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Studies on Dietary Mineral Composition of the Fruit of *Sarcocephalus latifolius* (Smith) Bruce (Rubiaceae)

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Abstract

The study was aimed at investigating the concentration of macro/micro elements and proximate content of the fruit of *Sarcocephalus latifolius* with the view of validating its nutritional benefit to man. The plant material was collected from Gaya in Hong L.G.A of Adamawa State, Nigeria. Proximate analysis was conducted following methods of Association of Official Analytical Chemists. The percentage values of moisture, ash, protein, fibre and carbohydrate available were 14.6, 4.5, 8.52, 32.60 and 45.80 respectively. The levels of 13 elements (Ca, Mg, Na, K, P, S, Fe, Mn, Zn, Cu, Co, Cr, Ni) was determined using atomic absorption spectrophotometry. While the content of phosphorus and sulphur in the fruit was determined by colorimetry. Results revealed moderate to high concentrations of some macro and micro elements in the fruit of *Sarcocephalus latifolius*. Phosphorus was the highest amongst the macro element (0.531 g/100 g) which represent 37.96% of its Required Dietary Allowance (RDA). Magnesium (0.329 g/100 g), potassium (0.294 g/100 g) calcium (0.242 g/100 g) and sodium (0.196 g/100 g) which represent 16.40%, 7.34%, 34.80% and 17.80% of their required dietary allowance. Sulphur was the lowest (0.045 g/100 g) among the macro element. For the microelements, Zn, a potent antioxidant was the highest (0.019 g/100 g) which represents 87.27% of its required dietary allowance (RDA). While Mn and Fe showed 99.8% and 33.3%. In conclusion, both the proximate and elemental concentrations for the fruit of *S. latifolius* was found within the permissible region set by the World Health Organization.

Keywords: Proximate analysis; Mineral content; Required dietary allowance (RDA); *Sarcocephalus latifolius*

Introduction

The fruits, seeds and leaves of many wild plants already form common ingredients in a variety of traditional native dishes for the rural populace in developing countries [1]. Fruits are commonly well known as excellent source of nutrients such as minerals and vitamins; and also contain carbohydrates in form of soluble sugars, cellulose and starch [2]. The diet of many rural and urban dwellers is deficient in protein resulting in high incidence of malnutrition and increase in dietary diseases; a situation in which children and especially pregnant and lactating women are most vulnerable [3]. Food and Agricultural Organization (FAO) reported that at least one billion people use wild foods in their diets [4]. In Ghana alone, the leaves of over 300 species of wild plants and fruits are consumed while about 150 wild plant species have been identified as sources of emergency food in India, Malaysia and Thailand [5]. Similarly, in South Africa about 1400 edible plant species are used [6]. It is therefore worthwhile to note that the incorporation of edible wild and semi-cultivated plants could be beneficial to nutritionally marginal populations, or to certain vulnerable groups within populations, especially in developing countries where poverty and climatic changes are causing havoc to the rural populace [7].

Sarcocephalus latifolius is a savannah tree or shrub up to 12m. Three other closely related species *Sarcocephalus pobeguinii, Sarcocephalus diderichi and Sarcocephalus Vandergushtii* are forest trees [8]. It is multi-stemmed and has an open canopy flowers with terminal spherical head like cymes of small whitish flowers. The fruit is a syncarp, the individual fruits being fused together into a fleshy mass with characteristic pitted surface. The seeds are minute and embedded in a pinkish flesh with straw-berry scent [9]. *S. latifolius* has been used for several economic and medicinal purposes. The fleshy fruits are edible, live-stock feed on the stalk and leaves, flowers provide nectar and pollen to bees, wood is termite-resistant and bark yields tannins used in dyeing [9]. Despite its use as food and medicine in this region, there has been little or no report on its proximate and mineral composition. Therefore, this work is aimed at evaluating the nutritional content of *S. latifolius* fruit obtained from Gaya, in Hong local government area, Adamawa State with the hope of encouraging the consumption of this forest fruit as an alternative food source.

Materials and Methods

Experimental sample collection and preparation

The matured fruits of *S. latifolius* were randomly sampled from different branches of the tree growing in areas around Gaya village, Hong local Government area, Adamawa state, Nigeria, West Africa. The samples were transported to the laboratory in air-tight polyethylene bags.

Analytical procedure

The samples were air dried and pulverised with porcelain mortar and pestle to fine particles and stored in plastic containers. Chemical analyses were carried out on the ground samples.

Moisture and Protein contents were determined by the method adopted by Anhwange et al. [10], ash and crude fibre contents by AOAC [11], and carbohydrate content by AOAC [12].

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Mineral content

0.5g of the sample was packed into an acid-washed porcelain crucible and then placed in a muffle furnace for four hours at 550°C. The crucible was removed from the furnace and cooled. Ten ml of 6M HCI was added and the content heated on a steam bath for 15 minutes. One ml of HNO_3 was then added and evaporated to dryness by continous heating for one hour so as to dehydrate silica and completely digest organic substances. Lastly, 5 ml of 6M HCI and 10 ml of water were added with heating on a steam bath to complete dissolution. The mixture was cooled and filtered through a whatman No.1 filter paper into a 100 ml volumetric flask and then made up to mark with distilled water [13].

Elemental analysis

The mineral composition was conducted using Perkin Elmer optima Analyst 400 atomic absorption spectrophotometer. Each element was analysed at an appropriate lamp current and a wavelength determined by the automated digital spectrophotometer. The concentration was recorded in milligram per liter (mg/l) with further conversion to gram per 100 gram [14].

Results and Discussion

Proximate analyses: The results of proximate composition of *S. latifolius* fruit are shown in Table1. Pearson [15] reported that moisture content is a measure of the water content in fruit samples, if moderate; it is an indication that it can be stored for a long time without the development of moulds. The moisture content of *S. latifolius* was 14.60% (Table 1) which falls within the range of values required as safe storage limit for plant food materials [5]. The value was lower compared to 43.2% and 22% reported for *Moringa citrifolia* fruit and *Moringa pubescens* fruit [16] which belongs to the same family of plant as *S. latifolius* (Table 1).

Crude protein of *S. latifolius* was 8.52%, which is higher than 8.32% reported for *M. citrifolia* and lower than 4.87% reported for *M. pubescens.* Ayessou et al. [17] in a study of the nutritional contribution of some Senegalese forest fruit reported that *S. latifolius* provided high protein content compared to *F. gnaphalocarpa* and *C. pinnata*. Dreon et al. [18] showed that most fruits had high carbohydrate content depending on the fruit type, maturity and environment. Carbohydrate content of *S. latifolius* was 45.80%. The value was found to be higher when compared to *Adansonian digitata* specie (20% and 32%) [19], but was lower than the carbohydrate content obtained for *Zizyphus Mauritania* specie (between 56-65%) [20].

Ash content is a measure of the total mineral content of a food. *S. latifolius* fruit showed ash content of 4.5% indicating its richness in mineral element. Ayessou et al. [17] reported similar result for the ash content of some Sudanese forest fruits (*S. latifolius, F. gnaphalocarpa, C. pinnata*). Crude fibre obtained from *S. latifolius* fruit (32.60%) was lower than that reported for *M. citrifolia* (33%) *fruit* and *M.* p*ubescens* (48%) fruit [15]. The fibre RDA values for children, adults, pregnant and breast feeding mothers are 19-25%, 21-38%, 28% and 29% respectively. Thus *S. latifolius* fruit is a good source of dietary fibre in human diet.

Parameter	Concentration (% DW)*
Moisture content	14.60 ± 1.02
Ash content	4.50 ± 1.10
Crude protein	8.52 ± 0.38
Crude fibre	32.60 ± 0.10
Carbohydrate content	45.80 ± 1.06

The data are Mean values ± Standard deviation (SD) of three replicates.
* Values expressed as % Dry weight.

Table 1: Proximate composition of the fruit of S. *latifoliu.*

Parameter	Concentration (% DW)*
K	0.294
Na	0.196
Ca	0.242
P	0.531
Mg	0.329

Table 2: Macro mineral content of the fruit of *S. latifoliu.*

Mineral composition: Mineral in order of their abundance in human body include seven major (macro) minerals Ca, P, K, Na, Cl, S and Mg. Important trace (micro) elements include Fe, Co, Cu, Zn, I and Se. Macro minerals are present in virtually all cells in the body, maintaining general homeostasis and required for normal functioning. Acute imbalances of these minerals can be potentially fatal. Diet can affect levels of macro nutrients in the body but effect are generally chronic e.g. a high intake of sodium can lead to hypertension [21]. Table 2 shows the macro mineral composition of *S. latifolius* fruit. Calcium forms component of bones and teeth, necessary for blood clotting and muscle contraction. Some forms neutralize acidity, may help clear toxins and provide signaling ions for nerve and membrane function [22,23]. The calcium content of the fruit was 0.242 g which was lower compared to the Senegalese specie of *S. latifolius* fruit (0.472 g/100 g), *F .gnaphalocarpa* fruit (0.612 g/100 g) and *Icacina senegalensis* (0.309 g/100 g) obtained by Ayessou et al. [17].

Phosphorus is related to calcium for bone, teeth and muscles growth and maintenance. it is essential for proper utilization of Mg, Fe, Na and K other than Ca [23]. 0.531 g/100g obtained for phosphorus was appreciably higher than 0.214 and 0.209 g/100g reported for *S. latifolius* fruit [17]. The availability of calcium in the body depends on calcium to phosphorus ratio and presence of anti-nutritional factors. For good calcium intestinal absorption, Ca: P ratio must be 1:1 [5]. Ca: P ratio for the fruit of *S. latifolius* was 2:1 in the study which indicated that the diet can be supplemented with phosphorus sources. Magnesium is an important element in connection with circulatory diseases and calcium metabolism in the bone [24]. The value of magnesium (0.329 g/100 g) reported here was higher than (0.156 g/100 g) reported for *S .latifolius* by Ayessou et al. [17]. Potassium is a systematic electrolyte and essential in co regulating ATP with Na. it is required for regular contraction of the muscle, maintaining the electrical conductivity of the brain and normality of blood pressure in human body [25]. Also, it is preferred as an efficient stress buster, ensure proper growth of muscle tissue, assist in the metabolic processing of various nutrients and supports the kidney to remove waste by the process of excretion [26]. The potassium content of *S. latifolius* fruit (0.294 g/100 g) in the study was found to be lower than 0.939 g/100 g reported for *S .latifolius* fruit by Ayessou et al. [17]. Sodium content in combination with potassium is involved in maintaining proper acid-balance and in nerve transmission in the body [27]. The variation of potassium to sodium content in this work is of significant importance particularly to people suffering from hypertension [5]. The value of 0.196 g/100 g of Na obtained in this study was lower than 0.011 g/100 g (*S .latifolius* and *C .pinnata*) 0.0210 g/100 g (*F .gnapharlocarpa*) 0.138 g/100 g (*I .senegalensis*) reported by Ayessou et al. [17]. However, it was found to be below the daily required dietary intake for sodium [28].

Micro minerals contribute to good health, if they originate from an organic source because they are essentially been processed by

Parameter	*Sarcocephalus latifolius* (g/100g DW)
Zn	0.019
Fe	0.01
Cr	0.000012
Cu	ND
Co	ND

Table 3: Macro mineral content of the fruit of *S. latifolius.*

Plants. When consumed by humans it easily assimilates and toxicity by assimilation does not occur [29]. However, micro minerals from inorganic sources such as heavy metals cannot be used by the body as they tend to build up in the tissues [30]. The recommended dietary allowance (RDA) for some micro elements estimated for safety and adequate daily intakes for adults are as follows; Cr (0.6-3); Mn (26-60); Se (0.9); and Zn (190) in µg/kg body weight [31]. According to WHO recommendation, the maximum permissible limit of toxic metals like arsenic (As), cadmium (Cd) and lead (Pd) amounts to 1.0, 0.3 and 10 ppm respectively [32]. This study reports the concentrations of six microelements Zn, Fe, Cr, Cu, Co and Ni in the fruit of *S .latifolius* (Table 3).

The content of zinc (0.019 g/100 g) in *S .latifolius* fruit was much higher than the other micro nutrients. Although, lower than that reported for *S .latifolius* (19.2 mg/kg) by Ayessou et al. [17], the value falls within the recommended range of 25-150 mg/kg [33]. Zn is a potent antioxidant. It is required for several enzymes such as carboxy-peptidase and liver hydrogenase. Also, it is required for wound healing, postrate disorders, weight loss, hair care and appetite loss [34]. The iron content of *S. latifolius* fruit (0.01 g/100 g) was also lower than that reported by Ayessou et al. [17]. Iron is an essential micronutrient for haemoglobin formation, normal functioning of central nervous system (CNS) and in the oxidation of carbohydrate, protein and fat [30]. The required dietary allowance of iron is put at 5mg/day. Since it had significant amount of iron, its consumption should be encouraged particularly for menstruating and lactating women. The chromium (Cr) content of was low (1.2×10^{-5} g/100 g). However, it was found to be within the permissible limit [32]. Cu, Co and Ni were not detected in the analysed fruit sample probably due to their very low concentration or presence below the detection limit of the instrument.

Conclusion

The results of the nutritional analysis show that *S. latifolius* fruit is a good source of macro and micronutrients. It is recommended for nutritional purposes, considering the amount and diversity of nutrients it contain. This work supports earlier reports that environmental condition and genetic variation exert significant influences on chemical composition of plants. This study further showed that no single plant could provide the required food nutrients.

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