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Performance and Nutrient Digestibility of West African Dwarf goats fed *Panicum maximum* supplemented with *Gmelina arborea* leaves mixture

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Target Audience: Smallholder Ruminant Farmers, Modern Intensive Ruminant Animal Producers and Animal Scientists

Abstract

An experiment was carried out to investigate the performance and nutrient digestibility of twenty (20) growing West African Dwarf bucks, aged 4-6 months weighing between 6.50 9.00kg were fed varying levels of Gmelina arborea leaves and Panicum maximum as a basal diet for 56 days. The results showed that dry matter intake increased (P<0.05) with supplementation of Gmelina arborea leaves, with T_5 (100% G. arborea leaves and 0% P. maximum) having the highest dry matter intake (4.93kg) and T_3 (50% G. arborea leaves and 50% P. maximum) have the least value (4.03kg).Goats fed T_2 (75% P. maximum and 25% G. arborea leaves) has the highest weight gain (28.57g/day) followed by T_3 (16.79g/day) while T_1(100% P. maximum and 0% G. arborea leaves) has the least value of 5.54g/day. The nutrient digestibility trial showed that T_3 diethas the highest dry matter digestibility (88.06%) while T_2 diet had the lowest value of 87.68, with no significant difference (p<0.05). The highest (CP) digestibility (9.58%) and (CF) digestibility (22.53%) was recorded in T_5 diet. Based on the result of this study, it can be concluded that Gmelina arborea appeared to have the potential as protein feed supplements as well as serves as a good feed resource for modern intensive ruminant animal production at inclusion level of 75%Panicum maximum and 25% Gmelina arborea leaves for a better feed utilization, and at 100% Gmelina arborea leaves and 0% Panicum maximum to achieve best dry matter intake.

Key words: WAD goats; legume; tropical grass; digestibility

Description of the Problem

Small ruminants, particularly goats, play an important role in the life of small-holder farmers via their ability to convert low cost feed resource to high value products (meat, milk and skin). Goat is one of the most important, adaptable and geographically widespread livestock species, which provides a good source of meat, milk and other by-products and are therefore referred to as "poor man's cow" (1).They derive nutrients (the main required nutrients are protein and energy) from offered feed, which are used for body maintenance, growth and reproductive

purposes. If the nutrients are not correctly balance to meet the specific production needs of an animal, the animal's productive efficiency drops. West African Dwarf (WAD) goat breed is an important indigenous goat breed that is well adapted to the humid and sub-humid regions known to be associated with tsetse flies that cause trypanosomiasis.In most tropical countries, ruminant animals are maintained on native pastures, crop residues and agro-industrial by-products as their main source of nutrients (2). Hence, the use of pasture grass and legumes has been advocated for small ruminant animal production as they readily serves as feed source.

Gmelina arborea leaves (*G. arborea*), a leguminous browse plant, has been identified as one of the cheapest way in reducing feeding cost in ruminant production in the tropics (3) since its leaves are relished by small ruminant animal especially sheep and WAD goats. It is a perennial leguminous tree, particularly notable for its fast growth, large green leaves and very high dry matter yield (4). It is commonly used as shade tree in houses, because of its canopy. Its trunk is used also in the paper industry. However, the leaves which are always in large quantities; are not being put into use (5).*Panicum maximum*(a tropical, tufted and perennial grass) is one of the most natural occurring grasses in tropic and sub-tropic of Africa which has high yield and re-growth, very responsive to nitrogenous fertilizer (6) and highly palatable to livestock at all stages of growth which makes it one of the best fodder grasses. Low fibre content and relative availability are major factors that enhance the high intake and utilization of the *Panicum maximum* by small ruminant animals.*Panicum maximum* was among the most frequently picked grasses by grazing small ruminant animals as reported by (7).

Prediction of an animal responses to nutrient is the main focus of practical application of nutrients.Hence, the mixture use of both *Gmelinaarborea* leaves and *Panicum maximum* has been identified as a cheapest way of feeding small ruminant animals. Therefore the study was to determine the performance and nutrient digestibility of West African Dwarf bucks fed *Panicum maximum* supplemented with *Gmelina arborea* leaves mixture.

Materials and Methods

Experimental site

The experiment was carried out at the Sheep and Goat Unit, Teaching and Research Farm, Oyo State College of Agriculture and Technology,Igboora located between latitude 7°15' North and longitude 3° 30' East with an annual average rainfall of 1278mm and average temperature of 27°C.

Experimental animals

Twenty (20) growing West African Dwarfbucks of 4 - 6 months of age were separated from the bucks in the Sheep and Goat Unit of the college, weighed between 6.50-9.00kg were used for the experiment. The animals were acclimatized for two (2) weeks and treated against ectoparasites and endoparasites prior to the commencement of the experiment.

Experimental layout, design and feeding method

The animals were allocated at random into five treatments of four goats per treatment and each animal serves as a replicate, in a completely randomized design (CRD). The experimental diets were: T_1 (0% *G. arborea* leaves and 100% *P. maximum*), T_2 (25% *G. arborea* leaves and 75% *P. maximum*), T_3 (50% *G. arborea* leaves and 50% *P. maximum*), T_4 (75% *G. arborea* leaves and 25% *P. maximum*), and T_5 (100% *G. arborea* leaves and 0% *P. maximum*). Each groups of animal were assigned to experimental diets, and were fed *ad libitum* while fresh water was made available.

Data Collection

Daily feed intake was estimated by the differences in the feed provided and the left over which was weighed the following morning, before another fresh feed was supplied.The initial and final weight obtained for each replicate were arranged in a completely randomized design (CRD) (8). After acclimatized for two weeks, urine and feaces were collected separately from each animal daily throughout the last sevendays of the experiment in metabolic cages. The feaces samples collected were oven-dried at 80^{0}C until constant weight was reached. The urinary output were collected in sample bottles with plastic cover containing 20% dilute tetraoxosulphate (VI) acid and then stored at -20 ^{0}C for subsequent analysis. The faecal samples were chemically analyzed using A.O.A.C procedure (9) while the fiber fractions (NFE, NDF and ADF) were determined using (10) procedure.

Statistical analysis

All data obtained (performance and nutrient digestibility) were subjected to one-way Analysis of Variance (ANOVA) (8). Differences among the means were separated using Duncan's Multiple Range Tests (11). The statistical model was:

$$\mathbf{Y_{ij} = \mu + T_i + e_{ij}}$$

where:

Y_{ij} = Variable of measurement

μ = overall mean

T_i = effect of i*th* treatment diet

e_{ij} = random residual error

Results and Discussion

The percentage chemical composition of *G. arborea* leaves and *P. maximum* mixture on dry matter basis are shown in Table 1.The crude protein (CP) content of *G. arborea* leaves was 23.00%. The value obtained for crude fibre (CF) content of *G. arborea* leaves was 17.15% while the crude fibre content of *P. maximum* was 22.20%. The value of the Nitrogen free extract of the *G. arborea* leaves 34.48% was lower than the value 66.00% of *P.maximum*. The CP value 23.00% obtained in *G. arborea* leaves in this study is comparable with previously reported values in literature (12)

Table 2 shows the performance characteristics of goats fed *P. maximum* supplemented with *G. arborea* leaves mixtures. The results of feed trial showed that the dry matter intake (DMI) increased by inclusion levels of *G. arborea* leaves across all dietary treatments. The highest dry matter intake (DMI) of 4.93kg was observed in

Table 1: Chemical composition of *G. arborea* leaves and *P. maximum* on dry matter basis

Parameters (%)	*G. arborea Leaves*	*P. maximum*
Dry Matter	93.71	32.80
Crude Protein	23.00	5.30
Ether Extract	13.60	2.90
Ash	5.39	3.30
Crude Fibre	17.15	22.20
Nitrogen Free Extract	34.48	66.00
Gross Energy (Kcal/g)	2.98	3.15

G. arborea = Gmelina arborea; P. maximum = Panicum maximum

T_5, followed by T_4 with value of 4.46, while T_3 has the lowest value of 4.03. The high DM intake by goats fed T_5 diet could be attributed to the protein quality of the *G. arborea* leaves supplement which enhanced the intake of the DM (13). The highest average weight gain (1.60kg) was observed in T_2, followed by T_3 with value of 0.94kg, while the lowest value of 0.31kg was observed in T_1. The highest daily weight gain (28.57g/day) was recorded in T_2, followed by T_3 with value of 16.79g/day, and the lowest value of 5.54g/day was observed in T_1. The highest weekly weight gain (228.57g/week) was recorded in T_2, followed by (134.29g/week) in T_3 and the lowest value of 44.29g/week was observed in T_1.The highest feed conversion ratio (FCR) and feed efficiency ratio (FER) of 13.81 and 0.70 respectively was recorded in T_1 while the lowest FCR of 2.58 was recorded in T_2, and lowest FER of 0.18 was recorded in T_5.The highest weight gain (28.57g/d) and better feed conversion ratio (FCR) observed in goats fed T_2 diet might be attributed to the palatability, higher dry matter and protein intake that improve the digestibility of the diet. This observation agrees with the finding of (14) which stated that weight gain was dependent of dry matter, protein intake and digestibility of the nutrients. There were significant ($P<0.05$) difference across the dietary treatments.

Table 2: Summary of nutrient digestibility of growing WAD Goats fed varying levels of *G.arborea* leaves and *P. maximum* mixture.

Parameters (%)	T_1	T_2	T_3	T_4	T_5	SEM(±)
Average initial weight (kg)	7.75	8.45	8.68	8.50	9.93	0.32
Average final weight (kg)	8.06^{e}	10.05^{b}	9.62^{c}	9.35^{d}	10.80^{a}	0.40
Average weight change (kg)	0.31^{d}	1.60^{a}	0.94^{b}	0.85^{bc}	0.87^{c}	0.18
Daily weight gain (g/day)	5.54^{d}	28.57^{a}	16.79^{b}	15.18^{c}	15.54^{bc}	3.27
Daily weight gain (g/w)	44.29^{d}	228.57^{a}	134.29^{b}	121.43^{c}	124.29^{bc}	26.17
Dry matter intake	4.28	4.13	4.03	4.46	4.93	0.14
Feed conversion ratio	13.81^{a}	2.58^{e}	4.29^{d}	5.25^{c}	5.67^{b}	1.74
Feed efficiency ratio	0.72	0.39	0.23	0.19	0.16	0.09

DM=Dry matter; CP=Crude protein; CF=Crude fibre; NFE=Nitrogen free extract; NDF=Neutral detergent fibre; ADF= Acid detergent fibre. $^{a, b, c}$represents Means in the same row with different superscript are significantly different ($P<0.05$).

Table 3 shows the percentage summary of nutrient digestibility of WAD goats fed varying levels of *G. arborea*leaves and *P. maximum* mixture. The DM digestibility content of the mixture obtained fell within the range of 87.68% (T_2) to 88.06% (T_3), which is still enough to meet the production and maintenance requirements of small ruminants. The differences in DM digestibility in experimental diets may be due to difference in stages of harvest. The highest CP digestibility (9.58%) was recorded in T_5 while the lowest value of 8.73% was recorded in T_1.The CP digestibility of the experimental diets ranges from 8.73- 9.58% and fell within the recommended value (9.5-10%) for maintenance in small ruminant animals (15). It was observed that with increase in the level of inclusion of *G. arborea*leaves, there is corresponding increase in CP digestibility of the experimental diet .The percentage CF digestibility ranged from 19.88- 22.53 %.This observation supports the findings of (16) who reported that the fibre fraction of a feed has the greatest influence on its digestibility, and both the amount and chemical composition of the fibre are important. The highest ADF digestibility (42.23%), NDF digestibility (59.72%) and NFE digestibility (52.58%) was observed in T_1, which could be attributed to the fact that as the plant matures, the fibre fraction (ADF, NDF and NFE) also increases. This observation was in accord with the findings of (16) who reported that with advance in forage plant maturity; there is an increase in its dry matter, ADF, NDF and NFE content with appropriate decrease in its crude protein.

Table 3: Summary of nutrient digestibility of growing WAD Goats fed varying levels of *G.arborea* leaves and *P. maximum* mixture.

Parameters (%)	T_1	T_2	T_3	T_4	T_5	SEM(±)
DM Digestibility	87.87^{a}	87.68^{a}	88.06^{a}	87.98^{a}	87.84^{a}	1.70
CP Digestibility	8.73^{b}	9.02^{a}	9.38^{a}	9.48^{a}	9.58^{a}	0.86
CF Digestibility	19.88^{b}	21.44^{a}	20.77^{a}	21.65^{a}	22.53^{a}	1.14
Ash Digestibility	5.36^{b}	5.59^{b}	6.11^{a}	6.07^{a}	6.31^{a}	1.64
NFE Digestibility	52.58^{a}	50.25^{b}	50.45^{b}	49.36^{c}	47.94^{c}	1.07
NDF Digestibility	59.72^{a}	57.39^{b}	57.19^{b}	56.10^{b}	54.68^{c}	1.72
ADF Digestibility	42.23^{a}	40.35^{c}	41.52^{b}	40.75^{c}	41.28^{b}	1.24

DM=Dry matter; CP=Crude protein; CF=Crude fibre; NFE=Nitrogen free extract; NDF=Neutral detergent fibre; ADF= Acid detergent fibre. $^{a, b, c}$ represents Means in the same row with different superscript are significantly different ($P<0.05$).

Conclusion and Applications

1. Variations were observed in the performance and nutrients digestibility of the experimental animals. These variations were in respect of varying levels of inclusion of *G. arborea* leaves and *P. maximum* mixture fed to the WAD goats.
2. The study showed that *G. arborea*

leaves, be incorporated into the diet of WAD at 75% *P. maximum* and 25% *G. arborea* leaves for a better feed utilization, and at 100% *G. arborea* leaves and 0% *P. maximum* to achieve best dry matter intake.

3. It can be concluded from the results of this study that the selected browse plant (*G.arborea*) appeared to have the potential as protein feed supplements and may therefore serve as a good feed resource for modern intensive ruminant animal production.

Recommendations

It is therefore recommended that farmers should incorporate the inclusion level of *G. arborea* leaves at 100% in diets of small ruminants because it is readily available, cheap and high in crude protein which is needed for optimum growth, maintenance and production of small ruminants.

References

1. Ajibike, A.B., Ilori, B.M., Awotunde, E.O., Adegboyega, R.A., Osinbowale, D.A.,Bemji, M.N., Durosaro, S.O. and Adebambo, A.O. 2016. Genetic diversity and effectof selection at the mitochondrial hypervariable region in major Nigerian indigenous goat breeds. *Asian-Australasian Journal of Animal Sciences*. DOI: http://dx.doi.org/10.5713/ajas.15.0775
2. Agricultural and Food Research Council (AFRC) (1991). AFRC Technical committee on response to nutrients number 7. Theory of response to nutrients by farm animals *Nutrition Abstract and reviews* (series B) 61: 683-722.
3. Okpara, O.,Akporhuarho, P.O., Okagbare, G.O. and Sorhue, G.U. (2012). Performance evaluation of WAD goats fed varying levels of *Gmelina arborea* as supplement in the humid environment of Southern Nigeria. *Journal of General Agriculture* 8(3): 119 – 124.
4. Adu, I.F, Aina, A.B.J and Okeyele, K.A. (1996). On farm establishment and productivity of *Gmelina arborea* as browse for goats. *Nigeria Journal of Animal Production*23(1): 47 – 52
5. Onabanjo, O.O and Onwuka, C.F.I (1998). *Gmelina arborea* leaves and some supplements as dry season feed for West Africa Dwarf goats. *Proceedings of the Silver anniversary of the conference of the Nigeria society of Animal production*. Oduguwa, O.O, Fanimo, A.O. and Osinowo, O.A (eds). 21 - 26, March. Pp: 369 - 370.
6. Crowder, L.V. and Chheda, H.R. (1982). Growth pattern common to grazing livestock in humid tropics. *Tropical Grassland Husbandry,* Longman, London.
7. Aina, A.B.J and Onwuka, C.F.I. (2002). Estimation of nutrient content of

some selected grasses as affected by age of cutting in production. Annual conference of Animal Science Association of Nigeria (ASAN) Sept. 16 - 19, 2002, Pp: 212 - 214.

8. SAS (1999). SAS/STAT User Guide version 8 for Windows. SAS Institute, Cary, North Carolina, USA.
9. A.O.A.C. (1995). Official Method of Analysis. 15th Edition. Association of Official Analytical Chemists, Washington DC. Pp: 68 – 69.
10. Van Soest J. P. (1991). The use of detergents in the analysis of fibrous feeds. Determine of plant cell constituents. *Journal of the Association of official Analytical Chemists* 50: 50 – 55.
11. Duncan, D.B. (1955). Multiple ranges and multiple F-test. *Biometrics* 11: 14 - 20.
12. Okagbare, G.O., Akpodiere, O.J., Esiekpe, O. and Onagbesan, O.M. (2014). Evaluation of *Gmelinaarborea* leaves supplemented with grass (*Panicum maximum* and *Pennisetumpurpureum*) as feed for West African Dwarf goats. *Tropical Animal Health and Production,* 36:593-598.
13. Babayemi, O. J. and Bamikole, M. A. (2006). Supplementary values of *Tephrosia bracteolate, Tephrosia candida, Leucocenaleucocephala* and *Gliricidiasepium* for WAD goats kept on *Panicum maximum*. *Journal of Central European Agriculture* 2: 32.
14. Bamikole, M.A. and Ezenwa, I. (1999). Performance of rabbit in Guinea grass *Veranostylo* hays in the dry season and effect of concentrate supplementation. *Animal Feed Science and Technology* 80:67-74
15. Ahamefule, F.O., Ibeawuchi, J.A. and Ibemere, J.C. (2001). Digestibility and Nitrogen balance studies in WAD goats fed fortified cassava peel meals poultry waste diets. *Journal of Applied Chemical Res.* 7:69-74.
16. Mc Donald, P. Edwards, R.A. Greenhalgh, J.F.D. and Morgan, C.A. (1995). *Animal Nutrition*. 5th edition.Longman.