport of fats in the circulation. A series of phosphorus compound are formed in the utilization of carbohydrates in the body. It is vital to the fundamental process of metabolism in the body. The Indian council of medical research has recommended a daily allowance of 1g of phosphorus [24]. Magnesium is an essential component of a healthy human diet. Magnesium ions are essential to all cells of all known living organisms. Several enzymes require Mg^{2+} for their catalytic action. ATP exists in cells normally as a chelate of ATP and a magnesium ion.

Malic acid

Malic acid content in the Saba fruit was found to be high (47.2 mg) which could be responsible for the usual sourness of the fruit. It is an important component of cell metabolism in fruits and vegetables, and is the primary found some fruits which plays a major role in metabolism in the human body. Malic acid is also an indicator of the freshness of fruits and vegetables and, with other organic acids, is used as common parameter to evaluate the quality of agricultural products and food control points in the food process [25]. The face-scrunching flavor of the Saba fruit is an indication of the high malic acid content. This is similar to what malic acid contributes to some foods and also has some benefits in personal care. Malic acid is also one of a variety of fruit acids compounded into chemical facial peels used to combat skin dryness, pimples and sun damage [25]. With malic acid content of 47.2 mg, the Saba fruit can serve as flavoring source in the food processing industry especially in wine production where malic acid contributes positively to the organoleptic character of wine when in balance with the other wine components.

Brix level

Brix level is the percentage of solids present in the juice of a fruit. These solids are mostly made up of sugar and minerals. Testing the brix level of fruits gives an idea of the fruit quality; high brix means more and better flavor. This is especially true when a good percentage of the brix is made up of minerals. Higher brix also means better

nutrition; higher mineral content usually means an increase in vitamin content as well. The brix level is usually compared with the brix chart which categorises the level into poor, good and excellent. The brix level of the Saba fruit (14.1%) falls on the excellent range with fruits like avocados, banana, lemon and coconut.

This also indicates that the fruit has higher sugar content, higher mineral content, higher protein content and better storage attributes

Titrateable acidity

The acids concerned are “weak acids” and not completely ionized. The analysis showed that the total amount of the acid in the Saba fruit juice was 30.44 g/L which gives an acid percentage of 3.04 and the sugar/acid ratio of 46:100. It is the sugar/acid ratio which contributes towards giving many fruits their characteristic flavor and which is an indicator of ripeness. At the beginning of the ripening process the sugar/acid ratio is low, because of low sugar content and high fruit acid content, this makes the fruit taste sour. During the ripening process the fruit acids are degraded, the sugar content increases and the sugar/acid ratio achieves a higher value. Overripe fruits have very low levels of fruit acid and therefore lack characteristic flavor.

pH

With a pH of 2.24, it shows that the fruit is acidic which could be why people complain that they become rather very hungry shortly after eating the Saba fruit. A pH value of 2.5 to 5.5 tends to prolong the shelf life of fresh fruit and inhibit the multiplication of micro-organisms. The pH of the fruit means that Saba fruit products will be able to withstand microbial activities and therefore will have a prolonged shelf life [10].

CONCLUSION

The biochemical composition of the Saba fruits collected in the wild from Tumu in the Upper West region was determined as 0.53 % and 8.75 % crude protein of pulp and seed respectively, 16.41 mg of vitamin C, 47.2 mg of malic acid and 2.14 %, and 8.92 % crude fat of seed and pulp respectively. Total minerals (crude ash) and sugar content investigated 2.8 % and 14.1 % of edible portion respectively. The available carbohydrate recorded was 74.23 % with high nutritive value of 379.32 kcal/100 g. A fiber content of 13.52 % of the edible portion was also recorded. Minerals analyzed gave 810 ppm of Ca, 357.5 ppm of P and 47.5 ppm of Mg. The results suggested that the consumption of the fruit in sufficient amount could provide nutrients and adequate protection against diseases. It is recommended that research be carried out on crude fat of both the pulp and seed at different ripening stages.

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