Nutrient intake and digestibility of selected browse plants fed in combination with *Panicum maximum* to West African dwarf (WAD) bucks

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Abstract

A study was conducted to evaluate nutrient intake and digestibility of *Panicum maximum* fed in combination with selected browse plants to West African dwarf (WAD) bucks. Four intact West African dwarf (WAD) bucks of mean body weight 17.50kg were used to conduct digestibility study in a 4 x 4 Latin Square design experiment. Four forage combinations, diets A, B, C and D were fed to the goats. Diet A, the control, was 100% *Panicum maximum*, while diets B, C and D contained 60% *Panicum maximum* each plus 40% of *Alchornea cordifolia*, *Manniophyton fulvum* and *Gmelina arborea*, respectively. The study lasted 56 days in a 14-day x 4 change over periods. Data were collected on dry matter intake (DMI), nutrient intake and digestibility. Simple linear regression and correlation were used to assess the degree of relationship between some of the digestion components. The result of proximate analysis indicated that the diets (P. max + browse) B, C and D had significantly ($p < 0.05$) higher dry matter (%DM) contents of 81.12, 81.09 and 80.68%, respectively, than the 75.71% for diet A (sole P.max). Crude protein content of 17.56, 15.62 and 17.52%, respectively were also higher ($p < 0.05$) than the 8.38% for diet A. There was higher ($p < 0.05$) ether extract content of 2.43, 2.38 and 2.32%, for diets B, C, and D, respectively than the 1.32% for diet A. The ash content of 10.71, 9.78 and 9.76% for diets B, C and D respectively, were also higher ($p < 0.05$) than the 7.83% for diet A. Metabolizable energy (MJ Kg^{-1}) values of 1.41, 1.42 and 1.42 for diets B, C and D were also higher ($p < 0.05$) than the 1.31 for diet A. However, the crude fibre value of the diet A (27.26%) was significantly ($p < 0.05$) higher than the 18.30, 19.30 and 18.58% for diets B, C and D, respectively. There were significant ($p < 0.05$) differences in DMI among treatment means. Nitrogen intake (g/d) was significantly ($p < 0.05$) higher for animals fed diets B (15.04), C (13.12) and D (14.48) wherein P.max was fed in combination with browse plants than in the diet A (6.28) group fed sole P.max. Faecal nitrogen showed no significant ($p > 0.05$) difference among treatment means. Urinary nitrogen was significantly ($p < 0.05$) higher in diet A group (0.39) than in diets B (0.30), C (0.34) and D (0.43) groups. There was positive nitrogen balance for all in the treatment groups. Apparent nitrogen digestibility (%) was significantly ($p < 0.05$) higher in diets B (92.37), C (90.51) and D (91.63) groups than in diet A (79.49). Nitrogen intake (g/d) could not reliably predict faecal nitrogen (g/kgDM) in diets C and D groups. Absorbed nitrogen ($\text{g/d/WKg}^{0.75}$) could not predict urinary nitrogen ($\text{g/d/WKg}^{0.75}$) in any of the diets. Biological value (BV) of the diets were A (55), B (45), C (81) and D (97). The result of this study shows that the animals fed P. max + browse recorded higher DMI, nutrient intake and digestibility than the sole P.max diet. These evaluation indices were, however, mostly better in the diet B group (60% P. maximum + 40% *Alchornea cordifolia*). The combination of 60% P. maximum + 40% *Alchornea cordifolia* is therefore recommended for West African dwarf (WAD) goats reared in the humid tropics of Nigeria for optimum intake and improved nutrient utilization.

Keywords: Nutrient, intake, digestibility, bucks, forage, browse

Introduction

Goats are small ruminant herbivores. They predominantly depend on pasture and natural grassland for survival (Ahamefule, 2005). Goats also browse a wide variety of forages where sheep and cattle would ordinarily starve to death (Field and Taylor, 2008). They are more likely to select woody plants and certain shrubs and trees to browse, thereby expanding their intake of marginal quality feedstuffs relative to other domestic ruminants (Campbell *et al.*, 2003). Goats therefore appear more efficient in digesting coarse feed than either cow or sheep (Devendra and McLeroy, 1982). However, feed availability is a limiting factor in goat production in South Eastern Nigeria due to seasonality of forage. This region falls within the humid rain forest zone of West Africa and is characterized by long duration of rain and a short period of dry season. The dry season results in a rapid decline in quality and quantity of forage, leading to low forage intake and digestibility, with a resultant low animal performance (Tona *et al.*, 2014). The production of the West African Dwarf (WAD) goat and in extension all other breeds of goat in this region is low due to poor supply of fodder especially during the dry season when there is decline in quality and quantity of grasses.

Browse plants, beside grasses constitutes one of the cheapest source of feed for goats. Browsers have been used as feed by both domestic and wild life (Ukanwoko and Ironkwe (2013). They provide year round ever green fodder for browsing animals and supply vitamins and frequently mineral element mostly lacking in grasses (Ahamefule *et al.*, 2006). Obua (2006) observed that neither browse plants nor tropical grasses can constitute a complete feed when fed sole. The substitution level however, will depend on the production

status of the animal and quality of both the basal diet (grass) and the browse species. Many legumes especially the browse species contain appreciable concentration of condensed (non-hydrolysable) tannins whose role in nutrition are problematic; low to moderate concentration of tannin precipitate soluble plant proteins and thus protect them against degradation in the rumen, but if the proteins are too bound to the tannin, they are not digested in the small intestine. Digestibility especially of protein tends to be low for foliage with high concentration of condensed tannins (55g/kgDM) (McDonald *et al.*, 2011). However, lower levels of condensed tannins (20-45g/kgDm) found typically in some pasture legumes are considered to be beneficial to ruminants. By protecting protein from hydrolysis in the rumen they increase amino acid absorption from the small intestines. They also modify gas production in the rumen, thereby reducing the danger of bloat and possibly reducing methane production. Condensed tannin are also claimed to restrict the growth of gut parasites (Reddy, 2011). *Panicum maximum* was introduced to almost all tropical countries as a source of animal fodder and it is often considered as one of the best grass species for beef production (Pietse *et al.*, 1997). FAO (2003) reported nutrient composition of 25.7 %DM, 7.8% CP, 33.4% CF, 12.2% Ash, 1.4% EE and 45.2% NFE for fresh mature *Panicum maximum* in Nigeria. This study was therefore conducted to evaluate the nutrient intake and digestibility of selected browse plants fed in combination with *Panicum maximum* to West African dwarf (WAD) bucks.

Materials and methods

Experimental Site

This study was conducted at the Sheep and

Goat unit of the Teaching and Research farm, Michael Okpara University of Agriculture, Umudike, Abia State. Umudike is located at latitude 05°, 28' North and longitude 07°, 32' East and lies on an altitude 122 m above sea level. This area lies within the humid tropical rainforest zone of West Africa characterized by long duration of rainfall (about 5-7 months) and short period of dry season; average rainfall is 2169 mm in 148-155 rainy days. Monthly ambient temperature is 20° C – 36° C, while relative humidity ranges from 50 – 95% depending on season (NRCRI, 2014). This study was conducted within the dry season (November – December 2014).

Experimental diets

Four experimental diets A, B, C and D were used for the study. Diet A, the control was 100 percent *Panicum maximum*, while diets B, C and D were made up of 60 percent *P. maximum* each plus either 40 percent of *Alchornea cordifolia*, *Manniophyton fulvum* or *Gmelina arborea*. The vegetative parts (leaves, stalk and tender stems) of these forages were harvested fresh and wilted for about 24-48 hours at room temperature to reduce moisture level and fed to the goats as soilage.

Experimental animals design and management

Four intact West African Dwarf (WAD) bucks with a mean body weight of 17.50kg were obtained from the Sheep and Goat unit of the Teaching and Research farm, the Michael Okpara University of Agriculture, Umudike. The animals were sprayed with Ferbendazole to control ecto-parasite and were dewormed with Pfizone and then vaccinated against Peste des petites ruminants (PPR) disease. The four (4) intact West African Dwarf (WAD) bucks were transferred into separate metabolism cages constructed for the comfort of the animals with provision for separate faecal

and urine sample collection. Each of the animals received one of the four (4) treatment diets in a 4 x 4 Latin square design. There were four periods of 14 days each, the first 7 days was for the animals to evacuate all previous fed in their system while the last 7 days was for total faecal and urine collection. During period I, each animal was offered 1 kg of one of the four treatment diets for 14 days. In period II-IV, each animal was offered 1kg of one of the four treatment diets in a change over period of 14 days. Portable water was offered daily to each animal. Daily voluntary feed intake was determined by weighing the feed offered and the refusal. Total faeces and urine voided by the experimental animals were collected in the morning before feeding and offering water during the last 7 days of each period. The faeces were weighed fresh, dried and bulked for each animal for each period. A sub-sample from each animal was dried in forced draft oven at 100-105°C for 48 hours for DM determination, while another sample was dried at 60° C for 48-72 hours for determination of proximate composition. Total urine for each animal was collected daily in the morning before feeding and offering of water. The urine was trapped in calibrated transparent container placed under each cage and to which 15ml of 25% H₂SO₄ was added daily to prevent volatilization of ammonia and microbial growth in the urine. The total volume of urine output per animal was measured and about 10% of the daily outputs were poured into plastic bottles labeled and stored in refrigerator for determination of nitrogen content according to AOAC (2000). At the end of the 7-day collection period, the faecal samples collected were bulked for each animal and sub-samples taken for analysis. Samples of the diets were also preserved and used for dry matter

determination and proximate composition according to AOAC (2000). The animals were weighed at the beginning of each period and at the end of each period.

Statistical Analysis

The data obtained from this study were subjected to Analysis of Variance (ANOVA) applicable to 4 x 4 Latin square design experiments (Steel and Torrie, 1980). Differences between means were separated according to Duncan's multiple range test (Duncan, 1955) using SAS (1999). Simple linear regression and correlation were used to assess the degree of relationship between some of the digestion components using SAS (1999).

Results and discussion

The analysed proximate composition of the browse plus *Panicum maximum* combinations fed goats is presented table 1. The dry matter (DM) content of *Panicum maximum*, diet A (75.71%) was significantly ($p < 0.05$) lower than the DM values of the browse + *P.max* groups, diets B, C and D. However, the DM value obtained in this study was comparable with the 75.75% reported for *P.max* by Tona *et al.* (2014). The crude protein content of the *P.max* (8.38%) was significantly ($p < 0.05$) lower than those of the *P.max* + browse combinations. The crude protein of browse expectedly should be higher than that of the *P.max* as it contains higher nitrogen than the grass. The CP of the *P. max* + browse diets which ranged from 15.62-17.56% 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 (27.26%) of *P. max* was higher ($p < 0.05$) than the values, 18.0, 19.30 and 18.58% for *P. max* + *A. codifolia*, *P. max* +

M. fulvum and *P. max* + *G. arboria*, respectively. However, the 27.26% 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 *P. max* was significantly ($p < 0.05$) lower than the values obtained from the *P. max* + browse combinations. The ether extract value of 1.32% is close to the 1.40% (FAO, 2003) and 1.26% (Adegun (2014). The ash content of *P.max* (7.83%) was lower ($p < 0.05$) than the 10.71, 9.78 and 9.76% for the *P.max* + browse combinations, respectively. Nitrogen free extract of *P.max* (30.92%) was similar ($p > 0.05$) with the 32.11 and 32.57% obtained from the *P. max* + *A. cordifolia* and *G. arboria*, respectively, but lower than the 34.01% obtained from the *P. max.* + *M. fulvum*. The metabolizable energy value, 1.31 MJKg⁻¹ of the *P. max* was lower ($p < 0.05$) than the 1.41 1.42 and 1.42 MJKg⁻¹ for the various *P. max.* + browse combinations.

Generally, the chemical composition of forage plants varies with nutrient profile of the soil where the forage was harvested, geographical location as well as the rate of water and nutrient uptake (Ajayi, 2012). However, plant species, stage of growth, season of harvest, analytical techniques and technical ability of the personnel who conducted the analysis are likely to influence chemical composition of forage. Table 2 represents the nutrient intake and digestibility by WAD goats fed *Panicum maximum* with different browse combinations. There were significant differences ($p < 0.05$) in dry matter intake (DMI) (g/day) among treatment means. Animals on the *P. max* + browse combinations recorded significantly ($p < 0.05$) higher DMI B (535.10) C (524.77) and D (516.64) than the diet A (469.13) group. This observation is in

Table 1: Analysed proximate composition of the browse plus *Panicum maximum* combinations fed goats

Parameters (%DM)	A 100% <i>P.max</i>	B 60% <i>P.max</i> + 40% <i>A. Cordifolia</i>	C 60% <i>P. max</i> + 40% <i>M. fulvum</i>	D 60% <i>P. max</i> + 40% <i>G. arborea</i>	SEM
Dry matter	75.71 ^b	81.12 ^a	81.09 ^a	80.68 ^a	1.32
Crude protein	8.38 ^b	17.56 ^a	15.62 ^a	17.52 ^a	2.18
Crude fibre	27.26 ^a	18.30 ^b	19.30 ^b	18.58 ^b	2.14
Ether extract	1.32 ^b	2.43 ^a	2.38 ^a	2.32 ^a	0.27
Ash	7.83 ^b	10.71 ^a	9.78 ^a	9.76 ^a	0.61
NFE	30.92 ^b	32.11 ^{ab}	34.01 ^a	32.57 ^{ab}	0.64
*ME (MJ/kgDM)	1.31 ^b	1.41 ^a	1.42 ^a	1.42 ^a	0.03

^{a,b} Means within the same row with different superscripts differ significantly (p<0.05)

NFE-Nitrogen free extract; ME-metabolizable energy; * Calculated

Table 2: Nutrient intake, nitrogen balance and digestibility by WAD goats fed *Panicum maximum* with different browse combinations

Parameters	A 100% <i>P. max</i>	B 60% <i>P. max</i> + 40% <i>A. cordifolia</i>	C 60% <i>P. max</i> + 40% <i>M. fulvum</i>	D 60% <i>P. max</i> + 40% <i>G. arborea</i>	SEM
Mean wt. (Kg)	11.90	12.40	12.03	12.20	0.32
DMI (g/day)	469.13 ^c	535.10 ^a	524.77 ^{ab}	516.64 ^b	6.70
DMI (WKg ^{0.75})	100.80 ^c	111.26 ^a	109.64 ^{ab}	108.36 ^b	1.06
DMI as % Body wt.	3.99	4.37	4.40	4.26	0.11
CP Intake (g/day)	39.22 ^d	93.97 ^a	81.97 ^c	90.51 ^b	5.66
N-intake (g/day)	6.28 ^d	15.04 ^a	13.12 ^c	14.48 ^b	0.91
N-intake (g/dWKg ^{0.75})	3.82 ^c	7.64 ^a	6.89 ^b	7.43 ^a	0.40
Faecal-N (g/day)	1.29	1.15	1.25	1.21	0.03
Urinary-N (g/day)	0.39 ^{ab}	0.30 ^b	0.34 ^{ab}	0.43 ^a	0.02
Urinary-N (g/dWKg ^{0.75})	0.49 ^{ab}	0.40 ^b	0.44 ^{ab}	0.53 ^a	0.02
N- Balance (g/day)	4.60 ^d	13.59 ^a	11.54 ^c	12.84 ^b	0.92
N-Balance (g/dWKg ^{0.75})	3.15 ^d	7.08 ^a	6.26 ^c	6.78 ^b	0.41
Absorbed-N(g/day)	4.99 ^d	13.89 ^a	11.87 ^c	13.27 ^b	0.92
Absorbed-N(g/dWKg ^{0.75})	3.34 ^d	7.20 ^a	6.40 ^c	6.95 ^b	0.40
Appt. N-digestibility (%)	79.49 ^c	92.37 ^a	90.51 ^b	91.63 ^{ab}	1.37

^{a,b,c} Means with different superscript across the rows are significantly different at p<0.05; SEM- Standard error of mean; DMI- dry matter intake

agreement with the inverse relationship between DMI and fibre content of feed reported by Reid and Klopfenstein (1983), but did not agree with the reports of Okah *et al.* (2012) and Ahamefule (2005) who reported a higher DMI for diets with high fibre content than those with low fibre content. However, the nature of fibre and its interaction with other nutrients like protein might also influence intake. Lower DMI in the diet A group might be as a result of lower crude protein content of the diet as earlier reported by Rajpool *et al.* (1981), and also

agrees with the report of Okah *et al.* (2012) that low nitrogen content of feed significantly reduces dry matter intake of feeds. DMI expressed as percentage of body weight were similar (p>0.05) for the treatment groups A, B, C and D with values 3.99, 4.37, 4.40 and 4.26 respectively. The DMI as percent body weight was within the range of 3.5 – 5% of body weight per day reported by Alan (1992) for goats. Obioha (1977) observed that even though dietary nutrients and palatability are necessary factors which influence intake in animals,

satiety signals are set by a combination of such complex factors as gut fill, body fat and changes in the body chemical constituents.

Crude protein (CP: g/day) intake significantly ($p<0.05$) differed among treatment means with higher values recorded by the *P. max* + browse groups B (93.97), C (81.97) and D (90.51) than the diet A group (39.22) the control. Nitrogen intake followed the same pattern as CP intake and recorded significant ($p<0.05$) differences among treatment means. The values obtained were higher in B (15.04), C (13.12) and D (14.48) than in A (6.28). Faecal – N (g/day) did not indicate any significant ($p>0.05$) difference among treatment means.

Urinary – N (g/day) recorded significant ($p<0.05$) differences among the treatment means and the values obtained were 0.39, 0.30, 0.34 and 0.43 for diets A, B, C and D respectively. This result, however, did not agree with the report of Okah *et al.* (2012) that animals which consume less DM and less nitrogen excrete less nitrogen in urine. The lower urinary nitrogen could also be suggesting a more conducive ruminal environment that supported better nitrogen utilization by the microbes. There was a positive nitrogen balance for all the treatment groups, which suggests that all the diets met the maintenance requirement of the experimental animals. Nitrogen balance (g/day) followed the same trend as nitrogen intake (g/day) and showed significant ($p<0.05$) differences among

treatment means. The values obtained were A (4.60), B (13.59), C (11.54) and D (12.84).

Absorbed – N (g/day) was significantly ($p<0.05$) higher for animals fed *P. max.* + browse diets and followed the same pattern as the nitrogen balance. Apparent N-digestibility (%) showed significant ($p<0.05$) differences among treatment means. The values obtained were for diets B (72.37), C (90.51) and D (91.63), and were higher than in diet A (79.49). Higher N-intake promoted apparent N-digestibility, and this agrees with the report of Olaleru and Adegbola (2001).

Table 3 represents the relationship between faecal nitrogen (g/kgDM) and nitrogen intake (g/day). The coefficient of correlation (r) differed significantly ($p<0.01$) for A, B, and C respectively while D showed no significant difference. The values obtained were 0.904, 0.656, 0.616 and 0.139 for A, B, C, and D, respectively. Faecal-N (g/kgDM) was positively correlated with N-intake (g/day). The intercept on the ordinate axis gave the nitrogen excreted in faeces for each diet, when the nitrogen intake was hypothetically zero, which is the metabolic faecal nitrogen (MFN). The coefficient of determination (R^2) which measures the degree of reliability of regression equation indicated that faecal nitrogen could not be reliably predicted by nitrogen intake in animals fed diets B, C and D but, was 82% reliable in diet A group. The values of MFN ranged from -0.782 in A to 1.224

Table 3: Regression analysis and correlation coefficient between faecal nitrogen (g/kgDM) (Y) and nitrogen intake (g/day) (X) in WAD goats fed *Panicum maximum* with different browse combination

TRT	Regression equation	Correlation Coefficient(r)	R ²	SEM	Intercept on Y-axis	MFN g/100gDM
A	$Y = -7.815 + 1.451X$	0.904**	0.817	0.044	-7.815	-0.782
B	$Y = -4.157 + 0.353X$	0.656**	0.430	0.076	-4.157	-0.416
C	$Y = 12.239 + 0.704X$	0.616**	0.380	0.160	12.239	1.224
D	$Y = 0.735 + 0.033X$	0.139 NS	0.019	0.081	0.735	0.074

TRT - Treatment; SEM -Standard error of the mean; ** correlation significant at $p<0.01$; NS - Not significant

(g/100g/DM) with a mean of 0.025g/100gDM, which is lower than the 0.24g/100gDM reported by Ellis (1956) for ruminants.

The variation compared with the report by

Ellis (1956) might be due to differences in the type of feed consumed, species, within breed, physiological status of animals, environmental conditions and or seasons when studies were conducted.

Table 4: Regression analysis and Correlation coefficient between Urinary Nitrogen (g/day WKg^{0.75}) (Y) and Absorbed Nitrogen (g/day WKg^{0.75}) (X) in WAD goats fed *Panicum maximum* with different browse combination

TRT	Regression equation	Correlation Coefficient (r)	R ²	SEM	Intercept on Y-axis	EUN (day/WKg ^{0.75}) g/100g
A	Y= -1.483+0.591X	0.250NS	0.068	0.051	-1.483	-1.483
B	Y= -7.174+1.053X	0.541*	0.292	0.087	-7.174	-7.174
C	Y= -2.126-0.264X	0.145NS	0.021	0.121	-2.126	-2.126
D	Y= 0.020+0.073X	0.193NS	0.037	0.050	0.020	0.020

TRT- Treatment; SEM-Standard error of the mean; * correlation significant at p<0.05; NS - Not significant

The relationship between urinary -N (g/day/WKg^{0.75}) and absorbed -N (g/day/WKg^{0.75}) is presented in Table 4. All treatments in this study indicated positive correlation but were not significant (p>0.05) in diets A, C, and D groups, while B showed significant (p<0.05) difference.

The intercept on the Y-axis gave the urinary nitrogen values at zero nitrogen absorption, which is the endogenous urinary nitrogen (EUN) in g/day/WKg^{0.75}. The regression equation however, indicated that absorbed nitrogen was not reliable in predicting urinary nitrogen in all the treatment diets.

Table 5: Regression analysis and Correlation coefficient between Nitrogen Balance (g/day WKg^{0.75}) (Y) and Absorbed Nitrogen (g/d WKg^{0.75}) (X) in WAD goats fed *Panicum maximum* with different browse combination

TRT	Regression equation	Correlation Coefficient(r)	R ²	SEM	N-absorbed at zero N balance	BV	DCP g/d/W Kg ^{0.75}
A	Y= 0.416+0.818X	0.592*	0.351	0.026	0.056	55	0.35
B	Y= 2.723+0.605X	0.754**	0.568	0.028	0.131	45	0.82
C	Y= -0.925+1.124X	0.838**	0.702	0.049	0.117	81	0.73
D	Y= -0.036+0.981X	0.983**	0.966	0.025	0.131	97	0.82

TRT-Treatment; SEM- Standard error of the mean; ** correlation significant at p<0.01; * Correlation significant at p<0.05 BV- biological value; DCP-digestible crude protein

The relationship between nitrogen balance (g/day/WKg^{0.75}) and absorbed nitrogen (g/day/WKg^{0.75}) is presented in Table 5. Nitrogen balance was positively correlated with absorbed nitrogen in all treatments. The coefficient of correlation (r) showed significant (p<0.05) differences in diet A, and (p<0.01) in diets B, C and D. The gradient of the lines relating N-balance to absorbed -N were the indices of biological value (BV) while the absorbed -N at zero N-balance when multiplied by 6.25 gave

the digestible crude protein (DCP) requirement for maintenance. The mean DCP (0.68) in this study agreed with the range of 0.63-0.68g/d/WKg^{0.75} DCP reported by Akinsoyinu (1974) for goats for maintenance. The variation in DCP will depend on the kind of diet consumed by the animal, physiological state of the animal as well as age of the animal. The BV obtained for WAD goats in this study ranged from 45 in diet A to 97 in diet D. Mean BV obtained in this study (69.50) is however comparable

to 65.25±10.87 reported by Okah *et al.* (2012) for WAD sheep fed concentrate diets. The biological value (BV), which is a measure of the feed protein which can be utilized by the animal for synthesizing body tissues and compounds, will depend on the kind of diet fed and on the animal species and breed. The coefficient of determination

(R²) values in Table 5 indicated that nitrogen balance can reliability be predicted in the *P. max* + browse diets, B, C, and D with 56.80, 70.20 and 96.60% levels of reliability respectively, but was unreliable in diet A (35.1%). This result seems to suggest that higher nitrogen intake by animals promotes nitrogen absorption and nitrogen balance.

Table 6: Apparent digestibility coefficient (%) of WAD goats fed *Panicum maximum* with different browse combinations

Parameter (%)	A 100% <i>P. max</i>	B 60% <i>P. max</i> + 40% <i>A. cordifolia</i>	C 60% <i>P. max</i> + 40% <i>M. fulvum</i>	D 60% <i>P. max</i> + 40% <i>G. arborea</i>	SEM
Dry Matter	71.13 ^b	76.29 ^a	75.62 ^a	75.80 ^a	0.56
Crude Protein	79.50 ^c	92.37 ^a	90.51 ^b	91.37 ^{ab}	1.36
Crude Fiber	79.39 ^c	86.25 ^a	85.10 ^b	86.19 ^a	0.26
Ether Extract	81.67 ^c	86.46 ^{ab}	82.67 ^{bc}	88.82 ^a	0.96
NFE	55.29 ^c	63.81 ^b	66.80 ^a	63.91 ^b	1.16

^{a,b,c} Means within the same row with different superscripts differ significantly (p<0.05); SEM-Standard error of the mean; NFE- Nitrogen free extract.

Dry matter and nutrient digestibility coefficient are presented in Table 6. The result showed that apparent nutrient digestibility coefficient values were significantly different (p<0.05) among treatment means. Dry matter digestibility (%) was higher for the animals fed *P. max* + browse diets B (76.29), C (75.62) and D (75.80) than in diet A (71.13), which suggests that combining browse with grass species promotes dry matter digestibility. Tona *et al.* (2014) reported a similar range of 77.47 to 81.67% for goats fed *Panicum maximum* with concentrate diets containing graded level of *Moringa oleifera* leaf meal. The value obtained for CP digestibility were significantly (p<0.05) higher in the *P. max* + browse diets B (92.37), C (90.51) and D (91.37) than in the sole *P. max* diet, A (79.50). CP digestibility in this study is relatively higher than the value 84.56% reported by Nwagu (2004) for rams fed *Panicum maximum* and *Gmelina arborea* at the ratio of 60:40 respectively. There was significant difference (p<0.05) in CF digestibility among treatment means. The

values obtained for diets A (79.39), B (86.25), C (85.10) and D (86.19) showed that the groups fed *P. max* + browse diets, B, C and D had significantly (p<0.05) higher CF digestibility than diet A, sole *P. max*. This result however, indicates that the higher CP level of the *P. max* + browse diets (B, C and D) positively influenced CF digestibility which agrees with the reports of Fasae *et al.* (2005) and Okah *et al.* (2012) that CF digestibility and CP digestibility increase with increasing level of CP in diet. This results is also in line with the report of Minson (1990) that supplementation of browse to a basal grass diet can help improve the dietary protein as well as improve the DMI and digestibility of the diet. There was significant difference (p<0.05) in ether extract digestibility. The values obtained were 81.67, 86.46, 82.67 and 88.82 % for diets A, B, C and D, respectively. NFE digestibility were higher in the *P. max* + browse diets than in the sole grass (*P. max*) diet, the values obtained were A (55.29), B (63.81), C (66.80) and D (63.91). Feeding either grasses or browse

plants alone therefore, would not support adequate nutrient intake and digestibility, but a combination of the two and at the appropriate ratio will enhance nutrient utilization for overall productivity of the animal.

Conclusion and recommendation

Nutrient composition of any feed can be determined by chemical analysis of the feed, but the extent to which these nutrients are utilized by animals can only be determined after making allowance for the inevitable losses that occur during digestion, absorption and metabolism. The results of this study indicated that combination of grass based diet (*Panicum maximum*) with browse promoted dry matter and nutrient intake, and also enhance digestibility in WAD goats fed 60:40% *Panicum maximum*: browse combinations. However, of all the combinations, diets B (60% *P. maximum* + 40% *Alchornea cordifolia*), C (60% *P. maximum* + 40% *Manniophyton fulvum*) and D (60% *P. maximum* + 40% *Gmelina arborea*), the diet B group, 60% *P. maximum* + 40% *Alchornea cordifolia* happened to give the best results in DMI, nutrient intake and digestibility in the goats. It is therefore, recommended that the tropical grass *P. maximum* be supplemented with browse in diets of goat to enhance the performance of the animals. The combination ratio might however, depend on the production status of the animal and 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 that will be best for different production status of goats with different qualities of both basal grass diet and browses. Supplementation of basal grass diet with browse, particularly *Alchornea cordifolia*, at 60:40(3:2) ratios is therefore recommended in the humid

tropics of Nigeria for goats, especially during the dry season when there is decline in quality and quantity of the basal grass diet.

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