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Assessment of the Proximate and Mineral Compositions of *Acacia ataxacantha* Leaves

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Abstract: ***Study was carried out to evaluate the nutritive values and mineral concentrations of Acacia ataxacantha leaves to underscore the suitability for intensive livestock projection, The proximate parameters analyzed revealed the presence of moisture (6.47%±0.02), ash (4.00%±0.06), crude fat (13.24%±0.77), crude fiber (39.78%±0.75), lignin (0.95%±0.07), nitrogen (1.05%±0.07), crude protein (6.58%±0.45), and total carbohydrate (51.75% ±0.38). The Lassaigne's test revealed Sulphur, Nitrogen, Phosphorus and the halogens. The concentration of the minerals determined were Sodium (0.01mg/100g) Iron, Potassium (0.02mg/100g), Calcium, Zinc, Manganese (0.03mg/100g), Magnesium (0.26mg/100g) and Phosphorus (2.93mg/100g). The significance of this plant leaves was discussed in relation to the presence of these nutritive values and mineral elements. It was found that the leaves have good levels of nutrients, low and safe concentration of minerals that could form good feed resources for modern animal production, grazing and browsing.***

Keywords: *Acacia ataxacantha,* proximate compositions, Minerals and nutritive values

1. Introduction

The increasing demand and subsequent high cost of conventional animals feed ingredients in the tropics has created the need for sustainable alternatives, particularly natural feeds resources indigenous to the region [1].Inadequate amounts, low feed quality and unhealthy environment result in various forms of diseases that reduced livestock productivity in tropical countries. To address these issues we need to manage and utilized our indigenous tree species in order to exploit their nutritive potentials, and to maintain a balance between their productivity and growing demands.

Fodder trees and shrubs have always played an important role in feeding ruminants as well as non-ruminants, and as foliage are increasingly recognized as important components of animals feeding. In difficult environmental conditions, where available grazing is not sufficient to meet the maintenance requirements of animals during the dry and crop-fallow season, fodder species are used [2]. This occurs, for instance in some mountain regions and in the dry tropics where grazing is also sometimes much degraded. Thus, in extensive animal production systems in the dry areas of Africa, it is generally estimated that igneous materials contribute up to 90%of rangeland production and account for 40 – 50% of the total available feed. Therefore, there is an urgent need not only for better knowledge, but also for better use of such potential, particularly in the present context of environmental degradation, which is affecting our planet[3].

The Acacia specie is a large group of woody species, including shrubs of the family Leguminosae and belongs to the sub-family Mimosoidae [4]. *Acacia* ataxacanthaor 'Flame Thorn' is an African tree species with conspicuous red pod and numerous hooked prickles [4, 5]. A. ataxacantha is widely spread in the tropical Africa especially in Sudan savanna where it is often form dense and in sub-Sahara Africafrom Senegal in the west Sudan in the east, Namibia, Botswana, Zimbabwe and in Transvaal and kwazula-Natal and Northern Nigeria[6].

[4] Reported in a survey studies on Acacias found that A. ataxacantha leaves are used as medicines, livestock feed, fencing and shade. [7] studied the antibacterial effectiveness and established the presence of alkaloid, balsam, carbohydrates, flavonoid, saponins, tannins, terpenes, steroids on aqueous and ethanolic extract of the leaves. The extracts and component of A. ataxacantha plants are commonly used for the treatments of digestive system disorders, joint and backache, stomach herbal drug, dysentery, chest ailments, infestations, respiratory system disorder, source of vitamins, minerals and ulcer protective potential [8, 9].

Among over 5000 trees and shrubs listed as being suitable for feeding livestock in Africa. It has been suggested that only 80 are of real fodder value while 5 may be recorded as good [1]. This probably underscores the lack of information on the values of many of these plants and the need to scientifically evaluate their nutritive importance.

Leguminous seeds and foliage have comparatively higher protein content than non-legumes material, probably through their nitrogen symbiosis. The high protein content makes them desirable plants in agriculture [10]. This necessitated the work particularly for the fact that the leaves have been described as useful medicinally and pastorally. Much work has been done on the plant bark as reported in the literature, the leaves has to be exploit much more.

This study examines the proximate and mineral compositions of *Acacia ataxacantha* leaves to underscore the suitability for intensive livestock projection.

2. Materials and Methods

Sample Collections and Identification

Fresh *Acacia ataxacantha* plants were collected along Lamingo road, Eto Baba, Jos North Local Government Area, Jos, Plateau State. The plant was identified in the Department of Plant Science, University of Jos, Jos, Plateau State.

Sample Treatment

The leaves and the roots of the plant were separated from the stalk and sun dried under shade six hours daily for ten (10) days. Then milled into fine powder, sieved and stored in an air tie container to the commencement of the analysis [11].

Proximate Analysis

Each treatment was replicated three times; the proximate analysis content were moisture, ash, crude fat, crude fiber, crude protein, total carbohydrate, lignin, chloride and nitrogen. These parameters were analyzed using the following methods or procedures according to [12]

Moisture content was determined by oven dried method. About 5g of the sample was oven dried at 105^0C for 24hrs, transferred into desiccators to cool after which was weighed and the loss in weigh was expressed as percentage moisture content.

Ash content was achieved by muffle furnace ashing method. About 2g moisture free sample were transferred into a porcelain crucible and placed in a muffle furnace at 600^0C for 8hrs. The weight after cooling the ash was expressed as percentage ash content.

Crude fat content was analyzed by soxhlet extraction method using petroleum ether 60-80^0C. After being dried in an oven maintained at 105^0C for 24hours, cooled and weighed. The loss in weigh of the dried sample was expressed as percentage fat content.

Crude fiber content was obtained by muffle furnace ashing method. This was achieved by loss in weigh on ignition of dried lipid free residues after digestion with 200ml of 1.25N H_2SO_4, and 200ml of 1.25 NaOH boiled with 3 lots of acetone, dried for 24hrs at 105^0C in an oven. Weighed and ashed at 600^0C for 6hrs. The percentage crude fiber was calculated as the difference in weight between residue and ash.

The value of crude protein content was determined by micro-kjeldahl method. The method involved the determination of total Nitrogen content of the sample and multiplying by a conversion factor of 6.25 as described by [13].

Total carbohydrate and reducing sugar were determined using L-cysteine suphuric acid method and Nelson method respectively [14].

Sodium fussion test. The Lassignes filtrates (sodium extract) was prepared and subsequently analyzedquantitatively for Nitrogen, Phosphorus, Sulphur and Halogens.

Lignin determination. The sample was ether extracted by soxhlet extraction and oven dried, digested, filter, washed and the lignin was determined as loss in weight on ignition. As described by [15].

Preparation of Sample for Mineral Analysis

Mineral analyses were carried out by acid digestion according to the method described by [16] using Atomic Absorption Spectrophotometer (Jenway 6405 model). Standards of various metals were prepared covering various ranges and ran against individual cathode lamps for the elements according to [14].

Statistical Analysis

The results of the statistical analysis were produced in triplicate and the percentage, mean, standard deviation, standard errors, were calculated by ibmSPSS version 12 and results expressed as the %Mean±SEM.

Results

Table 1 show the quantitative analysis for Sodium, Nitrogen, Phosphorus and the Halogens using Sodium/Lassaigne filtrate. The results show the presence of Phosphorus, Nitrogen and Chlorine.

Table 1: Sodium/Lassaigne's Test

Test	Observation	Inference
2cm^3 of sample filtrate + conc. HNO_3 (0.5cm^3) + 5% solution + ammonium molybdate + heat	Yellow ppt soluble in aq. NH_3	Phosphorus present
Filtrate + sodium nitroprusside Solution	No colour change	Sulphur absent
Filtrate + $FeSO_4$+dil. NaOH solution + heat	Green heavy ppt observed	
Cooled + dil. H_2SO_4	Iron (ii) hydroxide obtained	Nitrogen present
Filtrate + excess dil. HNO_3 +HgCl	No visible colour change	Iodine absent
Filtrate + excess	Clear solution observed	
Dil. HNO_3+ $AgNO_3$ solution	Effervescence	
Filtrate + excess NH_4CO_3	Oily like solution	
+NH_3 solution +heat	Soluble solution	
Filtrate + dil. HNO_3	White clear solution	Chlorine suspected
Solution + NH_3	Whit ppt soluble in AqNH_3	Chlorine present

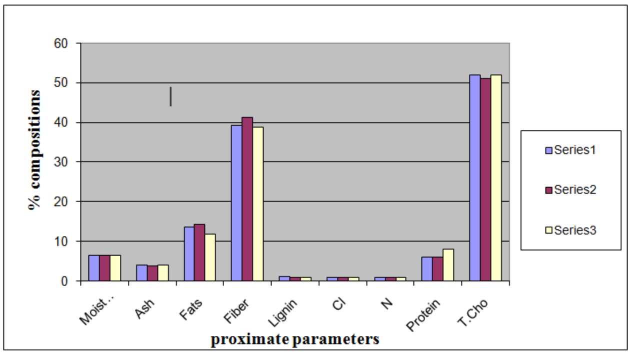

Figure 1: Bar Chart of Percentage Proximate Composition

Figure 1 Bar Chart of percentage mean Composition of proximate parameters.

Figure 1 The percentage mean values for proximate compositions of the plant leaves in dry weight (DW) expressed as %mean±SEM for each parameter.

The bar chart distributions show percentage mean compositions of the proximate parameters. The results show that total carbohydrate content, crude fiber, crude fat, crude protein and moisture contents are in the increasing order of abundance in the leaves of *Acacia.ataxacantha*.

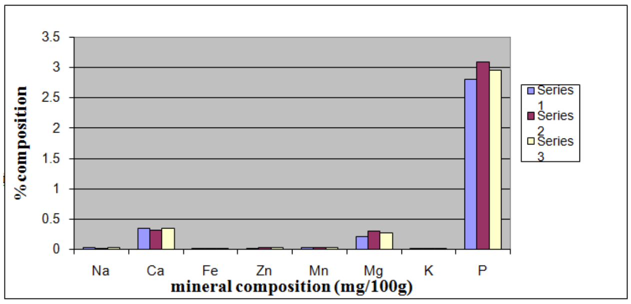

Figure 2: Bar Chart of percentage Mineral Composition (mg/100g)

Figure 2 show the mineral compositions in percentage mean ±SEM of *Acacia Ataxacantha* leaves.

The bar chart distributions of the elements with Phosphorus the most abundant followed by Magnesium and Calcium.

3. Discussion

Proximate Composition

The nutritive value of forages for livestock feeding depends on the balance between the nutritive components of the plants, the digestibility of such nutrients, the metabolism of absorbed nutrients and the quantity of nutrients ingested by the animal [6]. In order to decrease the cost and time involved in *in vivo* forage evaluation, laboratory procedures have been developed. Chemical and physical analyses contribute to determine the nutritive value and have been suggested as alternative ways to determine quality of feedstuffs [1, 6]. Proximate analysis is useful, screening the potential of the array of tropical browses plant utilized by indigenous farmers for ruminant feeding [1].

The moisture content of *Acacia ataxacantha* leaves (6.47%DW) is comparable to (93.98% DM) [17] for the same leaves. This value is low compared to that obtained in *Acacia modesta* (53.43% DM), *Acacia nilotica* (44.78% DM) [2], *Cajanus cajan leaves* (11.20%)[10], and comparable to leaves Dry Matter (DM) of *Diodia scandens* (92.20%), *Microdesmis puberuba* (93.00%), *Nuaclea popegnine* (92.00%), *Palisota hirsute* (93.60%), *Ricinodendron heudelotti* (93.20%). *Urena lobata*(93.00%), *Veronialobata* (91.40%)(Okoli et al, 2003). These are forage leaves for animals grazing, with this low moisture content and high Dry Matter is an indication that *Acacia ataxacantha* leaves are less prone to microbial attacked in the course of storage. Dry Matter is the actual amount of feed material leaving water volatile acids and bases if present [2].

The ash content is a measure of total amount of minerals, was found to be (4.00%), is low compared to others forage leaves as stated by [1, 2]. This is an evident that *A. ataxacantha* leaves contain reasonable minerals which are useful for animals nutrition. Ash content is also important in the evaluation of purity of drugs showing the presence or absence of foreign organic matter such as metallic salt and silica [10].

The value of the crude fat (13.24%) was high compared with the leaves of *Talinum triangulare* (5.90%), *Baseila alba* (8.71%), *Amaranthus hybridus* (4.80%) and *Cajanus cajan* (2.75%) [10]. Dietary fats increase the palatability of food for absorbing and retaining flavor. A diet providing 1-2 % of its caloric energy as fat is said to be sufficient to human being as excess fat consumption is implicated in certain cardiovascular disorder such as cancer and ageing [18] and suggest significant caloric value for animals.

The crude fiber content (39.78%) is high compared with some Acacia species like *A. modesta* (22.80%), *A. nilotica (13.91%)*, bitter leaves- *Vernonia amygdalina* (6.50%) [10] and others reported by [1] ranges from (7.50- 19.90%) for some selected forage in Southeastern Nigeria. These values are low when compared with the tropical grass species, which may be high as 45-50% at more mature stages of growth. *A. ataxacantha* leaves is also higher than cassava leaves meal (15.60%), guava leaves (16.10%) [1]. The adequate intake for crude fiber ranges from 12 to 38g/day depending on the age and sex. It shows that A. ataxacantha contain moderate fibrous and indigestible carbohydrate. However, high fiber content reduces minerals, protein and carbohydrate bioavailability by hindering their hydrolytic breakdown [18].

The crude protein content (6.58%) as also (6.63%) reported by [17] for the same plant leaves but higher in some *Acacia* species like; *A. modests* (16.28%), *A. nilotica* (13.91%), *A.seyel* (11.29%)[2], cassava leaves- *Manihot utilisima* (24.88%), *Piper guineeses* (29.78%) (David, 2014). The 6.56% CP content for *A.ataxacantha* is relatively below Minimum Protein Requirement of ruminants (10-12%) estimated by [19] but comparably meet up with the minimum CP content 7.1% for grazer and 6% for browser which is considered necessary for maintenance of good animals' condition [17].

However, the leaves contain (1.05%) Nitrogen and can be consumed alongside other nitrogen rich plant; it could be a supplement for animal's feeds. Indigenous plants have however, been shown to perform better than the exotic species in the acid soil [1]

The total carbohydrate content (51.75%) is high compared with African beans (19.20%), African walnut (17.80%), water melon (10.96%) and melon seed (7.30%) [18]. The leaves contain moderate amount of carbohydrate, which is very useful as it contributes to the caloric value of the animal feed while reducing sugar is an indication of the presence of hydrolysable sugar.

Lignin content of the plant leaves (0.95%) is low compared to the same plant leaves (15.69%) and other same species. Organic Matter Digestibility (OMD) is positively correlated with energy (crude protein) available and negatively to fiber content and degree of lignifications [17]

Mineral Composition

The result of the mineral composition shows that sodium (0.01mg/100g), iron and potassium (0.02mg/100g) even though low, their values for normal body functions and animal nutrition is significant. Na is useful as transport minerals and electrolytes. Fe is an essential trace element for haemoglobin formulation, normal functioning of central nervous system and oxidation of carbohydrate, protein and fats. K is for normal retention of protein during humane growth [18].

Calcium, Zinc and Manganese concentration levels are low (0.03mg/100g) for *Acacia ataxantha* but when compared with the leaves of same species; *A.refic*iens (12.10g/kg DM) and *A. Senegal* (14.20g/kg DM) for Ca, *A. reficiens* (22.9mg/kg DM), *A. Senegal* (17.90mg/kg DM) for Zn and *A. reficiens* (67.80mg/kg DM), *A. Senegal*(25.90mg/kg DM) for Mn are low [3]. Calcium are used for bone formation while Zinc and Manganese are useful for vitamins stabilization.

The concentration levels Magnesium and Phosphorus are (0.30%) and (3.95%) respectively are higher in *A.ataxacantha* leaves when compared with other elements in this study. Mg support normal growth while P is for bone formation.

Generally, animal feeds are rich in microelement, base on species, plant parts and seasonal changes will influence their mineral concentration [3]

4. Conclusion

The result our findings indicate that the leaves of *A.ataxacantha* has the potential for grazing, browsing and good feed resources for modern animal production. The minerals concentration suggests that the plant leaves can effectively contribute to the diets of animals. Animals required minerals in trace amount but can be supplement from other sources if needed in high concentration. There is need to expand this study to other nutrients and anti-nutritional factors such are oxalate, nitrite, saponin, tannin, phytin and hydrocyanic acid.

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