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Article

Nutritional Properties of *Senna alata* Linn Leaf and Flower

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Abstract: The present study sought to investigate the nutritive value and some anti-nutritional factors present in *Senna alata* Linn leaves and flowers. Result from proximate analysis revealed that the leaves contained 4.49±0.50 g/100g moisture, 9.53±0.06 g/100g ash, 15.73±0.03 g/100g crude fibre, 18.23±0.13 g/100g crude protein, 3.91±0.01 g/100g crude lipid, 47.73±0.01 g/100g carbohydrate and food energy value of 298.61±0.40 Kcal/100g. The flower contained 6.16±0.14 g/100g moisture, 7.00±1.0 g/100g ash, 14.75±0.01 g/100g crude fibre, 13.14±0.02 g/100g crude protein, 1.81±0.09 g/100g crude lipid, 57.04±0.04 g/100g carbohydrate and food energy value of 296.98±0.61 Kcal/100g. The antinutritional analysis revealed 6.75±0.70 g/100g alkaloid, 2.00±0.01 g/100g saponin and 8.03±0.06 mg/100g oxalate in the leaf while the flower contained 8.50±0.01 g/100g alkaloid, 5.16±0.14 g/100g saponin and 3.50±0.01 mg/100g oxalate. Results from mineral analysis prefigured that the leaf is rich in K (779.20 mg/100g), Mg (142.80 mg/100g), Fe (42.35 mg/100g) and Ca (158.38 mg/100g). The flower is rich in K (1121.95 mg/100g), Mg (148.21 mg/100g), Fe (25.33 mg/100g) and Ca (63.30 mg/100g). Results obtained from vitamin analysis revealed that the leaves and flowers are excellent sources of β-carotene, vitamin C and vitamin E. Conclusively, the leaf and flower are rich in some nutrient, and the antinutritional factors present should not pose a problem since they may be loss during the process of domestication.

Keywords: *Senna alata* Linn; leaf; flower; nutrients; antinutrients; vitamin; mineral.

1. Introduction

Senna alata Linn locally known as gungoroko (Nupe – Northern Nigeria), asunwon oyinbo (Yoruba – Western Nigeria), nelkhi (Igbo – Eastern Nigeria) is a pantropical ornament shrub, belonging to *Caesal piniaceae*. It is commonly known as ringworm plant and widely distributed from tropical America to India (Ibrahim *et al*., 1995; Singh *e*t *al*., 1990). The leaves of *Senna alata* Linn possess analgesic, antimicrobial, antitumor and antidiabetic properties (Palanichamy *et al*., 1988; Palanichamy and Nagarajan, 1990; Somchit *et al*., 2003). It is locally used in Nigeria in the treatment of several infections such as ringworm and parasitic skin diseases (Dalziel, 1956; Palanchamy *et al.*, 1990). The leaves have been used as abortificient and to hasten labour (Yakubu *et al*., 2010). Traditionally, *Senna alata* Linn flower is well known for medicinal utility and commonly used to treat problems related to liver, kidney, intestine and vision. The leaves are reported to be useful in treating convulsion, gonorrhea, heart failure, abdominal pains, oedema and also used as purgative (Ogunti *et al.*, 1993).

The flower is locally credited for the treatment of syphilis and diabetes. The effectiveness of *Senna alata* Linn against skin diseases was confirmed by modern scientific studies (Makinde *et al.*, 2007). The phytochemical components such as alkaloids, anthraquinones, saponins, tannins, terpenes, steroids, flavonoids and carbohydrates of *Senna alata* Linn have been investigated for their therapeutical potency (Owoyale *et al.*, 2005). The utilization of feeds by living organisms significantly elevates man's development, his health and well being. Undernutrition is the basic concern of developing countries. *Senna alata* Linn leaves and flowers are well known for their medicinal benefits. Howbeit, the nutritional information is skimpy. The present study is aimed at evaluating the inorganic, proximate, vitamin and antinutrient compositions of *Senna alata* Linn leaf and flower.

2. Materials and Methods

2.1. Plant Collection and Identification

Senna alata Linn leaves and flowers were obtained from Shonga, Edu Local Government area of Kwara State, Nigeria. The plant materials were taxonomically identified at College of Agriculture Mokwa, Niger State, Nigeria. The flowers and the leaves of *Senna alata* Linn were sun dried and subjected to the following analysis.

2.2. Proximate Determination

The methods of the Association of Analytical Chemists (AOAC, 1990) were used to determine moisture, ash, crude fiber, crude protein and crude lipid present in *Senna alata* Linn leaf and flower.

Percentage of carbohydrates was obtained by difference i.e. 100% – % (moisture + crude protein + crude lipid + ash + crude fiber).

2.3. Antinutrient Determination

Alkaloid was determined based on the method described by Harbone (1973). Saponin was determined using the method described by Obadoni and Ochuko (2001). The method described by Day and Underwood (1996) was used to determine the oxalate contents present in the leaf and flower of *Senna alata* Linn.

2.4. Mineral Determination

One gram (1 g) of the samples was digested using 15 mL of HCl and 5 mL of nitric acid (3:1). Mineral compositions of the digested samples were determined using atomic absorption spectrophotometer (AAS 6800) made by Shimadzu.

2.5. Vitamin Determination

Vitamin E, vitamin C and β-carotene were determined using UV-vis spectrophotometer (UV-2550) made by Shimadzu.

3. Results and Discussion

The results obtained are shown in Tables 1-4.

Table 1. Proximate analysis of *Senna alata* Linn leaf and flower

Parameters	Leaf (g/100g)	Flower (g/100g)
Moisture	4.49±0.50	6.16±0.14
Ash	9.53±0.06	7.00±1.0
Crude fibre	15.73±0.03	14.75±0.01
Crude protein	18.23±0.13	13.14±0.02
Crude lipid	3.91±0.01	1.81±0.09
Carbohydrate	47.73±0.01	57.04±0.04
Food energy value	298.61±0.40 (Kcal/100g)	296.98±0.61 (Kcal/100g)

Note: Values were expressed as mean ± standard deviation of three determinations.

Table 2. Antinutrient composition of *Senna alata* Linn leaf and flower

Antinutrient	Leaf	Flower
Alkaloid (%)	6.75±0.70	8.50±0.01
Saponin (%)	2.00±0.01	5.16±0.14
Oxalate (mg/100g)	8.03±0.06	3.50±0.01

Note: Values were expressed as mean of three ± standard deviation of three determinations.

Table 3. Mineral composition of *Senna alata Linn* leaf and flower

Elements	Leaf (mg/100g)	Flower (mg/100g)
K	779.20	1121.95
Zn	0.55	2.14
Cd	0.61	0.33
Na	0.53	0.14
Mg	142.80	148.21
Fe	42.35	25.33
Ca	158.38	63.30

Table 4. Vitamin composition of *Senna alata* Linn leaf and flower

Vitamins	Leaf	Flower
β-Carotene (IU)	50.37	51.00
Vitamin C (mg/L)	9.09	6.23
Vitamin E (IU)	31.50	25.89

3.1. Results from Proximate Analysis

The result obtained from proximate analysis on the leaf and flower of *Senna alata* Linn was depicted in Table 1. The leaf of *Senna alata* Linn contained 4.49± 0.50 g/100g moisture, 9.53±0.06 g/100g ash, 15.73±0.03 g/100g crude fiber, 18.23±0.13 g/100g crude protein, 3.91±0.01 g/100g crude lipid, 47.73±0.01 g/100g carbohydrate and caloric value of 298.61±0.40 Kcal/100g. The flower contained 6.16±0.14 g/100g moisture, 7.00±1.0 g/100g ash, 14.75±0.01 g/100g crude fibre, 13.14±0.02 g/100g crude protein, 1.81±0.09 g/100g crude lipid, 57.04±0.04 g/100g carbohydrate and food energy value of 296.98±0.61 Kcal/100g. The moisture content of *Senna alata* Linn leaf was low compared to 10-13 g/100g obtained in grain *amaranth* (Akingbade *et al.*, 1997) and 11-12% obtained in the grain of cowpea varieties (Henshaw and Sobowale, 1996). The moisture content of the flower was also low compared to 7.50% moisture content of *Cassipourea congoensis* (Nkafamiya *et al.*, 2007). This implies that dried leaves and flowers of *Senna alata* Linn can be stored for some days without any physiological changes and biochemical reactions due to the low moisture content.

The ash content was high (9.53 g/100g) in the leaf, which is an indication of high mineral content. The ash content (7.00±1.00 g/100g) of *Senna alata* Linn flower was almost the value reported for the ash content of *Moringa oleifera* leaf, but high (9.53 ±0.06 g/100g) in the leaf of *Senna alata* Linn as compared to *Moringa olefeira* (Ogbe *et al*., 2012). Fiber contents value (14.75± 0.01 g/100g) of the flower was higher than the value reported for *Milletia obanensis* (Umoren *et al*., 2005).

The crude fiber contents of *Senna alata* Linn leaf and flower were higher than the reported values 13.65%, 4.63% and 3.09-4.66% for *Senna siamea* seeds and for some legumes (Ingweye *et al*., 2010; Khattab *et al*., 2009; Mubarak, 2005). The complex carbohydrates that are not digested by the human enzymes are collectively referred to as dietary fiber. Fiber absorbs large quantities of water and toxic compounds produced by intestinal bacterial. Fiber also improves glucose tolerance by the body. This is mainly done by a diminished rate of glucose absorption from the intestine. Consumption of dietary fibre above 30 g per day may decrease the intestinal absorption of certain minerals e.g. Ca, P, and Mg.

The crude protein content (18.23±0.03 g/100g) of *Senna alata* Linn leaves is comparable to 18.74% crude protein contents of *Myriathus arboreus* (Amata, 2010). The crude protein contents of *Senna alata* Linn leaves and flowers are also comparable to some wild edible leafy vegetables such as *Momordical balsamina* (11.29), *Moringa olefeira* (20.72%) (Lockett *et al*., 2000) and *Lesianthera africana* (13.10 -14.90) (Hensisan and Umar, 2006). Protein from plants leaf sources is perhaps the most naturally abundant and cheapest source of protein, such that there has been growing realization in the use of plant leaf meals in livestock diets. Apart from the nutritional significance of protein as a source of amino acids, it also plays a part in the organoleptic properties of foods (Okon, 1983). High content of carbohydrate in the leaf and flower of *Senna alata* Linn may play a significant role in protein sparing action. Protein performs a specialized function of body building and growth. The wasteful expenditure of protein to meet the energy needs of the body should be curtailed. Carbohydrate comes to rescue and spare the proteins from being misused for caloric value.

The crude lipid yield (3.80%) was high in the leaf, but low in the flower (1.80%) as compared to crude lipid content (2.11%) of *Moringa oleifera* (Ogbe *et al*., 2012). Lipid is important in diets because it promotes fat soluble vitamins and does not add to the bulk of the diet (Bogert *et al.*, 1994).

3.2. Antinutrient Composition

Wild edible plants are rich in several nutrients. However, the main problem related to the nutritional exploitation of these kinds of plants is the presence of antinutritional and toxic factors. The results obtained from antinutritional analysis depicted in Table 2 revealed that the oxalate contents (8.00± 0.06 and 3.50±0.01 mg/100g) of *Senna alata* Linn leaves and flowers were low compared to that of *H. esculentus* (23.4%) and *T. triangular* (6.93-7.4%) (Oyesiku, 2006). At low pH, oxalate inhibits calcium absorption from the gut of animals (McDonald *et al.*, 1995). Oxalate forms complex with calcium thereby making it unavailable, and more also high oxalate diets can increase the risk of renal calcium absorption (Osagie and Eka, 1998).

The saponin contents (2.00±0.01 and 5.16±0.14 g/100g), compared to 12.1 g/100g of *M. utilis* were low (Siddhuraju and Becker, 2005). Saponins are naturally occurring surface – active glycosides. They are mainly produced by plants, but also by lower marine animals and some bacteria (Riguera, 1997; Yoshiki *et al*., 1998). Animal nutritionists have generally considered saponins to be deleterious compounds. In ruminants and other domestic animals, the dietary saponins have significant effects on all phases of metabolism, from the ingestion of food to the excretion of wastes (Cheeke, 1996). Saponin reduces protein digestibility probably by the formation of sparingly digestible saponin protein complexes (Potter *et al*., 1993). Saponin is associated with growth retardation in non-ruminants (e.g. chicks and pigs), primarily due to reduction in feed intake (Cheeke and Shull, 1985). In ruminants, saponin may not retard growth since it undergoes bacteria degradation in the rumen (Lu and Jorgensen, 1987). Alkaloids are more or less toxic substances which act primarily on the central nervous system (Hegnuauer, 1963).

Antinutrients are found at some level in almost all foods for a variety of reasons. However, their levels may be reduced as a result of process of domestication. Saponins are characterized by a bitter taste and foaming properties. The adverse effect of saponin can be overcome by repeated washing with water which makes the feed more palatable by reducing the bitterness associated with saponins (Joshi *et al*., 1989). Dietary oxalate may be degraded by rumen microbes into CO_2 and formic acids

3.3. Mineral Composition

The results obtained from mineral analysis on the leaf and flower of *Senna alata* Linn portray in Table 3 revealed low content of sodium and high contents of calcium, potassium, iron and magnesium. The result showed that the magnesium, potassium and iron contents of the leaf and flower of *Senna alata* Linn were high compared to magnesium (19.16 mg/kg), iron (3.80 mg/kg) and potassium (0.6 mg/kg) contents of shear butter leaf (Abidemi *et al*., 2009). Minerals perform several essential functions which are important for the existence of the organism. These include calcification of bone, blood coagulation, neuromuscular irritability, acid – base equilibrium, fluid balance and osmotic regulation. Several minerals participate as co-factors for enzymes in metabolism. Certain hormones exert their function through the mediation of Ca^{2+} (instead of cAMP). Calcium is regarded as a second messenger for such hormonal action e.g. epinephrine in liver glycogenolysis. Calcium serves as third messenger for some hormones e.g. antidiuretic hormone (ADH) acts through cAMP, and then calcium.

The iron contents of *Senna alata* Linn leaf and flower were greater (42.35 and 25.33 mg/100g) than 2.88, 8.8, 9.7 and 2.4-4.1 mg/100g reported for raw *Canavalia* spp, beach pea, mung beans and *Desi chickpea* seeds respectively (Shahidi *et a*l., 1999; Sridhar and Seena, 2006; Umoren *et a*l., 2005; Zia-Ul-Haq *et al*., 2007). Iron is mostly found in foods in ferric form (Fe^{3+}) bound to proteins or organic acids. In the acid medium provided by gastric HCl, the Fe^{3+} is released from foods. The reducing substances such as ascorbic acid (vitamin C) and cysteine convert ferric iron (Fe^{3+}) to ferrous form (Fe^{2+}). Iron in the ferrous form is soluble and readily absorbed. Iron is associated with the effective immune competence of the body.

The leaves and flowers of *Senna alata* Linn are excellent sources of potassium, but the values (779.20 and 1121.95 mg/100g) obtained from this study were lower than 1029-1786 mg/100g and 2000 mg/100g reported for *Cassia hirsute* (Vadivel and Janardhanan, 2000).

The zinc contents (0.55 and 2.5 mg/100g) of *Senna alata* Linn leaf and flower were far below the dietary requirement (10-15 mg/day). Zinc deficiency is associated with poor wound healing, growth retardation, loss of appetite and loss of taste sensation. It is also useful for protein synthesis, normal body development and recovery from illness (Mohammed *et al*., 2011). Zinc may be regarded as an antioxidant since the enzyme superoxide dismutase (zinc containing) protects the body against the free radical damage.

The magnesium composition obtained from this study is enough to consider the leaf and the flower as good source of magnesium. Magnesium is necessary for efficient metabolism of carbohydrates and lipids, involved in cellular respiration and general cellular biochemistry and function (McDonald *et al*., 1995).

3.4. Vitamin Composition

Results obtained from vitamin analysis were shown in Table 4. The results revealed that the leaf contained 50.37 IU β-carotene, 9.09 mg/L vitamin C and 31.50 IU vitamin E. The flower contained 51.00 IU β-carotene, 6.23 mg/L vitamin C and 25.89 IU vitamin E. The presence of vitamin E in the leaves and flowers of *Senna alata* Linn may play a significant role in alleviating aluminium toxicity. Regional accumulation of aluminium in albino rat brain was found to be affected by dietary supplementation of vitamin E (Abubakar *et al*., 2004). Consumption of *Senna alata* Linn leaves and flowers may protect the liver from being damage by toxic compounds such as carbon tetrachloride due to the presence of vitamin E. As an antioxidant, vitamin E works in association with vitamin A, C and β-carotene, to delay the onset of cataract. Vitamin C performs a sparing action on other vitamins such as vitamin A, vitamin E and some B-complex vitamins from oxidation. Vitamin C reduces the risk of cancer and coronary heart diseases.

4. Conclusions

The results obtained from this present research revealed that the leaves and flowers of *Senna alata* Linn were rich in crude fiber, crude protein, carbohydrate, potassium, magnesium, iron, calcium, β-carotene and vitamin E. If well processed, *Senna alata* Linn leaves and flowers may improve the health status of livestock.

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