



ABSTRACT

This study investigates the proximate and mineral compositions of browse tree leaves commonly utilized as ruminant feed in Northern Nigeria. Five deciduous species—Khaya senegalensis, Angiosus leiocarpus, Adansonia digitata, Ficus sycomorus, and Tamarindus indica—were collected from Bauchi Local Government. Proximate analysis indicated moisture contents ranging from 5.350% to 8.350%, with protein levels varying from 7.875%

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ROXIMATE AND MINERALS COMPOSITIONS OF SOME BROWSE TREE LEAVES HAY USED AS RUMINANT FEED IN NORTH EASTERN NIGERIA

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Introduction

The role of browse tree leaves as animal fodder has gained momentum in the domain of sustainable livestock feeding practices (Paterson *et al.*, 2020). In regions like Northern Nigeria, where traditional fodder sources may be inadequate or subject to seasonal fluctuations, the utilization of indigenous browse species provides a viable alternative (Smith *et al.*, 2019). Browse tree leaves not only serve as a source of nutrients but also contribute to the ecological sustainability of livestock production systems through improved soil quality and biodiversity.



to 12.775%. Mineral analysis revealed significant variability in calcium, magnesium, potassium, zinc, and iron concentrations among the species. Notably, *Ficus sycomorus* exhibited the highest calcium content (188.96 mg/100g), while *Tamarindus indica* showed the lowest (97.53 mg/100g). These leaves demonstrated favorable nutritional profiles conducive to ruminant health, making them suitable additions to livestock diets. The findings underscore the potential of these indigenous tree leaves as valuable nutritional resources for improving ruminant feed sustainability in the region.

Keywords: Composition, Minerals, Browse Trees, Ruminants, Feed.

Proximate analysis of feed materials is essential, as it informs about the primary nutritional constituents necessary for animal health and productivity. (Jones and Brown, 2021).

Parameters such as moisture, crude protein, crude fiber, and ether extract are particularly relevant in assessing the suitability of feedstuffs. Additionally, mineral composition, comprising essential micronutrients like calcium, magnesium, potassium, zinc, and iron, plays a crucial role in the overall metabolic functions and health of ruminants. (Thompson, 2018).

The current study aims to characterize the proximate and mineral profiles of five select browse tree species that are prevalent in Northern Nigeria, assessing their nutritional contributions and their potential as feed options. This research is particularly significant in addressing the nutritional needs of ruminants, since optimizing their diet can have profound effects on livestock growth rates, reproductive performance, and overall health. The findings are set to provide insights into enhancing feed strategies and contributing to sustainable livestock management practices within the region.

Materials and Methods

Plant Material Collection were obtained in the available farms. The leaves of five different plant species were collected from Bauchi Local Government location. The collection occurred between may to October, 2024, ensuring that leaves were collected at similar developmental stages to minimize variability.

Sample Preparation

Collected leaves were washed under running water to remove dirt and contaminants. They were then air-dried in a shaded area until a constant weight was achieved. The dried leaves were ground into a fine powder using a laboratory mill and stored in airtight containers at room temperature until further analysis.



Proximate Analysis

The proximate composition analysis of the leaf samples was conducted according to standard methods: Moisture, Ether extract, crude protein and crude fibre Content were determined by drying the samples in an oven at 105 °C until a constant weight was achieved. Ash Content: Ashed in a muffle furnace at 550 °C for 4 hours, and the residue was measured for mineral content (AOAC, 2000). Crude Protein: Analyzed using the Kjeldahl method, where nitrogen content was estimated, and protein content was calculated by multiplying the nitrogen value by a factor of 6.25 (AOAC, 2000). Ether Extract: The lipid content was extracted using a Soxhlet apparatus with petroleum ether (diethyl ether) (AOAC, 2000). Crude Fiber: Determined using the acid and alkaline treatment method (AOAC, 2000).

Carbohydrates: Calculated as the remaining content after subtracting the moisture, ash, crude protein, ether extract, and crude fiber from 100%.

Mineral Composition Analysis

The mineral composition of the leaf samples was determined using the following methods:

1. **Sample Digestion:** Approximately 0.5 g of each powdered leaf sample was digested with a mixture of nitric acid and perchloric acid (10:1 v/v) in a digestion block until a clear solution was obtained.
2. Calcium (Ca) and Magnesium (mg) were measured using atomic absorption spectrophotometry (AAS) following standard calibration procedures (Noble and Reed, 1999).
3. **Potassium (K):** Assessed via flame photometry (Lindsay and Norvell, 1978). Zinc (Zn) and Iron (Fe): Quantified with AAS using appropriate wavelengths specific for each metal (Whiting *et al.*, 2015).

Statistical Analysis

All analyses were performed in triplicate, and results were expressed as means $\pm$ standard deviation. Data comparisons among leaf samples were carried out using one-way analysis of variance (ANOVA) followed by Duncan's multiple range test to identify significant differences ($p < 0.05$) using SPSS, R.

Materials

- Laboratory Equipment: Laboratory mill, oven (105 °C), muffle furnace, Soxhlet apparatus, analytical balance, atomic absorption spectrophotometer, and flame photometer.



- Reagents: Nitric acid, perchloric acid, petroleum ether, solvents for analysis.

RESULTS AND DISCUSSION

Table I provided the proximate composition of selected leaves used as animal feed, detailing various constituents such as moisture, ash, crude protein, Ether Extract, Crude fibre, and Carbohydrates for five different plant species: *Khaya senegalensis*, *Angiosus leiocarpus*, *Adansonia digitata*, *Ficus sycomorus*, and *Tamarindus indica*.

Table1: Proximate composition of some selected leaves used as animal feed (%)

Constituents	T1	T2	T3	T4	T5
Moisture	8.350	6.250	7.300	5.350	7.950
Ash	7.750	10.70	8.150	10.500	6.200
Crude protein	11.550	8.575	10.15	7.875	12.775
Ether Extract	1.550	1.700	2.950	2.450	3.850
Crude fibre	14.400	9.200	12.200	12.050	10.350
Carbohydrates	56.400	63.575	59.250	61.775	58.875

Key: T1 = *Khaya senegalensis* leaf, T2 = *Angeisus leiocarpus*, T3 = *Adansonia digitata* leaf, T4 = *Ficus sycomorus* leaf, T5 = *Tamarindus indica* leaf.

The moisture content in the leaves varies from 5.350% in *Ficus sycomorus* to 8.350% in *Khaya senegalensis*. The moisture content is critical for determining the shelf life and nutritional quality of feed. According to the literature, optimal moisture content in feed should not exceed 15% to avoid spoilage and growth of pathogenic microorganisms (Norton, 1994). Therefore, all the aforementioned leaves are suitable in terms of moisture retention. The ash content in these leaves ranged from 6.200% in *Tamarindus indica* to 10.700% in *Angiosus leiocarpus*. Ash content reflects the mineral content in feeds. While a higher ash content can indicate higher mineral levels, excessive ash can lead to reduced energy value of the feed (Khan et al., 2004). The leaves analyzed fall within acceptable ranges, although *Angiosus leiocarpus* might contribute a higher mineral load than is optimal for certain livestock. Crude protein levels vary from 7.875% in *Ficus sycomorus* to 12.775% in *Tamarindus indica*. The protein content is vital for the growth and reproduction of animals, ideally needing to be around 16-20% in the diet of ruminants (Baker et al., 2002). The leaves analyzed demonstrate moderate protein levels, with *Tamarindus indica* being the most beneficial from a protein standpoint, while *Ficus sycomorus* may be less adequate for high-performance animals. The ether extract, which represents the fat content, ranges from 1.550% in *Khaya senegalensis* to 3.850% in *Tamarindus indica*. While fats are essential for energy, too high a fat content can lead to digestive issues (Norton,



1994). The fat content in these leaves is relatively low, which is typical in green foliage, making them more suitable as a roughage source rather than a primary energy source. Crude fiber content varied from 9.200% in *Angiosus leiocarpus* to 14.400% in *Khaya senegalensis*. Crude fiber is crucial for digestive health in ruminants (Martin et al., 2012). The fiber levels observed suggest these leaves could aid in promoting gut motility and support overall digestive health. Carbohydrate levels ranged from 56.400% in *Khaya senegalensis* to 63.575% in *Angiosus leiocarpus*, indicating a significant proportion of these leaves' composition. Carbohydrates are an important energy source for livestock. According to Van Soest (1994), a diet should comprise about 60-70% carbohydrates for optimal energy provision. These values show that the leaves can play a supportive role in providing energy when fed as part of a balanced diet.

Mineral composition of some selected leaves used as animal feed

The mineral composition of selected leaves used as animal feed is summarized in the table 2. Highlighting the micronutrient content across five different leaf types: *Khaya senegalensis* (T1), *Angeisus leiocarpus* (T2), *Adansonia digitata* (T3), *Ficus sycomorus* (T4), and *Tamarindus indica* (T5). The values are expressed in mg per 100g of leaf material. Calcium (Ca) content varied significantly among the leaf types, with *Ficus sycomorus* (T4) showing the highest concentration at 188.96 mg/100g. This is consistent with literature indicating that *Ficus* species can be a good source of calcium, which is crucial for bone development and metabolic functions in livestock (Hassan et al., 2013). *Tamarindus indica* (T5) had the lowest calcium content (97.53 mg/100g), which aligns with previous research suggesting that certain leguminous trees may have lower levels of this mineral compared to others (Norton et al., 2017).

Table 2: Mineral composition of some selected leaves used as animal feed (mg/100g)

Minerals	T1	T2	T3	T4	T5
Calcium (ca)	165.02	133.32±0.003	154.44±0.008	188.961±0.0009	97.526±0.00
Magnesium (mg)	56.983±0.009	144.87±0.001	119.3±0.001	164.011±0.005	87.322±0.002
Potassium (k)	45.341±0.002	177.442±0.007	130.953±0.004	148.632±0.007	134.076±0.003
Zinc (zn)	144.076±0.008	128.98±0.011	117.65±0.008	78.345±0.001	154.104±0.003
Iron (fe)	166.56±0.001	133.82±0.002	188.76±0.005	106.453±0.004	111.59±0.006

Key: T1 = *Khaya senegalensis* leaf, T2 = *Angeisus leiocarpus*, T3 = *Adansonia digitata* leaf, T4 = *Ficus sycomorus* leaf, T5 = *Tamarindus indica* leaf. Note: The values represent the mean of triplicate determination ± standard deviation.



Magnesium (Mg) levels ranged from 56.98 mg/100g in *Khaya senegalensis* (T1) to 164.01 mg/100g in *Ficus sycomorus* (T4). The high magnesium content in *F. sycomorus* promotes its use in animal nutrition to enhance metabolic functions (Elshafie *et al.*, 2019). The values for *Angeisus leiocarpus* (T2) and *Adansonia digitata* (T3) show moderate magnesium levels, highlighting their potential role as supplementary feed in areas where magnesium deficiency is a concern (Sultana *et al.*, 2021). Potassium (K) content was highest in *Angeisus leiocarpus* (T2) at 177.44 mg/100g. This is beneficial as potassium plays a vital role in osmotic balance and muscle contractions (Nour *et al.*, 2018). All leaf types showed significant potassium levels, suggesting they can be useful in formulating balanced rations for animals, given potassium's importance in overall health and productivity.

Zinc (Zn) levels varied, with *Tamarindus indica* (T5) having the highest concentration at 154.10 mg/100g. Zinc is essential for immune function and enzyme activity (Whiting *et al.*, 2015). The lower levels in *Ficus sycomorus* (T4) at 78.35 mg/100g indicate potential variability depending on environmental factors affecting mineral uptake in plants. Iron (Fe) Iron content was highest in *Adansonia digitata* (T3) at 188.76 mg/100g, which corresponds with findings that many leaves from tropical regions can be rich in iron, facilitating better hemoglobin formation in livestock (Hassan *et al.*, 2013). The lower amounts in *Tamarindus indica* (T5) emphasize the need for diverse feed sources to ensure adequate trace mineral intake (Fasuyi *et al.*, 2013)

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