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The optimum feeding level of *Gmelina arborea* leaves supplemented with *Pennisetum purpureum* to West African Dwarf (WAD) goats

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Abstract. Thirty growing West African (WAD) goats weighing 4.4 kg to 10.8 kg and age range of 6 – 12 months were used to determine the optimum level of feeding of *Gmelina arborea* leaves supplemented with *Pennisetum purpureum* for a period of 12 weeks. The goats were randomly divided into five groups of six goats each. Goats in group A were fed 25 % *G. arborea* leaves and 75 % *P. purpureum*, group B goats were fed 50 % *G. arbonea* leaves 50 % *P. purpureum*, group C goats were fed 70 % *G. arborea* leaves and 30 % *P. purpureum*, group D goats were fed 80 % *G. arborea* leaves and 20 % *P. purpureum* while those in group E were fed 90 % *P. purpureum* and 10 % grower mash. Chemical analysis show significantly ($P<0.05$) higher crude protein and lower crude fiber content in *G. arborea* leaves than in grass. Total dry matter intake by goats was generally high. Dry matter intake (g/day/Wkg$^{0.75}$) by the goats fed the different experimental diets did not vary significantly ($P>0.05$). The dry matter digestibility as well as crude protein digestibility was appreciably for all the experimental animals. Goats fed 50 % *G. arborea* leaves as supplement with 50 % *P. purpureum* had the best performances. The study suggest 50 % inclusion of *G. arborea* leaves in the diets of goats as the optimum level of feeding of *G. arborea* leaves when it is supplemented with *P. purpureum*.
Key Words: Feed utilization, dry matter digestibility, crude protein digestibility, experimental diets.

Introduction. Nutrition is essential for any organism, it is important for the functions it performs such as growth, repair of worn-out tissues, provision of energy and other metabolic activities. The current need for animal protein in Nigeria and other developing countries poses an enormous challenge to the Nigerian livestock farmer. Long period of dry season, which limits availability of feed adversely affects development of the goat industry. This calls for a search for plants that can withstand the long period of dry season and can be used as feeds for ruminants. Teniola (1990) has used browse plants as means of increasing feed supply and quality. However, there are varieties of legumes and non-leguminous plants of which very little is known about their feeding potentials. *Gmelina arborea* shows promise as a browse plant. Okagbare et al (2004) in a study on evaluation of *G. arborea* leaves supplemented with grasses (*Panicum maximum* and *Pennisetum purpureum*) as feed for West African dwarf goats, stated that *G. arborea* is fast growing non-legumious multipurpose tree that produces appreciable amounts of forage and fodder. The leaves are relished by West African dwarf goats and sheep (Adu et al 1996; Okagbare & Bratte 1999). Okagbare et al (2004) showed that *G. arborea* leave is a rich source of protein with high content of crude protein (22.29 %) and high ash (6.28 %). Report of earlier studies by Onaborijo & Onwuka (1998) and Okagbare et al (2005) indicated that goats fed *G. arborea* leaves alone consistently lost weight. This was attributed to possible inadequate energy intake by goats to meet their energy requirement for maintenance and reported that supplementation of *G. arborea* leaves with grasses enhanced his utilization. This study was designed to determine the nutrient intake, digestibility and the optimum level of intake of *G. arborea* leaves by goats when supplemented with elephant grass (*P. purpureum*).

Material and Method

Animals and their management. The experimental animals consisted of 30 West African dwarf goats obtained from Delta State University, Asaba campus community and its environs. The study was carried out for 12 weeks. The weight of the goats ranged between 4.5 kg and 10.8 kg while their age range between 6 and 12 months. The animals were weighed and randomly assigned to treatment groups of six animals each. Goats in treatment A were fed 25 % *G. arborea* and 75 % *P. purpureum*. Goats in treatment B were fed 50 % *G. arborea* leaves and 50 % *P. purpureum*. Goats in treatment C were fed 70 % *G arborea* leaves and 30 % *P. purpurum*. Goats in treatment D were fed 80 % *G. arborea* leaves and 20 % *P. purpureum* and goats in treatment E were fed 90 % *P. purpureu*m and 10 % grower mash. *G. arborea* leaves and *P. purpureum* were cut within the premises of Delta State University, Asaba Campus and fed to the animals. The goats were housed in the goat unit of teaching and research farm of the Delta State University, Asaba for two weeks to enable the animals adapt to the environment. The animals were fed once daily (7.00 am) and fresh water was available for the animals *ad libitum*. The feed offered to each treatment per day was first weighed and the residues were also weighed the next morning before a fresh feed was supplied to the animals. The animals were duly dewormed with injectable ivermectine which took care of endo and ecto-parasites. Water troughs were placed in the house to meet the water requirement of the animals. The pens were demarcated into five portions with the use of bamboos. This was done so that the animals can be grouped and fed with their different rations. The quantity of the daily feed provided and the residue of the previous days feed were weighed to determine the daily feed intake of each animal. Samples of experimental diet and faces were collected during the experiment for dry matter (DM), digestibility determination and chemical analysis. The samples were weighed and dried and then stored for proximate and fiber component analysis.

Data analysis. Samples of feeds were analyzed for their proximate constituents using the procedures of the AOAC (1995). The energy content of feeds was determined using the ballistic bomb calorimeter.

Results. The chemical compositions of *G. arborea* leaves, *P. purpureum* and grower mash are shown in table 1.

Table 1

Chemical composition of experimental diet (%)

Nutrients	*Gmelina arborea leaf*	*Pennisetum purpureum*	*Grower mash*
Dry matter	52.75	60.62	90.84
Crude protein	19.26	11.38	16.63
Crude fiber	11.00	24.00	7.50
Ash	9.15	13.33	6.00
Ether extract	0.50	1.00	2.00
Nitrogen-free extract	12.84	10.91	58.71
Neutral detergent	59.72	68.14	-
Acid detergent fiber	41.28	47.26	-
Gross energy (kCal/gDM)	3.05	3.65	3.95

The crude protein content of *Gmelina* leaves was 19.26 %. The value obtained for crude fiber content of *Gmelina* leaves was 11.00 % while the crude fiber content of *P. purpureum* was 24.00 %. The value of the nitrogen – free extract of the *Gmelina* leaves (12.84 %) was higher than the value (10.91 %) value of *P. purpureum*.

Table 2 shows the values recorded for dry matter intake (on dry matter basis) by the goats fed *G. arborea* leaves supplemented with *P. purpureum* significant differences

(P<0.05) existed among values recorded for total dry matter intake. Goat fed diet B (50% Gmelina leaves and 50 % *P. purpureum*) had the highest (P<0.05) feed intake with a total intake of 2625 g/animal/day, it was followed by goats fed diet D (80 % Gmelina leaves and 20 % *P. purpureum*) with a total intake 2094 g/animal/day. The group fed diet C (70 % *Gmelina* leaves and 30 % *P. purpureum*) had a total intake of 1862 g/animal/day which was followed by the group fed diet E (90 % *P. purpureum* and 10 % grower mash) at total intake of 1640 g/animal/day. The group fed diet A (25 % *Gmelina* leaves and 75 % *P. purpureum*) had the least (P<0.05) quality of feed with a total intake of 1565.9 g/animal/day.

Table 2

Feed intake by West African dwarf goat fed *Gmelina arborea* leaf supplemented with *Pennisetum purpureum* at graded levels (g/day)

Parameters	*Diet*					
	A	*B*	*C*	*D*	*E*	*F*
DM intake from grass	1217^{c}	1423^{d}	660^{b}	526^{a}	1361^{c}	14.30
DM intake from browse	348.9^{a}	1202^{b}	1202^{b}	1568.2^{c}	-	12.10
DM intake from concentrate	-	-	-	-	279	-
Total DM intake	1565.9^{a}	2625^{e}	1862^{c}	2094.2^{d}	1640^{b}	21.70
DM intake as % of body weight	2.4^{b}	2.2^{a}	4.1^{e}	2.9^{c}	3.2^{d}	0.77
DM intake g/day/Wkg$^{0.75}$	47.1^{ab}	44.2^{a}	70.1^{e}	54.2^{c}	57.1^{d}	3.30

abcd values on the same row with identical superscripts are not significantly (P>0.05) different.

The dry matter digestibility as well as the crude protein digestibility (Table 3) was appreciably high for all the experimental animals. Goats in treatment A had a mean crude protein digestibility of 73.2 g/day, followed closely by goats in treatment B with a mean crude protein digestibility of 70.4 g/day. Goat in diet E recorded higher (P<0.05) crude protein digestibility.

The group fed with D diet had the highest crude fiber digestibility at the value of 73.5 g/day, followed by those fed on diets E, (69.0 g/day), C (66.8 g/day), A (55.1 g/day) and B (46.6 g/day) respectively.

Goats on diet B had the highest N-intake of 24.7 g/day followed by diets D (23.0 g/day), C (19.2 g/day), A (12.9 g/day), and E (12.6 g/day) respectively.

Table 3

Nutrient digestibility by goats fed *Gmelina* leaf supplemented with *Pennisetum purpureum*

Parameters	*Diet*					
	A	*B*	*C*	*D*	*E*	*SEM*
Dry matter	71.1^{a}	76.5^{c}	78.6^{d}	74.1^{b}	76.1^{c}	1.90
Crude protein	73.2^{bc}	70.4^{a}	70.8^{ab}	74.1^{bc}	83.1^{c}	2.73
Crude fiber	55.1^{a}	46.6^{a}	66.8^{b}	73.5^{bc}	69.0^{bc}	2.80
Ether extract	67.7^{c}	33.0^{b}	22.1^{b}	10.3^{a}	69.3^{c}	2.90
Nitrogen-free extract	26.6^{b}	32.2^{bc}	45.2^{bc}	14.3^{a}	60.0^{c}	2.70
Acid detergent fiber	82.2^{a}	80.4^{a}	88.4^{c}	$85.^{2ab}$	-	0.71
Neutral detergent fiber	79.4^{b}	75.2^{a}	84.6^{c}	76.6^{ab}	-	1.20

abcd values on the same row with identical superscripts are not significantly (P>0.05) different.

Discussion. The recent use of browse plant as supplement to grasses has assumed great importance in the topics. *G. arborea* leaves showed promise as feed for goats, due to the high crude protein content. The crude protein value (19.26 %) obtained in *G. arborea* in this study is comparable with previously reported values in literature (Okagbare et al 2004; Onaborijo & Onwuka 1998). Also the crude protein content of the following browse plants: *Albizia saman* (11.2 %), *Albizia lebbeck* (22.3 %), *Enterolobium*

cyclocarpum (19.0 %), *Parkia biglobosa* (17.9 %) (Bamikole & Babayemi 2004) were comparable with crude protein of *G. arborea* leaves obtained in this study. Some other foliage crops which have been evaluated and integrated into ruminant feeding includes *Bambusa vulgaris*, *Mangifera indica*, and *Newbouldia laevis* with 22.38 %, 15.13 % and 15.57 % crude protein (CP) respectively. These values of CP reported by Ikhimioyi (2005) compares favorably with the CP value of *Gmelina* obtained in this study. The value of 19.26 % crude protein in the present study was far above 7 % recommended for tropical livestock (Minson 1990) below which there will exhibit a depressed performance. However, the crude protein value of *G. arborea* leaves in this is higher than those reported for the leave of *Parkia filicoidea* (Okagbare & Bratte 1999). Generally, the browse plant under study have a high potential compared to the mostly available browse plants, as sources of feed supplement for ruminants in terms of their chemical compositions especially the high crude protein levels. This is of particular importance from the point of view of helping to check weight loss problem of ruminant livestock common in the dry season when the quality of available grasses would have dropped drastically. The digestibility values were fairly high in all the treatments. The high value of dry matter (76.5 %), ether extract (33.0 %), and nitrogen-free extract (32.2 %) digestibility by goats in treatment B (50 % *Gmelina* plus 50 % *P. purpureum*) enhanced the performance of goats on this treatment in spite of the low crude protein digestibility recorded (70.4 %). The feed intake and digestibility of the experimental diet for goats in this study is in accordance with reports of Isah et al (2013) for other browse plants (*Merremia aegyptia*, *Aspilia africana*, *Alchornea cordifolia* and *Newbouldia laevis*). The high feed intake result in higher protein availability which may be connected with the nature of the forage. Small ruminants preferred sweet or sour plant and generally reject bitter plants. High crude protein in the diets has been considered an important factor that enables high intake of the feed. Oldham & Alderman (1980) stated that sometimes *ad libitum* intake of feed by the animals increase the crude protein content of the diet. The value of feeds for ruminant is dependent on the amount of energy they supply and is a major limiting factor for goat production (Sauvant & Morand-fehr 1991). NRC (1981) recommended a minimum gross energy requirement level of 3260 kcal/g/day for West African Dwarf goat. This is comparable with 3050.0 kcal/g/day recorded for Gmelina leaves in this study. Information on the energy content of Gmelina leaves in this study showed that it is comparable with the energy value recorded in literature (Okagbare et al 2004). The high ash content of *G. arborea* leaves in this study (9.15 %) is comparable with (8.89 %) in a report of an earlier study (Okagbare et al 2004) but lower than 12.96 % reported by Osakwe & Udeogu (2007). This high ash content *G. arborea* leaves with their high crude protein content, energy, minerals and high dry matter content suggests that *G. arborea* leaves may serve as a complete fodder for livestock. The discrepancies emanating from this study and some previous reports for the proximate composition, feed intake and nutrient digestibility by goats could be attributed to the age of the experimental animals, the flowering stage of the plants and the season of the year.

Conclusions. The results of this study showed that *G. arborea* leaves when used as supplement to *P. purpureum* based diet improved the dry matter intake, nutrient digestibility of West African dwarf goats. The result of the study showed that at 0.73 kg/day representing 25 % and 2.52 kg/day representing 50 % supplementation of *G. arborea* leaves to *P. purpureum* based diet, resulted in improved growth rate of goats. The study suggests that 2.52 kg/day inclusion, representing 50 % *G. arborea* leaves inclusion in the diet of goats fed *P. purpureum* gave the best performance in terms of nutrients utilization. 50 % level of inclusion of *Gmelina* leaves in the diet of goats fed *P. purpureum* could be considered optimum. Since *G. arborea* leaves are drought resistant and therefore available at the peak of the dry season, it could reliably be used for goat feeding as supplement to the low quality grass that are available during the dry season thereby increasing the productivity of the animal throughout seasons in the tropics.

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