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The nutritional potential of *Senna alata* seed

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Abstract

The nutrients and some anti-nutrients in the seed of *Senna alata* linn were investigated using standard procedures. Findings from the proximate analysis revealed high content of carbohydrate (58.44±0.16 g/100g) and low moisture content (2.90±0.01 g/100g). The anti-nutritional analysis prefigures low content of alkaloid (2.00 g/100g) while saponin was not detected. Mineral analysis revealed respectively excellent source of K (1356.74mg/100g), Ca (288.55 mg/100g), Mg (134.00 mg/100g) and Fe (14.50 mg/100g). The GC/MS analysis on the seed oil yield reasonable percentage of linoleic acid (53.80%), and the least was recorded for behenic acid (1.34%). The high nutrient content in the seed of this plant suggest it could be used as an alternative feed source for livestock.

Introduction

Senna alata Linn (fabaceae) locally known as Gungoroko (Nupe, northern Nigeria) is an ornamental shrub, which grows well in forest areas of West Africa (Owoyale *et al*., 2005). The plant can be found in Nigeria, Malaysia, Australia, Thailand, tropical America and many other parts of the world. It is locally used in Nigeria for the treatment of several infections, which include ringworm and parasitic skin diseases (Dalziel, 1961; Palanichamy *et al*., 1990).

The antimicrobial value of this plant may be attributed to the presence of some metabolites such as the phenols, tannins, saponins, alkaloids, steroids, flavonoids and carbohydrates respectively. The work of Sule *et al.* (2011) revealed that the steroidal compounds present in the leaf extract of this plant are of pronounced worth and concern due to their correlation with numerous anabolic hormones. The leaf is used traditionally in treating convulsion, venereal diseases (syphilis and gonorrhoea), heart failure, abdominal pains, oedema, stomach problems, fever, asthma, snake bite and as a purgative (Owoyale *et al*., 2005).

The methanolic extracts of the leaves, flowers, stem and the root of this plant have been shown to have a broad spectrum of antibacterial activity after fractionating with petroleum spirit, dichloromethane and ethyl acetate. The dichloromethane fraction of the flower extract was found to be the most effective (Khan *et al*., 2001). This plant is also credited for the treatment of haemorrhoids, constipation, inguinal hernia, intestinal parasites, syphilis and diabetes (Sule *et al*., 2010).

The nutritional information on the seed of this plant is scant and this encouraged the researchers to examine the potential of Senna alata, in this case the nutrient composition of the seed.

Materials and Method

Plant collection and identification

The Senna alata seeds were obtained from Shonga, Edu Local Government area of Kwara State, Nigeria. The plant material was identified and authenticated at College of Agriculture Mokwa, Niger State, Nigeria.

Plant preparation

The seeds were dried at room temperature and then pulverised.

Reagents

All reagents used were of analytical grade.

Proximate determination

The method of the Association of Analytical chemists AOAC (1990) was employed to determine the moisture, ash, crude fibre, crude protein and crude

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lipid content in the seed of this plant. Percentage of carbohydrates was obtained by difference i.e. 100 – % (moisture + crude protein + crude lipid + ash + crude fibre). The energy value was calculated using the factors reported by Onyeike and Osuji (2003).

Antinutrient determination

Alkaloid content was determined based on the method described by Harborne (1998). Saponin content was determined following the method described by Obadoni and Ochuko (2001). Phytic acid was determined using the procedure described by Lolas and Markakis (1975). The titration method described by Day and Underwood (1986) was used to determine the oxalate content.

Mineral determination

One gram (1 g) of the sample was digested using 20 ml of aqua regia. Mineral compositions of the digested sample were determined using a Shimadzu Atomic Absorption Spectrophotometer (AAS 6800) (AOAC, 1990)

Vitamin determination

Vitamin E was determined following the method of Thompson and Hatina (1979). Vitamin C (Nobrega and Lopes, 1996), β – Carotene (Ferreira and Rodriguez-Amaya 2008) and B1 (Soliman, 1981) were also determined.

Fatty acid determination

The oil extracted from the seeds of this plant was analysed using a Shimadzu GC-MS QP 2010, with a RTx 5Ms column. The machine was operated under the following conditions: Initial temperature 70°C for 0.00 min and then heated at the rate of 10°C per min to 250°C for 5 min. Carrier gas (He)- flow rate was 1.80 ml per min. The identification of components was based on the comparison of their mass spectra with standards present in the National Institute for Standard Technology (NIST) standard reference database.

Results and Discussion

The result obtained from the proximate analysis is shown in Table 1. The seed of this plant had 58.44±0.16 g/100g carbohydrate, 12.07±0.06 g/100g crude protein, 10.08±0.14 g/100g crude fibre, 9.20±0.00 g/100g crude lipid, 7.30±0.17 g/100g ash, 2.90±0.01 g/100g moisture and food energy value of 364.85±0.65 kcal/100g. The composition of carbohydrate and lipid (58.44±0.16 and 9.20±0.00 g/100g) obtained in this research work were comparable to the percentage of carbohydrate (57.30%) and lipid (8.90%) reported for Abrus prepatorius (Pugalenthi *et al*., 2007).

Table 1. Proximate composition of Senna alata seed

Parameters	Percentage (%)
Ash	7.30 ± 0.17
Crude fibre	10.08 ± 0.14
Crude lipid	9.20 ± 0.00
Moisture	2.90 ± 0.01
Crude protein	12.07 ± 0.06
Carbohydrates	58.44 ± 0.16
Food energy value	364.85 ± 0.65

Values are mean of three determinations ± Standard deviation.

Carbohydrates are the principal source of energy, supply 60 to 80% of the caloric requirement of the body and as well important for the synthesis of pentoses e.g. (ribose) which is the constituents of several compounds in the body e.g. nucleic acids (DNA and RNA) and coenzymes (NAD^+ and FAD).

The percentage of the lipid yield (9.20±0.00 g/100g) was relatively diminutive. This makes the seed oil not potential for oil industries. However, the seed oil from this plant may have some metabolic profit. For example, lipids supply triacylglycerol that normally constitute about 90% of dietary lipid, which is a concentrated source of fuel to the body.

The crude protein content (12.07±0.06) was low compared to the crude protein content of pigeon pea (17.80%), melon seeds (23.60%), locust beans (35.20%) and soya bean (44.60%) (Oboh, 2006). The functions carried out by proteins in living cells are innumerable. Traditionally, protein have been regarded as body building foods. The crude fibre content (10.08±0.14 g/100g) of *Senna alata* seed was high compared to the crude fibre content (7.06 – 8.34 g/100g) of *Canavalia* spp seed (Bhagya *et al*., 2007). Dietary fibre significantly adds to the weight of the food stuff ingested and gives a sensation of fullness to the stomach. Therefore, satiety is achieved without the consumption of excess calories. The percentage of ash (7.30±0.17 g/100g) obtained in this study is an indication of high mineral content. The ash content (7.30±0.17 g/100g) was higher than the value (3.60%) reported for the ash content of *Pachyrhizus erosus* L. (yam bean) (Duke, 1981). The low moisture content (2.90±0.01 g/100g) implies that the seed of this plant may be stored for long periods with little fear of microbial insult.

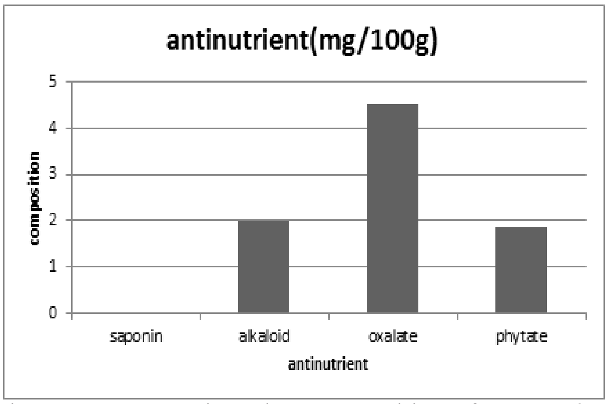

Figure 1. Some anti-nutrient composition of *Senna alata* seed.

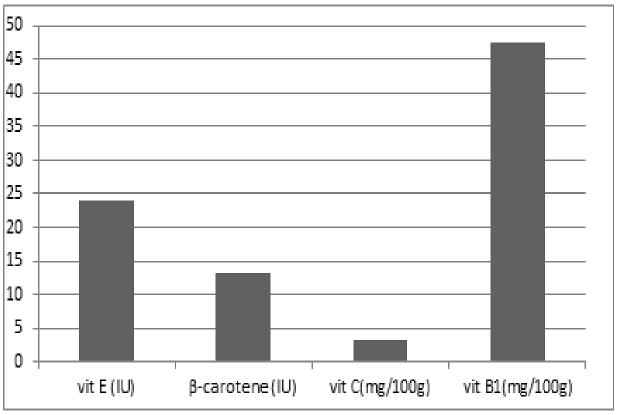

Figure 2. Vitamin composition of *Senna alata* seed.

The results obtained for the anti-nutritional analysis, shown in Figure 1, revealed 2.00 g/100g alkaloids, 4.52 mg/100g oxalate, 1.86 g/100g phytic acid and saponins were not detected. The anti-nutritional factors are substances generated in natural feed stuffs by the normal metabolism of the species and by different mechanisms (e.g. inactivation of some nutrients and diminution of the digestive process or metabolic utilisation of feed), which exert effects contrary to optimum nutrition (Gemede and Ratta, 2014). Phytic acid binds calcium, iron, zinc and other minerals, thereby reducing their availability in the body. It also inhibits protein digestion by forming complexes with them. However, the phytic acid content (1.86 mg/100g) obtained in this study can be reduced further by domestication process (Abdulwaliyu *et al.*, 2013). Supplementing high phytic acid diets with the enzyme phytase can also increase the availability of some dietary mineral (Hardy, 2000). Interactions among various anti-nutrients in a particular feed source may also reduce their individual toxic effect (Francis *et al.*, 2001).

Animal nutritionists have generally considered saponin as a deleterious compound (Francis *et al.*, 2002). However, saponin was not detected. A large number of feed materials contain both saponin and protein and the nature of the interaction between saponin and protein may reduce protein digestibility.

The results shown in Figure 2 revealed the vitamin composition of *Senna alata* seed. The seed contained 3.38 mg/100g vitamin C, 36.17 IU vitamin E, 40.39 IU β-carotene and 47.45 mg/100g vitamin B_1. The result clearly showed that the seed of this plant is richer in vitamin C, vitamin E, β-carotene and vitamin B1 compared to the values 0.56 mg/100g,1.3 IU,15.27 IU and 0.08mg/100g reported for the vitamin C, Vitamin E, β-carotene and vitamin B_1 content of mango seed which had also been proposed as an alternative feed for livestock (Fowomola, 2010).

Among the vitamins analysed, vitamin B_1 (thiamine) had the highest value (47.45 mg/100g). Vitamin B_1 is mostly associated with carbohydrate metabolism. The irreversible conversion of pyruvate to acetyl CoA catalysed by pyruvate dehydrogenase is dependent on thiamine. In thiamine deficiency, carbohydrate metabolism is impaired.

The vitamin C (ascorbic acid) content (3.38 mg/100g) obtained in this study was low. Many animals can synthesize ascorbic acid from glucose via uronic acid pathway. However, man, other primates, guinea pigs and bats cannot synthesize ascorbic acid due to the deficiency of a single enzyme namely L-gulonolactone oxidase. The metabolic role of vitamin C cannot be left out. Therefore, there is need to supplement the seed of this plant with vitamin C rich feeds.

The vitamin E content (36.17 IU) obtained in this study is appreciable. Vitamin E (tocopherol) is a naturally occurring antioxidant. It is essential for normal reproduction in many animals. Most of the function of vitamin E is related to it antioxidant properties such that, it prevents the non-enzymatic oxidation of various cell components (e.g poly-unsaturated fatty acids) by molecular oxygen and free radicals such as superoxide (O_2^-) and hydrogen peroxide (H_2O_2).The seed of this plant contained ample amount of β-carotene (40.39 IU). β-carotene also functions as an antioxidant and reduces the risk of cancers initiated by free radicals and oxidants. It is also said to prevent heart attacks.

Table 2 reveals the mineral composition of the seed. This result clearly showed that the iron composition (14.50 mg/100g) of *Senna alata* seed was high compared to the content (8.80 mg/100g and 9.70 mg/100g) in the beach pea and mung bean respectively (Shahidi *et al.*, 1999; Umoren *et al.*, 2003). Iron mainly exerts its functions through the compounds in which it is present. The requirement for iron is most critical in young suckling animals, because milk is a poor source of iron (Ingweye *et al.*,

Table 2. Mineral composition of *Senna alata* seed.

Parameter	Weight (mg/100g)
K	1356.74
Zn	2.02
Na	0.36
Mg	134.0
Fe	14.50
Ca	288.50

2010).

The Na composition (0.36 mg/100g) obtained in this study was low, suggesting the need to supplement the seeds of this plant with Na rich feeds. Deficiency of sodium causes body dehydration, poor growth and reduced utilization of the digested protein (McDonald, 2002). Sodium is the chief cation of the extracellular fluid. About 50% of the body sodium is present in the bones, 40% in the extracellular fluid and the remaining (10%) in the soft tissues. In alliance with chloride and bicarbonate, sodium regulates the body's acid – base balance. It is also involved in the intestinal absorption of glucose, galactose and amino acids.

The zinc composition in this plant seed (2.02 mg/100g) is comparable to 1.7–2.0 mg/100g reported for Cassia floribunda (Vadivel and Janardhanan, 2001). Feeding animals with seeds of *Senna alata* may improve the taste sensation of livestock, since Gusten (Zn containing protein of the saliva) is important for taste sensation.

The percentage of magnesium composition (134.00 mg/100g) procured in this study, was far higher than the value (22.34±0.01 mg/100g) reported for the magnesium constituent of mango seed flour (Nzikou *et al*., 2010).

Calcium is the most abundant among the minerals in the body. The total content of calcium in an adult man is about 1–1.5 kg which may be lower or even higher in some animals. The calcium content (288.55 mg/100g) of *Senna alata* seed was higher than the calcium composition 9.40 mg/100g of *Cocculus hirsutus* (Gupta *et al*., 1989).

Among the minerals analysed, potassium had the highest value (1356.74 mg/100g). The potassium composition obtained, was twenty four times higher than the potassium composition (54.70 mg/100g) of *C.hirsutus* (Khan *et al*., 2012). Potassium is required for the regulation of acid-base balance and water balance in the cells. Serum potassium concentration is usually maintained within a narrow range. Either low or high magnesium concentrations may affect proper metabolic function.

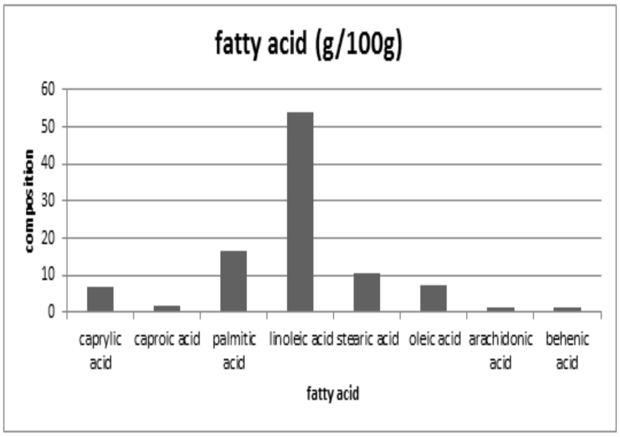

Figure 3. Fatty acid composition in the seed oil of *Senna alata.*

The result obtained from the fatty acid analysis (Figure 3) showed 37.52% saturated fatty acids, 7.21% monounsaturated fatty acids and 55.27% polyunsaturated fatty acids. This result also clearly shows that the essential fatty acid linoleic acid is the major fatty acid composition of this plant seed oil.

Hexadecanoic acid (palmitic acid) and octadecanoic acid (stearic acid) were the major saturated fatty acid present in the seed oil. The palmitic acid content (16.65%) was lower than the values 25-30% obtained for the palmitic acid content of Pachyrhizus spp (yam bean) (Grüneberg *et al.,* 1999). Consumption of palmitic acid increases the risk of cardiovascular diseases, placing it in the same evidence category as trans-fatty acids (WHO, 2003).

The seed oil had (10.66%) stearic acid. Unlike palmitic acid, stearic acid has a neutral effect on the blood total and low density lipoprotein (LDL) cholesterol levels. Thus, stearic acid may not increase the risk for cardiovascular disease.

The oleic acid (9-octadecenoic acid) was the only monounsaturated fatty acid present in the seed oil. The percentage of the oleic acid (7.21%) was lower than the oleic acid content (42.68%) of *Bauhinia malabarica* (Vijayakumari *et al*., 1993). Oleic acid is commonly found in various types of plant products and its main benefits are its ability of lowering the blood pressure, decreasing the levels of LDL cholesterol and increasing the levels of HDL cholesterol in the blood. It also synergistically enhances cancer drug effectiveness (Menendez *et al*., 2005).

The seed oil also revealed ample amount of linoleic acid. It is the major fatty acid content of *Senna alata* linn seed oil as obtained in this study. The linoleic acid content (53.80%) obtained is comparable to the value (54.30%) obtained for the linoleic acid content of soya bean (Nzikou *et al*., 2010).

Linoleic acid is a member of the group of essential fatty acids (EFAs), so called because it cannot be produced within the body and must be acquired through diet. Linoleic acid plays a vital role in many metabolic processes and it deficiency may result to poor wound healing and loss of hair.

Conclusion

The results obtained in this study suggest that the plant seed, if properly processed can serve as an alternative food source, particularly for livestock.

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