RESEARCH ARTICLE

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Acceptability of *Pennisetum purpureum* by West African dwarf rams as influenced by manure application rates

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Abstract

The present study evaluated the chemical composition and acceptability of Pennisetum purpureum by West African dwarf (WAD) rams as influenced by manure application rates. The experiment was a completely randomized design replicated three times. Grasses that have been fertilized with 5 and 10 t ha-1 of swine manure and unfertilized (control (0 t ha-1)), were harvested from the experimental site 9 weeks after planting from 15 cm above ground level and evaluated for proximate and fibre composition. The harvested grasses were also offered to nine WAD rams on cafeteria basis, to assess the acceptability indices of the grass based on treatments. Results showed that the grass with manures consistently had higher ($p<0.05$) crude protein (CP) contents than the control (unfertilized plants) while all the grasses with different manure rates had similar ($p>0.05$) neutral detergent fibre (NDF). Consumption, co-efficient of preference and relative palatability of P. purpureum by WAD rams were improved by manure application, where highest values of acceptability indices was recorded in grass with manure rate of 5 t ha-1 over 10 t ha-1 manured grass. Percentage consumption, co-efficient preference and relative palatability index were in the order 5 t ha-1 > 10 t ha-1 > 0 t ha-1 (unfertilized). From the result, it can be concluded that P. purpureum with manure had a better chemical composition profile (higher CP) and better acceptability than unfertilized grass. Enhancing P. purpureum with manure at 5 t ha-1 had higher ash content and improved acceptability by WAD rams than grass with 10 t ha-1 manure application rate.

Keywords: Acceptability, Nutritive value, Pennisetum purpureum, Swine manure

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INTRODUCTION

Inadequate nutrition is one of the factors that generally affect livestock productivity. Despite the naturally endowed vegetation, there are still inadequate feeds and feedstuffs for livestock in Nigeria. Akinlade et al. (2005) reported that a major problem facing small ruminant animal producers is how to feed the animals adequately all year round. Consequently, the issue of palatability and nutritive quality changes has become a matter of interest and great concern to researchers (Huston et al., 1993). Ruminants in the tropics are raised predominantly on grasses which are inherently poor in digestibility, nutritive value and unavailable in the off-season (Babayemi, 2009). Forage plants depend on soil for their supply of nutrients while ruminants obtain the majority of their nutrients from plants growing on such soil. Fertilizers are needed to improve soil chemical and bio-

logical properties and this reflects on the phytonutrient contents and palatability of herbage plants (Alalade, et al., 2013). However, inorganic fertilizers are expensive and this has made researchers to have shifted attention to examining the performance of crops with organic manure considering that organic manure is cheap and readily available (Ojo et al., 2013). Manure has a longer-lasting effect than the equivalent nutrient levels to chemical fertilizer. This is because a large proportion of the mineral nutrients are combined with organic substances which are released gradually as they decay, hence improved yield may continue years after the addition of manure to the soil (Plaster, 1992).

Elephant grass (Pennisetum purpureum Schumach.) is a major high yielding tropical grass, which is very versatile and can be grown under a wide range of conditions and systems. Elephant grass requires high level of fertilizer and a regular water supply (Mannetje, 1992). With no or inadequate fertilizers, yields are in the range of 2-10 t DM/ha/year (Bogdan, 1977) lower than 20 to 80 t DM/ha/year for normal yield.

Free choice intake and acceptability study is a quick assessment of the physical quality of a feed. Coefficient of Preference (CoP) is a direct measure of acceptability and nutritional capability of feedstuff or forage. In recent times cafeteria techniques have been used to assess the acceptability of some forages (Babayemi et al., 2006). The feed intake or the palatability of forage is regulated by many factors: harvesting, physical and metabolic feedback and secondary metabolites. This study evaluated the effect of swine manure rates on the chemical composition and acceptability of Pennisetum purpureum by West African dwarf rams.

MATERIALS AND METHODS

The experiment was conducted at the Pasture Unit of Federal University of Agriculture, Abeokuta (FUNAAB) Farm, Ogun State, Nigeria (7°58′ N, 3°20′ E; 75 masl). The site is situated in the derived savannah agro-ecological zone of Southwest Nigeria with average annual rainfall of 1,037 mm. Mean monthly temperature ranges from 25.7 °C in July to 30.2 °C in February (earth.google. com/).

The experimental land area was ploughed twice and allowed to rest for a period of two weeks before harrowing. The land area was divided into 3 equal blocks with a buffer zone of 1 m between blocks, while each plot measured 4 × 5 m, with a buffer zone of 1 m between plots. Analysis of the soil from the site indicated that it contained 0.12 % total nitrogen, 1.41 % organic carbon and 30.40 mg kg-1 phosphorus. Swine manure was collected from the Piggery Section of the Directorate of University Farms FUNAAB, 14 days before application in bi-axially oriented polypropylene bags. Following collection of the manure, it was air dried under a barn for a period of 11 days after which it was analyzed to determine its nutrient content. The swine manure was collected from pigs that had been fed a standard "Pigs finisher diet" and chemical analysis of the manure revealed that it contained: Ca: 4.13%, P: 1.21%, Mg: 2.42% and K: 1.91% on DM basis. The manure was raked into the soil of individual plots according to application rates (0, 5 and 10 t ha-1) for the grass in a single application 2 weeks before planting the grass. Stem cuttings of 30 cm long of P. purpureus was planted at 1m x 1m per plot, according to treatment. The plots were kept weed-free as much as possible throughout the experimental period. Nine WAD rams (three treatment groups of three animals each) with weights ranging between 10-15 kg were used for the study and they were tagged for easy identification. The animals were from Sheep unit of Universiy farms with regular health care. The environment was regularly disinfected. The grass were harvested based on the treatment from the experimental site 9 weeks after planting from 15 cm above ground level. Grass of 1 kg based on treatments were introduced on a cafeteria basis in feeding troughs to the animals and the experiment was repeated for five consecutive days. Nine feeding troughs containing the harvested grass based on the manure treatments with two troughs being empty to avoid border bias, were set before the animals, thus each animal has free access to each of the diets in the trough. The positioning of the feeding troughs containing the different treatment of grass were changed daily to prevent bias by the animals taking a particular part of the pen as the position for a particular type of grass. The grasses were offered at 08.00hr and withdrawn by 08.30hr and the left-over were weighed and recorded. Grasses were offered before the animals were allowed to graze or offered any feed for the day. The experiment was a completely randomised design replicated three times. The preference for the grass based on manure rates were calculated as the percentage of the grass consumed relative to grass offered for five days

$$\% \text{ Consumption} = \frac{\text{Grass offered} - \text{Grass remnant}}{\text{Grass offered}} \times 100$$

The preferred grass was assessed from the coefficient of preference (CoP) value, calculated from the ratio between the intakes for the individual grass, divided by the average intake of the grass (Babayemi et al., 2006). The grass were therefore said to be relatively acceptable if the CoP is greater than unit.

The CoP was expressed as:

$$\text{CoP} = \frac{\text{Intake for individual grass offered}}{\text{Mean intake of all the grass offered}}$$

Table 1. Effect of manure application rates on proximate and fibre composition (%) of Pennisetum purpureum

Factors	DM	CP	EE	Ash	NDF	ADF	ADL	Hemicellulose	Cellulose
Manure (t ha-1)									
0	96.18	8.12b	12.61 ab	10.06a	59.50	39.25a	7.88a	20.25c	31.37a
5	96.22	9.80 a	12.20 b	10.10 a	59.21	36.43 b	5.12 b	22.78 b	31.31 a
10	96.52	10.12a	12.77 a	8.82b	60.33	35.73c	4.71c	24.60a	31.02b
SEM	0.43	0.32	0.11	0.22	0.24	0.54	0.50	0.65	0.07
P – value	0.000	0.000	0.053	0.000	.148	0.000	0.000	.000	0.050

Means on the same column with different superscript differ significantly ($p<0.05$)
DM: Dry matter, CP: Crude protein, EE: Ether extract, NDF: Neutral detergent fibre, ADF: Acid detergent fibre, ADL: Acid detergent lignin
SEM: Standard error of mean

Daily relative palatability index (RPI) was calculated for the grass by dividing the consumption values for each treatment by that of the highest value and multiplied by 100 (Larbi et al., 1993).

The RPI is expressed as follows:

$$\text{RPI (\%)} = \frac{\text{Consumption values for each grass} \times 100}{\text{Grass consumption highest value}}$$

Subsamples (300 g) of harvested grass based on manure treatments were oven-dried at 65 ^{o}C to constant weight, following which they were milled and allowed to pass through a 1 mm sieve screen. The dry matter, ether extract, crude protein and ash contents were determined according to the standard methods of AOAC (2000). Neutral detergent fibre (NDF), acid detergent fibre (ADF), and acid detergent lignin (ADL) were determined according to Van Soest et al. (1991). Cellulose concentration was estimated as the difference between ADF and ADL concentrations, while hemicellulose concentration was estimated as the difference between NDF and ADF concentrations.

Statistical Analysis

Data collected was subjected to one way analysis of variance using the general linear hypothesis testing (GLHT) package of the R Statistical software (R Core Team, 2020). Mean values were separated using Tukey's HSD test.

RESULT AND DISCUSSION

In Table 1, the manured grass consistently has higher ($p<0.05$) CP contents than the control (unfertilized grass). Higher significance of ash content was recorded in grass fertilized with 5 t ha -1 of swine manure and in the unfertilized above the one fertilized with 10 t ha -1 of swine manure. Significantly ($p<0.05$) highest ADF and ADL contents were recorded for unfertilized grass above the grass with manures. The increase in CP contents with grass with manure may have been due to the fact that manuring makes more nutrient available to the grass, such that the soil nutrient resource pool in the manured plots was larger than the control. This findings emphasizes the importance of fertilization for grasses to get high quality forages, and is consistent with the reports of some previous reports in the literature which also reported improved CP content with manuring (McRoberts et al., 2016; Utamy et al., 2018). The significantly ($p<0.05$) lower ash content recorded at the highest manure application rate for P. Purpureum suggests that higher nutrient availability may have a possible antagonist effect on ash accumulation of P. purpureum. It is possible that luxury consumption of an abundantly rich soil nutrient pool brought about by manure application caused a passive absorption of ash accumulation in P. purpureum. In the literature, McRoberts et al. (2018) reported that this passive response is possibly curtailed when soil nutrient levels decline such that higher accumulation of ash (inorganic nutrients) is favoured by the plants as seen in the unfertilized P. purpureum plant. More so, higher ash content in grass fertilized with 5 t ha -1 of swine manure above the one with 10 t ha -1 of swine manure, might be that 5 t ha -1 of swine manure meet the nutrient needs of the grass. This findings reflect the different nutrient absorption strategy employed by the grass given the levels of nutrient resource available. The NDF recorded is within the range of 600-650 g kg-1 suggested as the critical limit above which efficiency of utilization of tropical forages by ruminants would be impaired (Muia, 2000). The moderate fibre levels of the grass depending on different manure rates will help to facilitate the colonization of ingesta by rumen microorganism which in turn might induce higher fermentation rates, that will help in improving digestibility, intake and animal performance.

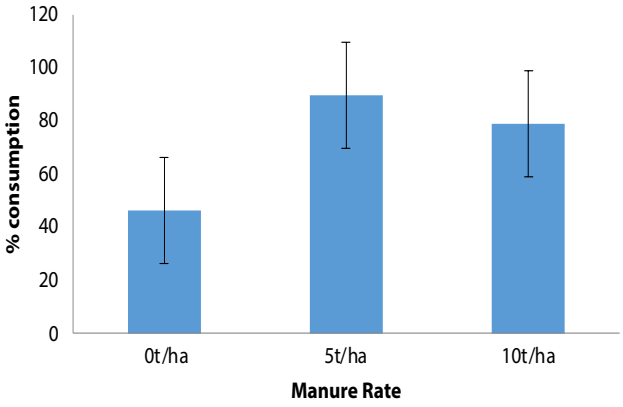

Figure 1. Influence of manure application rates on Percentage consumption of P. purpureum by WAD rams

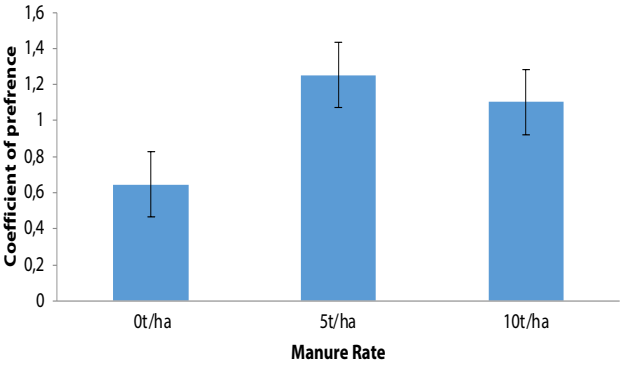

Figure 2. Influence of manure application rates on Co-efficient of preference of P. purpureum by WAD rams

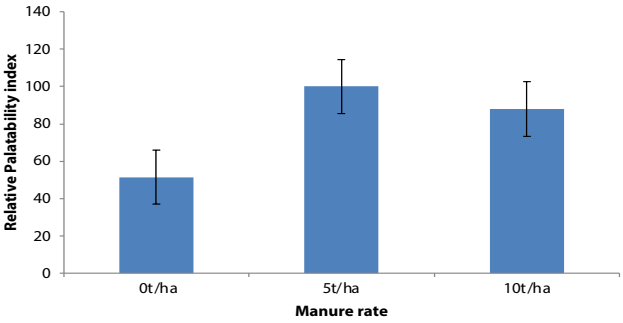

Figure 3. Influence of manure application rates on Relative palatability index of P. purpureum by WAD rams

Percentage consumption of P. purpureum, co-efficient of preference and relative palatability index by WAD rams were improved by manure application while unfertilized grass had lower acceptability (Figures 1, 2 and 3). This could be as a result of higher CP contents in fertilized grass since CP has been reported to enhance higher intake (Ergon et al., 2017) as well as moderate fibre contents. Moreover, Milne (1991) reported that diet selection in ruminants is complex. The relative palatability index (RPI) was a bit higher than the range of 0 to 70 % reported by Goatcher md Church (1970) as the preference range for ruminant animals. Palatability is a complex phenomenon determined by dietary type and environmental variables (Molyneux and Ralph, 1992). The differences reported could have been as a result of variations in environmental variables.

CONCLUSION

From the study, it can be concluded that P. purpureum with manure application rates had higher protein contents and moderate fibre constituents and were more accepted by animals than the unfertilized grass. However, the acceptability indices investigated demonstrated that the P. purpureum manured with 5 t ha -1 was highly acceptable by rams compared to the one with manure rate of 10 t ha -1. In addition, the application of manure is recommended because of its beneficial effects on the chemical composition and acceptability by animals.

However, the coefficient of preference demonstrated that the P. purpureum fertilised with 5 t ha -1 is highly acceptable compared to unfertilized grass.

COMPLIANCE WITH ETHICAL STANDARDS

Conflict of interest

The authors declared that for this research article, they have no actual, potential or perceived conflict of interest.

Author contribution

The contributions of the authors to the present study is equal. The authors read and approved the final manuscript. The authors verify that the Text, Figures and Tables are original and that they have not been published before.

Ethical approval

This research was in compliance with the guideline and animal experimentation protocol of the College of Animal Science and Livestock Production, Federal University of Agriculture, Abeokuta, Nigeria.

Data availability

All data associated with this research were indicated and used in the manuscript submitted.

Consent for publication

All authors consented to the publication of this manuscript.

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