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Comparative Evaluation of The Feed Potentials of *Acacia ataxacantha*, *Glycine max* and *Leptadenia hastata* Leaves

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Abstract
The study analyzed the proximate and mineral composition of *Acacia ataxacantha*, *Glycine max*, and *Leptadenia hastata* leaves from Bauchi State, Nigeria. The results showed that *Glycine max* had the highest crude protein content (2.25% ± 0.00%), indicating its potential as a valuable source of protein for animal feed. In contrast, *Leptadenia* had the highest crude fibre content (2.02% ± 0.02%), which could provide a natural source of fibre for livestock. The study also found that the crude lipid content was highest in *Glycine max* and *Leptadenia* (0.10% ± 0.02%), while the ash content was highest in *Leptadenia* (2.35% ± 0.01%). The moisture content varied significantly among the three plant species, with Acacia having the lowest value (10.12% ± 0.02%). In terms of minerals, Acacia had the highest concentrations of chromium (2.85 mg/kg ± 0.01), iron (4.79 mg/kg ± 0.02), and calcium (3.70 mg/kg ± 0.02). *Leptadenia* had high levels of magnesium (14.30 mg/kg ± 0.20) and phosphorus (0.96 mg/kg ± 0.00), while *Glycine max* had high levels of potassium (13.76 mg/kg ± 0.02). The study concluded that the variations in composition suggest that these plants could provide essential nutrients for livestock diets and address specific dietary needs, highlighting their potential as alternative sources of feed ingredients for the animal industry, thereby promoting sustainable livestock production and improving animal health and productivity.

Keywords: Feed potentials, *Acacia ataxacantha*, *Glycine max*, *Leptadenia hastata*, proximate composition.

1. Introduction

The global population continues to grow, resulting in an increased demand for food and livestock products. This surge in demand places pressure on existing feed resources, such as maize, soybean, and beans, leading to competition between human and animal consumption. To address this challenge, researchers and farmers are exploring alternative feed sources that can sustainably support livestock production. One promising avenue is the utilization of plant leaves as feed supplements, which offers several advantages, including their availability, nutritional content, and potential economic benefits [1].

Among the plant species under investigation, *Acacia ataxacantha* (commonly known as Flame Thorn) stands out. This African species, characterized by its hooked prickles and distinctive red pods, belongs to the Fabaceae family. Previous studies have reported its high protein content and rich mineral profile [3][13][10] Our findings align with these observations, as A. ataxacantha exhibits elevated levels of chromium and potassium. These minerals play essential roles in metabolic processes and overall health, making this plant a potential candidate for livestock feed supplementation.

Soybean (*Glycine max*), on the other hand, is a globally recognized leguminous crop. Originally native to Asia, soybeans are now cultivated worldwide. The seeds are valuable for oil extraction, and the resulting high-protein cake serves as a major component in animal diets. Beyond its role in livestock feed, soybeans are versatile and feature prominently in various cuisines. The amino acids derived from soybean protein contribute to muscle development and overall growth in livestock [13][15][12].

Leptadenia hastata, commonly known as "asparagus vine," belongs to the Asclepiadaceae family. Although less familiar than soybean or acacia, this wild plant has been valued for centuries in African populations for its nutritional and therapeutic properties. It is used both as a vegetable and in traditional medicine [18][17][19]. Our study highlights its high crude fiber content, which could be advantageous for ruminant animals with specific dietary requirements. Fiber aids in digestion, prevents bloat, and supports gut health [5][2][7][8].

The rapid population growth necessitates innovative approaches to meet the increasing demand for food and livestock products. By evaluating the nutritional potentials of *Acacia ataxacantha*, *Glycine max*, and *Leptadenia hastata* leaves, we aim to contribute to sustainable livestock production.

The studies on *Leptadenia hastata* and Acacia ataxacanta leaves revealed varying nutritional profiles. *Leptadenia hastata* leaves were found to have high moisture, ash, and energy content, making them a potential source of energy for human consumption, with notable amounts of calcium and magnesium for bone development. In contrast, Acacia ataxacanta leaves had lower moisture content but higher fibre content, making them a potential feed resource for animal production due to their high nutrient levels and safe mineral concentrations, with notable amounts of potassium, calcium, magnesium, and phosphorus for maintaining overall animal health [6][9]. Some studies have highlighted the varying nutritional composition of *Leptadenia hastata* leaves and stems, with leaves having higher moisture, protein, and ash content, while stems are richer in fiber and nitrogen-free extract. However, the presence of anti-nutritional compounds like oxalate and phytic acid in leaves may affect mineral absorption. Similarly, high levels of carob seed germ meal in the diet of rainbow trout fingerlings have been shown to have negative effects on growth, body protein levels, and liver protein accumulation due to anti-nutritional factors like tannins [16][11]. It is also revealed that these plants are rich in essential nutrients, including protein, carbohydrates, and minerals such as calcium, iron, potassium, and magnesium. These findings suggest that the leaves can serve as a valuable source of energy and minerals for both humans and animals, with potential applications in animal feed production and addressing nutrient deficiencies like anaemia [9][6].

This study focused on analysing the proximate composition and mineral content of these plants. Understanding their unique attributes will inform livestock farmers and researchers, enabling them to optimize animal nutrition and productivity.

2. Materials and Methods

Materials

In this study, only chemicals with high analytical purity were utilized. The research utilized several instruments, specifically an Atomic Absorption Spectrophotometer (AA320N), UV/Visible Spectrometer (752N 4nm), and an Analytical weighing balance (WT2203GH).

Reagents/Solutions

All solutions used in the research were prepared using chemicals of analytical reagent grade purity and distilled water.

- **10.00% (v/V) Ethanoic Acid:** Ethanoic acid (10.00 cm^3) was measured into a 100 cm^3 volumetric flask containing 15.00 cm^3 of water. The resulting solution was made to volume with water.
- **1.00% (v/V) Ethanoic Acid:** Ethanoic acid (1.00 cm^3) was measured into a 100 cm^3 volumetric flask that contained 5.00 cm^3 of water. The resulting solution was made to mark with water.

- **mol/dm³ Potassium Tetraoxomanganate (VII) Solution:** Potassium tetraoxomanganate (VII) crystal (1.58 g) was weighed and dissolved in 100.00 cm³ of water in a 250 cm³ beaker. The resulting solution was quantitatively transferred into a 1000 cm³ volumetric flask and water was added to capacity.
- **4.00% (w/V) Trioxoboric (III) Acid Solution:** A mass of 4.00 g trioxoboric (III) acid was weighed and dissolved in 50.00 cm³ of water in a 100 cm³ beaker. The resulting solution was quantitatively transferred into a 100 cm³ volumetric flask and water was added to volume capacity.
- **0.10 mol/dm³ Sodium Hydroxide Solution**: Sodium hydroxide pellets (4.00 g) were weighed and dissolved in 100.00 cm³ of water in a 250 cm³ beaker. The resulting solution was quantitatively transferred into a 1000 cm³ volumetric flask and water was added to capacity.
- **0.31 mol/dm³ Sodium Hydroxide Solution:** Sodium hydroxide pellets (12.40 g) were weighed and dissolved in 100.00 cm³ of water in a 250 cm³ beaker. The resulting solution was quantitatively transferred into a 1000 cm³ volumetric flask and water was made to mark.

Sampling and Sample Treatment

Fresh leaves of three plant species - *Acacia ataxacantha*, *Glycine max*, and *Leptadenia hastata* - were collected from Bauchi Metropolis, Nigeria, and brought to the Department of Biological Sciences at Abubakar Tafawa Balewa University for identification. The leaves were then processed by washing, homogenizing, air-drying, and grinding each sample into a powder using a mortar and pestle, before being stored in labeled plastic containers for further analysis.

Digestion of Samples

One gram of each sample was separately digested by mixing it with a solution of 20.00 cm³ of concentrated HNO_3, H_2SO_4, and $HClO_4$ in a 2:1:2 ratio, and then filtered using Whatmann filter paper number 1 into a 100 cm³ volumetric flask, which was then filled to capacity with water.

Determinations of Mineral Compositions

The digests of the three samples were analyzed separately to determine their mineral contents, including sodium, potassium, calcium, chromium, magnesium, manganese, iron, copper, and zinc, using an Atomic Absorption Spectrophotometer (AA320N) at specific wavelengths. Phosphorus content was determined using a UV/Visible spectrometric technique.

Determinations of Nutritional Compositions

- **Moisture content:** A sample of 5.00 g of fresh leaves was dried in an oven at 105°C for 3 hours to remove moisture, then cooled and weighed. This process was repeated until no further weight loss was observed, with the sample being dried, cooled, and weighed at hourly intervals. The weight of moisture lost was calculated and expressed as a percentage of the original sample weight.
- **Crude protein content:** A 1.00-gram sample was first digested with a mixture of concentrated sulfuric acid, potassium sulfate, and copper (II) sulfate, which broke down the sample's organic compounds into simpler molecules. The resulting solution was then diluted with distilled water to create a clear liquid. A portion of this digest was then transferred to a distillation flask and mixed with excess sodium hydroxide solution, causing ammonia gas to be released. This ammonia gas was trapped in a conical flask that initially contained 20 cubic centimeters of 4% boric acid. The distillate, which is the liquid collected during the distillation process, was then titrated against a standardized sodium hydroxide solution in the presence of methyl red indicator. The amount of sodium hydroxide required to neutralize the acid in the distillate was measured, allowing for the calculation of the nitrogen content in the original sample. This, in turn, enabled the calculation of the percentage of crude protein in the sample.
- **Total ash content:** The ash content of the sample was measured using a gravimetric technique, following the AOAC method. Five grams of the sample were heated in a Muffle furnace at 550°C for six hours, then cooled in a desiccator and weighed to determine the percentage of ash content.
- **Determination of crude fibre**

  Crude fibre was determined by acid-base digestion method. A mass of 2.00 g of each sample was weighed into a round bottom flask, 100.00 cm3 of 0.25 mol/dm3 tetraoxosulphate (vi) acid was added and the mixture was boiled for 30 mins. The hot solution was filtered, the insoluble matter was washed with hot water several times and quantitatively transferred into a flask. 100.00 cm3 of 0.31 mol/dm3 sodium hydroxide was added to the content of the flask, boiled for 30 mins and filtered. The residure was washed with hot water, dried in an oven at 100 0C, cooled in a desiccator and weighed. The weighed sample was then kept in a muffle furnace at 550 0C for 2 hours, cooled and reweighed. The percentage crude fibre content was calculated.

- **Determination of crude lipid**
  A 5.00g sample was extracted using petroleum ether in a Soxhlet apparatus, where the solvent was heated, vaporized, and condensed back into the flask until the reflux flask was full, and then siphoned over. The extracted oil was then dried in an oven at 60°C for 30 minutes to remove any residual solvent, cooled in a desiccator, and weighed to determine the percentage of extract recovered relative to the original sample mass.
- **Determination of carbohydrate**
  Soluble carbohydrate in each sample was determined by difference, where the percentage values of all the parameters were subtracted from 100 and whatever that was left was regarded as concentration of carbohydrate in each sample.
- **Determination of metabolizable energy**
  Metabolizable energy was determined in each plant sample by multiplying the percentage crude protein value and percentage carbohydrate value by the factor of 4 and percentage crude lipid value by factor of 9, summed up the values and converted into kcal/100 g.

3. Results and Discussion

Results

Tables 1 and 2 show the results of proximate and mineral compositions of the leaves of *Acacia ataxacantha*, *Glycine max* and *Leptadenia hastata*.

Proximate composition of the leaves of the investigated plants

Table 1 shows that proximate composition of the leaves Acacia a. ranged from 0.04 % (crude lipid) to 87.58 % (carbohydrate), that of *Glycine m.* ranged from 0.10 % (crude lipid) to 86.53 % (carbohydrate) and that of *Leptadenia h.* Spread from 0.10 % (crude lipid) to 87.28 % (carbohydrate).

Table 1: Percentage Proximate Composition of the Leaves of Plants

Parameters	**Percentage Composition**		
	Acacia a.	***Glycine m.***	***Leptadenia h.***
Moisture content	8.20 ± 0.20	8.14 ± 0.02	8.06 ± 0.02
Ash content	1.56 ± 0.03	1.74 ± 0.02	1.30 ± 0.01
Crude fiber	1.05 ± 0.70	1.24 ± 0.02	2.02 ± 0.02
Crude lipid	0.04 ± 0.02	0.10 ± 0.02	0.10 ± 0.02
Protein content	1.57 ± 0.02	2.25 ± 0.00	1.15 ± 0.00
Carbohydrate	87.58	86.53	87.28
Metabolizable Energy (kcal/100 g)	356.96	356.02	354.62

Values are mean ± standard deviation (n=3).

Table 1 provided represents the proximate composition of three different leaves species: *Acacia ataxacantha*, *Glycine max* and *Leptadenia hastata*.

The results of this research indicate that the three plant species, Acacia auriculiformis (Acacia a.), *Leptadenia hastata* (*Leptadenia h.*), and Glycine macrophylla (*Glycine m.*), have relatively low moisture contents. Specifically, Acacia a. had the highest moisture content at 8.20%, while *Leptadenia h.* had the lowest at 8.06%. *Glycine m.* fell between the two, with a moisture content of 8.15%. These values are within an acceptable range for storage and suggest that these plant species are suitable for long-term storage as feed materials.

The observed moisture contents in this study are also in fairly good agreement with reported literature values. For example, a study by [9] found a moisture content of 6.47% in Acacia a., while a study by [4] found a moisture content of 7.67% in *Leptadenia h.* In contrast, [20] reported a much higher moisture content of 57.80% in *Typha domingensis*, which suggests that the plant species studied in this research have relatively low moisture levels compared to other plants.

In addition to moisture content, the study also analyzed the ash content of the three plant species. The results show that *Glycine m.* has the highest ash content at 1.74%, while *Leptadenia h.* has the lowest at 1.39%. Acacia a. fell between the two, with an ash content of 1.56%. These values differ from literature values reported by [4][6][20] who found ash contents ranging from 8.73% to 17.67%. However, the observed values in this study are close to the threshold levels of 2.50% reported for Cinnamon, suggesting that *Glycine m.*'s high ash content may be suitable for use in feed formulation with slight spiking.

The study also analyzed the nutritional content of these leaves. The results showed that *Glycine max* had the highest crude fiber content, with a value of 2.02%, while *Acacia ataxacantha* had the lowest, with a value of 1.05%. This is significantly lower than the reported literature values of 15.60% and 16.10% for cassava leaves and guava leaves, respectively. However, the values are higher than those reported by [6] for *Leptadenia hastata*. The crude fiber content is an important consideration in livestock diets as it helps to prevent constipation, bowel and piles problems.

The crude lipid content was found to be highest in *Glycine max* and *Leptadenia hastata*, with a value of 0.10%, compared to 0.04% in *Acacia ataxacantha*. Crude lipid is an important source of energy and fat-soluble vitamins in animals, but excessive intake can lead to obesity and related diseases.

The crude protein content was highest in *Glycine max*, with a value of 2.25%, compared to 1.57% in *Acacia ataxacantha* and 1.15% in *Leptadenia hastata*. This is significantly lower than the reported literature values of 8.86% and 11.29% for *Typha domingensis* and Moringa oleifera leaves, respectively. The recommended dietary allowance (RDA) range for protein is between 10-12%. This suggests that these leaves may not be a good source of protein in livestock feed.

The available carbohydrate content was high in all three leaves, with values ranging from 86.53% to 87.58%. This suggests that they could serve as a good source of energy for animal feed, particularly for low-temperature feed processes.

Mineral Composition of the Leaves of the Studied Plants

Table 2 depicts that the mineral composition of the leaves of Acacia a. spread from 0.53 (phosphorus) to 13.76 (potassium), that of *Glycine m.* spread from 0.21 (zinc) to 14.30 (magnesium), while that of *Leptadenia h.* spread from 0.66 (phosphorus) to 9.51 mg/kg (potassium).

Table 2: Mineral Composition (mg/kg) of the Leaves of Some Plants

Mineral Elements	**Concentration**		
	Acacia a.	***Glycine m.***	***Leptadenia h.***
Calcium	3.64 ± 0.01	1.11 ± 0.02	3.70 ± 0.02
Copper	1.93 ± 0.01	0.29 ± 0.02	0.72 ± 0.02
Chromium	2.85 ± 0.01	2.04 ± 0.02	0.82 ± 0.02
Iron	4.15 ± 0.03	3.36 ± 0.01	4.79 ± 0.02
Magnesium	10.30 ± 0.16	14.30 ± 0.20	8.80 ± 0.20
Manganese	1.94 ± 0.02	0.35 ± 0.02	2.39 ± 0.01
Potassium	13.76 ± 0.02	10.34 ± 0.02	9.51 ± 0.02
Phosphorus	0.53 ± 0.02	0.96 ± 0.00	0.66 ± 0.00
Sodium	0.89 ± 0.02	1.04 ± 0.02	1.34 ± 0.01
Zinc	2.36 ± 0.01	0.21 ± 0.03	3.30 ± 0.10

Values are mean ± standard deviation (n=3).

Table 2 above represents the mineral composition of three different leaves in *Acacia ataxacantha*, *Glycine max* and *Leptadenia hastata* plant samples. These minerals are essential for the nutrition and health of animals, making these plants potentially valuable as animal feed. The minerals of interest in this study include calcium, copper, chromium, iron, magnesium, manganese, potassium, phosphorus, sodium and zinc respectively.

The levels of calcium investigated in this study are: Acacia a. and *Leptadenia h.* (3.70 mg/kg) were approximatly equal and fairly higher than that of *Glycine m.* (1.11 mg/kg). These results are much lower than litrature values of 43,085.67 mg/kg found in *Leptadenia h.* [6], 23,900.00 mg/kg found in *Typha domingensis* [20] and also much lower than the RDA values of 2980.00 mg/kg for goats and 87.00 g/day for cows. Calcium is a mineral element vital for bone and teeth development in animals, as well as muscle function and blood clotting. Long term calcium deficiency can lead to rickets and poor blood clotting. This suggests that the leaves of the three plants are poor sources of calcium, and therefore, calcium supplement are required when formulating animal feed with them.

The concentrations of copper observed in this study was highest in Acacia a. (1.93 mg/kg) compared to values found in *Leptadenia h.* (0.72 mg/kg) and *Glycine m.* (0.29 mg/kg). These results are in strong disagreement with litrature values of 12.80 mg/kg found in *Leptadenia h.* [6] and 20.00 mg/kg found in *Typha domingensis* plant [20] and also to the RDA value of 9.00 mg/ kg for goats. This suggests that other sources of copper would have to be added in order to meet up with the required copper concentration as it is an essential mineral element for various enzymatic reactions and the formation of connective tissues.

The values of iron determined in this study was highest in *Leptadenia h.* (4.79 mg/kg) compared to Acacia a. (4.15 mg/kg) and *Glycine m.* (3.36 mg/kg) which was the lowast. These values are much lower than 135.00 mg/kg found in Vitex doniana leaves [21] and 70.00 mg/100 g in Cassia siemea leaves [6]. The observed values are also lower than RDA values of 16.20 mg/kg for goat and 516.00 mg/day for cows. Iron is a crucial mineral element that plays a vital role in haemoglobin formation, normal functioning of the central nervous system, oxygen transport in the blood and overall energy production. However, excess intake of iron increases the risk for cardiovascular diseases and for bacterial infection [21].

The magnesium content of the *Glycine m.* has the highest value of 14.30 mg/kg compared to Acacia a. (10.30 mg/kg) and that of *Leptadenia h.* (8.80 mg/kg), making it an excellent choice for animals with specific magnesium requirements. The values observed in this study are much lower than 27,400 mg/kg found in *Typha domingensis* [20] and also much lower than the RDA (290 mg/ kg) for goats and 24.00 mg/kg for cows. Magnesium is a mineral element that is important for muscle and nerve function, as well as bone health.

The levels of manganese found in *Leptadenia h.* (2.39 mg/kg) was highest compared to 1.94 mg/kg found in Acacia a. and that of 0.35 mg/kg found in *Glycine m.* was the lowest value. [20] reported much higher value of manganese found in *Typha domingensis* (470.00 mg/kg) and 29.50 mg/kg found in *Leptadenia h.* [6]. However, the RDA values of goats are much lower (0.93 mg/kg). This therefore suggests that the leaves are good sources of manganese. Manganese is important to animals in bone development and cartilage synthesis, enzyme system, reproduction and immune system.

The concentrations of potassium determined in the present study indicates that Acacia a. has the highest potassium content (13.76 mg/kg), followed by *Glycine m.* (10.34 mg/kg) and *Leptadenia h.* having the lowest content (9.51 mg/kg). The observed values are much lower than potassium reported literature values of 7920.00 mg/kg found in *Typha domingensis* [44] which is significantly lower than RDA value of 1580.00 mg/kg for goats. Ruminant animals require up to 800.00 mg/100 g potassium in their feed. This indicates that in formulating animal feed with the studied leaves, other sources are needed to enhance the potassium content. Potassium is an essential mineral element for nerve function, muscle contractions, and maintaining proper fluid balance in animals.

The values of phosphorus determined are (0.53 mg/kg) Acacia a., (0.96 mg/kg) *Glycine m.* and (0.66 mg/kg) *Leptadenia h.* which is significantly lower than the phosphorus literature value of 3.95 mg/kg found in *Leptadenia h.* and that of 3750.00 mg/kg found in *Typha domingensis* [20] for goats, which in turn is fairly close to the RDA value of 1.50 mg. This suggests that all the three leaves are good sources of phosphorus. Phosphorus is an essential mineral element necessary for bone and teeth development, as well as energy metabolism.

The sodium levels found in *Leptadenia h.* (1.34 mg/kg) was highest compared to 0.89 mg/kg found in Acacia a. was the lowest, while that of 1.04 mg/kg found in *Glycine m.* fell within the two extreme values. The observed values are not in agreement with sodium literature values of 1520.00 mg/kg found in *Typha domingensis* [20] and that of 901.25 mg/kg found in *Leptadenia h.* [6] which in turn is lower than the RDA values of 5,150.00 mg/kg for goats and 16.00 g/day for cows. This shows that in formulating animal feed with the leaves, other sources of sodium mineral would have to be supplemented so as to meet up with RDA values of the herbivores. Sodium is an important mineral element for maintaining proper fluid balance and nerve function in animals.

The values of zinc determined in this study was significantly higher in *Leptadenia h.* (3.30 mg/kg) compared to that of 0.21 mg/kg in *Glycine m.*, whilst 2.36 mg/kg found in Acacia a. fell between the two extreme values. These values are much higher than 0.20 mg/kg found in *Typha domingensis* plant [20] and the RDA values of 5.64 mg/kg for goats and 688 mg/day for cows. This suggests that a zinc supplement is needed when formulating animal feed with these leaves. Zinc is an essential mineral element for growth, immune function and wound healing in animals.

The values of chromium determined in Acacia a. and *Glycine m.* have relatively similar and higher chromium contents (2.85 and 2.04 mg/kg), whilest *Leptadenia h.* has a lowest concentration of 0.82 mg/kg. Chromium is a mineral element that is important for glucose metabolism and insulin sensitivity in animals.

4. Conclusion

The study analyzed the proximate and mineral compositions of *Acacia ataxacantha*, *Glycine max*, and *Leptadenia hastata* leaves to evaluate their nutritional content and potential as alternative animal feed sources. The results showed that all three plants have low moisture content, making them suitable for long-term storage. *Glycine max* exhibited high ash, protein, and phosphorus content, making it a potential source of minerals and protein in livestock feed. *Leptadenia hastata* had high crude fiber and iron content, suggesting it may provide more fiber and iron for certain livestock. *Acacia ataxacantha* had high calcium, copper, and potassium content, making it a suitable source of these minerals. Overall, each plant has its unique nutritional profile, highlighting their potential as alternative feed sources for different types of livestock.

In conclusion, this study sheds light on the nutritional profiles of *Acacia ataxacantha*, *Glycine max* and *Leptadenia hastata* leaves, providing valuable insights into their potential as alternative sources of animal feed. The variations in proximate and mineral compositions in these plants highlighted their diverse nutritional contributions, suggesting that their incorporation into livestock diets could address specific dietary needs. The findings underscore the importance of diversifying feed resources to optimize livestock nutrition and overall health.

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References

[1]. Amata, I.A. and Nwagu, K.M. (2013). Comparative Evaluation of Nutrient Profile of the Seeds of Four Selected Tropical Plants and Maize. International Journal of Applied Biology and Pharmaceutical Technology, 4:177-189.

[2]. Bello, A., Aliero, A., Said, A., Muhammad, S. and Shinkafi, B.Y. (2011). Evaluation of Polyphenolic Content and Alphaghicosodase Inhibitory Effect of *Leptadenia hastata*. Nigerian Journal of Botany, 19: 181-186.

[3]. Dagba, B.I. and Harris, B.J. (2014). Studies of Acacia in Zaria Area of Kaduna State, Nigeria. International Journal of Science and Research, 3(4): 445-452.

[4]. Fai, F.Y., Wilson, L.D., Muhammad, M.M. and Simon, Y.S. (2015). Chemical Composition and Nutritive Value of *Leptadenia hastata* Leaves. International Journal of Innovation Science and Research, 4(10): 480-484.

[5]. Haruna, A., Mann, A. and Ogbadoyi, E.O. (2017). Phytochemical Composition and Antitrypanasomal Activity of the Leaf Extract of *Leptadenia hastata*. Bayero Journal of Pure and Applied Sciences, 10(2): 292-299.

[6]. Hassan,U.F., Hassan, H.F., Baba, H., Shibdawa, M.A. and Iorfa, E.N. (2017). Nutritional Evaluation of *Leptadenia hastata* Leaves. International Journal of Advancements in Research and Technology, 6(3): 4-10.

[7]. Ibrahim, H. A., Ali, G.Y., Halliru, S.N., Usaini,S. and Abdullahi, I.I. (2012). Ethnobotanical Survey of the Wild Edible Food Plants Consumption among Local Communities in Kano State, North-Western Nigeria. International Journal of Science and Technology, 2: 713-717.

[8]. Inuwa, I.M. (2012). Nutrient and Anti-nutrient Composition of *Leptadenia hastata* and Senna obtusifolia linn Leaves. An M.Sc. Thesis, Department of Biochemistry, ABU, Zaria,Nigeria. Unpublished.

[9]. Janet, M.D., Dayil, A.D., Olakotun, P., Esther, O. and Miriam, A.A. (2015). Assessment of the Proximate and Mineral Compositions of Acacia ataxacanta Leaves. International Journal of Science and Research, 6(5): 2319-2328

[10]. Madubuike, S.A., Mailafia, S., Ode, O.J. and Okpo, N. (2018). Phytochemical Screening and Antimicrobial Susceptibility of Escherecia coli 01157:H7 Isolate on *Acacia ataxacantha* Leaves. Journal of Microbiology and Antimicrobials.

[11]. Maria N. A. (1990). Comparative Evaluation of Soybean Meal and Carob Seed Germ Meal as Dietary Ingredients for Rainbow Trout Fingerlings. National Centre for Marine Research GR 16604, 3: 235-241.

[12]. Masoero, F., Pulimeno, A.M. and Rossi, F.(2005). Effect of Extrusion, Expansion and Toasting on the Nutritional Values of Peas, Tababeans and Lupins. Italian Journal of Animal Science, 4:177-189.

[13]. Menesses, Q.H., Waaijenberg and Pierola, P., (1996). Las Leguminosae en la Agricultural Boliviana Revision de information Cochabamba, 2:120-129.

[14]. Mokoboki, H.K., Ndlolu, L.R., Ngambi, J.W., Malaye, M.M. and Nikolora, R.V. (2005). Nutritive Value of Acacia Tree Foliages Growing in the Limpopo Province of South Africa. South African Journal of Animal Science, 35(4): 221-228.

[15]. Pfizer, W. (2002). "Nutrient Levels of Feed Ingredient". Nutrient Master Plan Livestock Feed Master, pp. 1-5.

[16]. Tijjani, H., Joel, B.E., Ibrahim, A.A., Abdullahi, I. S. and Habila, S. (2017). Proximate, Minerals and Anti-nutrient Assessment of the Leaves and Tender Stem of *Leptadenia hastata*. Bayaro Journal of Pure and Applied Science, 9(2): 43-50.

[17]. Tamboura, H.H., Bayala, B., Lompo, M., Guissoe, I.P. and Sawadogo, L. (2006). Ec0x4078745483dbFE521a6fe416C84e9959255Aa940ological Distribution, Morphological Characteristics and Acute Toxicity of Aqueous Extracts of Holarrhena floribunda (G. Don) Durand & Schinz, *Leptadenia hastata* (Pers.) Decne and Cassia sieberiana (DC) Used by Veterinary Healers in Burkina Faso. African Journal of Traditional, Complementary and Alternative medicines, 2(1): 13-24.

[18]. Thomas S.D. (2012). *Leptadenia hastata*: A Review of its Traditional uses and its Pharmacological Activity. Medicinal Chemistry, 2(7): 144-150.

[19]. Aliero, A.A. and Wara, S.H. (2009). Validating the medicinal potential of *Leptadenia hastata*. African Journal of Pharmacy and Pharmacology, 3(6): 335-338.

[20]. Hassan, U.F., Hassan, H.F., Baba, H. and Sulaiman, A.S. (2018). The Feed Quality Status of Whole *Typha domingensis* Plant. International Journal of Scientific and Engineering Research, 9(5): 1609-1617.

[21]. Chinelo, A. E. (2019). Nutrient Content Assessment of six Citrus Species Parts and their Significance. Agriculture and Food Sciences Research, 6 (2): 166-171.