

NUTRITIONAL COMPOSITION OF PILIOSTIGMA RETICULATUM SEED

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Abstract: The nutritional compositions of piliostigma reticulatum seed was determined. The seeds of the species selected were analyzed for their nutrient and mineral elements. Proximate analysis, mineral analysis and antinutritional analysis of piliostigma reticulatum was carried out using standard analytical techniques, photo spectrometric method and titrimetric method of analysis. Results obtained showed the percentage (%) Moisture contents as 7.6 ± 0.03 , Ash as 9.80 ± 0.14 , Crude fiber as 6.50 ± 0.702 , Crude protein as 2.63 ± 0.04 , Crude lipid as 8.40 ± 1.72 and total carbohydrate as 58.27. The relatively low moisture content reveals good storage stability while the high carbohydrates level indicates that the seed are potential energy source, however the low protein content suggest limited usefulness as a primary source of protein. The findings also revealed appreciable concentration of calcium contents as 1632.33 ± 2.19 mg/g, magnesium contents as 61.21 ± 0.09 mg/g, potassium contents as 1803 ± 8.88 mg/kg and that of sodium content as 86.3 ± 7.50 highlighting the seeds as a rich source of essential macro minerals. Iron content as 7.2 ± 0.79 , zinc content as 4.56 ± 0.19 mg/g and manganese as 197mg/g. The antinutritional analysis of the seeds shows phyates as 0.28mg/100g, saponin as 0.21mg/100g, oxalate as 0.04mg/100g and tannins as 0.01mg/100g.

Keywords: Piliostigma reticulatum, Proximate analysis, Mineral composition, Antinutritional factors, Nutritional assessment.

I. INTRODUCTION

Piliostigma reticulatum (camel foot) is a pan tropical weed commonly found in cultivated fields, water areas and settlement throughout West Africa. Almost all parts of the plants are used to treat a variety of health complaints. The juice of the plant are used as condiment. The seed are anti halmentic, carminative cardiac stimulant and are useful in fever and diarrhea (Bayala et al., 2025).

Externally it acts as a rubefacient and vesicant. The pungent seed can be pickled or used as a mustard substitute in curries. The seed oil is used for cooking. The leaves are used as an external application to wound and ulcers. The leaves and young shoots are cooked as a vegetable. The paste of root is applied also externally in the treatment of earaches. Traditionally piliostigma reticulatum are used for soil improvement, fodder and medicinal purposes, its seeds are gaining attentions for their nutritional potentials. The seeds of piliostigma reticulatum was studied for their nutritional potentials, especially in the context of animal feed formulations and food security (Agarwal et al., 2022).

Preliminary studies have shown that the seeds of p. reticulatum are rich in protein, dietary fibre and essentials minerals such as calcium , potassium, phosphorus and iron (Davy et al., 2023).

Despite these promising attributes, the seed also contains anti-nutritional factors such as tannins, phytate and oxalates which may limits nutrients bioavailability and digestibility if consumed raw. Given the increasing demands for sustainable, climates resilient food sources, there is compelling needs to scientifically evaluate the nutritional compositions of p. reticulatum seeds. this could support their integration into local food systems and enhances their use in livestock feeding (Centre, 2023).

However, the seeds remains largely under-utilized and scientific information on their nutritional quality is scarsed compared to other common legumes such as cowpea or groundnut. Evaluating the proximate and minerals compositions of piliostigma reticulatum seeds is essentials to established their nutritional potential , promote their use in food and feed systems, and enhances the economic value of this indigenous resources (Salim & Nehvi, 2023).

The present aim of this research is to determine the proximate composition of piliostigma reticulatum seeds including moisture, ash, crude protein, crude fibre, crude fat and carbohydrate content and analyse the mineral profile of the seed focusing on both major elements (ca, mg, k, Na, p) and trace elements (Fe, zn, cu, mn) (Jimoh & Oladiji, 2020).

II. MATERIAL AND METHOD

1. **Sample Collection:** Matured seeds of *piliostigma reticulatum* was collected from four different healthy trees and four different locations in dakingari districts, suru local government area of Kebbi state, Nigeria. By using stratified random sampling, foreign materials (stones, pods ,dust) was removed manually.
2. **Sample preparation:** The seeds are washed thoroughly with distilled water to removes dirt and air dried at room temperature for 48 hours, then oven dried at 60-70 °C for 2 hours. The dried seeds was grinded into powder using laboratory mill and stored in an airtight container.
3. **Preparations of Standard solution**
 - i. **Preparation of 10%HCL**
Exactly 10cm³ of concentrated HCl was diluted to the mark of a 100cm³ mark of a volumetric flask with distilled water.
 - ii. **Preparation of 1.25%H₂SO₄**
Exactly 1.25cm³ of concentrated tetraoxosulphate(vi)acid was diluted to 100cm³ mark of a volumetric flask with distilled water.
 - iii. **Preparation of 1.25%NaOH**
Exactly 1.25cm³ of NaOH was diluted to 100cm³ mark of a volumetric flask with distilled water.
 - iv. **Preparation of 4% Boric acid:**
This was prepared by dissolving 4g potassium ferricyanide to 1000ml mark of volumetric flask with distilled water. 0.01MH₂SO₄ has been prepared by diluting 0.01MH₂SO₄ to the mark of 100ml volumetric flask with distilled water.

4. **Proximate Analysis**

- **Determination of moisture content (loss of weight):** 5g of the sample was placed in a clean and dry pre-weight crucibles and heated in an oven at 105°C for 3-5 hours, its then covered with lid and transferred quickly into a desiccators to cool for 30 minutes, procedure was repeated until constant weight. The percentage moisture content was calculated as in equation (1.0) (A OAC, 2017).

$$\% \text{moisture} = \frac{W_2 - W_1}{W_1} \times 100 \dots \dots \dots (1.0)$$

- **Determination of Ash content (total minerals) :** 5g of the samples was incinerated in a muffle furnace at 550°C for 4-6 hours until constant weight is achieved. The percentage ash content was calculated using equation, (1.1):

$$\% \text{ Ash} = \frac{w^3}{w^2} \times 100 \dots \dots \dots (1.1)$$

- **Determination of crude protein:** 5g of the sample was digested with concentrated sulphuric acid in a kjeldahl digestion flask using a catalyst mixture of potassium and copper sulphate, the digest was distilled with 40% NaOH and then 4% boric acid containing mixed indicator. The distillates was titrated against 0.1M HCl acid until the end point was reached.. % of crude protein was calculated.

$$\text{Crude protein} = \frac{\text{TV} \times \text{H}_2\text{SO}_4 \times \text{NF} \times \text{VSD} \times 100}{\text{Wet of sample} \times \text{volume of aliquot}} \dots \dots \dots (1.2)$$

Where ;
 TV :Titre valve
 NF: Nitrogen factor
 VSD ; volume of sample dilution
 (Bakere, 1985).

- **Determination of crude Fat:** crude Fat was determined by continuous extraction of the sample with petroleum ether for 6-8 hours in a soxhlet extractor. The solvent dissolves the fat, which was later recovered after evaporation of the solvent.

$$\text{Crude fat} = \frac{\text{weight of extracted fat} \times 100}{\text{weight of sample}} \dots \dots \dots (1.3)$$

- Determination of crude Fibre: Organic fibre residue was established after sequential digestion with 1.25% sulphuric acid and dilutes NaOH for 30 minutes , the filtrate is washed with water followed by ethanol and then ignited in a muffle furnace at 550°C.

$$\% \text{ crude fibre} = w_2 - w_3 / w_1 \times 100 \dots\dots\dots(1.4)$$

Where: w_1 = weight of sample used
 w_2 = weight of crucible + sample after drying
 w_3 = weight of crucible + sample after ashing

- Determination of carbohydrates content: carbohydrates content was calculated by subtracting the difference of the sum of moisture, ash, crude protein, crude fat and crude fibre from 100.
5. Minerals Analysis: The mineral composition of the seed sample was determined in standard procedures of AOAC (2019).
 - Wet acid digestion: samples is digested with mixture of nitric acid sulphuric acid and per chlorate.
 - Dilutions: The digested sample is cooled, filtered and diluted with ionizes water.
 - AAS and Flame photometry: Samples was taken for AAS and Flame photometry with standard solutions of known concentration.
 6. Anti-nutritional analysis: The levels of selected anti-nutritional factors such as tannins, phytates, oxalates, saponins and alkaloids have been determined using standard procedures of AOAC (2019)
 - Determination of Tannins; sample extract is reacted with ferric chloride, formation of blue black complex indicates tannins.
 - Determination of Phytate: Sample is extracted with acid and mixed with ferric chloride and centrifuged , insoluble complex is formed which indicates phytates.
 - Determination of oxalates: extracted sample is titrated with 0.05m permanganate solutions until paint colour persist for 30 seconds. the amount of the oxalate is determined based on the volume of permanganate used.
 - Determination of saponin: The extracted sample is separated into layers with diethyl ether and upper layer is discarded, followed by addition of 10ml n butanol and evaporation to dryness. Saponin content is determined gravimetrically.
 - Determination of alkaloids: the extracted was reacted with concentrated NH₄OH in drop wise until precipitate is formed, settled and washed with NH₄OH solution. the residue is heated in an oven to constant weight.

III. RESULT AND DISCUSSION

Table 1: Proximate composition of the seed of piliostigma reticulaum (Kalgo)

Parameters	Values (%)
Moisture content	7.6 ±0.03
Ash content	9.80±0.14
Crude fiber	6.50±0.702
Crude protein	2.63±0.04
Crude lipid	8.40±1.72
Total carbohydrate	58.27

The nutritional content of the seed of piliostigma reticulatum (camel foot) were investigated. The results of the proximate analysis are shown in Table 1 above. the moisture content was found to be 7.6% indicating good storage stability of the seed, The high values of ash content (9.8±0.4%) in the sample indicate a high mineral content in it. The crude fiber content was observed to be (6.50±0.702%) an appreciable value that could aid digestive health, Crude protein content (2.63±0.04%) of the sample was obtained ,which is an indication that it contains nitrogenous substance.the crude fat content was (8.40%) indicating moderate lipid level that can contribute to energy supply and essential fatty acid.Total carbohydrate content was found to be (58.27%) indicating the seed as an important energy source.

Table 2: The results of minerals analysis for the seed of *piliostigma reticulatum*

Elements	Values (mg/100g)
Magnesium	61.21±0.09
Calcium	1632.33±2.19
Potassium	1803.20±4.80
Sodium	86.3±7.50
Zinc	4.56±0.19
Iron	7.2±0.79
Copper	0.98±0.05
Manganese	2.26±1.02
Phosphorus	81.0±2.84

The mineral composition of *piliostigma reticulatum* revealed appreciable amount of essential micro and macro elements. Potassium(1803.20±4.80) was the most predominant mineral, indicating its role in maintaining fluid balance and nerves transmission and muscles functions. Calcium(1632.33±2.19) level suggest the seed may contribute to the bone development, structural formation and magnesium(61.21±0.09) support energy metabolism and enzymatic activity. The presence of phosphorus (81.0±7.30) further enhances the nutritional value of the seed as its vital for ATP formation and skeletal health . The relatively low sodium content is nutritionally beneficial as excessive sodium intake is associated with hypertension . Trace elements such as iron, zinc, copper and manganese were detected in moderate quantities. Iron (7.2±0.79) indicate that the seed may assist in preventing anemia by supporting the hemoglobin formation.Zinc(4.56±0.19)contributes to immune function and cellular metabolism while copper (0.98±0.05) plays a role in iron utilization and antioxidant defense. Manganese (2.26±1.02) is involved in metabolic processes and bone development. Overall, the mineral profile demonstrates that *piliostigma reticulatum* seeds contains essential macro and micro-nutrients necessary for human health and could contribute to nutritional security when incorporated into food formulation.

Statistical Interpretation of Mineral Analysis

The mineral composition of *piliostigma reticulatum* seed was analysed in triplicate and expressed as mean ± standard deviation(SD). The standard deviation values obtained for all the minerals were relatively low indicating minimal variation amongst replicate measurement and suggesting high precision and reliability of the analytical method employed. Potassium exhibited the highest mean concentration (1803.20 mg/100g) with a low SD value (±4.80) reflecting consistent readings across the three determinations.Similarly calcium (1632.33±2.19mg/100g) and phosphorus (81.0±2.84mg/100g) show narrow dispersion around their mean values indicating stable mineral content in the sample analyzed. Trace elements such as iron (7.2±0.79mg/100g) ,zinc (4.56±0.19mg/100g), copper (0.98±0.05mg/100g) and manganese (2.26±1.02mg/100g) also recorded low variability ,suggesting good reproducibility of the atomic absorption spectrophotometric measurement. The coefficient of variation (CV) for each mineral was low (generally less than 5%) which further confirms the accuracy and precision of the experimental procedures. Low CV values indicates that the experimental error was minimal and that the result obtained are statistically dependable. Overall the statistical evaluation demonstrates that the mineral values content reported for *piliostigma reticulatum* seeds are reliable and can be confidently used for nutritional assessments and comparisons with the existing literature.

IV. CONCLUSION

The findings from these research clearly demonstrates that, the seeds of *piliostigma reticulatum* possesses nutritionally rich composition with significant variation among the measured parameters. The proximate analysis shows that carbohydrates constitutes the highest proportion of the seed composition followed by ash content and crude lipid indicating the seed potential as primary source of energy and the presence of essential mineral and potential for metabolic function. The moderate protein and crude fiber observed suggest the seed body building and digestive health benefits. The reported mean values with standard deviation reflect consistency in the analytical procedure.

The mineral composition results shows notable concentration of essential macro elements such as potassium, calcium, sodium and magnesium, alongside micro elements including iron, zinc, and copper, these minerals are known to support physiological processes such as bone formation, electrolyte balance, oxygen transport and enzymatic activities. The comparatively higher level of potassium and calcium observed in the sample emphasize the nutritional importance of the seeds in maintaining cardiovascular and skeletal health.



Moreover, the statistical analysis using ANOVA indicates significant differences ($P < 0.05$) among the nutritional parameters confirming that the variation observed in proximate and mineral analysis were not due to random error but reflect the true compositional differences.

Conclusively, the proximate and mineral data obtained in this study confirm that *piliostigma reticulatum* seed are a valuable source of energy, essential nutrients and minerals. The nutritional findings in this research support the potential utilization as a supplementary food material. However, further investigation into processing techniques, nutrient bioavailability and long term safety are recommended to maximize their application in food and feed formulations.

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