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Chemical composition and nutrient digestibility of three varieties of elephant grass (*Pennisetum purpureum*) by Sokoto Gudali heifers

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Abstract

Pennisetum purpureum is often rejected by grazing cattle during the rainy season but readily acceptable during the dry season when forage is scarce. However, a significant limitation of elephant grass as fodder for ruminants is its low nutritive value which depreciates as the plant matures. Thus, this study was carried out to evaluate the chemical composition and digestibility of three varieties of Pennisetum purpureum by Sokoto Gudali heifers. The varieties (Landrace purple, S-King and S.13) were harvested at 8 weeks regrowth for the experiments. Nine Sokoto Gudali heifers of about 14 months of age and average weight of 178.05 kg were used for digestibility study and they were randomly assigned to the three experimental diets (L. purple, S-King and S.13) using completely randomised design. Results of chemical analysis of the grasses showed that L. purple had the highest CP content of 11.2% while S.13 and S-King had 7.7 and 7.4% respectively. Dry matter (DM) content was significantly (P<0.05) lowest in S-King with a value of 17.9%, higher in L. purple having a value of 22.5% and highest in S.13 with a value of 26.3%. There was no significant (P>0.05) difference in neutral detergent fibre and acid detergent fibre of the three grasses. Results showed apparent digestibility values for S-King as 56.52, 50.06, 50.57 and 47.55% for DM, CP, EE and ash, respectively; S.13 had apparent digestibility values for same parameters as 68.89, 65.66, 51.18 and 58.82 respectively, while L. purple had apparent digestibility values of 69.77, 74.9, 71.45 and 61.4% for DM, CP, EE and ash respectively which were significantly (P<0.05) higher than those of the other two varieties. Digestibility of crude fibre (CF) and nitrogen free extract (NFE) were highest in S.13 but not significantly different (P>0.05) from L. purple and lowest in S-King. Apparent digestibility of nutrients differed significantly (P<0.05) across all parameters considered with S-King having the lowest digestibility values for all parameters. It is concluded that L. purple had the highest CP value and its nutrient contents were better digested than the other two varieties, thus recommended for production intensification.

Keywords: Cattle, fodder crop, nutritive value, elephant grass, Sokoto Gudali

Introduction

Livestock production is a socio–economic activity that can boost household income and improve standard of living among Nigerians (Akinola, 2009). The increasing human population implies that more foods of plant and animal origin must be supplied to meet the rising demands. Animal products are noted to be rich in quality protein with great potentials to improve household nutrition (Oluyomi, 2012). The low animal protein intake in Nigeria, coupled with the increasing demand for livestock products provides a great incentive to increase cattle production. In order to improve cattle production in Nigeria, there is need for a paradigm shift from nomadic grazing to more intensive rearing systems where fodder cropping plays a central role. The current agitation in Nigeria to abolish or modify nomadic grazing of cattle in favour of ranching systems cannot be achieved without a well-defined fodder production scheme. In

selecting appropriate fodder species for cultivation, biomass yield, acceptability by cattle and nutritive value of such fodders must be put into consideration.

Elephant grass (*Pennisetum purpureum*) or Napier grass is a common grass that thrives in sub-Saharan Africa with abundant biomass. It is a major forage plant used in silage production and cut-and-carry systems for both beef and dairy cattle production (Olorunnisomo, 2011; Rusdy, 2016). It is often rejected by grazing cattle during the rainy season but readily accepted during the dry season when forage is scarce. A significant limitation of elephant grass as fodder for livestock is its low nutritive value which depreciates as the plant matures. This study was therefore designed to assess the nutritive value of three varieties of *Pennisetum purpureum* for intensive cattle production in Nigeria. The three varieties (Landrace purple, S-King and S.13) were evaluated for chemical composition and nutrient digestibility using Sokoto Gudali heifers as experimental animals.

Materials and methods

Experimental site

This research work was conducted at the Dairy Unit of University of Ibadan Teaching and Research Farm.

Experimental design

Nine Sokoto Gudali heifers of about fourteen months of age and average weight of 178.05 kg were used. They were randomly assigned to three treatments corresponding to the three varieties of elephant grass (L. purple, S-king and S.13) using a completely randomized design. Each treatment consists of three replicates with one heifer per replicate.

Preparation of experimental diets

The three elephant grass varieties were the sole diets used in this experiment. They were freshly harvested at 8 weeks regrowth and chopped to approximately 3cm by a mechanical chopping machine before feeding to the animals. Representative sample of each diet was taken after thorough mixing, oven dried at 65°C, milled and then subjected to chemical analysis. The proximate composition of the diets is presented in Table 1.

Animal management

A week before commencement of the experiment, they were pre treated against endo and ecto parasites using ivemectin injection. The pens were cleaned, washed and disinfected and at commencement of the experiment, the heifers were scrubbed, washed and thoroughly cleaned. Each animal was housed in individual pens made of concrete, purposely constructed at a gradient of 0.066 for quick drainage of urine and easy collection of faeces. Each pen measured 1.5 x 2.5 m and was open sided. Measured quantity of each diet was provided twice daily at 08.00hrs and 17.00hrs for 14 days. Fresh water was offered free choice on daily basis.

Data collection

In this study, an in-situ faecal collection method was used. Faeces were collected from the experimental animals as soon as they were voided on a 24-hour basis, using hand trowels and deposited inside well labelled buckets. Three attendants were assigned to collect the faeces on an 8-hour shift. Harness bags were not used in this study due to the tendency of zebu cattle to wriggle and rub against the wall to remove the bags, thus spilling the excreta. Ten percent of faeces voided by each animal was taken daily, oven dried at 65°C, milled and kept in air tight containers for chemical analysis.

Chemical analysis

Proximate analysis of diets and faecal samples were determined using the general procedures of AOAC (2005) while fibre fractions were determined using the

methods of Van Soest and Robertson (1991).

Statistical analysis

The data on nutrient digestibility obtained from this experiment were subjected to one-way analysis of variance (ANOVA) (Steel and Torrie, 1980). Significant means were compared by Duncan's Multiple Range Test using procedures of ASSISTAT Version 7.7en (2016).

Results and discussion

The proximate composition of the diets is presented in Table 1. Dry matter (DM) content of the three varieties differed significantly ($P<0.05$) from one another. Landrace purple had DM of 22.5% while S.13 had the highest value of 26.3%. S-King had the lowest DM of 17.9% which is close to DM of 17.2% reported by Olorunnisomo and Fayomi (2012). This low DM suggests high moisture content in S-King. The range of crude protein (CP) amongst the three cultivars varied from 7.4% to 11.2%. This value is not too different from the reports of several authors who worked on different cultivars of *P. purpureum*. Halim *et al*. (2013) reported CP ranges of 9.2% to 12.1% at cutting intervals of 7 to 8 weeks while Njoka-Njiru *et al*. (2006) and Bayble *et al*. (2007) reported CP ranges of 8.1% and 7.8% to 14.1% respectively at cutting interval of 8 weeks. The most important factor affecting crude protein content of elephant grass is age at harvest or cutting interval (Wadi *et al*., 2004). As plants age, the dry matter yield increases while crude protein declines. Such a trend in crude protein content is mainly attributed to dilution of crude protein content of forage crops by rapid accumulation of cell wall carbohydrates at the advanced stage of growth (Humphreys, 1991). Ether extract was significantly low in S.13 but there was no significant difference between ether extract values for L. purple and S-King.

Table 1: Proximate composition (g/100g DM) of three elephant grass varieties

Parameters (%)	Elephant grass varieties			SEM
	L. purple	S-King	S.13	
Dry Matter	22.50[b]	17.90[c]	26.30[a]	1.767
Crude Protein	11.20[a]	7.40[b]	7.70[b]	0.897
Crude Fibre	27.00[c]	28.00[b]	33.00[a]	1.347
Ether Extract	9.00[a]	9.50[a]	6.50[b]	0.688
Ash	14.80[b]	16.00[a]	13.60[c]	0.508
Nitrogen Free Extract	38.00	39.10	39.20	0.379

[a,b,c] Means with different superscripts on the same row differ significantly (P<0.05)

Table 2 shows the fibre fractions of the three grasses. The S-King and S.13 had ADF values of 36.7% and 37.1% respectively with L. purple having a lower ADF of 34.7%. These values agree with those of Olajumoke (2003) who reported 30.6 to 40.2% ADF for elephant grass cut at 4 to 8 weeks of regrowth and Teklesadik *et al.* (2004) who reported 31.2 to 34.3% ADF for Dwarf elephant grass. Forage with high ADF value is classified as low quality roughage (Rusdy, 2016). According to Kellems and Church (1998), roughage with less than 40% ADF are categorized as high quality and those with greater than 40% as poor quality. Based on this assertion, the elephant grass varieties used in this study can be classified as high quality forage because their ADF values were below 40%.There was no significant ($P>0.05$) difference between NDF content of L. purple, S-King and S.13 which were 53.44, 54.65 and 54.11% respectively. Singh and Oosting (1992) pointed out that roughage feeds containing NDF values of less than 45% could be classified as high quality,

those with values ranging from 45% to 65% as medium and those with values higher than 65% as low quality. High NDF values can be a limiting factor to dry matter intake, as dry matter intake and NDF content are negatively correlated (Van Soest, 1994). Based on this fact, the three varieties can be categorised as medium quality forage in terms of their NDF values which fall within the medium category.

Table 2: Fibre fractions of the three elephant grass varieties

Parameters (%)	Elephant grass varieties			
	L. purple	S-King	S.13	SEM
ADF	34.7[b]	36.7[a]	37.1[a]	0.762
NDF	53.44	54.65	54.11	0.683
ADL	9.8	9.9	10.2	0.097

[a,b,c] **Means with different superscripts on the same row differ significantly (P<0.05)**
SEM = Standard Error of Mean.

The mean values for apparent digestibility of the grass varieties are presented in Table 3. The L. purple showed higher digestibility values of DM, CP, EE and ash with values as 69.77, 74.9, 71.45 and 61.4% respectively, which was significantly different from the values of the other two varieties. This high nutrient digestibility could be attributed to the high protein content of L. purple which is in agreement with Nori *et al*. (2009) who posited that protein content of feed enhances digestibility. CF and NFE digestibility in S.13 differed significantly from that of S-King but not significantly different from L. purple and this may be related to the higher dry matter contents of both S.13 and L. purple which had DM values of 26.3 and 22.5% respectively. High CF digestibility is also attributable to the ADF content (Table 2) of the grasses which was within the range of ADF value that qualifies forage as high quality (Kellems and Church, 1998). The reported values of dry matter digestibility which ranged from 56.52 to 69.77% were not too different from the 35 to 77.4% reported by Rusdy (2016) and Stobbs and Thompson (1975) for *in vitro* dry matter digestibility of most tropical grasses.

Table 3 shows that apparent digestibility was relatively high both in L. purple and S.13 but S-King had the lowest digestibility value for all parameters. Considering the ADF and NDF values of the three varieties shown in Table 2, it is expected that CF digestibility for the three grasses would be high (Kellems and Church, 1998; Singh and Oosting, 1992). While digestibility values for L. purple and S.13 were relatively high, values recorded for S-King were relatively low. The reason for the low digestibility observed in S-King is not presently clear and may be due to intrinsic factors within the plant or other unexplained environmental influences during the study. Among the three varieties of elephant grass evaluated, L. purple showed the highest digestibility values for heifers, indicating that this variety has higher nutritive value for cattle than S.13 or S-King.

Table 3: Mean values for apparent digestibility of three varieties of *Pennisetum purpureum* fed to Sokoto Gudali Heifers

Digestibility (%)	Elephant grass varieties			SEM
	L. purple	S. King	S.13	
Dry Matter	69.77[a]	56.52[b]	68.89[a]	1.409
Crude Protein	74.90 [a]	50.06 [c]	65.66 [b]	1.784
Crude Fibre	70.11[a]	58.54[b]	72.94 [a]	1.347
Ether Extract	71.45[a]	50.57[b]	51.18 [b]	1.999
Ash	61.40[a]	47.55[b]	58.82[a]	1.706
Nitrogen Free Extract	72.35[a]	61.51[b]	72.54[a]	1.318

[a,b,c] **Means with different superscripts on the same row are significantly different at (P<0.05)**
SEM = Standard Error of Mean.

Conclusion

The chemical composition and higher digestibility values observed in L. purple compared to S.13 and S-King indicates it has a higher nutritive value for cattle. Based on these results, it is suggested that agronomic practices that would further enhance the productivity of this variety of elephant grass should be investigated. Since protein content of grasses depend on plant age, cutting interval that optimizes biomass yield with high protein content should also be investigated. These preliminary results support the use of elephant grass in intensive, smallholder cattle production systems.

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