NUTRIENT COMPOSITION AND FATTY ACIDS PROFILE OF *SENNA SIAMEA* FLOWER AND FLOWER OIL

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ABSTRACT

The proximate composition, mineral elements contents and fatty acids profile of *Senna siamea* flower were examined with a view to evaluating its nutrient potentials. The proximate analysis showed that the flower contains (g/100g); crude protein (25.49±0.014), crude fibre (15.63±0.04), ash (7.10±0.03), crude fat (9.68±0.04), moisture content (5.54±0.03) and carbohydrate (36.56±0.01). The results of mineral analysis (mg/100g) indicated that calcium, magnesium, manganese, copper, zinc, iron, cadmium and lead are 726.00, 938.00, 64.00, 30.00, 30.00, 8.00 and 16.00 respectively. The fatty acids profile of the flower oil showed that the oil contains higher proportion of unsaturated fatty acid (51.06%) than saturated fatty acid (39.75%). Among the saturated fatty acids quantified, palmitic acid (31.92%) was the most abundant while linoleic acid (20.86%) and linolenic acid (16.93%) were the most abundant unsaturated fatty acids. The results showed that the flowers of *S. siamea* are good sources of essential nutrients but the detection of cadmium and lead calls for caution and as a consequence, the flowers should be properly processed before consumption.

Key words: Minerals, Nutrients, Proximate composition, *Senna siamea*.

INTRODUCTION

Senna siamea (syn. *Cassia siamea*) is a shrub belonging to the *Fabacea* family [1], native of Southeast Asia and better known in folklore, feeding and agriculture, and it is widely distributed in Africa (including Nigeria, Cote d'Ivoire, Eritrea, Ethiopia, Ghana, Kenya, Togo, among others) and in Latin America [2,3]. The plant is about 10-12 m tall, occasionally reaching 20 m.

The bole is short, crown dense and rounded at first, and later becoming irregular and spreading. The young bark is grey and smooth and possesses longitudinal fissures at later stages. The leaves are alternate, 15-30 cm long; compound with 6-14 leaflets each ending in a tiny bristle [4]. It has bright-yellow flower which is up to 60 cm long, upright with pyramid-shaped panicles. The fruits are flat with indehiscent pod, 5-30 cm long, and constricted between the seeds. There are about 20 seeds per pod. The seeds are bean-shaped greenish brown and 8-15 mm long [5].

S. siamea is effective in managing several ailments including constipation, diabetes, insomnia [6], hypertension, asthma, typhoid fever, and diuresis [7]. The leaves and bark of the plant are used locally as antimalarial drug especially when decocted [8]. In traditional medicine, the fruit is used to charm away intestinal worms and to prevent convulsion in children. The young fruits and leaves are also eaten as vegetables in Thailand. The flowers and young fruits are used as curries [9].

However, under-nutrition is the basic concern of developing countries. *S. siamea* flowers are only known for their medicinal properties as reported in literatures. This study therefore sought to examine the proximate compositions, mineral elements and fatty acids profile of *S. siamea* flowers for public and dietary awareness of its nutrients potential.

EXPERIMENTAL

Sample collection and preparation

Fresh young flowers of *S. siamea* were collected from Ladoke Akintola University of Technology (LAUTECH) Ogbomoso, Nigeria, and authenticated in the Department of Pure and Applied Biology of the institution. The fresh young flowers were oven dried to a constant weight and then crushed into small pieces using laboratory mortar and pestle. It was further reduced to powders using a Kenwood electric blender (KW 10). The powdered was then stored in an air-tight container prior to analyses. About 150g of fresh samples were infused in 100 mL of distilled water by boiling.

Proximate analysis

The proximate composition of the sample was determined using the method of [10]. Drying loss content was obtained by heating the samples to a constant weight in a thermostatically controlled oven at 105 ^{0}C. The ash content was done by igniting 0.5 g test sample in a muffle furnace at 550

^{0}C until light grey ash resulted. Protein was determined using the Kjedhal method (N× 6.25). The dried pulverized sample was extracted with petroleum ether (boiling point 40-60 ^{0}C) for 6 h using a Soxhlet apparatus to obtain the crude lipid content while crude fibre content was determined by consecutive acid and alkali digestion of sample followed by washing, drying, ashing at 600 ^{0}C and calculating the weight of the ash free fibre. The carbohydrate was calculated by difference.

Digestion of samples

Ground samples were digested by weighing 0.5 g of samples into Kjedahl flask and 10 mL of concentrated HNO_3 was added and allowed to stand overnight. The content was heated until the production of brown nitrogen (iv) oxide fume ceased. The flask was cooled and 2-4 mL of 70% H_2O_2 was added. Heating was continued until the solution turned colourless. The solution was transferred into 100 mL standard flask and made up to mark with deionized water.

About 10 mL of the Infusion was digested by the addition of 5 mL of concentrated HNO_3 and 5 mL of 30% H_2O_2 solution. The mixture was evaporated to near dryness.

Quantification of mineral elements

The mineral constituents of the whole plant and its infusion, namely Ca, Fe, Mg, Mn, Cu, Zn, Pb and Cd were determined using the methods of analysis described by [10] with little modifications. Total mineral content was analyzed using Atomic Absorption Spectrophotometer (Buck Scientific 200 A model).

Fatty acids analysis and quantification

About 50 mg of the extracted fat content of the sample was esterified with 3.4 mL of 0.5M methanolic KOH for five minutes at 95 ^{0}C. The mixture was neutralized using 0.7 M HCl and 3 mL of 14% boron trifluoride in methanol. The mixture was heated for 5 min at temperature of 90 ^{0}C to achieve complete methylation process. The fatty acid methyl esters were extracted thrice from the mixture with redistilled n-hexane. The content was concentrated to 1 mL for gas chromatography analysis and 1 µL was injected into the injection port of the gas chromatography (HP6890 Powered with HP Chem Station Rev. A 09.01 (1206) software) equipped with flame-ionization detector and a 30×0.25 m column coated with a 0.25 µm film of HP INNOWAZ. Split injection (split ratio 20:1) was performed, with nitrogen as a carrier gas at flow rate of 22 psi.

The column temperature was maintained at 60 ^{0}C for 1 min after injection then programmed at 12^{0}C min^{-1} to 250^{0}C, held for 2 min and then at 15 ^{0}C min^{-1} for 3 min, held for 8 min. The injection port temperature was 250 ^{0}C and detector temperature was 320 ^{0}C. The fatty acids were identified by comparing their retention times those of standards and the content of fatty acids was expressed as percentage of total fatty acids.

Statistical analysis

Three replicates were analyzed per sample and the data generated were subjected to statistical analysis and reported as mean ± standard deviation (SD) of the three different determinations. Analysis of variance (ANOVA) was used to determine the significant difference between the whole flower and the infusion. Differences at $P<0.05$ were considered significant.

RESULTS AND DISCUSSION

The proximate composition of *Senna siamea* flower (on dry weight basis) was reported in Table 1. The percentage moisture content was 5.54 %. This was lower compared to 46.01% in *S. siamea* leaf [11] and 6.16% in *S. alata* flower [12]. However, the moisture content is low to ensure prolonged shelf life and prevent deterioration due to microbial attack and this implies that the flowers of *S. siamea* can be stored for some days without any physiological changes and biochemical reactions. The protein content of the flower (25.49 %) was much higher than 4.01% reported in the leaves of *S. siamea* [11], 18.23% and 13.14% in *S. alata* leaf and flower respectively [12]. The observed variations may be due to the differences in the geographical locations and plant parts. Apart from the nutritional significance of proteins, it also plays a part in the organoleptic properties of foods [13].

The crude fibre content of *S. siamea* flower (15.63%) was higher than the reported values of 13.63%, 4.63% and 3.09-4.66% for *S. siamea* seeds and some legumes [14- 16]. The intake of fibre can lower serum cholesterol level, risk of coronary heart disease, hypertension, diabetes, colon and breast cancer [17]. Low fibre diet has been associated with heart diseases, colon cancer, obesity, diabetes, constipation and appendicitis [18, 19]. Thus, *S. siamea* flowers could be valuable sources of dietary fibre in human nutrition as a result of its relatively high fibre.

Crude fat content of the sample (9.68%) was low but this value is higher than 3.5% reported for *Senna hirsuta* and 4.4% for *Senna obtusifolia* flower [20]. The ash content (7.10 %) which is an

indication of the mineral contents in the food was higher than 6% reported for *S. alata* leaves [20]. Thus, *S. siamea* flowers could be sources of mineral elements.

Table 1: Proximate composition of *S. siamea* flower

Parameters	Concentration (%)
Moisture content	5.54 ± 0.03
Crude fat	9.68 ± 0.04
Crude protein	25.49 ± 0.04
Crude fibre	15.63 ± 0.04
Ash content	7.10 ± 0.03
Carbohydrate	36.56 ± 0.01

The levels of micro and macro elemental nutrients are presented in Table 2. Minerals are recognized to be important in human nutrition [21]. It is evident from Table 2 that there are significant difference ($p<0.05$) in the mineral constituents (Ca, Mg, Fe, Mn, Pb, Cd and Zn) of the whole and infused sample, with the whole flower having higher values than the infusion. However, the level of Ca was higher in *S. siamea* flower (726.00 mg/100g) than that of *S. alata* leaf and flower (mg/100g) which were 158.38 mg/100g and 63.30 mg/100g respectively. Thus the flower when used as food adjunct can assist in preventing calcium deficiency related diseases such as osteoporosis [22].

The flower contained copper, which is required in the body to prevent anaemia, heart diseases and nervous disorders. It is also responsible for the production of vitamins, enyzmes and hormones. Cu deficiency decreases the tinsel strength of arterial walls and hence leads to aneurysm formation and skeletal maldevelopment [23]. *S. siamea* flower contained low level of Zn. Zn is used in the treatment and prevention of zinc deficiency such as stunted growth and acute diarrhea in children. Adequate levels supports body's immunity and strength [24].

The iron content of the sample is high. Iron is an important element required by the body to prevent diseases such as anemia, useful for the formation of hemoglobin, normal functioning of the central nervous system and in the oxidation of carbohydrate, proteins and fats [25]. Deficiency of iron often leads to fatigue, decrease immunity and antioxidant stress. The Recommended Dietary Allowance (RDA) for iron is 8 mg. The high level observed in *S. siamea* could be beneficial to the body because high concentration of iron has been reported to enhance

pro-oxidant activity via the Fenton reaction. Iron is also required for growth of tissue and organs and for expanding the red blood cells mass [26].

Manganese is one of the important essential elements required in carbohydrate metabolism. It is required by the body for treatment and prevention of weak bones and anemia. It is also required in a small quantity and its deficiency rarely occurs [27]. The level of Mn in the flower sample was 64.00 ±0.07 mg/100g while in the infusion it was 3.88 ± 0.13 mg/100g; only about 2-5 mg per day is required by the body as excess of it can cause serious side effect such as Parkinson's disease [28].

The flower of the sample contained higher magnesium (938.00 ± 0.27 mg/100g) compared to the infusion (53.0 ± 0.13 mg/100g). The need for magnesium in food diet is very important since type 2 diabetes have been reported to be associated with low magnesium content in the body [29].

Table 2: Mineral element concentrations of *S. siamea* flower

Mineral elements	Infusion (mg/100g)	Flower (mg/100g)
Ca	19.75±0.01b	726.00±0.26a
Cd	0.38±0.01b	8.00±0.18a
Cu	2.13±0.02b	236.00±0.41a
Fe	14.50±0.17b	30.00±0.22a
Mg	53.00±0.23b	938.00±0.27a
Mn	3.88±0.13b	64.00±0.17a
Pb	1.75±0.13b	16.00±0.09a
Zn	8.88±0.15b	30.00±0.13a

Mean±standard deviation, means with the same alphabet in the same row were not significantly ($p<0.05$) different.

Fatty acids profile

Twenty-eight fatty acids were identified in the *S. siamea* flower (Table 3). The result revealed that saturated fatty acids constituted 39.75% while monounsaturated fatty acids constituted 9.06% and polyunsaturated fatty acids amounted to 51.06%. Among the saturated fatty acids present, palmitic acid was found to be the most abundant (31.92%). The unsaturated fatty acids present were majorly linoleic acid (20.86%) and linolenic acid (16.97%). Linoleic and linolenic acids are essential polyunsaturated fatty acids that cannot be synthesized by the body and they have been reported to be crucial in the maintenance of some key physiological functions in the

body. Deficiency of bioactive linoleic acid leads to poor growth, fatty liver, skin lesions and reproductive failure [30]. Hence, *S. siamea* flower oil could be a dietary source of these polyunsaturated fatty acids in ameliorating health related diseases.

Table 3: Fatty acids profile of *Senna siamea* flower oil

Fatty acid		Percent (%)
SATURATED		
Lauric	(C12:0)	0.16
Myristic	(C14:0)	0.35
Palmitic	(C16:0)	31.92
Stearic	(C18:0)	7.05
Arachidic	(C20:0)	0.13
Behenic	(C22:0)	0.13
Lignoceric	(C24:0)	0.02
TOTAL		**39.75**

Fatty acid		Percent (%)
MONOUNSATURATED		
Myristoleic	C14:1 (cis-9)	0.02
Palmitoleate	C16:1 (cis-9)	1.53
Petroselaidate	C18:1 (trans-6)	0.05
Petroselinic	C18:1 (cis-6)	3.13
Eladic	C18:1 (trans-9)	0.00
Oleate	C18:1 (cis-9)	3.82
Cis-vaccinic	C18:1 (trans-11)	0.11
Gondoic	C20:1 (cis-11)	0.22
Erucic	C22:1 (cis-13)	0.17
Nervonic	C24:1 (cis-15)	0.02
TOTAL		**9.06**
POLYUNSATURATED		
Linoleic	C18:2 (cis-9,13)	20.86
Linoleate	C18:2 (trans-9,12)	0.05
linolenic	C18:3 (cis-6,9,12)	16.93
Linolenate	C18:3 (cis-9,12,15)	12.73
Eicosadienoic	C20:2 (cis-11,14)	0.02
Dihomo-linolenic	C20:3 (cis-8,11,14)	0.15
Eicosatrienoate	C20:3 (cis-11,14,17)	0.08
Arachidate	C20:4 (cis-5,8,11,14)	0.14
Clupanodonic	C20:5 (cis-5,8,11,14,17)	0.09
Brassic	C22:2 (cis-13,16)	0.08
Cervonic	C22:6 (cis-4,7,10,13,16,19)	0.06
TOTAL		**51.06**

CONCLUSION

The results obtained from this present research indicated that *S. siamea* flowers contain essential nutrients for good human and animal health. In line with increase in global demand for food, *S. siamea* flower can serve as a potential source of nutrient filled foods if properly consumed.

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