Nigerian J. Anim. Sci. 2018, 20 (1): 106-114

Predicting nutrient retention for body weight gain in ewe-lambs fed diets containing gliricidia (*Gliricidia sepium)* and neem (*Azadirachta indica*) leaves supplement

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***Target audience**: Animal Scientists, Ruminant Nutritionists, Sheep Farmers*

Abstract

This study investigated the effect of Gliricidia sepium with neem leaves supplementation on nutrient retentions for body weight gain in ewe-lambs. Twelve West African dwarf ewe-lambs with an average weight of 7.00 ± 0.32kg were randomly allotted to three dietary tratments with four ewe-lambs per treatment in a completely randomized design. The compared treatment diets were; diet I (I (50% guinea grass + 20% Gliricidia sepium + 30% concentrate), II (45% guinea grass + 25% G1iricidia sepium + 30% concentrate) and III (40% guinea grass + 30% Gliricidia sepium + 30% concentrate). Diets II and III received 3 and 6 grams of neem leaves meal per animal per day respectively as additional supplement. A metabolism trial was conducted at the end of the feeding trial to assess the diets on energy and nitrogen retentions after the growth study of the ewe-lambs. Results obtained showed that gross energy (3981.14MJ/kg DM/day), faecal energy and nitrogen output (1101.78 MJ/kg DM/day and 4.33g/day), daily feed intake (273.43g/day) and feed conversion ratio (7.32) were significantly (P < 0.05) highest in ewe-lambs fed diet I. Ewe-lambs on diet III were significantly (P < 0.05) highest in terms of digestible and metabolizable energy intakes (1306.37 and 1071.20 MJ/kg DM/day), nitrogen intake (20.93g/day), nitrogen balance and retention (17.33g/day and 81.47%), final body weight (11.08kg), total and daily weight gains (4.10kg and 48.81g) than those on diets I and II. No significant (P > 0.05) effect was recorded among the treatment diets with regards to urinary energy output, metabolizability, urinary nitrogen output and initial body weight. It was concluded that ewe-lambs fed 40% guinea grass + 30% Gliricidia sepium + 30% concentrate with 6g neem leaves had better nutrient retentions for body weight gain in ewe-lambs

Keywords: *Gliricidia sepium*, neem leaves, nutrient retentions, growth, ewe-lambs.

Description of Problem

The problem of feed availability on a sustainable basis has been the major limitation to small ruminant livestock production in Nigeria. This situation becomes more critical and challenging during the dry season, when sheep and goats are unable to meet their protein and energy requirements from the available poor quality forages with consequent marked weight loss and mortality. The prevailing high cost of feedstuff due to competition between man and livestock for the existing scarce feeds is making the situation unbearable for sheep and goat farmers (1) more now that the world is

facing recession. Therefore, to prevent the collapse of small ruminant industry, the need to incorporate feed supplement that can efficiently support forage nutrient availability and consequently reduce the cost of sheep production is of paramount importance. However, tree foliage are increasing recognized as one of the suggested means of supplementing poor quality forage during the dry season to alleviate the effect of long scarcity of inadequate feeds supply in ruminant production. Supplementations with foliage strategies have been reported (2) to increase nutrient availability in sheep when forages are deficient in nutrient in order to maximize production in ruminant livestock in the tropics.

Gliricidia sepium and neem leaves are potentially characterized by their high nutrient quality resources that can be used as supplement to low quality forages. *Gliricidia sepium* is a leguminous foliage tree that is characterized by their high nitrogen content, good fodder value and high foliage productivity. It is suitable feed for ruminants that can be used in large quantity without deleterious effects on animal performance (3). On the other hand, neem plant (*Azadirachta indica*) is a non-leguminous multi-purpose tree which belongs to the family *Meliceae*. The neem tree is a drought tolerant plant that is known to thrive well in areas with long dry season. When the leaves are incorporated into ruminant feeds, it can help to increase the utility of the plant and alleviate the severe feed inadequacy experienced in the tropics during the dry season (4). The major limitation to their effective utilization lies on their odour and bitter taste, which requires some levels of harnessing to increase the acceptability. This review the highlights potential of *Gliricidia sepium* and neem leaves as fodder that can be harnessed to bridge the seasonal deficits in quantity and quality of forage. Previous works (3, 5) indicated that foliage have intrinsic properties useful for ruminants as feed. This study was therefore design to predict energy and nitrogen retentions for body weight gain in ewe-lambs fed *Gliricidia sepium* and neem leaves supplement.

Materials and Methods

Experimental site:

The experiment was carried out at the Small Ruminant Unit of the Teaching and Research Farm, Ambrose Alli University, Ekpoma, Nigeria. The area is located on latitude 6.42^0N and longitude 6.09^0E within the south-south geographical zone of Nigeria. The mean annual temperature and rainfall of the area are about 31^0C and 1556mm respectively.

Preparation of experimental diets:

Gliricidia sepium foliage and guinea grass were obtained within the Teaching and Research Farm. They were allowed to wilt for 12 to 24hours before been chopped to small sizes. The neem leaves that were obtained fresh within Ekpoma were air-dried under shade for about 7 days before milled into meal. The concentrate comprised 70% wheat offal, 20% dried brewery grain, 8% rice bran, 0.75% limestone, 0.25% bone meal, 0.75% salt and 0.25% vitamin.

The three experimental diets that were prepared consist of diet I (50% guinea grass + 20% *Gliricidia sepium* + 30% concentrate), diet II (45% guinea grass + 25% *G1iricidia sepium* + 30% concentrate) and diet III (40% guinea grass + 30% *Gliricidia sepium* + 30% concentrate). Diet I received no neem

leaves meal while diets II and III received 3 and 6 grams of neem leaves meal per animal per day respectively.

Experimental animals and their management:

Twelve growing West African dwarf ewe-lambs, aged between 7 and 8 months with mean body weight of 7.00 ± 0.32kg were allotted to the three experimental diets of four replicates with one animal per replicate in a completely randomized design. The ewe-lambs were housed in individually demarcated pens. The pens were adequately ventilated, clean daily and wood shavings were changed fortnightly. The treatment diets were offered to the animals in 5% of their body weight once daily at about 8:00am in the morning. The treatment diets were in form of complete mixing and ensured voluntary consumption among the ewe-lambs. The animals also had unrestricted access to clean fresh water. They were allowed out for exercise early in the morning on days with favorable weather. During the trial, recommended vaccinations and medications were adequately administered to the ewe-lambs. The study lasted for 84 days after 14day of adjustment period.

Live body weight of ewe-lamb was measured prior to determine change in body weight. Total body weight gains were calculated as the difference between the initial and final weight of each ewe-lambs. The quantity of the experimental diets offered to ewe-lambs and leftovers were also weighed daily in the morning prior to feeding. The weight difference between them was the feed intake.

Nutrient retention trial:

The four ewe-lambs per treatment were randomly allotted to individual metabolic cages, designed for separate collection of faeces and urine. Energy and nitrogen metabolism trial were carried out in the last 7-day feeding trial after 7-day adjustment period. The sampled treatment diets were stored separately in an air-tight containers while daily faecal sub – samples were weighed, bulked together and stored in a freezer until they were required for analysis. Daily urine sub – samples from each ewe-lamb were collected in sample bottles containing concentrated sulphuric acid and frozen for -20^0C until required for analysis.

Gross energy (GE) of feeds, faeces and urine was determined using an adiabatic bomb calorimeter. The GE intake was calculated as the GE of the feed in dry matter (DM) multiply by DM of the feed intake. Faecal energy (FE) output was determined as the GE of the faeces in DM multiply by the quantity of the faeces in DM. Digestible energy intake was calculated as the different between GE intake and FE output divided by GE intake and multiply by 100 and GE of the feeds in DM. Metabolizable energy (ME) was estimated by 82% of DE intake as reported by (6, 7). The metabolizability (qm) was calculated as ME/GE for each treatment diet (8, 7).

Nitrogen balance by ewe-lambs was calculated as the difference between nitrogen intake and nitrogen excreted from faeces and urine. The nitrogen retention percent was computed from the nitrogen balance expressed as a percentage of nitrogen intake (9).

Laboratory and Statistical Analyses*:*

Samples of the test ingredients (*Gliricidia sepium* and neem leaves) and the experimental diets as well as faecal

output were analysed for proximate composition using the procedure of (10).

Data obtained from energy and nitrogen metabolism as well as growth parameters were subjected to analysis of variance (ANOVA) and significant difference between means was separated using Duncan multiple range test (11).

Results and Discussion

Dry matter content of the test feedstuff and experimental diets that ranged from 77.03% in *Gliricidia sepium* to 92.42% in neem leaves were quite high suggesting the ability of the feedstuff and the diets to accumulate nutrients. The crude protein (CP) values recoded for the treatment diets (15.87% to 17.43%) in this study, were higher than the minimum level of 7% CP required in forages to enhance voluntary intake, nutrient digestibility and utilization by ruminants (1). This implies that the diets were able to supply enough protein from the feeds to the study ewe-lambs. The percentage of crude fibre content was highest in diet I (26.74%) than diets II (25.98%) and III (25.11%). The varying levels of guinea grass inclusion in the diets could be the reason for such disparity. The variation observed in ash content values ranged between diet III (8.34%) and diet I (8.77%) explained the inverse values of crude protein and ash content across the treatment diets. Ether extract that ranged between 1.28 to 1.60% was lowest in diet I than diets II and III, explaining the poor contribution of the guinea grass to the ether extract content to the treatment diets. Nitrogen free extract values (33.00 to 35.91%) in diets explained the level of energy supplied to the diets. However, the proximate composition values of *Gliricidia sepium* and neem leaves obtained in this study were similar to the reports of (3; 4).

Table 1. Proximate composition (% DM) of the test feedstuff and experimental diets

			Experimental diets		
Parameters	GS	NS	I	II	III
Dry matter	77.03	92.42	88.57	86.03	85.99
Crude protein	28.31	19.68	15.87	16.92	17.43
Crude fibre	20.06	16.61	26.74	25.98	25.11
Ash	6.67	7.10	8.77	8.66	8.34
Ether extract	3.00	4.16	1.28	.1.50	1.60
Nitrogen free extract	39.02	44.91	35.91	33.00	33.42

GS = *Gliricidia sepium*, NL = Neem Leaves

Table 2 shows the energy utilization of West African dwarf ewe-lambs fed experimental diets. Energy utilization by ruminants has been reported to play an important role in determining nutrient retention and growth performance in ruminants (12). The gross energy intake that varied between 3891.81 and 3981.14 MJ/kg DM/day was significantly ($P < 0.05$) high in diet I and lowest in diet III. The progressive decrease in the gross energy intake across the diets in response to inclusion level of guinea grass could probably be the reason for such disparity. This observation is consistent with the report of (13) who noticed that energy content of a feed with the feed intake is a function of gross energy intake of

ruminants. The estimated faecal energy output for ewe-lambs fed on diet I (1101.78MJ/kg DM/day), followed by diet II (998.08MJ/kg DM/day) with the list value recorded in diet III (712.24MJ/kg DM/day). The higher faecal energy output observed in diet I could be the result of high level of fibre component contributed by guinea grass, which indicate poor energy utilization in the ewe-lambs. The urinary energy output (2.00 and 3.02 MJ/kg DM/day) followed that same trend as observed in faecal energy output. However, the gradual decrease in trend of energy loss from diets I to III in response to increase in *Gliricidia sepium* with neem leaves supplement explained their attributes to the proper balancing in levels of digestible nutrient and better energy utilization by the ewe-lambs.

Calculated Digestible Energy (DE) and Metabolizable Energy (ME) intake values were significantly ($P < 0.05$) high in ewe-lambs placed on diet III (1306.37 and 1071.22 MJ/kg DM/day) compared with diets II (1117.04 and 915.97 MJ/kg DM/day) and I (1053.05 and 863.50MJ/kg DM/day). This variation in values could be explained by the differences in energy loss through faecal and urinary energy output. This finding is in conformity with the report of (14) who observed that low level of total energy loss has a direct postive effect on the DE and ME intake of goats. The metabolizability values were not significantly ($P > 0.05$) different among treatment diets. This could be due to the close range between DE and ME. This observation is in consonance with the finding of (15) who observed that the metabolizability of a complete feed in livestock is relatively low and constant.

Table 2. Energy utilization (MJ/kg DM/day) of West African Dwarf ewe-lambs fed experimental diets

	Diets			
Parameters	I	II	III	SEM ±
Gross energy	3981.14[a]	3924.61[b]	3891.81[c]	1.03
Faecal energy output	1101.78[a]	998.08[b]	712.24[c]	0.69
Urinary energy output	3.02	2.62	2.00	0.04
Digestible energy intake	1053.05[c]	1117.04[b]	1306.37[a]	0.96
Metabolizable energy intake	863.50[c]	915.97[b]	1071.22[a]	0.78
Metabolizability	0.81	0.82	0.82	0.02

[a,b,c] Means within the same row with different superscript differ significantly ($P < 0.05$). SEM = Standard error of mean.

Nitrogen metabolism of ewe-lambs containing diet with *Gliricidia sepium* and neem leaves supplement is shown in Table 3. Nitrogen intake values were similar numerically in diets II (19.55g/day) and III (20.93g/day) but significantly ($P < 0.05$) higher than diet I (17.24g/day). The higher nitrogen intake observed in diets II and III could be a reflection of *Gliricidia sepium* and neem leaves supplement in the diets. Aye and Adegun (3) reported that *Gliricidia sepium* increase nitrogen intake when supplemented with forages in sheep diets. The faecal nitrogen (g/day) output values of 4.33, 3.60 and 3.44 that were obtained in diets I, II and III respectively

was significantly (P > 0.05) higher in ewe-lambs on diet I compared with those on diets II and III. This variation in values could be connected with the degree of nutrient utilization and retention in the study ewe-lambs. This support the report of (16) who found that poor utilization of dietary protein increases faecal nitrogen output rather than contributing to the nutrient requirement. The urinary nitrogen (0.37g/day to 0.88g/day) output observed in this study was not significantly (P > 0.05) affected by the treatment diets, though diet I had the higher numerical value than others. It is important to note that the ability to manipulate the excretion of nitrogen in ruminants has important nutritional application in sheep. This finding is in conformity with the earlier report of (17) who found that nitrogen excreted in urine will depend on urea recycling and the efficiency of utilization of ammonia produced in the rumen by microbes in the rumen.

However, it is known that if more nitrogen could be retained as a percentage of total nitrogen fed, more nitrogen would be available to maximize growth and production in ruminant animals. The significant higher (P < 0.05) nitrogen balance and retention values obtained in ewe-lambs paced on diets III (17.33g/day and 81.47%) compared with diets II (15.21g/day and 77.86%) and I (12.13g/day and 70.30%) could probably be explained by the presence of optimism anti-microbial effect on diet III than diets I and II. Thus, the type and method of feeding protein diet may positively influence the balance and retention of nitrogen in sheep (17).

Presented in Table 3 is also growth performance of ewe-lambs fed *Gliricidia sepium* and neem leaves supplement. Growth parameters observed were all significantly (P < 0.05) affected by treatment diets except initial body weight that was not significantly (P > 0.05). Final body weight values were similar for ewe-lambs on diets II (11.01kg) and III (11.08kg) but significantly (P < 0.05) higher than those on diet I (10.78kg). The effect of gliricidia and neem leaves supplement in diets II and III could be attributed to the higher final body weight observed compared with diet I. Total weight gain was significantly (P < 0.05) highest in ewe-lambs placed on diet III (4.10kg) compared with those on diets I (3.14kg) and II (3.67kg). This difference explains the superiority of energy and nitrogen utilization and retentions for ewe-lambs on diet III than diets I and II. Daily weight gain for ewe-lambs that recorded 37.38g, 43.69g and 48.81g in diets 1, 11 and 111 were significantly (P < 0.05) different across the dietary treatments.

Daily feed intake values that ranged from 243.39g in diet III to 373.43g in diet I does not followed the same trend as observed in daily weight gain. Feed intake appears to decline across the dietary treatments with increase in inclusion levels of gliricidia and neem leaves. However, the highest significant (P < 0.05) feed intake value obtained on diet I could be as a result of the ewe-lambs taking more feeds to meet their nutrient requirements or the acceptability level of the diet. It is well established that feed intake is not directly proportional to the rate of growth in farm animals, when the nutrient intake requirement of the animals are not met (18). Feed conversion ratio (FCR) was significantly (P < 0.05) high in ewe-lambs on diet I (7.32), followed by diet II (5.10) before diet III (4.99). However, the study diet III that posted positive response on

weight gain and FCR further attest the superiority of ewe-lambs on the diet in terms of energy and nitrogen utilization and retentions over diets I and II. This confirm the report of (19) who found that sheep retained more nutrient and grow quite normally on a diet that is having up to 40% gliricidia supplement. This is true because inclusion of gliricidia and neem leaves at 30% and 6 grams respectively in the ewe-lambs performed better in terms of growth than those animals fed the other treatment diets.

Table 3. Effects of *Gliricidia sepium* and neem leaves supplementation on nitrogen metabolism and growth performance of ewe-lambs

Parameters	Diets			SEM ±
	I	II	III	
Nitrogen intake (g/day)	17.24[b]	19.55[a]	20.93[a]	0.21
Faecal nitrogen output (g/day)	4.33[a]	3.60[b]	3.44[b]	0.61
Urinary nitrogen output (g/day)	0.88	0.74	0.37	0.12
Nitrogen balance (g/day)	12.13[c]	15.21[b]	17.33[a]	0.18
Nitrogen retention (%)	70.30[c]	77.86[b]	81.47[a]	0.15
Growth Performance				
Initial body weight (kg	7.64	7.34	6.99	0.16
Final body weight (kg)	10.78[b]	11.01[a]	11.08[a]	0.35
Total weight gain (kg)	3.14[b]	3.67[b]	4.10[a]	0.03
Daily weight gain (g)	37.38[c]	43.69[b]	48.81[a]	0.74
Daily feed intake (g/day)	273.43[a]	261.99[b]	243.39[c]	1.06
Feed conversion ratio	7.32[a]	5.10[b]	4.99[c]	0.08

[a,b,c] Means within the same row with different superscript differ significantly ($P < 0.05$). SEM = Standard error of mean.

Conclusion and Applications

The findings of this study showed that:

1. In order to improve nutrient retention for body weight gain in sheep production, particularly during the period of dry season, supplementation of tree foliage with forage grass could be successfully utilized by ewe-lambs as feeds in the tropics.
2. Supplementation of 30% *Gliricidia sepium* with 6 grams had the highest positive significant effect on nutrient retention for body with gain in ewe-lambs.
3. Hence, for maximum ewe-lambs production during feeds scarcity most especially during dry season, supplementation of *Gliricidia sepium* with neem leaves strategic is suggested to be one of the best options when using tree foliage.

References

1. Ngele, M. B., Adegbola, T. A., Bogoro, S. E. F., Abubakar, M. and Kalla, D. J. U. (2010). Nutrient intake, digestibility and growth performance of yankasa sheep fed urea-treated or untreated rice straw with supplements. *Nigerian Journal of Animal Production.* 37(1): 61 – 70.
2. Oduguwa, B. O. and Adu, I. F. (2010). Feeding value of shrimp waste meal for West African Dwarf sheep fed soybean stover basal diet.

Nigerian Journal of Animal Production. 37(1): 71 – 84.

3. Aye, P. A. and Adegun, M. K. (2010). Digestibility and groth in WestAfrican Dwarf sheep fed gliricidia – based multi nutrient black supplements. *Agricultue and Biology Jounral of North American* 1(6): 1133 – 1139.
4. Ogbuewu, I. P., Odoemenam, V. U., Obikaonu, H. O., Opara, M. N., Emenalom, O. O., Uchegbu, M., Okol, I. C., Esonu, B. O. and Iloeje, M. U. (2011). The growing importance of neem (*Azadirachita indica*) in Agriculture, Industry, Medicine and Environment: A review. *Research Journal of Medical Plants*, 5(3): 230 – 245.
5. Mishra, R. K. and Singh, S. K. (2005). Effect of aqueous leaf extract of *Azadirachita indica* on the reprodcuive organs in male mice. *Indian Journal of Experimental Biology,* 43: 1093 – 1103.
6. National Research Council (NRC, 2007). Nutrient requirements of small ruminant. Washington, D. C. National Academy Press. Pp. 362.
7. Redagas Filho, J. G. L., Pereira, E. S. P., Villarroe, A. B. S., Pimentel, P. G., Fontenele, R. M., Ferreira, M. R. G., Gomesmaia, L. S. and Sombra, W. A. (2011). Efficiency of metabolizable energy utilization for maintenance and gain and evaluation of Small Ruminant Nutrition system model in Santa Ines sheep. *Revsta Brasileira de Zootecnia*, 40(11): 2558 – 2564.
8. Agricultural and Feed Research Council (AFRC, 1993). Energy and protein requirements of ruminant. Wallingford Common-wealth Agricultural Bureaux International. Pp. 159.
9. Okoruwa, M. I., Adewumi, M. K., Bamigboye, F. O. and Ikhimioya, I. (2014). Effects of feeding guinea grass and varying levels of Avocado seeds with orange peels on nitrogen metabolism and rumen micro-organisms in rams. *Nigerian Journal of Animal Science*, 16(1): 124 – 132.
10. AOAC (1990). Association of Official Analytical Chemists. Official methods of analyses. Washington DC: Pp. 141.
11. SAS (2000). Statistical Analysis System. Institute Inc. Users Guide Statistic version 6th ed. Carry North Carolina, USA.
12. Johnson, D. E., Ferrel, C. H. and Jenkins, T. G. (2003). The history of energetic sufficiency in animal research. *Journal of Animal Science*, 55: 1190 – 1199.
13. Okoruwa, M. I. and Edokpayi, I. M. (2014). Evaluation of energy and haematological indices of West African Dwarf goats fed varying levels of yam peels and cowpea husk. *Scholars Journal of Agriculture and Veterinary Science*, 1(4): 255 – 259.
14. Bawala, T. O. and Akinsoyinu, A. O. (2002). Nutritional evaluation of browsers, *Gliricidia sepium* and ficus thoningii foliage in goat diet: Energy utilization and requirement.*Annual Conference of Animal Science Association of Nigeria*. Pp. 174 – 176.
15. Amaefule, K. U., Onwudike, O. C., Ibe, S. N. and Abasiekong, S. F. (2009). Nutrient utilization and digestibility of growing pigs fed diets of different proportions of palm kernel meal and brewer dried grain.

Pakistan Journal of Nutrition, 8(4): 361 – 367.

16. Ososanya, T. O. and Akinlade, A. T. (2015). Effect of ammonium sulphate supplementation on growth performance, nutrient digestibility and nitrogen balance of West African Dwarf rams. *Proceeding* of 20th Annual Conference of Animal Science Association of Nigeria, University of Ibadan. Pp. 666 – 670.
17. Ebrahimi, M., Ajion, M. A., Men, Y. G., Shokryzadan, P., Sazili, A. Q. and Jahromi, M. F. (2015). Feeding oil palm (E*laeis guineensis*, Jacq.) fronds alters rumen protozoa population and ruminal fermentation pattern in goats. *Italian Journal of Animal Science*, 14: 403 – 409.
18. Zhan, X., Zhang, H., Wang, Z., Zhang, X., Zou, H., Tan, C. and Peng, Q. (2015). Effects of dietary carbohydrate composition on rumen fermentation characteristics and microbial population *in-vitro*. *Italian Journal of Animal Science*, 14: 524 – 531.
19. Ajayi, D. A., Adeneye, J. A. and Ajayi, F. T. (2005). Intake and nutrient utilization of West African Dwarf goats fed mango (*Mangifera indica*), ficus (*Ficus thionningii*), gliricidia (*Gliricidia sepium*) foliage and concentrates as supplements to based diet of guinea grass (*Panicum maximum*). *World Journal of Agricultural Science*, 1(2): 184 – 189.