Nutrient Intake and Digestibility of West African Dwarf Rams Fed Selected Browse Plants and *Megathyrsus maximus* Hay

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Abstract

Browse legume plants generates a lot of underutilized leaves which if properly harnessed can be a cheaper source of nutrients for small ruminant animal production, during dry season feed shortages. In this study, the nutrient intake and digestibility of West African dwarf (WAD) growing rams fed selected browse fodders with *Megathyrsus maximus* hay basal diet for 70 days feeding trial. A total of sixteen (16) growing WAD rams between 6 - 9 months of age with an average body weight of 9.00 - 12.00kg were randomly allocated to four treatments with 4 rams each and two rams per replicate in a completely randomized design. The experimental diet was fed at 3% body weight of individual ram while *G. arborea* (GA), *S. sesban* (SS) *and F. thonningii* (FT) fodders were fed at varied proportions with *Megathyrsus maximus* (MM) hay. The compared treatment diets were: T1 (100%MM hay), T2 (70%MM hay: 30%GA), T3 (70%MM hay: 30%SS) and T4 (70% MM hay: 30% FT) and fed for each ram per day. There were significant ($P<0.05$) differences in all parameters determined on nutrient intake and digestibility across the dietary treatments. Ram-fed T4 diet recorded the highest values (256.19g/d) of DM intake, (55.97g/d) of CP intake, EE intake (7.44g/d), ash intake (30.75g/d) and (108.28g/d) of NFE intake while the lowest values of DM intake (184.29g/d), CP intake (19.60g/d), EE intake (3.11g/d), ash intake (16.70g/d) and NFE intake (75.07g/d) was observed in ram fed T1 diet. Ram maintained on T3 diet had the highest DM digestibility (73.68%), while the lowest value (67.25%) for DMD was recorded on ram fed T1 diet. Ram fed T1 diet recorded the least crude protein digestibility (78.01%) while the highest value (85.76%) was recorded in ram fed diet T3. The highest value for CF digestibility (68.45%) was recorded in ram fed T4 diet while the least value (64.87%) was recorded in ram fed T1 diet. It can be concluded that the combination of grass-based diet (*Megathyrsus maximus*) with selected browse fodders enhanced nutrient intake and digestibility in WAD growing rams fed 70% *M. maximus* hay + 30% *S. sesban* fodders combination.

Keywords: *Tropical browse plant fodders, WAD rams, intake and digestibility of nutrients.*

Introduction

Inadequate supply of quality forage on a year-round basis and the high cost of conventional feedstuffs are major problems to the productivity of ruminants in Nigeria (Olorunnisomo, 2008). Ruminant animals especially West African dwarf sheep play an important role in the economic development

of Nigeria in terms of feeding the steadily growing population and providing investible resources for national development (Bolaji *et al*., 2016). They have the ability to convert poor-quality feedstuffs, such as grasses, legumes, farm wastes and crop residues that are unsuitable for human body tissue to meat (Fajemisin *et al*., 2010). At the onset of the dry season, grass becomes scarce as a result of rapid drying up and lignification, hence yield and quality of forage from perennial tropical grasses decline rapidly during the dry season, leading to a shortage in the supply of quality feed during this period. *Megathyrsus maximus* (Guinea grass) is one of the most widespread grasses in the derived savannah region of Nigeria. *Megathyrsus maximus* is suitable for pasture, cut-and-carry, silage and hay. Many *Megathyrsus maximus* cultivars have been developed for different purposes and agronomic situations (FAO, 2009). Guinea grass is tolerant of shade and fire but susceptible to water logging or severe drought. Under good conditions, its nutritional value is high, having up to 12.5 % crude protein, total digestible nutrients (TDN) of 10.2 % and calcium, phosphorus and magnesium. These grasses are abundant in the wet season but scarce in the dry season and where available, they are highly lignified. Preservation, therefore, remains the solution to their availability during the dry season. This problem of feed shortage is a contributory factor to the high cost of ruminant feeds which makes their products unprofitable and unsustainable for humans (Okoruwa *et al.,* 2012). Thus, there is a need to find reliable and sustainable alternative feed sources with the view to reducing the scarcity of feeds and improving the profitability of small ruminant production in the tropics (Konlan *et al.,* 2012). Notwithstanding, the use of guinea grass hay and browse fodders combination as feed sources alongside other strategies would go a long way in increasing feed supply for sheep in the tropics. The use of browse legumes as a supplement could help to alleviate the problem of dry season feeding of ruminants and equally reduce high-cost feeding associated with the use of conventional protein feeds (Olafadehan, 2013). In the predominantly small-scale, subsistence farming systems in the tropical agroecological zones, most of the farmers cannot afford a continuous supplementation of high-cost concentrate feeds to their animals. Recent research is therefore directed towards the exploration of affordable and abundant, alternate CP and energy-rich feeds from the prevalent evergreen tree species available (Osuga *et al.*, 2005). Findings show that tree leaves can be more efficiently utilized as a low-cost CP and mineral supplement to low-quality fibrous diets in the tropics, particularly during prolonged feed scarcity periods (Patra, 2010). In this regard, tree leaves are receiving increasing attention due to their potential to supply high CP and minerals and palatable fodder during periods of reduced accessibility to good-quality fodder (Abebe *et al.*, 2012; Khan and Habib 2012). Therefore, there is a need to look for protein sources that farmers could get from their farms at a minimum cost. One potential way for increasing the availability of feeds for smallholder farmers could be through the use of fodder trees and shrub legumes. The present study was designed to determine the feeding value of guinea grass hay and browse fodders combination on nutrient intake and digestibility of growing West African dwarf rams.

Materials and methods

Experimental site and animals

The experiment was carried out at the Sheep and Goat Unit, Teaching and Research Farm, Oyo State College of Agriculture and Technology, Igboora. Sixteen (16) growing West African dwarf (WAD) rams weighing

between 7.00 - 12.00kg and of 6 – 9 months of age were used. The animals were allowed to acclimatize for two weeks and treated against ectoparasites and endoparasites prior to the commencement of the experiment.

Harvesting and processing of experimental diets

The forages were harvested from the pasture demonstration plot of the college farm. *Megathyrsus maximus* (MM*)* forage was cut at 15cm above the ground level at the pre-flowering stage, chopped at 3 cm long and wilted for 2-3hours in the sun and air dried under shade for four to five days by spreading on a concrete floor and turning thoroughly to facilitate uniform drying for saving storage to prevent bleaching and loss of nutrients, bailed and stored for the experiment. Fresh *Gmelina arborea* (GA), *Sesbania sesban* (SS) *and Ficus thonningii* (FT) forages were harvested daily around the College vicinity.

Experimental layout, design and feeding method

The rams were allocated into four treatments, four rams per treatment and two animals as replicates in a completely randomised design (CRD). The animal was allocated based on their weights. The experimental diets' composition is T1 (sole100% hay), T2 (70%MM hay: 30% GA), T3 (70% MM hay: 30% SS) and T4 (70%PM hay: 30% FT). The *Megathyrsus maximus* hay and browse fodders combinations were thoroughly mixed to minimize selection by the animal. Each group of animals was assigned to an experimental diet and was fed *ad libitum* while fresh water was made available.

Nutrient intake and digestibility study, data collection and analysis

After 10 weeks of the feeding trial, two rams from each treatment were transferred into metabolic cages for faecal and urine collection. There was a 7-day acclimatization followed by 7 days of faecal collection. Urine and faeces were collected separately from each ram daily. Total faecal output was collected daily in the morning, weighed and mixed thoroughly. The faeces sample collected was bulked and oven dried at 80^0C until a constant weight was reached. Twenty per cent (20%) of formaldehyde was added to prevent further bacterial activity and the faecal samples were stored at -4^0C. A total urine output for 24 hours was collected. Plastic containers containing 10mls0.1N H_2SO_4 were placed under the metabolic crates. Ten per cent (10%) of daily urine output was taken from each ram and stored in a refrigerator at -20^0C for subsequent analysis. The faecal samples were chemically analyzed for nutrients present in the faecal samples using the AOAC procedure (AOAC, 1995) while the fibre fractions (NDF, ADF and ADL) were determined using van-Soest's (1991) procedure.

Statistical analysis

All data obtained were subjected to a one-way analysis of variance (SAS, 1999). Differences among the means were separated using Duncan's multiple-range test (Duncan, 1955).

Results and discussion

The analysed proximate composition of the selected browse fodders plus *Megathyrsus maximus* hay combinations fed growing rams are presented in Table 1. The dry matter (DM) content of *Megathyrsus maximus*, T1 diet with 5% lower was significantly ($p<0.05$) lower than the DM values of the browse fodder + MM groups, (T2, T3 and T4 diets).

Table1. Proximate composition of selected browse fodders with *Megathyrsus maximus* hay combination

Parameters (%DM)	T1 100%MM Hay	T2 MM70GA30	T3 MM70SS30	T4 MM70FT30
DM	78.21	81.10	81.14	80.56
CP	8.32	16.71	18.69	17.60
CF	27.33	19.87	19.02	20.11
EE	1.32	2.30	2.39	2.34
Ash	7.09	9.70	10.62	9.67
NFE	31.86	33.04	32.08	34.05
*ME(Kcal/Kg)	1546.85	1979.33	2025.87	2051.39

DM= Dry Matter, CP= Crude Protein, CF= Crude Fibre, EE= Ether Extract, NFE=Nitrogen Free Extract, MM= *Megathyrsus maximus* hay, GA=*Gmelina arborea* fodder, SS=*Sesbania sesban* fodder, FT= *Ficus thonnigii* fodder; *ME= Calculated Metabolizable energy,

However, the DM value obtained in this study was comparable with the value reported for MM. by Tona *et al.* (2014). The crude protein (CP) content of the MM hay (8.32%) was significantly (P<0.05) lower than those of MM hay + browse fodder combinations. The CP of browse fodder expectedly should be higher than that of the MM hay as it contains higher nitrogen than grass. The CP of the MM hay + browse diets which ranged from 16.71 – 18.69% was comparable with the average value of 17.92% reported for the same browses sole by Ahamefule *et al.* (2006) and was higher than the average of 10 -12% recommended for maintenance for small ruminants (NRC, 1981; Devendra and McLeroy, 1982). The crude fibre (27.33%) of MM hay was higher (P<0.05) than the values, 19.87, 19.02 and 20.11% for MM hay + GA, MM hay + *S. sesban* and MM hay + FT respectively. However, the 27.33% is close to the 30.72, 33.05 and 33.40% reported elsewhere (Yusuf *et al.,* 2013; Tona *et al.,* 2014).

The ether extract content of 1.32% obtained from the MM hay was significantly (P<0.05) lower than the values obtained from the MM hay + browse fodder combinations. The ether extract value of 1.32% is close to the value of 1.40% (FAO, 2003) and 1.26% reported by (Adegun, 2014). The ash content of MM hay (7.09%) was lower (P<0.05) than the 9.70, 10.62 and 9.67% for the MM hay + browse fodder combinations, respectively. The ether extract (EE) values which represented the crude fat content were higher in diets that contained the MM hay + browse fodder combinations and were also richer in fat compared to the sole MM hay. The EE values recorded for the MM hay + browse fodder combinations group, however, showed that they contained adequate crude fat to satisfy the energy requirement of ruminant animals for productive purposes. Feedstuffs having a crude fat value of 1-2% have been found sufficient to maintain good health by reducing the risk of diseases and ageing caused by excess consumption (Sodamade *et al.,* 2013).

Nitrogen free extract of MM hay (31.86%) was lower than the values of 33.04, 32.08 and 34.05% obtained from the MM hay

+ browse fodder combinations. Generally, the chemical composition of the forage plants varies with the nutrient profile of the soil where the forage was harvested, the geographical location as well as the rate of water and nutrient uptake (Ajayi, 2012).

Table 2. Nutrient intake of West African Dwarf rams fed selected browse fodders combinations with *Megathyrsus maximus* hay (g/day)

Parameters	T1 100%MMHay	T2 MM70GA30	T3 MM70SS30	T4 MM70FT30	SEM
DMI	184.29^{d}	209.20^{c}	231.01^{b}	256.19^{a}	13.29
CPI	19.60^{d}	43.10^{c}	53.21^{ab}	55.97^{a}	9.16
CFI	64.40^{a}	51.25^{cd}	54.15^{c}	63.95^{ab}	2.92
EEI	3.11^{d}	5.93^{c}	6.80^{ab}	7.44^{a}	0.83
Ash Intake	16.70^{d}	25.02^{c}	30.23^{ab}	30.75^{a}	2.82
NFE intake	75.07^{d}	85.22^{c}	91.33^{b}	108.28^{a}	6.03

DMI= Dry Matter Intake, CPI= Crude Protein Intake, CFI= Crude Fibre Intake, EEI= Ether Extract Intake, NFEI=Nitrogen Free Extract Intake, MM= *Megathyrsus maximus* hay, GA=*Gmelina arborea* fodder, SS=*Sesbania sesban* fodder, FT=*Ficus thonnigii* fodders

Table 2 represents the result of nutrient intake by WAD rams fed *Megathyrsus maximus* with different browse fodder combinations. Total DM intake was similar for all the treatments except treatment 1 which was significantly lower (P<0.05) than browse supplemented treatments group. The least DM intake was recorded for ram fed T_1 diet that contained sole *Megathyrsus maximus* hay. The animals took a longer time to adapt to this feed and this could probably indicate that a longer time is required for the rumen flora to become adapted to metabolizing the fibrous feed in the rumen (Theng *et al.,* 2003). According to Oladotun *et al.* (2003) variations in feed intake can be attributed to differences in breed, body weight and type of diet and length of time spent on the diet. Feed intake is greatly influenced by the palatability of the feed and the animals' level of productivity. The type of diet seems to be the major difference between the reports cited above and that in the present study. Therefore, the higher DM intake recorded by Adegbola *et al.* (1990) followed by that in this study could be attributed to the higher palatability of the diets used in the two studies than those in the other works cited. There were significant differences (P<0.05) in dry matter intake (DMI) (g/day) among treatment means. However, the nature of the fibre and its interaction with other nutrients like protein might also influence intake. Crude protein (CP: g/day) intake significantly (P<0.05) differed among treatment means with higher values recorded by the MM hay + browse fodder combinations group T2 than the diet T1 group the control. The crude fibre intake was highest (P<0.05) in the rams fed diet T1 (64.40g/day) and the least in the rams fed diet T2 (51.25g/day), this might be due to the fibre quantity of the diet T1. According to Topps (1996), the fibrosity of forages indicates the extent to which they can be degraded by rumen micro-organisms. Ash intake was highest in diets T3 and T4, followed by those on diet T2 and the least in

diet T1. The highest nitrogen-free extract (NFE) intake was obtained in rams fed on T4 diet that contained MM hay + FT forage while the lowest value for NFE intake was recorded in rams fed on T1 diet that contained 100% MM hay. ARC (1984) reported that supplementation of protein-based supplement enhances intake and growth performance. Supplementation of poor quality forages was reported to increase dry matter intake and performance of animals. The increase in dry matter intake by rams was due to increased protein intake as a result of browse plants supplementation which gave higher live weight gain (Ferdous *et al.*, 2011). Furthermore, the high dry matter intake of rams on MM hay with different selected browse fodder combinations could be due to high CP content. The level of DMI is influenced by several factors, such as the body composition of animals (composition of the body fat), environmental conditions especially climate, genetic factors, the weight of the animals, type of management, feed composition and quality (ARC, 1980). However, it has been observed that DMI can be favourably influenced by CP level (Karim *et al.*, 2001; Karim and Santra, 2003).

Table 3. Nutrient digestibility of West African Dwarf rams fed selected browse fodders combinations with *Megathyrsus maximus* hay (%)

Parameters	T1 100%MM Hay	T2 MM70GA30	T3 M70SS30	T4 MM70FT30	SEM
DMD	67.25^{d}	70.12^{c}	73.68^{a}	71.95^{b}	1.19
CPD	78.01^{d}	82.16^{bc}	85.76^{a}	83.28^{b}	1.40
CFD	64.87^{d}	67.59^{b}	66.10^{c}	68.45^{a}	0.69
EED	81.76^{cd}	82.14^{c}	86.07^{a}	84.19^{b}	0.86
Ash D	43.80^{d}	45.11^{c}	46.77^{b}	48.95^{a}	0.96
NFED	59.35^{d}	60.48^{c}	63.51^{a}	62.24^{b}	0.80

DMD= Dry Matter Digestibility, CPD= Crude Protein Digestibility, CFD= Crude Fibre Digestibility, EED= Ether Extract Digestibility, NFED=Nitrogen Free Extract Digestibility, MM= *Megathyrsus maximus* hay, GA= *Gmelina arborea* fodder, SS= *Sesbania sesban* fodder, FT= *Ficus thonnigii* fodder

Table 3 indicated the nutrient digestibility values of WAD rams fed selected browse fodders combinations with *Megathyrsus maximus* hay. The result showed that nutrient digestibility values were significantly different (P<0.05) among the treatment means. Dry matter digestibility (%) was higher for the rams fed MM + browse diets T3 (73.68), T4 (71.95) and T2 (70.12) than in diet T1 (67.25), which suggests that combining browse fodder with grass species promotes dry matter digestibility. The values obtained were comparable with Tona *et al.* (2014) who reported a similar range of 77.47 to 81.67% for goats fed *Megathyrsus maximus* with concentrate diets containing graded levels of *Moringa olerifera* leaf meal. The value obtained for CP digestibility was significantly (P<0.05) higher in the rams fed MM + browse fodder diets T3, T4 and T2 than in the sole MM hay diet T1. CP digestibility in this study was comparable with the value of 84.56% reported by Nwagu (2004) for rams fed *Megathyrsus maximus* and *Gmelina arborea* at a ratio of 60:40 respectively. There was a significant difference (P<0.05) in CF digestibility among treatment means. The values obtained for diets T1, T2, T3 and T4 showed that the groups fed MM hay + browse fodder diets T2, T3 and T4 had significantly (P<0.05) higher CF digestibility than diet T1 that contained sole MM hay diet. This result, however, indicates that the higher CP level of the MM + browse fodder diets (T2, T3 and T4) positively influenced CF digestibility which agrees with the reports by Okah *et al.* (2012) that CF digestibility and CP digestibility increase with increasing level of CP in the diet. These results are also in line with Minson (1990), supplementation of browse fodders to a basal grass diet can help improve the dietary protein as well as improve the DMI and digestibility of the diet. There was a significant difference (P<0.05) in ether extract digestibility. Increasing ether extract digestibility values with supplementation of selected browse fodders in the forage combinations shows that EE digestibility increased with increasing ether extract levels in the dietary combinations. (Okoruwa *et al.*, 2013; Okoruwa & Bamigboye, 2015). The low ash digestibility values observed in this study could be attributed to the interactions among ingredient components of the experimental diets which adversely affected microbial activity in the rumen (Okoruwa & Bamigboye, 2015). NFE digestibility was higher in the MM hay + browse fodder diets than in the sole MM hay diet, the values obtained were T1 (59.35), T2 (60.48), T3 (63.51) and T4 (62.24). Feeding either grass or browse plant fodders alone, therefore, would not support adequate nutrient intake and digestibility, but a combination of the two at the appropriate ratio will enhance nutrient utilization for the overall productivity of the animal.

Conclusion

The results of the study indicated that the combination of grass-based diet (*Megathyrsus maximus*) with selected browse fodder plants promoted dry matter and nutrient intake, and also enhance digestibility in West African Dwarf growing rams fed 70% *M. maximus* hay + 30% *S. sesban* combinations.

Recommendation

It is, therefore, recommended that the tropical grass *Megathyrsus maximus* be supplemented with browse fodder in diets of growing ram to enhance the performance of the animals. The combination ratio might, however, depend on the production status of the animal and the quality of both the basal grass diet and the browse plant species. It might be necessary, however, to further

investigate the ratio of grass: browse fodder that will be best for different production statuses of rams with different qualities of both basal grass diet and browse fodders.

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