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Distribution and Proximate Compositions of Dry Season Browses in Adamawa State, North-Eastern Nigeria

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Abstract

Pastoralists in the semi-arid zones of north-eastern Nigeria utilize diversities of browse trees to augment dry season ruminant feeding because of poor feed resource availability during the period. Primary data generated from 300 pastoralists surveyed across Mubi north, Gombi and Jada LGAs of Adamawa state were used to determine the commonly browsed trees in the state during the dry season period. Thereafter, proximate compositions of leaf meals from five most preferred dry season browses among these were determined in order to estimate their nutrient values. Ten commonly utilized browse plants were identified as being utilized in each of the LGAs, with *Balanite aegyptica, Khaya senegalensis, Tamarinae indica, Panicum maximum* and *Mangifera indica* being the most preferred by pastoralists in the area. Crude protein content of the leaf meals of these preferred plants ranged from the 9.35% recorded in *P. maximum* to 16.73% in *T. indica*, while ether extract values ranged from the 2.89% recorded in *P. maximum* to 6.72% in *K. senegalensis*. The leaf meals were moderate in their crude fibre, with *K. senegalensis* recording 23.53%, while *P. maximum* recorded 32.50%. Ash values were high with mean values standing at 10.41±1.97% and *M. indica* recording the highest value of 13.25%. These findings support the value placed on these plants by pastoralists as dry season feed resources. There is the need to promote extensive planting of these cherished browse species in the study area in order to provide the needed dry season feed resources to livestock, while limiting the frequent cutting of other tree species by the pastoralists; a habit that leads to deforestation and dwindling forest resources in the zone.

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Browses plants, Pastoralists, Semi arid zone.

Introduction

The feed resources of pastoralist cattle consists mainly of grasses, legumes, browses, and crop residues indigenous to the production zones and have been reported to be of low yield and quality (Shiawoya and Tsado, 2011; Nweze *et al*., 2012). Good quality forage is available in adequate amounts to support reasonable level of cattle production from early to late rainy seasons, while at other times, pasture and range plants decline in quantity and quality

(Moutari, 2008). During the dry season period, available natural pastures are low in protein, nitrogen, sulphur, vitamins and other nutrients, while fibre is high with dry matter content of more than 30% (Bonsi *et al.*, 1991; Hughes *et al.*, 2011).

The best way to evaluate feed quality is animal performance while intake, digestibility and efficiency of utilization are characteristics of feed that determine animal performance (Mertens, 1994). Chemical property of feed that have been linked with intake and digestibility are fibre, lignin and protein which are used increasingly to predict animal performance (Cherney and Mertens, 1998). Therefore, a systematic chemical characterization of feed for cattle must include determination of fibre, lignin, protein and critical to this is an accurate dry matter (DM) content determination (Adegbola, 1985 and Alhassan *et al*., 1987).

To consolidate this assertion, Okoli *et al*. (2003) stated that, proximate analysis of feed is specifically useful, in screening the array of tropical browse plants utilized by indigenous farmers for ruminant feeding. Also earlier research has shown that, chemical analysis of feed provides valuable information about the actual chemical constituents influencing digestion (Van Soest, 1994). The objectives of the study were to survey the distribution and evaluate proximate composition of the most cherished browses for cattle production during the dry season in Adamawa State, North-Eastern Nigeria.

Materials and Methods

Study area

Adamawa State is located at the area where the River Benue enters Nigeria from Cameroon Republic and is one of the six states in the North-East geopolitical zone of Nigeria. It lies between latitudes 7^0 and 11^0 North of the Equator and between longitudes 11^0 and 14^0 East of the Greenwich Meridian (Mohammed,1999). It shares an international boundary with the Republic of Cameroon to the east and interstate boundaries with Borno to the North, Gombe to the North-West and Taraba to the West and South (ASMLS, 2010a), as can be seen in figure 1.

The State has minimum and maximum rainfall of 750 and 1050mm and an average minimum and maximum temperature of 15^0C and 32^0C, respectively. The relative humidity ranges between 20 and 30% with four distinct seasons that include: early dry season (October – December); late dry season (January – March); early rainy season (April – June) and late rainy season (July – September) (Adebayo, 1999). The vegetation type is best referred to as guinea savannah (Areola, 1983;Adebayo and Tukur, 1997). The vegetation is made up of grasses, aquatic weeds along river valleys and dry land weeds inter-spaced by shrubs and woody plants. Plant heights ranges from few centimeters (Short grasses) to about one meter tall (tall grasses), which form the bulk of animal feeds.

Cash crops grown in the state include cotton and groundnuts, sugar cane, cowpea, benni seed, bambara groundnut, tiger nut, while food crops include maize, yam, cassava, sweet potatoes, guinea corn, millet and rice. The village communities living on the banks of rivers engage in fishing, while the Fulani and other tribes who are not resident close to rivers are pastoralists who rear livestock such as cattle, sheep, goats, donkeys, camels, horses and poultry for subsistence (Adebayo and Tukur, 1997; Adebayo, 1999).

Study site

Three Local Government Areas, one from each of the three senatorial districts in the state were chosen for the study. The Local Government Areas were purposively selected to cut across the State which represents the pastoral zones with higher number of cattle producers in the State (Adebayo, 1999). The study areas include Mubi North (Northern Senatorial Zone), Gombi (Central Senatorial Zone) and Jada LGAs (Southern Senatorial Zone) as shown in figure 2.

Data collection

The study was carried out between 2013 and 2014 and identification of browse trees were done by questionnaires, interview, kraal visits and direct field observation for at least two hours in the morning during grazing. About 500mg samples each of 10 most cherished browse resources from each location were collected and used for proximate analysis. The browse species were identified with the assistance of a botanist using Hausa, English and botanical names at the Department of Botany, Adamawa State University, Mubi and samples were deposited in the University herbarium.

(a) Dry matter (DM) content: The browses identified as being dry season feed resources for cattle were collected

fresh. The fresh samples were dried inside the Laboratory for 4 - 5 days to avoid lose of some nutrients. After drying, the samples were ground to gritty powder using muter and passed through a 1mm sieve. A quantity of 0.5Kg of each sample was preserved inside a sealed tube, labeled and stored for subsequent proximate analysis. Feed samples were analyzed for dry matter content in accordance with the methods of Association of the Official Analytical Chemists (AOAC, 1995; AOAC, 2004). Dry matter content for each sample was determined by oven-drying 3g at 105° C for 24 hours.

(b) Crude protein (CP): Samples of the feeds were analyzed for nitrogen (crude protein) in accordance with the Kjeldahl method (AOAC, 1995). Crude protein were determined by measuring the nitrogen content of the feed and multiplying it by a factor 6.25.

(C). Ash: About 3 grammes of each of the samples were analyzed for ash determination by complete combustion at 550^0 C in a furnace for 3 hours according to the methods of Association of the Official Analytical Chemists (AOAC, 1995; AOAC, 2004).

(d) Fiber: Fibre was analyzed by the trichloroacetic acid (TCA) digestion as described in the methods of Association of the Official Analytical Chemists (AOAC, 1995; AOAC, 2004).

(e) Ether extract: Ether extract was determined by dry soxhlet method for fat extraction as stated in the methods of the Association of the Official Analytical Chemists (AOAC, 1995; AOAC, 2004).

(f) Nitrogen Free Extract (NFE): NFE was obtained by subtracting the sum of percentages of all the nutrients already determined from 100. That is by using the formular %NFE =

DM - (% Ash + %CF = %EE + %CP).

(g) Detergent System of Fiber Analysis (NDF, ADF and ADL): This system was developed by Van Soest *et al*. (1991), and so is also referred to as the Van Soest system. This method separates cell contents from cell wall constituents which consist of hemicelluloses, cellulose, lignin and heat damaged protein.

(i) Neutral Detergent Fiber (NDF): This was carried out by boiling a sample of dry forage feed and refluxed in a neutral detergent solution (consisting of sodium lauryl sulphate, disodium dihydrogen ethylene amine tetra-acetate and phosphate buffer) after which, soluble carbohydrates, proteins and fats were extracted as described by Van Soest *et al*. (1991). The residue, which is mainly hemicelluloses, cellulose and lignin are components of the plant cell wall and is referred to as "neutral detergent fiber" (NDF).

(ii) Acid Detergent Fiber (ADF): This was also carried out by boiling a sample of dry forage feed and refluxed in an acidified detergent solution (consisting mainly of cetyl trimethylammonium bromide in sulphuric acid); soluble carbohydrates, proteins, fats and hemicelluloses are extracted into solutionas described by Van Soest *et al*. (1991). The residue, which is mainly cellulose and lignocelluloses is referred to as "acid detergent fiber" (ADF).

(iii) Acid Detergent Lignin (ADL or lignin): Percentage acid detergent lignin (ADL) or lignin content was obtained by finding the differences between NDF and ADF values as described by Church (1991). However, van Soests' detergent method also provides a means of determining cellulose and lignin by digesting the ADF with 72% H_2SO_4.

Data analysis

All survey data generated in this study were subjected to descriptive statistics such as frequencies and percentages.

Results and Discussion

Browse tree resources distribution during dry season in Adamawa State

The results of this study revealed 10 common tree browses that serve as dry periods feed resources in the study locations (Table 1). The results support the report of Okoli *et al*. (2003) that, there is an abundance of tropical browse plants available to ruminants in Nigeria. Earlier reports by Olayemi *et al*. (1998) and Omokaye *et al*. (2001) have also highlighted the available browse resources in Nigeria, while Opara (1996) and Oji and Isilebo (2000) reported that, such browse plants provide the vitamins and mineral elements, which are frequently lacking in grassland pastures. Their year round evergreen presentation and nutritional abundance provides for year round provision of fodder. The diversity and distribution of browse plants of Northern Nigeria have also received

attention in studies carried out in the North (Saleem *et al*., 1979) and Middle Belt (Ibeawuchi *et al.*, 2002) of Nigeria. Odoh and Adamu-Noma (2000) stated that, browses enable standing feed reserve to be built so that herds can survive critical periods of shortfall, or even prolonged periods of drought, without remarkable weight losses.

In recent time however, deforestation, urbanization and bush burning have become major factors responsible for dwindling proceeds of browse feed resources for ruminant livestock, especially in Northern Nigeria. For example, according to Yahya *et al.* (2000), traditional herdsmen and other pastoral groups habitually cut down branches from various trees species such as *Acacia, Adamasonia* and *Ficus spp*, making them available to livestock during the dry season, when no other forage is available. Browse plants, beside grasses, constitute one of the cheapest sources of feed for ruminants.

Many browse species have chemicals that appear to be produced for the purpose of deterring invasion or consumption of their leaves by microbes, insects and herbivorous animals (Njidda, 2010). However, Gidado *et al*. (2013), in their study of anti-nutritive factors and nutrient composition of some selected browse plants used as livestock feeds in neighboring Taraba State, reported that, the effects of high protein forage could over-ride the effect of the toxic compounds when used as supplement in the diets.

Proximate composition of the most preferred browses during dry season in Adamawa State

It has been observed from this study that adequate nutrient supply, as a factor of production is a major constraint to cattle productivity in the study area. The proximate composition (%) of the most preferred browses during dry season are shown in table 2. The results showed mean DM content of the most preferred browses during dry season was 89.78±3.99% with the range of 84.90 to 94.24% as presented in table 2. The *Balanite aegyptica* with 84.90% DM and therefore 15.10% moisture content was not properly dried and grow mold if stored for extended period. The results however fell within the reference values for tropical browse trees and agree with Gidado *et al*. (2013), who reported similar mean dry matter (MDM) content of some browse species in Taraba State to be 86.97%. These values are much higher than the mean dry matter value of 65.1 % reported by Carew *et al*. (1980) for browse plants in the derived savannah area of Nigeria.

The mean crude protein of the preferred browse plants was 13.96±3.08% with a range of 9.35 - 16.73%. *Khaya senegalensis* had the highest CP of 16.73% followed by *Tamarinae indica* with 16.50%, while the least was recorded by *Panicum maximum* (9.35%) which actually is a grass but was selected by the farmers for unknown reasons. Therefore, all browse plants have a reasonable quantity of crude protein which can be used in cattle production. The results agree with that of Njidda (2010), who reported similar CP content of semi-arid browse forages of North-Eastern Nigeria. Omoniyi *et al*. (2013) also reported *P. maximum* a tropical natural grass in humid and sub humid regions of Nigeria to have 9.27%, while *M. aegyptia* was reported to yield 19.63% CP. Norton (2003) also justifies the use of browse forages in small quantities in order to supplement poor quality pastures and crop residues.

The mean crude fiber content of the browses was 26.93±3.45%. *Panicum maximum* recorded the highest crude fibre (CF) content of 32.50% followed by *Mangifera indica* with 27.46%, while *Khaya senegalensis* had the lowest CF of 23.53%. The crude fiber content of the various browse plants is within the range of 15 - 20% CF recommended for improved intake and production in finishing ruminants since it represents insoluble carbohydrate such as alkali insoluble lignin, fibre bound Nitrogen and cellulose (Buxton, 1996).

The results of mean ether extract (EE) was 5.52±1.56%, with *Khaya senegalensis* having the highest value of 6.72%, followed by *Balanite aegyptica* with 6.71%, while the lowest value of 2.89% was recorded by *Panicum maximum*. Ether extracts content of browses in this study fell within the range of 4 – 10% EE recommendation (Preston, 1995 and Campbel *et al.*, 2006). The results agree with that of Njidda (2010), who reported a range of 2.00 to 5.00% for EE of Northeastern Nigerian browse forages. The value for all the browse species in this study are higher than the 3.0% reported by Dibal (1991) and Ifut (1982) in semi-arid Northeastern Nigeria and for browse plants in Western Nigeria.

The mean ash value of the browse plants was 10.41±1.97%, with a range of 7.74 - 13.25%. *Mangifera indica* had the highest value of 13.25% followed by *Khaya senegalensis* with 10.70% and the least value of 7.74% was recorded by *Tamarinae indica*. The results agree to that of Njidda (2010), who reported a range of 8.00 to 18.00% for ash of northeastern Nigerian browse forages. Omoniyi *et al*. (2013) also reported that ash content in *M. indica* was higher (13.66%) than other

plants. In Southern part of Nigeria, Ahamefule *et al*. (2006), reported ash content of heavily browsed plants to be comparatively higher than values obtained in this present study. Le Houerou (1980a) and Gohl (1981) stated that the different figures obtained in the ash content of browse plants in many regions may be due to differences in oil, species and season.

The mean nitrogen free extract (NFE) was 49.66±1.87%, with a range of 47.67 - 52.45%. *Panicum maximum* recorded the highest value of 52.45% followed by *Balanite aegyptica* with 50.23%, with *Tamarinae indica* having the least value of 47.67%. These results fell within the recommended values a feed would have for livestock feeding as NFE represents the soluble carbohydrate of the feed, such as starch, sugars, pectin, organic acids, hemicelluloses and alkali-soluble lignin.

Neutral Detergent Fiber (NDF) mean value obtained from the present study (Table 2) was 48.69±9.41%, with a range of 40.20 - 64.50%. The results therefore showed that *Panicum maximum* had the highest value of 64.50% followed by *Balanite aegyptica* with 48.50%, whereas *Khaya senegalensis* had the lowest with 40.20%. The results agree with Gidado *et al*. (2013), who reported similar mean NDF values for the browse plants analyzed to be 48.97%, higher than the as 25 - 45% and 20 - 35% reported by Le Houerou (1980b) and Norton (1994) respectively. The results, again, corroborate that of Njidda (2010), who reported fibre contents of 37.3 to 51.2% for NDF for browse forages in northeastern Nigeria.

The results *Panicum maximum* recorded the highest value of 39.40% followed by *Mangifera indica* with 34.53%, while the lowest value of 19.60% was recorded by *Khaya senegalensis*. Mean value stood at 27.88±8.57% and agrees with Gidado *et al.*, (2013), who reported similar ADF in 30 browse species to be 23.30%. The results again corroborates that of Njidda (2010), who reported ADF contents of 16.2 to 41.2% for browse forages in northeastern Nigeria.

The results show that *Mangifera indica* recorded the highest ADL of 13.45% followed by *Panicum maximum* with 9.61%, while the least was recorded by *Tamarinae indica* with 5.44%. The results corroborate that of Njidda (2010), who reported 4.9 to 12.7% ADL for browse forages in northeastern Nigeria. Omoniyi *et al*. (2013) also reported variations in the ADL from 6.46% - 34.53% for some browses.

Table.1 Commonly browsed tree resources during dry period

S/No.	Botanical Name	English Name	Hausa Name	Mubi North	Gombi	Jada	Freq
1	*Acacia spp*	Acacia	Madaci	+	+	+	3
2	*Leucaena leucocephala*	Leucaena		+	+	+	3
3	*Moringa oleifera*	Moringa	Zoggale	+	+	+	3
4	*Balanites aegyptica*		Adua	+	+	+	3
5	*Khaya senegalensis*			+	+	+	3
6	*Tamarindus indica*	Tamarind	Tsamiya	+	+	+	3
7	*Terminalia vicenoides*			+	+	+	3
8	*Mangifera indica*	Mango	Mangoro	+	+	+	3
9	*Afzelia Africana*			+	+	+	3
10	*Ficus polita*			+	+	+	3
Total				**10**	**10**	**10**	**30**

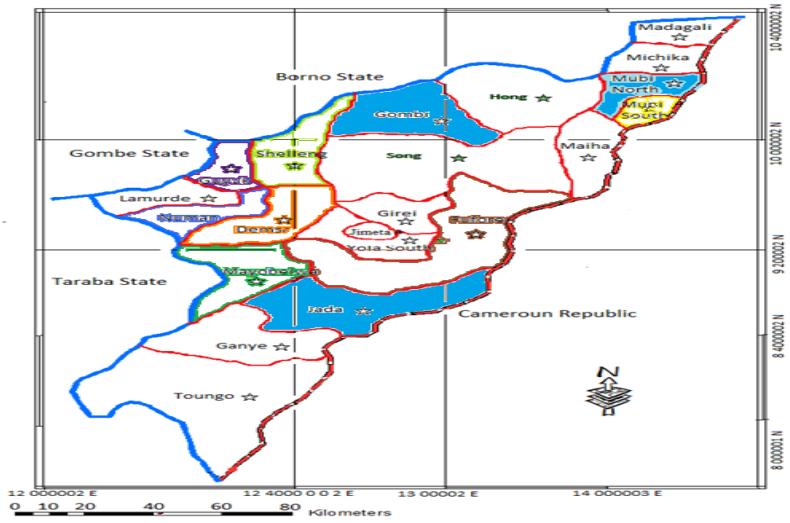
Table.2 Proximate composition (%) of the most preferred browses during dry season in Adamawa State

Parameters	*B. egypt*	*K. senegalensis*	*T. indica*	*P. maxim*	*M. indica*	Means/SD	Range
Proximate Composition							
DM (%)	84.90	88.60	87.64	93.54	94.24	89.78±3.99	84.90 - 94.24
CP (%)	14.71	16.73	16.50	9.35	12.54	13.96±3.08	9.35 - 16.73
CF (%)	26.37	23.53	24.80	32.50	27.46	26.93±3.45	23.53 - 32.50
EE (%)	6.71	6.72	5.62	2.89	5.67	5.52±1.56	2.89 - 6.72
ASH (%)	10.53	10.70	7.74	9.87	13.25	10.41±1.97	7.74 - 13.25
NFE (%)	50.23	49.70	47.67	52.45	48.27	49.66±1.87	47.67 - 52.45
NDF (%)	48.50	40.20	43.26	64.50	47.00	48.69±9.41	40.20 - 64.50
ADF(%)	22.64	19.60	23.25	39.40	34.53	27.88±8.57	39.40 - 19.60
ADL (%)	5.62	5.61	5.44	9.61	13.45	7.94±3.54	5.44 - 13.45
HEM(%)	25.90	20.60	20.00	25.90	12.50	20.98±5.50	12.50 - 25.90

Note: Dry matter (DM); Crude protein (CP); crude fiber (CF); Nitrogen Free Extract (NFE); Neutral Detergent Fiber (NDF); Acid Detergent Fiber (ADF); Acid Detergent Lignin (ADL); Ether extract (EE);

Fig.1 Map of Nigeria showing Adamawa state, the study area in blue

Fig.2 Map of Adamawa state showing the three study LGAs in blue



The mean hemicellulose value was 20.98±5.50%, with a range of12.50 - 25.90%, indicating that *B. egyptica* and *P. maxim* had the highest level of digestible carbohydrates. The results again, corroborate that of Njidda (2010), who reported 4.9 to 12.7% ADL for browse forages in northeastern Nigeria.

Conclusion and Recommendations

It was observed that, adequate nutrient supply as a factor of production is the major obstacle to cattle productivity in Northern Nigeria. The situation is worse during the long dry season when animals are unable to meet their protein and energy needs from available low-quality herbage with consequent marked weight loss and productivity. The browse forages in the study area had low to moderate content of fibre. This is a positive attribute of the browse forages since the voluntary DM intake and digestibility are dependent on the cell wall constituents (fibre), especially the NDF and lignin (Bakshi and Wadhwa 2004). The availability of a variety of browses and the selection process enable cattle to extend as well as meet their feed preferences. Traditional farmers in the semi-arid region of Nigeria allow their cattle to browse on tree forages in the range lands and they cut and feed these tree foliages as supplements based on experience and convenience.

Browse plants are mostly considered alternative feed resources used by famers to support ruminant animals. All the browse plants offered to the animals, especially *B. aegyptica, K. senegalensis* and *T. indica* yielded higher leaf crude proteins and lower crude fibers, indicating that the browse plants could form better dry season feed resources if found in enough quantities. Feed resource conservation and storage culture should form part of our norms and values as an agrarian country who depend so much on agricultural products. Government and private stake holders should embark on massive tree planting campaign to save the zone from desert encroachment for better and quality life in general.

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