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## Chemical composition of some forages fed to ruminants in a Semi-arid environment of Kebbi State, Nigeria

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### Abstract

*This study assessed the chemical compositions of some naturally occurring forages used as ruminant feed during the raining season at Aliero Local Government Area, of Kebbi State. A total of eight (8) pasture species were sampled comprising of four (4) grasses; Pennisetum pedicellatum, Mitracarpus hiristus, Eragrostis tremula and Digitaria alata, three (3) forbs Monechma ciliatum, Commelina banghalensis, Ipomoea kotschyana and one (1) legume; Euphorbia convolvuloides. All the parameters measured showed significant ( $P < 0.05$ ) differences among the treatments. Digitaria alata had the highest dry matter (99.00%) while the highest crude protein (11.93%), nitrogen free extract (52.07%), and ether extract (3.50%) were recorded for Euphorbia convolvuloides. Ipomoea kotschyana had the highest crude fiber (20.50%) and ash (11.50%). The values recorded for the mineral compositions indicated that the legume (Euphorbia convolvuloides) the higher sodium, calcium and magnesium concentrations (132.50 mg/g, 0.85 g/mg and 1.65 mg/g, respectively) while the grass (Mitracarpus hiristus) and the forbs (Monechma ciliatum) species had the highest potassium (4200 mg/g) and phosphorus concentrations (5.18 mg/g) respectively. This study showed that mixture of forages in the diet of ruminants may optimize nutrients and minerals intake for growth and development.*

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**Key words:** Semi-arid, nutrients composition, forages, season, ruminants

### Introduction

Forages are extensively used to feed domesticated farm animals and comprise a wide variety of plant species which are predominantly grasses or legumes and can be fed fresh or conserved. The effect that rich pasture species can have on animal nutrition is related to its chemical composition. Thus, several authors (Fisher and Baker, 1996) have worked on the nutritive aspects of naturally occurring pasture species, reporting that their concentrations of Ca, Mg, Na, Co, and Se are higher than those found in sown species. In spite of this, there is still lack of information to accurately evaluate the nutritive value, expected yield and management conditions of pastures (Fisher and Baker, 1996). The major problem facing ruminant animal production in the tropics is insufficient quality pasture species particularly during the dry season since

the bulk of ruminant animals in developing countries are produced on natural grassland. The supply of good quality forage throughout the year is quite necessary if a higher level of production is to be obtained from these animals (Onwuka *et al.*, 1997).

Forage quality, voluntary intake and selection by animals are greatly influenced by the stage of pasture species maturity and amount of moisture found in the soil in which the plants grow. In addition, concentrations of nutrients and mineral elements in forage plants are dependent upon the interaction of a number of factors such as plant species, soil type, plant age, pasture management and climate (MacDowell *et al.*, 1993). Dayo *et al.* (2009) reported that the major feed resources of ruminant animals available in the savannah zone of Nigeria are the native pastures from the

communal grazing lands, fallows and marginal lands, farm weeds and crop residues as well as other agricultural by-products, they are generally inadequate during the dry season to support the productivity level desired to meet the demand for livestock products and services in the country.

During the rainy season (cropping period), ruminant production systems in the study area include full confinement, partial confinement or by tethering in order to prevent crop damages by these animals. With this, some farmers either engaged in cut and carry or purchased cut natural pasture species from youth who have taken this as a livelihood to feed their animals. In spite of this, there is dearth of information on the nutritive composition of uncultivated native forage species used as ruminant feed. Therefore this study was designed to determine the chemical composition of some naturally occurring pasture species in Kebbi State.

### Materials and Method

#### Study area

The research was conducted at Aliero Local Government Area between the months of July to September, 2019. Aliero is a town located in the southeastern part of Kebbi State, in north-western Nigeria. The town lies between the Latitude 12°19'06"N and Longitude 4° 3' 10"5. It has a short wet season lasting from May to October. The people of the town embark mostly on onion and pepper production, although mixed farming is also common among the farmers along with cattle, sheep and goats reared, they also produce other crops like maize, groundnut, millet and tree crops like mango, cashew etc (KARDA, 2012).

#### Sample collection and sorting

A total of seven (7) visits on fortnightly visits were done for the collection of the forage samples contained in sacks of various sizes

from hawkers at different locations within the town. Personal interview with the hawkers revealed that the cut forage species were collected at both cultivated and fallow areas within the study area. The collected samples were sorted and bulked together to represent a composite for each species. Thereafter they were air dried until constant weight was achieved. The species encountered were identified by their local names through the assistance of the local farmers in the study area. The air dried leaves of each specie were detached from the plant body and taken to the laboratory for analysis.

#### Chemical analysis

Thoroughly mixed dried leaves of each species were used for the analysis. Fifty grams (50g) of dried leaves was used to determine the chemical composition of the sample collected in the laboratory.

#### Proximate and mineral compositions

Dried samples were analyzed for proximate composition according to A.O.A.C (2000) procedures to determine the Crude Protein (CP), Ether Extract (EE), Ash, Crude Fiber (CF) and Nitrogen Free Extract (NFE). Dried samples were also analyzed to determine the mineral elements content. Sodium, Potassium and Calcium were estimated by using emission flame photometer, while Phosphorus and Magnesium were determined using Atomic Absorption Spectrophotometer.

#### Data analysis

All the data obtained were subjected to analysis of variance using the procedure of SAS (2004). Treatment means were compared using Duncan's multiple range tests (Duncan, 1955).

#### Results and Discussion

The pasture species encountered in the study area are presented in Table 1. A total of eight (8) pasture species were encountered

comprising of four (4) grass species namely; *Pennisetum pedicellatum*, *Mitracarpus hiristus*, *Eragrostis tremula* and *Digitaria alata*, three (3) forbs and one (1) leguminous species namely; *Monechma ciliatum*, *Commelina banghalensis*, *Ipomoea kotschyana* and *Euphorbia convolvuloides* respectively. These species are annual types. Deridder and Breman. (1993) reported that in the Sudan and Sahel rangelands, the vegetation

consisted mainly of annual plants. Presently, the most frequently cultivated forage grass species in Nigeria are northern *gamba* (*Andropogon gayanus*), woolly finger grass (*Digitaria smutssi*), *Sorghum almum* (Columbus grass), *kyasuwa* (*Pennisetum pedicellatum*), *setaria* (*Setaria anceps*) (Agishi, 1984; de leeuw, 1978). However the encountered species in the study area were uncultivated types.

**Table 1: Naturally occurring pasture species in the study area during 2019 rainy season**

Botanical names	Family names	Common names	Local names (Hausa)
<i>Pennisetum pedicellatum</i>	<i>Poacea</i>	Hairy fountain grass	<i>Kyasuwa</i>
<i>Monechma ciliatum</i>	<i>Commelinisea</i>	Milne redhead	<i>Danfarkami</i>
<i>Mitracarpus hiristus</i>	<i>Poacea</i>	Button grass	<i>Harwatsi</i>
<i>Eragrostis tremula</i>	<i>Poacea</i>	Love grass	Bubburwa
<i>Commelina banghalensis</i>	<i>Commelinisea</i>	Banghal day flower	<i>Bulasa</i>
<i>Ipomoea kotschyana</i>	<i>Commelinisea</i>	Morning glory	<i>Takalmin kwado</i>
<i>Euphorbia convolvuloides</i>	<i>Legumenisea</i>	Fula pulaar	<i>Nonon kurciya</i>
<i>Digitaria alata</i>	<i>Poacea</i>	Crab grass	<i>Harkiya</i>

Source: field survey, 2019

The proximate composition of the pasture species encountered is presented in Table 2. There was significant ( $P < 0.05$ ) difference in the values obtained among the treatments. However the values did not follow any consistent trend.

The dry matter (DM) values recorded ranged from 94.50% to 99.00% with the highest value obtained in a grass species (*Digitaria alata*) and closely followed by forbs and legume species (*Eragrostis tremula* and *Euphorbia convolvuloides*). The mean DM values obtained in this study were higher than those reported by Fadiyimu *et al.* (2011) but similar to those obtained from selected forages by Eyoh *et al.* (2018). The higher DM recorded might be due to the rainy period during which the species were obtained, which is in line with the findings of George *et al.* (2005).

The highest (11.93%) crude protein (CP) value was observed in a leguminous species (*Euphorbia convolvuloides*) while the least (6.41%) was recorded in a grass species

(*Digitaria alata*). The CP values of the forage species would provide the ammonia required for rumen microbes. The use of different types of forage species to feed ruminants is better than feeding a sole poor quality forage species and crop residues (Norton, 2003). The variations in the CP composition among the forages can be due to inherent factors such as soil type, location and age of the plant (Rittner and Reed, 1992). The high CP in the leguminous species relative to the grass and forbs indicated the importance of having grass-legume mixtures offered in the diet of ruminants as reported by Tudsri *et al.* (2002).

The highest (20.50%) and the lowest (9.00%) values of crude fiber (CF) were recorded in forbs species; *Ipomoea kotschyana* and *Commelina banghalensis*, respectively. The CF values obtained were lower than those reported by Eyoh *et al.* (2018). The CF values observed in this study were in the normal range for ruminants (Mac Donald *et al.*, 1995). According to Njidda *et al.* (2010) the voluntary

dry matter intake and digestibility of feed are dependent on the fiber contents of forages. Inadequate fiber intake in the diets of ruminants can lead to incidence of a wide range of diseases (Oke *et al.*, 2007). The significant ( $P<0.05$ ) differences observed among the forage species in this study is in agreement with the work of Durr *et al.* (2005).

The values of the carbohydrate (NFE) obtained indicated that grass species had higher values than the legumes. The highest (52.07%) value of NFE was recorded in *Eragrostis tremula*. Buckmaster (1990) reported that differences in forage quality between grasses and legumes can be very large. The NFE values obtained in this study were higher than those reported by Ukorebi *et al.* (2019).

The range of the ash content of the forages in this study ranged from is 4.50% to 11.50%,

with the highest value recorded in forbs specie (*Ipomoea kotschyana*) and the least in a grass species (*Digitaria alata*). The ash content which is an indication of the presence of mineral concentration in the soil area where the forage species are obtained is within the range reported by Kubmarawa *et al.* (2008); Amata and Lebari (2011).

The lipid (EE) compositions obtained among forage species varied significantly ( $P<0.05$ ). The highest (3.50%) EE was recorded in the leguminous species (*Euphorbia convolvuloides*) while the least (1.0%) was among the forbs (*Commelina banghalensis*) and grass (*Digitaria alata*) species. The values observed in this study were higher than those obtained by Onyeonagu and Eze. (2013).

**Table 2: Proximate composition of some forage species**

Species	%DM	%CP	%CF	%NFE	%ASH	%EE
<i>Pennisetum pedicellatum</i>	96.50±0.76 <sup>ab</sup>	4.90±0.26 <sup>d</sup>	14.50±0.60 <sup>b</sup>	67.10±0.21 <sup>d</sup>	7.50±0.76 <sup>b</sup>	2.50±0.35 <sup>b</sup>
<i>Monechma ciliatum</i>	94.50±0.76 <sup>ab</sup>	5.95±0.05 <sup>cd</sup>	15.50±0.66 <sup>b</sup>	76.35±0.09 <sup>b</sup>	10.50±0.66 <sup>a</sup>	2.00±0.13 <sup>b</sup>
<i>Mitracarpus hirstus</i>	95.50±0.82 <sup>a</sup>	6.21±0.05 <sup>c</sup>	15.50±0.61 <sup>b</sup>	65.29±0.20 <sup>c</sup>	8.50±0.50 <sup>b</sup>	1.50±0.5 <sup>c</sup>
<i>Eragrostis tremula</i>	98.50±0.76 <sup>b</sup>	7.61±0.05 <sup>b</sup>	14.00±0.21 <sup>b</sup>	81.09±0.36 <sup>a</sup>	4.50±0.40 <sup>c</sup>	2.00±0.13 <sup>b</sup>
<i>Commelina banghalensis</i>	94.00±0.76 <sup>b</sup>	4.29±0.06 <sup>d</sup>	9.00±0.51 <sup>c</sup>	74.71±0.19 <sup>c</sup>	4.50±0.40 <sup>c</sup>	1.00±0.15 <sup>c</sup>
<i>Ipomoea kotschyana</i>	94.50±0.76 <sup>b</sup>	4.55±0.05 <sup>d</sup>	20.50±0.60 <sup>a</sup>	55.95±0.06 <sup>g</sup>	11.50±0.56 <sup>a</sup>	2.00±0.15 <sup>b</sup>
<i>Euphorbia convolvuloides</i>	98.33±1.45 <sup>a</sup>	11.93±0.05 <sup>a</sup>	9.50±0.59 <sup>c</sup>	59.39±0.19 <sup>f</sup>	5.50±0.54 <sup>c</sup>	3.50±0.36 <sup>a</sup>
<i>Digitaria alata</i>	99.00±0.50 <sup>a</sup>	6.41±0.05 <sup>c</sup>	9.50±0.51 <sup>c</sup>	76.55±0.33 <sup>h</sup>	10.50±0.66 <sup>a</sup>	1.00±0.15 <sup>c</sup>

Means in the same column with different superscript are significantly ( $P<0.05$ ) different

The results of mineral compositions of some pasture species are presented in Table 3. The values obtained showed significant ( $P<0.05$ ) differences among the treatments. However, the observed values did not follow any consistent trends.

A legume species (*Euphorbia convolvuloides*) had the highest value (132.50mg/g) of sodium (Na) accumulation while the least value (57.50mg/g) was recorded for a grass species (*Pennisetum pedicellatum*). The Na values obtained in this study were higher than those reported by Eyoh *et al.* (2018). Forage

potassium (K) concentration was highest (4200mg/g) in the grass specie (*Mitracarpus hiristus*) than the legume and forbs species. However, the least K value was obtained in a grass species (*Digitaria alata*). Too large doses of K in the diet of ruminants can cause animal tertany (Stasys and Nomed, 2007). Adequate supply of K helps to maintain body weight and regulate water and electrolyte balance in the blood and tissues of livestock (NCR, 1989). The values of K obtained among the forages in the study were higher than those observed by Stasys and Nomed (2007). The calcium (Ca) content of all the forages obtained in this study was generally low (Table 3). However, the highest (0.85g/mg) and the least (0.50g/mg) values were obtained in a legume (*Euphorbia convolvuloides*) and forbs (*Commelina banghalensis*) species, respectively. Stasys and Nomed (2007) suggested that levels of 2.5g/kg are adequate for grazing animals in most of their biological circumstances. Optimal Ca concentration ensures proper assimilation of fat and fibres, reduces methane production in the faeces of ruminant animals (Machmuller and Kreuzer, 2005). However, excess of Ca in diets inhibits assimilation of Mg and some micro elements

(NRC, 2001). The magnesium (Mg) concentration obtained in this study were higher (1.65g/mg) in the forbs (*Monechma ciliatum*) and legumes (*Euphorbia convolvuloides*) while the least value (0.95g/mg) was recorded in grass specie (*Digitaria alata*). According to Stays *et al.* (2007) grass species accumulated less Mg than legumes. This is in line with the present study. Magnesium plays a major role in relaxing muscles along the respiratory tract of farm animals, it is also important in most reactions involving phosphate transfer (Appel, 1999). The values of Mg obtained in this study were higher than those reported by Eyoh *et al.* (2018). The forbs species (*Monechma ciliatum*) had the highest (5.18g/mg) phosphorus (P) value while the least value (3.77g/mg) was recorded for grass species (*Digitaria alata*). The P levels obtained among the forage species in this study were higher than the recommended levels of 3.2-4.4g/kg (NCR, 2001). Phosphorus plays an important role in carbohydrate, lipid and amino acid metabolism. It is also important for blood coagulation, bone formation, adequate growth rate and optimum utilization of calcium (Olomu, 2011).

**Table 3: Mineral compositions (g/mg) of some forage species**

Species	Na	K	Ca	Mg	P
<i>Pennisetum pedicellatum</i>	57.50±0.06 <sup>h</sup>	2600±0.00 <sup>e</sup>	0.65±0.06 <sup>b</sup>	1.45±0.06 <sup>abc</sup>	4.28±0.06 <sup>c</sup>
<i>Monechma ciliatum</i>	120.00±0.60 <sup>b</sup>	3100±0.00 <sup>d</sup>	0.75±0.60 <sup>ab</sup>	1.65±0.08 <sup>a</sup>	5.18±0.08 <sup>a</sup>
<i>Mitracarpus hiristus</i>	82.50±0.55 <sup>d</sup>	4200±0.00 <sup>a</sup>	0.55±0.06 <sup>cd</sup>	1.25±0.06 <sup>c</sup>	4.14±0.07 <sup>cd</sup>
<i>Eragrostis tremula</i>	70.00±0.36 <sup>f</sup>	2800±0.00 <sup>g</sup>	0.80±0.08 <sup>a</sup>	1.55±0.06 <sup>ab</sup>	4.20±0.27 <sup>c</sup>
<i>Commelina banghalensis</i>	77.50±0.45 <sup>e</sup>	3700±0.00 <sup>b</sup>	0.50±0.08 <sup>d</sup>	1.10±0.06 <sup>d</sup>	3.83±0.06 <sup>de</sup>
<i>Ipomoea kotschyana</i>	105.00±0.46 <sup>c</sup>	2300±0.00 <sup>f</sup>	0.60±0.08 <sup>b</sup>	1.35±0.06 <sup>c</sup>	4.78±0.06 <sup>b</sup>
<i>Euphorbia convolvuloides</i>	132.50±0.49 <sup>a</sup>	3400±0.00 <sup>c</sup>	0.85±0.08 <sup>a</sup>	1.65±0.06 <sup>a</sup>	4.05±0.07 <sup>cd</sup>
<i>Digitaria alata</i>	65.00±0.60 <sup>g</sup>	2100±0.00 <sup>h</sup>	0.65±0.03 <sup>abc</sup>	0.95±0.80 <sup>e</sup>	3.77±0.05 <sup>e</sup>

Means on the same column with different superscript are significantly (P<0.05) different

**Conclusion**

The study area constitutes various forages; grasses, legumes and forbs which are

important as ruminant feed and also serves as a means of livelihood for youths. Mixture of forage species in the diet of ruminants may

optimize nutrients and minerals intake for growth and development. The legumes were richer in crude protein, lipid, sodium and calcium than the forbs and grass species. Adequate management such as fertilization, irrigation, conservation practices and proper storage are necessary to improve the all year round production of these forages.

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