Evaluation Of The Nutritive Value Of Plants Browsed By Livestock At Gongoshi Grazing Reserve, Nigeria

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Abstract: Samples of five (5) selected heavily browsed plants harvested at Gongoshi grazing reserve in Mayo-Belwa local Government area of Adamawa State, were evaluated with respect to their proximate composition. These samples were randomly collected in the study area and identified by pastoralists, range manager and at the Department of Animal Production, Adamawa State University, Mubi. The parameters measured included dry matter (DM), crude fibre (CF), crude protein (CP), Ash (minerals), nitrogen free extract (NFE), ether extract and carbohydrate (CHO). Also evaluated minerals elements such as calcium (Ca), sodium (Na), potassium (K), iron (Fe), copper (Cu), and magnesium (mg). It was found that the dry matter content ranged between 78.28% – 91.66%, crude fibre (18.36 – 44.84%), crude protein (7.56 – 17.48%), Nitrogen free extract (10.20 – 21.72%), Ether Extract (3.96 – 9.35%), Ash (4.03 –15.08%) and carbohydrate (28.68 – 52.45%). Minerals elements ranged from 0.79% – 25.65% for calcium, sodium (0.30 – 4.21%), potassium (0.44 – 1.35%), phosphorus (0.42 – 6.25%), iron (12.25 – 41.40%), copper (4.70 – 9.65%), magnesium (0.30 – 8.43%). The result obtained was used to determine the suitability of the analysed browse species for ruminant animal production. The study also revealed that nutrient contents in samples vary in composition, which may be due to differences in plant species, stage of maturity, soil type, seasonal variation and the topography of the land. Feeding trials using ruminant animals is recommended in order to fully ascertain the inclusion values of these browsed plants in the diets of animals.
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Introduction

A browsed plant is an herbaceous plant which a herbivore feeds on its leaves, soft sh0ots or fruits of high growing, generally woody plants such as shrubs (Abeawuchi *et al.,* 2002). Browse plant provides protein, energy, vitamin and mineral elements which are inadequate in grass land pastures. The year round ever green presentation and nutritional abundance provides for all round provision of fodder. It also provides standing feeds reserve to be built so that herds can survive critical periods of shortfall, or even prolonged period of drought without remarkable losses (Oji *et al.*, 2000). These browse plants not only give the essential energy, proteins, vitamins, minerals and fiber in ruminant diets but provide high quality feed for livestock, and at the same time, improving soil quality and reducing greenhouse gas emission.

Browse plants provide vitamins and frequently mineral elements, which are mostly lacking in grassland pasture. Their year round evergreen presentation and nutritional abundance provides for year round provision of fodder (Ahamefule *et al.*, 2006; Oji and Isilebo, 2000; Opara, 1996).

Akbar *et al.* (1991) reported that *Mangifera indica*, *Gmelina arborea* and *Ficus thonnigii* improve intake and live weight gain when supplemented in ruminant diets. Browse plants, beside grasses, constitute one of the cheapest sources of feed for ruminants. The diversity and distribution of browse plants in Nigeria have received early attention in studies carried out for the north (Saleem *et al.,* 1979*)* and middle belt of Nigeria.

Ruminant livestock in most parts of the tropics graze intensively on naturally growing forage which is in most instances poor in quality. The presence of different classes of livestock in the same herd is beneficial as they differ in their grazing habits and therefore, their grazing preferences differ which will benefit the vegetation as the grazing pressure will be distributed among different plant types (Abusuwar and Ahmed, 2010). These forages usually contain less nitrogen and are less digestible. The quantity and quality of these grasses become more critically in the dry season imposing more serious constraints to the development and productivity of these animals. The low protein level characteristics of tropical forage during long dry seasons are the limiting factors in animal intake and performance. Over-exploitation of plant resources, introduction of alien (exotic) species, human population increase, unstable climatic condition on range lands, conversion into residential, road construction, industrial and similar uses are detrimental to browse forage resources. Extensive grazing of range land pasture reduces or removes desirable plants and inversely increases the density of undesirable plants at the expense of the desirable.

Tropical forage contains phytochemical substances which may be adverse and/or beneficial in nature. The knowledge of their levels of concentration and nature is necessary for improved animal production (Fadiyima *et al.,* 2006; Makkar *et al.,* 2007). Tropical forage has improved nutritional requirements of ruminant animals and subsequently greater production as the cheapest sources of feedstuff. There is therefore, the need for continuous screening of browse plants to identify those with good potential as livestock fodder and which could serve as alternative sources of feeds for livestock. It is against this backdrop that this study was conducted to determine the proximate composition of some browse plants in Gongoshi grazing site of Mayo-Belwa Local Government Area, Adamawa State.

Materials and Methods

Study Area

Gongoshi grazing reserve is located in Mayo-Belwa Local Government area of Adamawa State in the north-eastern part of Nigeria. The local government covers a land area of about 1,768km^2 while the range site covers a land area of about 8,000ha. It lies between latitude 9^{o}3'N and longitude 12^{o}3'E (Khobe, 2014). The major vegetation formation is the guinea Savanna. The mean annual rainfall here is between 900 and 1,600mm and the rainy season lasts for about 6 – 7 months. The more abundant woody species in the area are *Afzelia africana, Vittelaria paradoxa, Terminalia laxiflora, Terminalia glauscescens, Annona senegalensis, Burkea africana, Prosopis africana, Albizia zygia, Ficus exasperata, Pterocarpus lucens, Detarium microcarpum, Anogeissus leiocarpus, Balanites aegyptiaca, Tamarindus indica, Sclerocarya birrea, Khaya senegalensis, Ficus sycomorus, Borassus aethiopum, Boswellia dalzielli, Zizipus spina-christi, Daniella oliveri, Diospyros ellioti, Ceiba pentandra, Nauclea latifolia, Bombax costatum, Parkia biglobosa, Drypetes floribunda, Brachystegia eurycoma, Bysocarpus coccinens, Zanthoxylum zanthoxyloides, Vitex doniana, Piliostigma thonningii, Azadirachta indica and Entada abyssinica.* The most abundant grasses in the zone are species of *Andropogon, Hyparrhenia, Panicum, Ctenium, Pennisetum, Brachiaria and Aristida.*

Data collection

Fresh leaves from the apical portions of the branches of selected browse plants were randomly collected at various locations in the study area as they are being browsed by livestock. Data was collected for a period of one month. Five hundred grams (500g) of fresh leaves were identified and weighed.

Pre-treatment of samples

The samples collected were ground to powder using laboratory blender and sieved using 1mm mesh sieve. Each ground sample was put in a labeled polythene bag and stored in desiccators to avoid moisture absorption, and ready for laboratory analysis.

Equipment: Weighing balance, heating mantle oven and polythene bags.

Apparatus and Reagents: Burette conical flask, measuring cyclinder, kjeldhahl flask, distillation set up volumetric flask, crucible dishes, crucible holder, motor and pestle filter paper, clamps, funnel glass rod, pipettes and clamps desiccators fume cupboard.

acetone, copper sulphate, Ethanol, granulated zinc, hydrochloric acid, petroleum Ether, potassium hydroxide, sodium hydroxide, Methyl red indicator and litmus paper.

Proximate Analysis

Proximate composition of the collected samples was carried out at the Animal Science laboratory, Adamawa state University Mubi. Fresh Foliage of the selected browse plants were room-dried for five (5) days. There are therafter cut into pieces (2cm-5cm) with a knife, oven-dried at 64% for 24 hours and ground through 1mm screen for subsequent analysis. Proximate composition was determined for percentage dry matter (DM), crude protein (CP), crude fiber (CF), ether extract (EE) and ash while Nitrogen free extract (NFE) was calculated using the relationship:

NFE=100 - (%CP+%CF+%EE+%ash)

Dry matter (DM) determination

For dry matter determination, fresh samples were weighed and dried to constant weight in an oven. The percentage dry matter was then determined by the formula;

$$= \frac{Weight\ of\ crucible + sample\ before\ oven\ drying - weight\ of\ crucible}{Weight\ of\ crucible - weight\ of\ sample} x100$$

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$$= \frac{Final\ weight}{Initial\ weight} x100$$

Determination of crude protein

Crude protein (CP) was determined using micro *Kjeldahl* method as described by Skoog and Donald (1974). These include digestion, distillation and titration. The digestion was done by weighing 2g of sample into 500ml *kjeldah*l digestion flask and adding 7g of Potassium Sulphate to the mixed. Thereafter, 0.5g of crystal copper sulphate (catalyst) and 15ml concentration H_2SO_4 were also added. The flask was clamped in an inclined position in a wood cupboard that has in-built extractor because the fume generated by the process is highly toxic and choky. The mixture

was then heated to boil until a clear light blue or green solution was obtained. The solution was allowed to cool, and transferred into a 100ml standard or volumetric flask. This was then diluted with distilled water and filled up to make to make the solution ready for distillation procedure consisted of putting 25ml of the digest into micro kjelkahl, and then adding 25ml of 40% sodium hydroxide. A blue coloration was formed which turned dark brown as distillation proceeded. The released ammonia was condensed and collected into a receiver containing 10ml of boric acid. The pinkish boric acid colour changed into green colour because nitrogen in form of ammonia was absorbed by boric acid solution. The ammonia was the distilled till volume of boric acid became 50ml. after the distillation, the green colour ammonium borate was then back titrated with0.01ml HCL acid until the end point of the pink colour was obtained. The distillation was then tested for three neutral litmus papers until the neutral test was obtained.

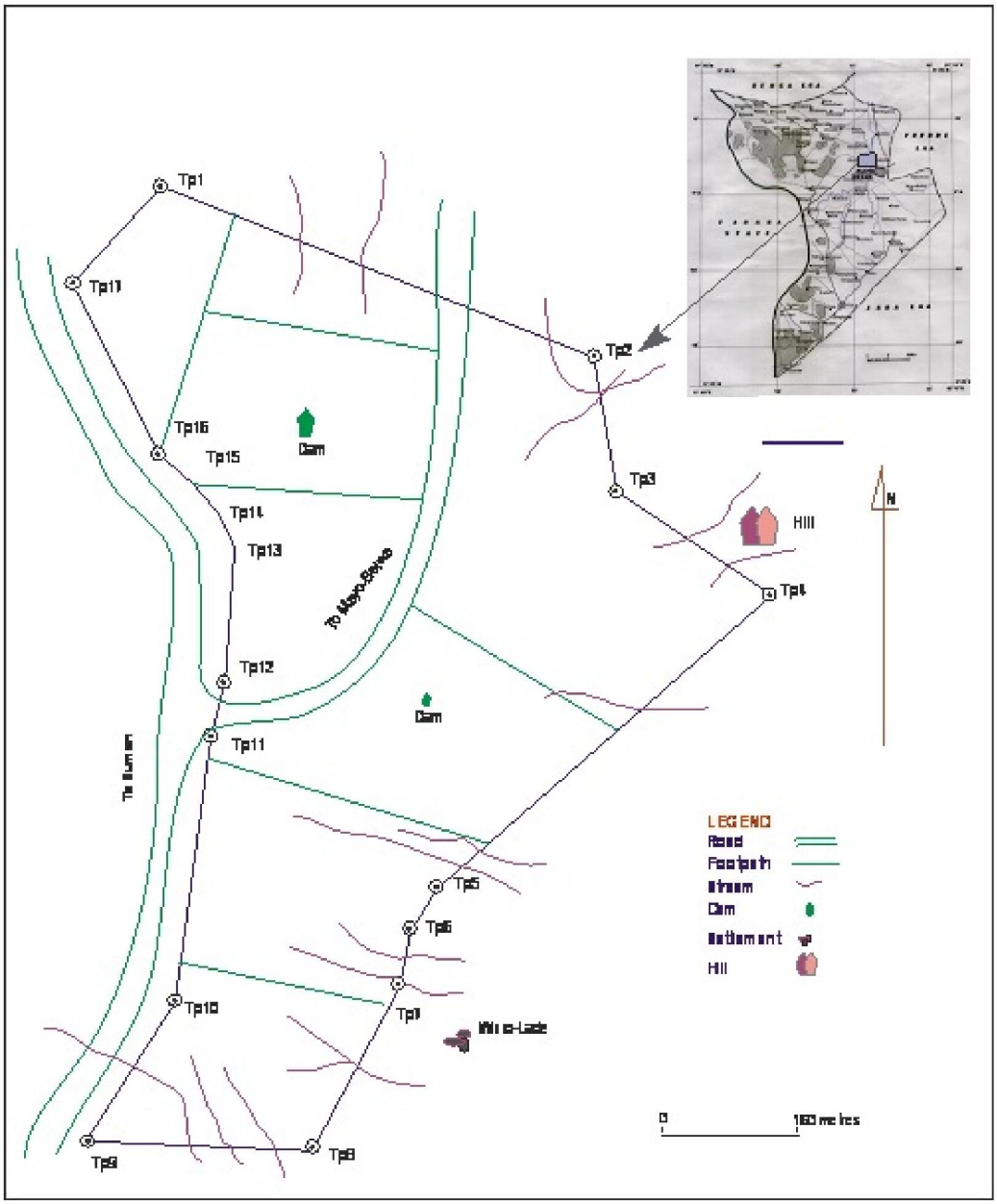

Fig. 1: Sketched Map of Gongoshi Grazing Reserve, Mayo-Belwa Local Government Area, Adamawa State (Area = 8,000ha).
Source: Khobe (2014).

Crude fiber determination

Crude fiber was determined according to AOAC (1994) in which 2g of the sample was weighed into a 250ml conical flask and 100ml TCA reagent was added to the sample and digested by refluxing for 40 minutes. It was then filtered to obtain the residue. The residue was washed 6 times with distilled boiling water and finally with 10mls of acetone. The residue was transferred to an oven and dried at 105^0 C overnight. The residue was scraped into the crucible and weighed; ash was done in a muffle furnace a 550^0 C for 2 hours. The ash sample was removed and cooled in desiccators after which the ash was weighed together with the crucible.

Weight of crucible + residue =W_2
Weight of crucible + ash = W_3
Weight of sample = W_1

$$= \frac{Weight\ of\ crucible + residue - weight\ of\ crucible + ash}{Initial\ sample\ weight\ (2g)}\ x\ 100$$

Percentage CF $= \frac{W_2 - W_3}{W_1} \times 100$

Determination of total ash

The total content of the mineral matter or total ash (non-combustible portion) of the feed was determined. Two grams (2g) of sample was weighed in a silica crucible. The sample was ignited on a burner until smoke ceases. The crucible was placed in a muffle furnace and heated to 600^0 C for 2 hours. At this temperature, all organic matter were burnt leaving behind minerals. The crucible was removed from the furnace carefully and cooled in desiccators at room temperature and weighed again.

Percentage ash $= \frac{W_2 - W_0}{W_1 - W_0} \times 100$

Where, W_0 = weight of empty crucible,
W_2 = crucible + sample,
W_1 = crucible + sample after burning.

Ether Extraction Determination

The crude fat (a combination of simple fat, fatty acid, esters compound fat, neutral fat, sterols, waxes, vitamins A D_2, E, K, carotene, chlorophyll, etc.) soluble in ether was estimated by extraction method. Two grams (2g) of the sample was weighed on the dry filter paper/thimble and inserted into a soxhlet's apparatus. 150mls of petroleum ether was poured into the flask. The soxhlet apparatus was immediately joined to the flask containing the petroleum ether. The soxhlet was connected to a condenser clamped a retort stand. The flask was then heated until the content started boiling. The fat was separated from the petroleum ether through distillation. After distillation, the flask containing the fat dried, cooled in desiccators and weighed.

$$\text{Percentage EE} = \frac{\text{Wt.of thimble + sample before extraction} - \text{wt of thimble}}{\text{Sample after extraction 2g (initial wt of sample)}} \times 100$$

Nitrogen Free Extracts (NFE) Determination

The NFE was calculated by using the formula:
Percentage NFE = 100 – (% CP + % CF+ %EE + Ash)

Data analysis

After all the analysis, the amount of nitrogen present in the sample was calculated. The calculation was performed as percentage nitrogen and percentage protein in the sample.

$$\text{Percentage nitrogen (PN), PN} = \frac{14.01 \times (\text{mltitrate} - \text{blank}) - (\text{N of titrate})}{\text{Sample wet (grams)} \times 1000} \times 100$$

The conversion factor was obtained by dividing 100 by 16= 6.25.

Therefore, percentage protein was determined using relationship 6.25x%N.

Results and Discussion

Species list of browse plants

The more abundant woody species in the area were observed and grouped into the heavily browsed, occasionally browsed, moderately browsed and fairly browsed plants species.

Table 1: shows list of the species

Status	Family Name	Species Name
Heavily Browsed	Meliaceae	*Khaya senegalensis*
	Fabaceae	*Faidherbia albida*
		Daniella oliveri
	Moringaceae	*Moringa oleifera*
	Moraceae	*Ficus exasperata*
		Ficus sycomorus
	Verbenaceae	*Vitex doniana*
	Combretaceae	*Terminalia glaucescens*
	Leguminosae	*Berlinia doka*
	Zygophyllaceae	*Balanites aegyptica*
	Malvaceae	*Adansonia digitata*
		Sterculia setigera
	Capparaceae	*Boscia senegalensis*
	Sapotaceae	*Vittelaria paradoxa*
	Annonaceae	*Annona senegalensis*
	Rhamaceae	*Zizphus mauritania*
		Ziziphus spina-christi
Moderately Browsed		
	Fabaceae	*Detarium microcarpum*
		Calopogonium mucunoides
	Fabaceae/leguninosae	*Centrosema pubescens*
	Daisy	*Tridax procumbens*
	Leguminosae	*Acacia tortilis*
	Compositae	*Aspilia africana*
	Amaranthaceae	*Amaranthus spinosus*
	Euphorbiaceae	*Alchomea cordifolia*
	Malvaceae	*Urena lobata*
	Acanthaceae	*Abystasia gangestica*
	Verbenaceae	*Gmelina arborea*
Fairly Browsed		
	Apocynaceae	*Calotropis pracer*
		Landolphia owariensis
	Fabaceae	*Tamarindus indica*
		Prosopis africana
		Acacia seyel
		Afzelia africana
		Parkia biglobosa
	Burseraceae	*Boswellia adorata*
	Ebenaceae	*Diospyros mespiliformis*
	Arecaceae	*Borassus aethiopum*
	Burseraceae	*Boswellia dalzeli*
	Combretaceae	*Terminalia laxiflora*
		Terminalia avicennoides
		Combretum racemosum
	Rubiaceae	*Gardenia ternifolia*

Source: field survey (2016)

Species List For Used for Proximate Analysis

Table 2 presents a checklist of species used for laboratory analysis.

Table 2: List of browse plants selected for the study

Botanical Names	Common Names	Local Names (Hausa)
Sterculia setigera	gum tree	Koronga
Anogeissus leiocarpus	chew stick	Marke
Ficus sycomorus	Ficus species	Baure
Khaya senegalensis	Mahogani	Madashi
Vitex doniana	Black plum	Dinya

Source: field survey (2016)

Proximate composition of five selected browse plants

The result of proximate composition of the selected browse plants is presented in Table

Table 3: proximate composition of five selected browse plants (%)

S/N	Sample	DM	CP	CF	EE	Ash	CHO	NFE
1.	*Sterculia setigera*	89.80	7.56	18.36	6.82	4.63	52.45	10.20
2.	*Annogeissus leiocarpus*	84.04	9.68	36.80	9.35	4.03	33.20	15.96
3.	*Ficus sycomorus*	78.28	15.26	34.75	4.86	15.08	33.99	21.72
4.	*Khaya senegalensis*	91.66	17.48	43.30	3.96	11.56	31.60	8.34
5.	*Vitex doniana*	84.28	13.20	34.84	7.60	10.64	28.68	15.72

Source: Analysed data (2016)

DM (Dry Matter), CP (Crude protein), CF (Crude fibre), Ash, CHO ( ), NFE (Nitrogen - free extract)

Dry matter

The result of proximate composition of the selected browse plants are presented in Table 3. Determination of dry matter in feed is important to insure that animals are receiving the proper amount of nutrients through their diet. The dry matter content of the browse plant ranged from 89.8% in *Sterculia setigera* in *Anogeissus leiocarpus* 84.04% to 78.28% in *Ficus sycomorus* while *Khaya senegalensis* has 91.66% and 84.28% in *Vitex doniana*. This agrees with the report of Agishi (1985), who stated that, the amount of dry matter in browse plants were more during the dry season. As compared to those that flourish well during the rainy season. A variety of factors affect the dry matter content of feeds. In many cases, the terming and method of harvest is the largest contributing factors to the dry matter content of the feed. However, weather and environmental condition, such as temperature, humidity, rain and snow, all affect feed dry matter content.

Crude protein

Table 3 revealed that some of the browse plants were found to have high crude protein content; *Sterculia setigera* (7.56%), *Anogeissus leiocarpus* (9.68%), *Ficus sycomorus* (15.26%), in *Khaya senegalensis* (17.48%) and *Vitex doniana* (13.20%). This agrees the result Le Houerou (1990), who stated that some tree leaves possess high crude protein content of 15-26% CP on average. This also coincides with the report of Kapu (1975), that animals have more desire for protein than any other nutrient. The remaining browse plants were found to contain low protein content ranging from 7.88 – 13.5% which is grossly inadequate for ruminant animal's requirement. Most of the browse plants in the present study have CP contents above 8%, a minimum requirement for ruminants. According to Mc Donald *et al.* (2002), feed containing less than 8% CP cannot provide the minimum ammonia levels required by rumen microorganism to support optimum activity. Forage with crude protein level below 7.9% are considered deficient, therefore may not improve the average daily weight gain in animals unless supplemented with protein feeds.

However the variation in crude protein may probably be due to difference in plant species, stages of maturity, soil condition and topography indicating that some plants have more protein than others as opined by Mc Donald *et al.* (2002). Therefore all browse plants should have a reasonable quantity of crude protein from 15% and above, which can sustain the life of ruminant animals.

Crude Fiber

The crude fiber obtained in this study (Table 3) range from 18 – 43% with lowest value in *Sterculia setigera* (7.56%) while the highest crude fibre is found in *Khaya senegalensis* (17.48%) which may be due to differences in plant species and the stages of maturity. Young and tender leaves have low fibre content as compared to the matured older leaves, which agrees with the report of Mc Donald *et al.* (2002). The low fibre fraction in the present study was explainable as

the level of fibre always depend on the stage of growth (Babayemi, 2007). The age of the browse plants used in the present study was not known. It has been established that the lower the fibre content, the better the feed intake and the digestibility since high lignin is reported to physically encrust structural carbohydrates, preventing enzyme attack and inhibiting attachment of rumen microorganism (Van Soest *et al*., 1994).

Ash

The ash contents range from 4% - 15%, *Ficus sycomorus* (15.08%) having the highest, *Anogeissus leiocarpus* (4.03%), has the lowest percent while *Khaya senegalensis* (11.56%), *Sterculia setigera* (4.63%), and *Vitex doniana* (10.64%). Therefore, considering the high values obtained in this research, it shows that the browse plants can act as an index of high feeding value to ruminants. This coincides with the report of Kapu (1975), that the presence of ash indicates the total minerals content of the feed.

Ether Extract

The ether extract of the browse plants range from 3% - 7% with lowest value in *Khaya senegalensis* (3.96%) and the highest values were obtained in *Anogeissus leiocarpus* (9.38%) while *Sterculia setigera* (6.82%), *Ficus sycomorus* (4.86%) and *Vitex doniana* (7.60%). The presence of lipid in large quantity in browse plant may probably lead to the acceptability of the feed by ruminants. This is in line with the reports of Mc Donald *et al.* (2002). Also the palatability and acceptability of feed by ruminants may be high due to the lipid content in the browse.

Nitrogen - Free Extract

Nitrogen free extract (NFE) were found to be high in the following browse plants *Khaya senegalensis*, *Anogeissus leiocarpus*, *Sterculia setigera*, *Ficus sycomorus*, and *Vitex doniana* ranging from 8.32 – 21.72%. This variation may be due to the stage of maturity of the plants and amount of crude fibre in the browse plants. Therefore those browse plants that contain high level of energy content may be consumed in large quantity by ruminants as revealed by NRC (1981).

Minerals contents of selected browse plants

Table 4 shows the minerals contents of the five (5) browse plants in this study. The difference were observed among the browse plants but, they all met the recommended minimum requirement, calcium (0.79 – 25.65%), sodium (0.30 – 4.21%), Potassium (0.44 – 1.35%), phosphorus (0.42 – 6.25%), Iron (12.25 – 41.40%), copper (4.70 – 9.65%), and magnesium (0.30 – 8.43%) for maintenance and proper functioning of physiological systems of the ruminant animals as reported by some workers, (Gimerenze, 2004; Rashid, 2008).

Table 4: minerals content of five selected browse plants (mg/100g)

S/N	Sample	Ca	Na	K	P	Fe	Cu	Mg
1.	*Sterculia setigera*	25.65	4.29	1.35	6.23	12.25	9.65	8.43
2.	*Annogeissus leiocarpus*	0.81	0.36	0.49	0.50	40.87	4.87	0.30
3.	*Ficus sycomorus*	0.81	0.38	0.51	0.51	41.40	5.90	0.42
4.	*Khaya senegalensis*	0.79	0.30	0.44	0.42	38.53	4.70	0.30
5.	*Vitex doniana*	0.80	0.41	0.45	0.48	39.70	5.60	0.34

Ca - calcium, Na - sodium, K - Potassium, Fe - iron, Cu -copper, Mg - magnesium.

Conclusion

Browse plants constitute an extremely valuable source of feed for the ruminant livestock. In view of the nutritive valuable of browse plants, there is need to plant and nature them in grazing reserves where they would provide the nutritional needs and readily supply vitamins and minerals elements lacking in grass land pasture especially during the dry months. Though browse plants are not planted or cultivated in plantation in Nigeria, the seasonal loss of weight of the range cattle and other range animals, their low productivity, generally make the establishment of browse plantation a necessity. For optimum utilization of brows plant, it essential that details of the browse production, palatability and nutritive value of the prominent species be made.

Recommendations

Therefore, in order to improve animal production in the study area, it is recommended to develop technique of managing and preserving browse forages with promising nutritional profile. It is also recommended that more browse plants should be analyzed in order to know their potentials. There is also need to expand the study to other nutrient and anti-nutritional factors such as tannins, oxalate, nitrate, saponins and alkaloids. Feeding trails using ruminant animals are recommended in order to fully ascertain the nutritional values of these browses.

Furthermore research was carried out on the establishment, management, production and toxicity of browse plants, not only in Gongoshi but also along major grazing routes and sites in all the states of Nigeria. This would generate a data bank on the

potentials of browse as feed resource for ruminant livestock in Nigeria.

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