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Research Article

Phytochemical Profile and Dietary Potential of *Senna siamea* (Kassod tree) Seeds*:* As a Sustainable Feed Resource for Cane Rats (*Thryonomys swinderianus*)

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ABSTRACT

The nutritional and phytochemical composition of *Senna siamea* (Kassod tree) seeds collected from Irepo Local Government Area (Kisi), Oyo State, was analyzed between October and December 2024. This study aims to generate data that will facilitate the effective utilization of this underexploited tropical seed in livestock feed formulation. The analysis revealed that the seeds contain a substantial protein content (21.69%), alongside notable levels of crude fat (7.65%), ash (5.96%), crude fiber (8.13%), and carbohydrates (48.44%). Additionally, they serve as a rich source of vitamin A (613.27 mg/100g) and contain vitamins D, C, and E, along with amounts of vitamins B1, B2 and B3. The mineral profile includes essential macro-minerals such as calcium, potassium, sodium, and magnesium, as well as micro-minerals like iron, manganese, zinc, and copper. Phytochemical screening identified several bioactive compounds, including alkaloids, tannins, phenolics, saponins, flavonoids, and steroids, with lower concentrations of cardiac glycosides and phytates. Although anti-nutritional factors such as phytates and oxalates were detected, their levels are unlikely to pose significant dietary challenges if appropriate processing methods are applied. The presence of these bioactive compounds suggests potential pharmacological applications, positioning *Senna siamea* seeds as a better resource for both traditional and modern medicinal formulations.

Keywords: Animal Nutrition; Bioactive Compounds; Caen Rats Domestication; Feed Formulation; Plant Macro-Minerals

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INTRODUCTION

The *Senna siamea* (popularly known as Kassod tree) is a fast-growing, evergreen leguminous tree from the Fabaceae family. Originally native to Southeast Asia. It has successfully spread and naturalized across tropical and subtropical regions, including Africa, due to its adaptability an adverse application (Orwa *et al.,* 2009). In Nigeria, this species plays a significant role in agroforestry, traditional medicine, and as a source of fodder, timber, and firewood (Akinyemi *et al.,* 2018). The seeds and leaves of *Senna siamea* are recognized for their nutritional value, providing essential proteins, vitamins and minerals making them a potential ingredient in animal feed.

The tree typically grows between 10 and 12 meters in height, although some specimens can reach up to 20 meters. It features a short bole with a dense, rounded crown that later develops an irregular, spreading shape. The bark starts off smooth and gray but develops longitudinal fissures as it matures. Its leaves, which grow alternately, are compound and measure 15-30cm in length, consisting of 6-14 leaflets, each ending in a fine bristle (Haba *et al.,* 2019). The plant produces distinctive bright yellow flowers, forming upright, pyramid-shaped panicles that can extend up to 60cm. the fruit consists of flat, indehiscent pods ranging from 5 to 30cm in length, with visible constrictions between the seeds. Each pod contains approximately 20 seeds,

which are bean-shaped, greenish-brown, and measure between 8 and 15mm in length (Nacoulma, 1996).

Previous studies have reported the protein content of *Senna siamea* seeds to range between 20-25%, making them a promising alternative to conventional protein sources in animal feed (Olowofeso *et al.,* 2012). The *Senna siamea* (Kassod tree) holds cultural significance across Nigeria, evidenced by its various indigenous names that reflect its widespread distribution and importance in local communities. Among the Hausa people, it is called Mariya, while the Yoruba refer to it as Asunwon Oyinbo or Eeru Ifon. In Igbo, it is known as Ubah and the Fulani call it the Tamsal tree. These names highlight the tree's integration into the daily lives of different ethnic groups, often linked to its uses in traditional medicine, agroforestry and other applications (Akinyemi *et al.,* 2018).

Plate 1: *Senna siamea* (Kassod tree) seed

METHODS AND MATERIALS

Collection and processing of sample seeds

Ripe pods of *Senna siamea* (Kassod tree) were collected from Irepo Local Government, (Kisi), Oyo State, Nigeria, and authenticated in the Forestry Research Institute of Nigeria. The seeds were removed mechanically from the pods of the sampled plants and cleaned to remove dirt. The seed sample was air-dried for five days and ground using a Kenwood electric blender (KW 10). It was then passed through a 40 mesh sieve, packaged in airtight sterile sample bottles, labeled, and stored in a plastic container and taken to the laboratory of the Institute for Agriculture Research and Training (IAR&T), Moor plantation, Apata, Ibadan, Oyo State, Nigeria.

Proximate Analysis

The Chemical Analysis for percentage crude protein, crude fiber, Moisture content, Ash, fat, and carbohydrate was conducted using the official methods outlined by the Association of Official Analytical Chemists (AOAC, 1990). Each determination was performed in triplicate.

Moisture Analysis

The sample was oven-dried at 100-105°C until a constant weight was achieved, typically within 12-30 hours, and the moisture content was determined based on the weight loss. The mineral composition of the seeds including Ca, Fe, Mg, Mn, Cu, Zn, Pb, and Cd, was analyzed using modified AOAC (1990) methods. Total mineral content was measured with an Atomic Absorption Spectrophotometer (Buck Scientific 200A model).

Vitamin Analysis

The vitamins including Vitamin A, B1, B2, B3, B12 C, E and K were analyzed using the method of vitamin Assay (FEFANA, 2006).

Crude Protein Content

The nitrogen content was analyzed using the Kjeldahl method, which involved three key staps: digestion, distillation, and titration. The Nitrogen value was then multiplied by a conversion factor of 6.25 (AOAC, 1990).

Available Carbohydrate

Available carbohydrate was estimated by difference using the formula: 100 – (%crude proteins + %crude lipid + Crude fibre + %Ash) (AOAC, 1990).

Anti-Nutritional Analysis

The anti-nutritional evaluation was conducted to determine the percentage composition of various anti-nutritional factors, including tannins, saponins, oxalate, alkaloids, flavonoids, steroids, and cardiac glycosides, following the method described by Krishna and Ranjhan (1980).

Data Analysis

All the data generated were analyzed using descriptive statistics as outlined by Olawuwi (1996). The results were expressed as mean ± standard deviation from triplicate determinations.

RESULTS AND DISCUSSION

Proximate Composition of Senna siamea (Kassod tree) seeds

The proximate composition of Kassod tree (*Senna siamea)* seeds is presented in Table 1. The findings of this study align with those reported by Ighodalo et al. (1993); however, they differ from previously documented values, which indicate protein content at 21.40%, crude fat at 7.65%, Ash content at 5.96%, crude fiber at 8.13%, and carbohydrate at 48.44%. Additionally, Ajah and Madubuike (1997) reported different values for *Senna siamea* seeds, with protein at 23.45%, crude fat at 5.87%, ash content at 4.80%, crude fiber at 10.25%, and carbohydrate at 47.63%.

Vitamins composition of Kassod tree (*Senna siamea*) seeds

The findings in table 2 indicate that the sample contains various essential vitamins required for cane rat growth

(Adoun & Alokan, 2006) in varying proportions. The vitamins identified in the analysis include A, B1, B2, B3, C, and E. Among them, vitamin C has the highest concentration at 5.09g/100g, while vitamin A had the lowest at 0.708µg/100mg. The presence of these essential vitamins suggests that Kassod tree seeds could serve as a nutritionally beneficial ingredient for enhancing cane rat health and growth performance.

Table 1. Proximate Composition of Kassod tree (*Senna siamea*) seeds

Macronutrients	Concentration (%)
Moisture content	06.45±0.18
Crude protein	21.69±0.14
Crude fat	07.65±0.16
Ash content	05.96±0.40
Crude fiber	08.13±0.13
Carbohydrate	48.44±0.05

Source: *laboratory based analysis, 2024*
The values are mean±standard deviation

Table 2. Vitamin composition of Kassod tree (*Senna siamea*) seeds

Vitamin	Concentration (%)
Vitamin A (µg/g)	**0.71±0.01**
Vitamin B1 (g/100g)	**1.28±0.14**
Vitamin B2 (g/100g)	**3.17±0.16**
Vitamin B3 (g/100g)	**3.99±0.23**
Vitamin C (g/100g)	**5.09±1.03**
Vitamin E (µg/100g)	**1.08±0.12**

Source: Laboratory-based analysis, 2024

Mineral composition of Kassod tree (Senna siamea) seeds

The mineral analysis results, represented in Table 3i, indicate the presence of macronutrients such as calcium, magnesium, potassium, phosphorus, and sodium (mg/g). Furthermore, Table 3ii displays the detected micronutrients, including iron, manganese, zinc, copper, molybdenum, cobalt, sulfur, selenium, and fluorine, measured in Mg/100g.

The occurrence of both essential minerals and nutrients suggests that Senna siamea (Kassod tree) seeds could serve as a sustainable feed ingredient for cane rats. Calcium, which was found in higher concentrations, is crucial for bone formation, blood function, and extracellular fluid balance. It also plays a vital role in cardiac muscle function, blood clothing, and cell permeability regulation. Sodium and potassium contribute to ionic balance in the body and help maintain moderate tissue excitability (Lall, 2002). Magnesium is an essential component of bone, cartilage, and the exoskeleton of crustaceans. Through its role in enzyme activation, it functions similarly to calcium by stimulating muscle and nerve contractions, regulating intracellular acid-based balance, and participating in carbohydrate, protein, and lipid metabolism (Gafar & Itolo, 2011). Although sodium was present in lower concentrations, it is essential for maintaining acid-based equilibrium, nerve impulse transmission, and the absorbtion of sugars and amino acids in the gut. A deficiency in sodium can lead to dehydration, poor growth, and reduced protein utilization (McDonald *et al.,* 1995).

The micronutrients detected in small amounts are vital components of various enzyme systems, such as cytochrome oxidase, lysyl oxidase, and ceruloplasmin. An iron-oxidizing enzyme in blood (Mills, 1981). Copper, for instance, aids in iron absorption and hemoglobin formation, which explains its link to anemia prevention (FAO/WHO, 1974). Zinc, a key component of metalloenzymes, plays a crucial role in nucleic acid metabolism (Atukorala & Waidyanatha 1987). Additionally, it functions as a membrane stabilizer and enhances immune response (Hambidge, 1978). Although manganese levels in Senna siamea seeds were relatively low, it remains essential for hemoglobin formation, though excessive amounts can be harmful

(Critchley, 1986). In contrast, Iron was present in higher concentrations making it beneficial for anemia prevention and overall health (Oluyemi *et al*., 2006).

Table 3i: Micro-mineral composition of Kassod tree (Senna siamea) seeds

Elements	Concentration (Mg/100g)
Calcium (Ca)	780
Magnesium (Mg)	773
Potassium (K)	750
Phosphorus (P)	690
Sodium (Na)	520

*** The values are means of three replicates ** Not detected

Table 3ii: Micro-mineral composition of Kassod tree (Senna siamea) seeds

Elements	Concentration (Mg/100g)
Iron	108.02
Zinc	24.06
Copper	9.26
Molybdenum	1.01
Cobalt	0.12
Selenium (Se)	0.01
Fluorine	0.72

*** The values are means of three replicates ** Not detected

Table 4: Phytochemical composition of Kassod tree (*Senna siamea*) seeds

Phytochemicals properties (mg/100g)	Status
Flavonoids	**++**
Tannins	**++**
Alkaloids	**+**
Saponins	**+**
Glycosides	**+**
Terpenoids	**Trace**
Phytate	**+**
Steriods	**-**

+, present; ++, highly present; - absent

Source: Laboratory-based analysis, 2024

The phytochemical analysis done on Senna siamea (Kassod tree) seeds revealed the presence of several antinutritive factors, such as flavonoids, tannins, alkaloids, saponins, glycosides, terpenoids, phytate, and steroids. However, these compounds are unlikely to pose significant nutritional concerns if the seeds are properly processed. Notably, germinated seeds were free of tannins and saponins, while cooking considerably reduced the levels of alkaloids, phytate and glycosides (D'Cunha *et al.,* 2009). Terpenoid levels were found very low, and steroids were absent. It is well established that only high concentrations of these antinutrients interfere with nutrient absorption, which is essential for metabolic processes (Yakubu, 2023). Excessive levels can distrupt zinc nd iron homeostasis, inhibit enzymatic protein digestion by forming complexes with proteins and may be toxic to the body (AOAC, 1999; Munro & Bansir, 1969). Although alkaloids glycosides, phytate and trace amounts of terpenoids were detected in the seeds, they are unlikely to pose major nutritional risks if the seeds are adequately processed before being included in cane rat diets. Further research is needed to determine the most effective processing methods for minimizing phytochemical content. Incorporating *Senna siamea* into cane rat feed has the potential to reduce feeding costs while also promoting the cultivation of the Kassod tree.

CONCLUSION

The objective of this study was to evaluate the nutritive and phytochemical qualities of *Senna siamea* (Kassod tree) seeds as a sustainable feed ingredient for cane rats. The findings revealed that *Senna siamea* seeds were abundant in proximate composition of carbohydrate and protein, which are crucial for energy

and body formation. Also abundant in Ca, Mg, K, P, Na, Fe, and Zn. However, the occurrence of some phytochemicals like phytate and terpenoids calls for the processing of these seeds to render these nutrients useful to cane rats.

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