Proximate and phytochemical composition of hay made from three different pasture species (*P. pedicellatum, A. gayanus and C. biflorus*) in Yobe State, Nigeria

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Abstract

This study investigated the quality and phytochemical contents of three indigenous grass species for grazing animals in Yobe State a semi-arid region in the sahel, Nigeria. The pasture species *Pennisetum pedicellatum, Andropogon gayanus and Chloris biflorus* were harvested from grazing rangelands in the study area, measured and then analysed for determination of their nutritive quality and phytochemical content. Plants were harvested at bloom stage, sundried to 40% moisture level,shade-dried for ten days, milled into 2 mm particle size and stored in airtight polythene bags until analysis. Results obtained for nutrient composition revealed that *A. gayanus* had higher mean value for crude protein (10.62 g/100g) followed by *P. pedicellatum* (8.94 g/100g) then *C. biflorus* (6.81 g/100g). Nitrogen free extract was highest in *C. biflorus* (50.53 g/100g) and lowest in *A. gayanus* (36.70 g/100g). Phytochemical analysis showed that the concentration of flavonoids in *P. pedicellatum* (0.15 g/100g) was slightly higher than the respective values of 0.07 and 0.04 g/100g obtained in *A. gayanus* and *C. biflorus*. Similarly, *P. pedicellatum* (0.26 g/100g) had higher tannin level than both *A. gayanus* (0.04 g/100g) and *C. biflorus* (0.02 g/100g). The mean concentration of saponins in the three grass species was 0.09 g/100g (*A. gayanus*), 0.10 g/100g (*P. pedicellatum*) and 0.16 g/100g (*C. biflorus*) while that of alkaloids fell within the range of 0.14g/100g in *C. biflorus* and 0.25g/100g in *A. gayanus.* Based on the nutritive value and phytochemical content of the pasture species analyzed, it was concluded that *A.gayanus* could be best used to improve rangeland and livestock productivity in Yobe state, Nigeria.

Introduction

The pastoral system of livestock husbandry is characterized by transhumance and communal grazing. In addition, sedentary livestock rearers' also depend on forage grasses and legumes from range lands in order to meet the nutritional needs of their animals. In essence, most ruminant livestock owners depend on grazed and conserved forage as basic feed resource (Ayodele, 2022).

The main advantages of forage as feed resource are its low unit cost and high availability compared to other animal feed materials. Forage grasses and legumes provide all the nutrients required for maintenance, production and reproduction. However, the low level of animal production experienced, particularly, in the savannah zones of Nigeria, is generally associated with the inability to sufficiently supply high quality forage, especially during the

dry season. This has been the main cause of southward migration of herdsmen and the seemingly unending cases of farmers-herder clashes, cattle rustling and banditry that have claimed several lives (Abdena, 2013).

Some of the most available and popularly used forage grasses in ruminant feeding in Northern Nigeria include *Pennisetum pedicellatum* (kyasuwa- Hausa), *Androgogon gayanus* (Gamba - Hausa), *Cenchrus biflorus* (karangiya - Hausa), *Chloris gayana* (kanarin doki - Hausa), *Digitaria horizontalis* (harkiya - Hausa), among others (Garba *et al.,* 2022). However, available data on their chemical composition in the Sahel to assess their nutritional value for animals and possible utilization in traditional medicine is scarce. *Pennisetum pedicellatum, C. biflorus* and *A. gayanus* are some of the most available and used grass pastures for ruminants feeding in the study area. Apart from nutritive value vis a vis the nutritional requirements of livestock, assessment of chemical composition of forages is also useful in the area of phytomedicine. Phytochemicals are plant-based bioactive compounds produced by plants for their protection.

The aim of this research work was to evaluate the proximate composition and some phytochemical profile of three grass species; *P. pedicellatum*, *A. gayanus,* and *C. biflorus* in Yobe State. Results obtained in this study will help animal scientists, pasture agronomists, extension agents and livestock farmers in making informed decisions on effective and optimal utilization of these forage species. It will also help compound ruminant feed millers and livestock farmers with intensive and semi-intensive ruminant production systems properly mix concentrates/supplements with chopped forage to balance rations to meet the nutrient requirements of their animals.

Methods

The study was conducted at Federal Polytechnic, Damaturu, Yobe State. The area is located within latitude 11^0 North and longitude 13.5^0 East. The state shares common boundaries with Borno to the East and South-East, Jigawa to the Northwest and Bauchi and Gombe states to the Southwest (NPC, 2006). The rainy season in Damaturu is short, scorching and starts from the month of June to September with its peak at August. Rainfall could be erratic, epileptic and ranges between 180 - 240mm with relative humidity of 75 % during the rainy season with a mean annual temperature of 28^0C. The vegetation is savannah grassland with grasses, sparse dwarf trees and shrubs. Cattle, sheep and goat are usually the most important animals grazing in the area by Fulani pastoralists (ACReSAL, 2023).

The study area was a natural rangeland and three (3) forage species of *P. pedicelatum, C. biflorus and A. gayanus* were harvested at bloom stage, shade-dried for 10 days, milled into 2 mm particle size and stored in polythene bags ready for laboratory analysis of proximate composition and phytochemistry. Laboratory analysis was done at the Federal Polytechnic, Damaturu, Yobe State using the procedure of AOAC (2005). Crude protein (CP), Crude fibre (CF) and Ether extract (EE) were analysed while Nitrogen Free Extract (NFE) was obtained by calculation using the following formula;

$$NFE\ \% = 100\% - (\%\ CP + \%\ EE + \%\ CF + \%\ Ash + \%\ moisture)$$

Test for alkaloids, tannins, saponins and flavonoids were conducted following the procedures of Sofowara, 1993.

All data obtained from laboratory analysis was analyzed for mean and standard deviation (Descriptive Statistics) using the SPSS v. 25 (SPSS, 2005).

Results and Discussion

Proximate composition of Pennisetum pedicellatum, Androgogon gayanus and Cenchrus biflorus

The results for proximate analysis of *P. pedicellatum*, *A. gayanus* and *C. biflorus* are presented in Table 1. Values for moisture content (g/100g sample) were 7.11 g for *A. gayanus,* 4.27 g for *P. pedicellatum,* and 3.65 g for *C. s biflorus*. Ash content ranged between 11.79 and 21.03 g in *A. gayanus* and *P. pedicellatum* respectively. Crude fibre level was highest in *A. gayanus* (31.23 g) followed by *P. pedicellatum* (21.03 g), then *C. biflorus* (16.42 g). The crude fibre content for *A. gayanus* obtained in this study is lower than 40.70 g/100g reported by Salah *et al.* (2014) and 34.32g/100g (Amada *et al.,* 2020). On the contrary, Rahman *et al.* (2020) reported a lower mean value (18.00 g/100g) for crude fibre in *P. pedicellatum* than obtained in the present study. Furthermore, the mean crude fibre value for *C. biflorus* obtained in this study is slightly lower than 20.80g/100g (Hassan *et al.,* 2018). These differences are probably attributable to the stage of growth at which the grass was harvested. Usually, plants harvested late in their growth cycle contain higher amount of crude fibre than those cut at earlier stage (Reference).

Ether extract was higher in *P. pedicellatum* (3.87 g) than in *A, gayanus* and *C. biflorus* which were identical (2.54 g). Values for crude protein were 10.62, 8.95, and 6.81 g for *A. gayanus, P. pedicellatum and C. biflorus,* respectively. These values are comparable with 9.81 g/100g for *P. pedicellatum* (Salah *et al.,* 2014), 2.60 – 19.0 g/100g for *A. gayanus* (Evitayani *et al.,* 2004) and 3.70 – 22.00 g/100g for *C. biflorus* (Ahmed *et al.,* 2003). Nitrogen free extract, ranged from 36.70 g to 50.53g and. was highest in *C. biflorus* and lowest in *A. gayanus*. However, the value for *A. gayanus* is comparable with 37.84g/100g reported by Salah *et al.* (2014).

Table 1: Proximate composition of selected pasture grass species in Yobe state, Nigeria.

	Grass specie			
Parameter (g/100g)	***A. gayanus***	***P. pedicellatum***	***C. biflorus***	**SD**
Moisture	7.11	4.27	3.65	0.07
Ash	11.79	21.03	16.42	0.02
Crude fibre	31.23	18.93	20.06	0.11
Ether extract	2.54	3.87	2.54	0.19
Crude protein	10.62	8.95	6.81	0.13
Nitrogen free extract	36.70	42.96	50.53	0.15

SD = Standard deviation

Phytochemical Contents of Pennisetum pedicellatum, Androgogon gayanus and Cenchrus biflorus

The results for Phytochemical analysis of *A. gayanus, P. pedicellatum*, and *C. biflorus* are presented in Table 2. Mean values for flavonoids were; *A. gayanus* (0.07 g), 0.15 g (P. *pedicellatum*) and 0.04 g (*C. biflorus*). The widespread distribution of flavonoids, their variety and their relatively low toxicity compared to other active plant compounds (for instance alkaloids) meant that many animals, including humans, could ingest significant quantities in their diet. Tannin content was higher in *P. pedicellatum* (0.26 g), followed by *A. gayanus* (0.04 g), then *C. biflorus* (0.02 g). This is much lower than 10.25 g/100g reported by FAO (2016) and Sulaiman *et al.* (2020) for *A. gayanus* and *P. pedicellatum* respectively. [Why the big difference?] Tannins can reduce feed intake when

found in high concentration in feed. They also precipitate proteins in the gut, reducing their digestibility (Mavromichalis, 2020).

Saponin values were 0.09 g (*A. gayanus*), 0.10g (*P. pedicellatum*) and 0.16 g (*C. biflorus*). These values are lower than 0.85 g/100g for *P. pedicellatum* (Clayton *et al.,* 2006), 4.01 g/100g for *A. gayanus* (FAO, 2016) and Cirade *et al.,* (1991) for *C. biflorus.* Saponins are glycosides present in plants, the low concentration of saponin obtained in this study will ensure an effective transverse tubular system and sarcoplasmic reticulum. (Desai *et al*., 2009). Mean values for alkaloids ranged from 0.14 g (*C. biflorus*), to 0.25 g for *A. gayanus*. Grinkevich and Safronich (1983) stated that alkaloids content in plants is usually very low and varies in plant, depending on the tissue. Depending on the type of plant, the maximum concentration is mostly observed in the leaves. This study provides an insight into the concentration of phytochemicals in the three indigenous pasture grasses studied. At harvest, the levels were low, indicating that that species could be selected for healthy animal nutrition without any detrimental effect on livestock fertility (Butkute *et al*. 2018)

Table 2: Phytochemical contents of three pasture grass species form Yobe state, Nigeria.

	Grass specie		
Parameter (g/100g)	***A. gayanus***	***P. pedicellatum***	***C. biflorus***
Flavonoids	0.07	0.15	0.04
Tannins	0.04	0.26	0.02
Saponins	0.09	0.10	0.16
Alkaloids	0.25	0.20	0.14

Conclusion and Recommendation

Based on the results obtained in this study it was concluded that the three grass pasture species *P. pedicellatum, A. gayanus and Cenchrus biflorus* harvested at the bloom stage of growth or life cycle contain appreciable levels of nutrients and secondary metabolites as required by ruminant animals especially during periods of forage and feed scarcity. *Andropogon gayanus* had the highest crude protein content of the three species, followed by *P. pedicellatum*. *Andropogon gayanus* is therefore recommended for improving rangelands for livestock production in semi-arid rangelands of Yobe state, Nigeria.

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