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NUTRIENT INTAKE AND DIGESTIBILITY OF WEST AFRICAN DWARF GOATS FED SELECTED FORAGE SPECIES AS SUPPLEMENT TO ELEPHANT GRASS

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ABSTRACT

A study was carried out to evaluate the effect of selected forage species on the nutrient intake and digestibility of West African dwarf (WAD) goats. Twenty four bucks of WAD goat weighing between 11.10 to 14.20kg were randomly assigned to six dietary treatments (*Spondias mombin, Ageratum conyzoides, Calopogonium mucunoides, Terminalia catappa, Dialium guineense and Pennisetum purpureum*) with four bucks per treatment in a completely randomized design in an experiment that lasted 84 days. A metabolism trial was conducted at the end of the feeding trial using eighteen bucks to assess the effect of the diets on nutrient digestibility. The result showed that dry matter intake (DMI) was significantly (P< 0.05) higher (257.69 g/day) in animals fed *Spondias mombin* supplemented with *Pennisetum purpureum*. The crude protein digestibility significantly (P < 0.05) highest value of 89.30% was observed in goats fed *P. purpureum + S. mombin* while the least value was observed in animals fed *P. purpureum + A. conyzoides.* Animals fed with *P. purpureum + D. guineense* had the best ash and ether extract digestibilities whereas the least CF digestibility value was noticed in goats fed with *P. purpureum + T. catappa* with no significant variations in the values of animals fed with *P. purpureum + D. guineense* and *P. purpureum + C. mucunoides.* The study concluded that goats fed *Spondias mombin* supplemented with *Pennisetum purpureum* gave the best performance in terms of the crude protein.

Key words: Forage, West African Dwarf bucks, Nutrient digestibility

INTRODUCTION

Ruminant livestock production in developing African countries is often characterized with low level of efficiency. Africa has about 40% of the total world ruminant livestock population yet, produces about 5.5% and 7.8% of the world total meat and milk respectively (Steinfeld, 2003). Adegbola (2002) reported that poor quality roughages fed to ruminants without supplementation during the dry season caused considerable weight losses and general poor performances. Browse plants are considered to be high in the production of good quality forage in terms of protein and minerals contents for palatability and digestion (Ogunbosoye and Babayemi, 2012). The West African Dwarf (WAD) goat is the dominant breed of small ruminants and makes up to 38% of the 38million goats found in the West African humid zone (Gall, 1996). It is well adapted to this environment and trypanotolerant. The main feed resources of this animal are native grasses, legumes that occur naturally in grasslands, tree leaves and crop residues. Generally the feeding pattern of this animal is characterized by the native husbandry practice whereby it scavenges for food to meet its daily nutrient requirements (Daramola *et al*., 2005)

The presence of anti-nutritional factors such as tannin, saponin, phytate, etc., in most of the leaves limit their use as sole animal fodder. Farmers usually minimize and overcome these problems by feeding different leaves in mixtures in small quantities, which not only dilutes and reduces the problem of palatability

and toxic effects (Lowry, 1990) but also extends feed base for animals.

The potentials of trees and shrubs as alternative fodder resources in ruminant nutrition have attracted the attention of researcher's worldwide (El Hassan *et al*., 2000). Several indigenous and exotic browse species have been investigated and evaluated for inclusion in ruminant feeding system in Nigeria. A substantial inclusion of unconventional feed resources such as *Spondias mombin, Ageratum conyzoides, Calopogonium mucunoides, Terminalia catappa* and *Dialium guineense* is one of the ways of improving the utilization of low quality forages. These necessitate nutritive quality evaluation of the browse species in the study area.

MATERIALS AND METHODS

Study site

The feeding and metabolic trials were carried out at Yaba College of Technology, School of Agriculture Odoragunshin Epe campus, Lagos State, Nigeria. The study site was located within longitude 6.47^0N and latitude 3.58^0E, it is 42m above the sea level. It lies in the lowland rain forest vegetation zone within the agro-ecological zone of Southwest Nigeria.

Source of Experimental feed materials

The five forage plants selected were harvested around the premises of the campus (Yaba College of Technology, School of Agriculture Odoragunshin Epe campus, Lagos State) and fed fresh to the animals as supplement to grass at 5% body weight (Omoniyi, 2014) as shown below:

Diet I (Control) – *Pennisetum purpureum* only (100%)
Diet II – *Spondias mombin* (40%) *and Pennisetum purpureum* (60%)
Diet III – *Ageratum conyzoides* (40%) and *Pennisetum purpureum* (60%)
Diet IV – *Calopogonium mucunoides* (40%) and *Pennisetum purpureum* (60%)
Diet V - *Terminalia catappa* (40%) and *Pennisetum purpureum* (60%)

Diet VI - *Dialium guineense* (40%) and *Pennisetum purpureum* (60%)

Experimental Animals, Management and Feeding

Twenty four growing West African dwarf bucks weighing between 11.10 – 14.20kg were randomly assigned to six dietary treatments having four replicates per diet in a completely randomized design. The pens were thoroughly washed and disinfected with Izal. Animals were de-wormed with Albendazole® 2.5% oral suspension (Anthelmintic) at 1ml/10kg body weight and treated against ectoparasites with Cypermethrin or Ivomectin at 1ml/10 kg body weight. The animals were weighed and randomly distributed to individual pens. Body weights of the animals were taken weekly to monitor weight changes during the trial. The experimental diets is compose of *Spondias mombin, Ageratum conyzoides, Calopogonium mucunoides, Terminalia catappa , Dialium guineense* and *Pennisetum purpureum* . A known quantity (40%) of selected forage plants with (60%) *Pennisetum purpureum* were offered to the animals while (100%) *Pennisetum purpureum* only was served to the control animals at 5% body weight in a wooden feeding trough. Clean water was offered daily *ad libitum* in a water trough. The animals were fed after two weeks adaptation period. Leftover feed was weighed and discarded every morning. Voluntary feed intake was determined as the difference between feed offered and feed refused. The period of the experiment was 84 days (12 weeks).

Digestibility studies

Digestibility studies were carried out by collecting total faecal and urine samples according to the methods describe by Osuji *et al*., 1993. Three animals per treatment were randomly selected weighed and transferred to individual metabolic cages for 14 days. During the last seven days, still using the same set of

feeds, faeces and urine voided by each animal were collected; weighed and 10% was kept for analyses. To avoid ammonia losses, urine was collected into bottles with few drops of concentrated H_2SO_4 by methods described by Osuji *et al*., 1993. Weights of the goats were measured at the beginning and at the end of the collection period.

Urine samples were frozen while faecal samples were oven dried at 60^{o}C to constant weight, ground and store in air tight container pending analysis.

Chemical analysis

Oven dried faecal samples were analysed for their proximate compositions: crude protein, crude fibre, ether extract and ash content (AOAC, 2005). Neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were determined according to methods described by Van Soest *et al*., 1991. Cellulose and hemicellulose were calculated as differences between ADF and ADL, and NDF and ADF respectively.

Statistical analysis

All data collected was subjected to one-way Analysis of Variance (ANOVA) while significant differences among means were compared using Duncan's Multiple Range Test (SAS, 1995).

Statistical model

$Y_{ij} = \mu + T_i + {}_{ij+} \varepsilon_{ij}$

Where:

Y_{ij}= observation from a j^{th} animal receiving i^{th} treatment;
μ= population mean;
T_i= mean effect of selected browse plants;
ε_{ij}= residual error

RESULTS

Feed intake and weight changes

Nutrient intake of WAD goats fed selected forages is presented in Table 1. There was significant (P<0.05) difference in total DM intake (615.89 g/day) in animals fed *P. purpureum + C. mucunoides* followed by animals on *P. purpureum + S. mombin* (611.17 g/day). Animals on *P. purpureum + A. conyzoides* recorded significantly (P < 0.05) least value for total DM intake (545.85 g/day). Addition of the selected forages to *P. purpureum* significantly (P < 0.05) affected OM and CP intake as animals on *P.purpureum + A. conyzoides* recorded least values (502.35 and 71.32 DM g/day) respectively. Total value recorded for CF intake ranged from 38.17 to 49.82 DMg/day in animals fed *P. purpureum + T.catappa* and *P. purpureum + C. mucunoides* respectively. Animals fed *P. purpureum + S. mombin* and *P. purpureum + A. conyzoides* have significanltly (P < 0.05) high values of total crude fibre intake 48.30 and 48.43 DMg/day. The total ash intake was highest in animals fed *P.purpureum + C. mucunoides* (45.70 DMg/day) followed by animals fed *P.purpureum + A. conyzoides* (44.44 DMg/day). The least value was recorded in animals fed *P.purpureum + T. catappa* (34.96 DMg/day). The total fat intake ranged from 45.34 to 50.47 DMg/day in animals fed *P. purpureum + D. guineense* and *P.purpureum* respectively.

The results of the apparent nutrient digestibility (%) of WAD goats fed the selected forages is presented in Table 2. There was significant difference in the diet of the parameters measured. The DM digestibility significantly varied (P <0.05) from 87.53 – 91.72% in goats fed *P. purpureum + T. catappa* and *P. purpureum + D. guineense* respectively. The crude protein digestibility was significantly (P < 0.05) highest (89.30%) in goats fed *P. purpureum + S. Mombin*, while the least value was observed in animals fed *P. purpureum + A. conyzoides*. Animals fed *P. purpureum + D. guineense* had the best ash and ether extract digestibilities whereas the least CF digestibility value was noticed in goats fed with *P. purpureum + T. catappa* with no

significant(P>0.05) difference in animals fed diet containing *P. purpureum + D. guineense* and *P. purpureum + C. mucunoides.*

DISCUSSION

Addition of browse forage to the basal diet (*P. purpureum*) significantly increased the total feed intake of the goats. Total feed intake observed in goats supplemented *with S. mombin* was higher when compared to the range of values reported by Njidda (2010) when WAD goats were fed semi-arid browse forages. Values reported for daily feed intake compared favourably with values reported by Omoniyi *et al*, (2012) when WAD goats were fed urea molasses multinutrient feed blocks. Lower values of daily feed intake were also reported by Ogungbesan *et al.* (2013) when WAD goats were fed selected browse plants and cassava peels. Positive correlation was observed between the total feed intake and the total weight gain. High feed intake observed in goats supplemented with *C. mucunoides* as well as those fed with *S. mombin* could be attributed to the texture of the plants, familiarity and palatability of the plants. This assumption was in line with the report of Daovy *et al.,* (2008) that structure of the leaves, coarse, soft versus hard, smooth versus waxy or hairy, content of substances causing the foliage to taste or smell distinctly or morphology of the plants resulting in different bite sizes. Grovum (1988) confirmed that animals need some time to get used to a new feed and also Provenza and Cincotta (1994) reported that conditioning influences preference of small ruminants for forages. Freer (1981) reported that intake of browse plants is affected both by their physical structure i.e. texture of the leaves and chemical compositions. The reduction in feed intake of goats supplemented with *A. conyzoides* as well as those fed with *D. guineense* when compared with those on the control diet could be ascribed to the bitter taste and odour of the plants. Omoniyi (2014) attributed low preference of *T.diversifolia* to the bitter taste associated with the plant as animals had a bite and abandoned for other plants. This same observation was made by Fadiyimu *et al.* (2011), Okunade *et al.* (2013) and Yusuf *et al.* (2013) when WAD sheep, Red Sokoto goats and yearling cattle were fed selected browse plants in separate experiments respectively. Least daily weight gain observed in goats fed *P. purpureum + A. conyzoides* was lower than those reported by Ajayi *et al.,* (2013).

The result of average weight gain however compared favourably with the values reported by Yeshambel and Mekuriaw (2012) when Washera sheep were fed mixture of lowland bamboo leaves and natural pasture grass hay at different ratios. Daily weight gain of animals fed *P. purpureum + D. guineense* was similar with the highest value (34.3 g/d) reported by Bamikole *et al*. (2003) when WAD goats were fed *Ficus religiosa*. The improvements observed in the average final weight gain of goats supplemented with *C. mucunoides* and *S. mombin* could be related to the CP content of the browse plants combined with the CP intakes of the animals. This was affirmed by Oni (2009) who reported highest weight gains of the animals fed 60% inclusion of dried cassava leaves. Yusuf (2011) reported that protein intake is a major determinant of ruminant performance due to increased availability of fermentable nitrogen and other nutrients required by rumen bacteria as well as the greater opportunities for some of the protein to escape rumen fermentation (by-pass protein).

Addition of browse forages to the basal diet of *P.purpureum* improved the digestibility of goats. The least DM and CP digestibility observed in goats supplemented with *A. conyzoides* could be attributed to the least intake of the plant by goats. The range of the DM digestibility values recorded in this study was higher to the values (54.4 – 65.3%) observed by Ilori *et al.,* (2013) in WAD goats fed with different dietary inclusion of baobab. However, The CP digestibility values observed

(82.65 – 89.30%) in this study compared favourably with the reported range of 83.88 – 89.35% in goats fed with *Moringa oleifera* and some browse forages (Asaolu *et al.,* 2011). The values observed for digestibility i.e. DM and CP in this study negates the report of Lascano and Palacios (1993) who observed that intake and digestibility of tropical dry season grasses by goats and sheep tend to be low due to high fiber and low crude protein concentration in these forages. Higher OM digestibility values of 81.16 – 83.68% was recorded in this findings when compared with the reported values by Aderinboye *et al.* (2012) when WAD goats fed graded levels of monensin, when WAD sheep were fed different roughages (Akinbode, 2011). The high digestibility values obtained for the nutrient in all the treatments including the control suggest that the plants were highly degraded in the rumen. Addition of browse forages to *P.purpureum* affects the nutrient intake of the goats. Highest total DM intake observed in goats fed with *P.purpureum+ S.mombin* fell within the reported range values of DMI of 445.23 – 641.37 g/day in WAD goats fed with some semi-arid browse forages (Njidda and Ikhimioya, 2010). Highest DMI intake observed in goats supplemented with *S.mombin* could be attributed to the familiarity of the goats to the plant which increase the consumption while the least DM intake observed in goats fed with control diets was higher than the highest values (120.8 g/d and 370.63g/d) reported by Wuanor *et al.* (2013) and Chineke *et al.* (2013) on WAD goats fed combination of forages and cassava processing by-products as well WAD rams fed corncobs respectively. Range of CP intake was higher than the reported CP intake (59.5 – 74.0 g/day) in WAD bucks by Aderinboye *et al*., 2012 but lower to the reported range values (101 – 112 g/d) reported by Oni *et al*., (2014) in WAD Goats.

Organic matter intake observed in this study was higher than the range reported by Aderinboye *et al* (2012) except in goat fed with *P.purpureum+A.conyzoides* which was a bit lower to the reported values by the author. These values compared favourably with the values reported by Akinbode (2011) when WAD sheep were fed with different roughages.

Table 1: Nutrient intake (DM g/day) of WAD goat fed selected forages

Parameters	*P. purpureum* only	*P. purpureum +D. guineense*	*P. purpureum+C. mucunoides*	*P. purpureum + S. mombin*	*P. purpureum+ A. conyzoides*	*P. purpureum +T. catappa*	SEM
Dry matter intake	0.00^{c}	232.40^{ab}	256.52^{a}	257.69^{a}	206.88^{b}	238.45^{ab}	19.25
Grass intake	574.75^{a}	331.90^{b}	359.37^{b}	353.48^{b}	338.97^{b}	351.24^{b}	18.13
Total intake	574.75^{ab}	564.30^{b}	615.89^{a}	611.17^{a}	545.85^{b}	589.68^{ab}	7.29
Crude protein intake	0.00^{d}	31.47^{b}	39.94^{a}	41.98^{a}	23.05^{c}	33.05^{b}	2.98
Grass intake	81.84^{a}	47.26^{b}	51.18^{b}	50.34^{b}	48.27^{b}	50.02^{b}	2.58
Total intake	81.84^{b}	78.73^{b}	91.11^{a}	92.32^{a}	71.32^{c}	83.06^{b}	1.66
Crude fibre intake	0.00^{d}	17.06^{b}	20.68^{a}	19.64^{a}	20.94^{a}	9.68^{c}	1.60
Grass intake	46.61^{a}	26.92^{b}	29.14^{b}	28.67^{b}	27.49^{b}	28.49^{b}	1.47
Total intake	46.61^{ab}	43.98^{b}	49.82^{a}	48.30^{a}	48.43^{a}	38.17^{c}	0.90
Ash intake	0.00^{d}	14.97^{b}	18.96^{a}	15.75^{b}	19.22^{a}	8.82^{c}	1.42
Grass intake	42.76^{a}	24.70^{b}	26.74^{b}	26.30^{b}	25.22^{b}	26.13^{b}	1.35
Total intake	42.76^{b}	39.66^{c}	45.70^{a}	42.04^{bc}	44.44^{ab}	34.96^{d}	0.81
Fat intake	0.00^{d}	16.20^{bc}	18.09^{b}	21.03^{a}	17.15^{bc}	15.62c	1.44
Grass intake	50.47^{a}	29.14^{b}	31.56^{b}	31.04^{b}	29.76^{b}	30.84^{b}	1.59
Total intake	50.47^{a}	45.34^{c}	49.64^{ab}	52.06^{a}	46.91^{bc}	46.46^{bc}	0.64
Organic matter plant intake	0.00^{c}	218.62^{a}	238.15^{a}	243.11^{a}	187.66^{b}	225.31^{a}	18.06
Grass intake	533.60^{a}	308.14^{b}	333.64^{b}	328.17^{b}	314.70^{b}	326.09^{b}	16.83
Total intake	533.60^{abc}	526.76^{bc}	571.79^{a}	571.28^{a}	502.35^{c}	551.39^{ab}	7.05

^{abcd}Means along the same row with different superscripts are significantly different (P<0.05).
SEM: Standard error of mean

Table 2: Apparent nutrient digestibility (%) of WAD goat fed selected forage plants

Parameters (%)	*P.purpureum* only	*P.purpureum +D. guinensis*	*P.purpureum+C. mucunoides*	*P.purpureum+ S. mombin*	*P.purpureum+ A. conyzoides*	*P.purpureum +T. cattapa*	SEM
Dry matter	90.55^{a}	91.72^{a}	91.02^{a}	89.82^{ab}	89.23^{ab}	87.53^{b}	0.45
Crude protein	87.55^{a}	87.74^{a}	87.44^{a}	89.30^{a}	82.65^{b}	88.25^{a}	0.72
Crude fibre	70.45^{bc}	79.36^{a}	78.57^{a}	75.24^{ab}	72.70^{abc}	66.61^{c}	1.32
Ash	73.80^{b}	83.31^{a}	77.83^{ab}	74.39^{b}	72.48^{bc}	65.52^{c}	1.53
Fat	89.41^{ab}	91.66^{a}	90.67^{ab}	88.73^{ab}	88.32^{ab}	86.13^{b}	0.69
Organic matter	82.69^{ab}	81.67^{bc}	83.68^{a}	83.59^{a}	81.16^{c}	83.41^{a}	0.28

^{abc} Means along the same row with different superscripts are significantly different ($P < 0.05$).
SEM= Standard error of mean

CONCLUSION

The browse species evaluated in the current study with the exception of *Ageratum conyzoides* had high feed intake and nutrient digestibility which would make them good supplements to poor quality feeds (grasses, roughages, crop residues) especially during feed scarcity without any adverse effect on the goats.

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