NIGERIAN AGRICULTURAL JOURNAL
ISSN: 0300-368X
Volume 49 Number 2, October 2018. Pp. 294-301
Available online at: http://www.ajol.info/index.php/naj

EFFECT OF SUBSTITUTING SOYA BEAN MEAL WITH *Gmelina arborea* LEAF MEAL ON PERFORMANCE AND RUMEN FERMENTATION OF RED SOKOTO BUCKS

[1]Njidda, A.A., [2]Zikachat, S.S. and [2]Udokpoh, P.R.
[1]Department of Animal Science and Fisheries, National Open University of Nigeria, KM4, Kaduna-Zaria road, Rigachukun, Kaduna State, Nigeria
[2]Department of Animal Science, Kaduna State University, Kafanchan campus, Nigeria
*Corresponding Author's email:ahmednjidda7@gmail.com

ABSTRACT
An experiment was conducted using sixteen 5-month-old Red Sokoto buck with an average weight of 6.29 ± 0.21 kg body weight (BW)) randomly distributed into four groups of four animals per group, were used to study the effects of substituting *Gmelina arborea* leaf meal with soybean meal on voluntary intake, body weight, morphological and testicular characteristics, and economics of production for 77 days in a completely randomized design using analysis of variance. The goats in treatment 1 received 0% *Gmelina arborea* leaf meal, treatment 2, 3 and 4 received 10, 20, and 30% GLM respectively replaced with an equal amount (dry matter basis) of soybean meal (SBM). Daily intakes of dry matter (g/d^{-1}), crude protein, organic matter, nitrogen free extract, neutral detergent fibre and acid detergent fibre were ($p<0.05$) affected by diets. Intake of acid detergent fibre was greater ($p<0.05$) for the treatment diets relative to the control diet. Diet effects on the body weight, linear body measurements and testicular morphology of the goats were marginal ($p>0.05$), except for initial scrotal length and circumference which was markedly ($p<0.05$) affected. Cost of feeding declined with the increasing level of *Gmelina arborea* leaf meal rate in the diet. Cost of feed consumed/goat and cost of feeding/kg BW gain were higher ($p<0.05$) for the control diet than for the treatment diets. Percent reduction in feed cost is outstanding for T_4 compare to other treatment groups receiving GLM. These findings suggest that *Gmelina* leaf meal can be safely used up to 100% level to substitute SBM in a mix diets for growing bucks, without depressing voluntary intake, body weight, morphological and testicular parameters, and improve economic benefits to farmers. However, for better economic returns, 100% substitution of *Gmelina arborea* leaf meal with soybean meal is superior.

Keywords: Soya bean, *Gmelina arborea*, performance, rumen fermentation, and goats

Introduction

Goats are known to utilize poor quality forages and browse better than sheep (Chukwuka *et al*., 2010). In the tropic, there is seasonal shortage of natural forage (Ukanwoko *et al*., 2012), and this has led to the search for nonconventional feedstuffs that are cheap and are not in high demand by humans (Amaefule, 2002). *Gmelina arborea* leaf is nonconventional feedstuffs that is available all year round, a factor that is attributable to all browse forages. The leaves remain green to larger part of dry season and have been fed to ruminants with appreciable results (Lamidi *et al*., 2015). It is rich in protein (10.01 – 38.40% CP) reported by Osakwe and Udeogu 2007); Ahamefule *et al*., (2006) and Adu *et al*., (1996). Ukanwoko and Okehielem (2016) also reported that the high crude protein of *Gmelina arborea* makes it a good substitute for goat production. Ahamefule *et al*. (2002) reported that Forages and feedstuffs containing less than 7 % CP are poorly digested by ruminants due to insufficient nitrogen to stimulate rumen microbial functions; although the value of CP content of *Gmelina arborea* as reported by many authors are more than the minimum protein requirement adequate for microbial functions Studies have shown that *Gmelina arborea* leaf can be used as cheap protein supplements which can improve voluntary intake, digestibility and the general performance of animals fed low quality feeds (Kakengi *et al*., 2001).
Information on the morphological characteristics of small ruminants is very useful for good animal management, monitoring growth and choosing replacement males and females.

Body measurements and live weights taken on live animals have been used extensively for a different reasons both in experimental work and in selection practices (Lawrence and Fowler, 2002; Cam *et al*., 2010). Information on the live body measurement of small ruminants is important for a number of reasons; for breeding, correct feeding and health statues of the animal (Slippers *et al*., 2000). The easiest way to assess body mass is weighing animals with a spring balance, a steelyard balance or any suitable scale, but these devices are too expensive for most of the small scale farmers who lack formal education on how to use weighing scales to estimate their animal body weight. Apart from taking live weight of animals, researchers also use other parameters such as Heart Girth (HG), Neck Girth (NG), Pine Bone (PG), Withers Height (WH), Body Length (BL), Scrotal Length/ circumference and Rump Height (RH) in order to adequately evaluate live animals (Atta *et al*., 2004). The objective of the research is to investigate the effect of substituting soybean meal with *Gmelina arborea* leaf meal on performance, body measurement and economic benefits of red sokoto bucks.

Materials and Methods

Location of the study

The experiment was carried out at the Kaduna State University Teaching and Research Farm, Kafanchan campus, Jema'a local Government area of Kaduna state, Nigeria. It is located within latitude 9°34'N and longitude 8°17'E. The vegetation of the area is the Guinea Savannah type and the area is designated as koppen's Aw climate with two distinct seasons, a wet season in summer and a dry season in winter. Rainfall occurs between the months of April to October with a peak in August. The mean annual rainfall is about 1800 mm and the mean monthly temperature is 25°C, while the relative humidity is about 63%, Ishaya and Abaje (2008).

Animals and treatment

Sixteen clinically healthy Red Sokoto bucks sourced from different herds, about 5 months old with 6.29±0.3 kg mean initial body weight (BW), were randomly assigned to one of four dietary treatments in a completely randomized design for a period of 77 days. The dietary treatments compared were: T_1 fed diet containing 0% GLM, T_2 fed diet containing 10% GLM, T_3 fed diet containing 20% GLM and T_4 fed diet containing 30% GLM as shown in Table 1. The diets were offered twice daily (08.00 and 15.00 hours) in two equal portions.

Chemical Analysis

Samples of the experimental diets were colleted and dried in an air-draft oven at 60°C for 96 h, ground separately to pass through a 1 mm sieve in a Wiley mill and sampled for chemical analysis using the standard methods of the Association of Official Analytical Chemists (AOAC) (1995). Dry matter was determined by drying at 100°C for 24 h. Ash concentration was determined after ignition at 550°C for 4 h in a muffle furnace and used to calculate organic matter (OM). Fiber fraction analysis was by the methods of Van Soest *et al*. (1991). Hemicellulose and cellulose were estimated as differences between neutral detergent fiber (NDF) and acid detergent fiber (ADF) and ADF and lignin, respectively.

Economic analysis

The variable cost of feeding the goats was considered the cost of the feeds, as all other costs (i.e. labor, capital investment, housing) were the same for all the treatments. The cost of harvesting and drying the *Gmelina arborea* leaves was included as part of the feed cost.

Data analysis

Data were subjected to analysis of variance (ANOVA) for a complete randomized design, with a model that included the diet as treatment effects, using Statistical Package for the Social Sciences (SPSS, 2009). When the ANOVA was significant, means were separated using Duncan's multiple range test at the level of $P \leq 0.05$.

Results and Discussion

Chemical composition

The chemical composition of the experimental diets is shown in Table 2. The Dry matter (DM) content of the experimental diets showed significant difference ($p>0.05$) among treatment groups. The DM (gkg^{-1} DM) was observed to increase with increase in the level of *Gmelina arborea* leaf meal. Similar trend was reported by Ukanwoko and Okehielem (2016). Ash content was highest for the 30% level of inclusion which agrees with the findings reported by Amata and Lebari (2011), Crude protein was highest for the 30% level of inclusion (203.30 g Kg^{-1} DM) and least for the 0% level of inclusion. These imply that increasing the inclusion level of *Gmelina arborea* leaves increases the crude protein of the diet. This agrees with the work reports of Okagbare *et al*. (2004) and Njidda (2011) that browse forage species have moderate to high crude protein content which remains all year round. The crude protein level in this study fell within the range of 162.1-202.3g kg^{-1} DM which is well above the values of 102.5 and 137.3g kg^{-1} DM reported by Abdu *et al*. (2012) and Okafor *et al*. (2012) , respectively The crude protein level of 203.30 g Kg^{-1} DM crude protein in the study is above 7% CP recommended for rumen microbes of tropical livestock by Minson (1990) below which there will be a deficiency in performance. The high crude protein content of the feed makes it suitable substitute for goats Njidda *et al*., (2010). The crude fibre content observed was lowest at 30% level (83.31g Kg^{-1} DM) of inclusion and highest at 0% (111.80g Kg^{-1} DM) level of inclusion which implies that increasing the level of inclusion of *Gmelina arborea* leaves decreases the crude fibre of the diet. This trend is similar to the report of Lamidi *et al*., (2015). The NDF and ADF level ranges from moderate to high from T1 (30% cowpea soya bean meal) to T4 (30% *Gmelina arborea* leaf meal). This is in line with the findings of Njidda (2011), who reported higher values ranging from 412.10 to 595.90 g kg^{-1} DM for NDF and 200.50 to 282.00 g kg^{-1} DM for ADF and Njidda *et al*. (2018) 325.10- 475.90 g kg^{-1} DM for NDF and 231.60 – 376.3 g kg^{-1} DM respectively for semi-arid browse forages. Meissner *et al*. (1991) observed that NDF level of forage above 65% can limit feed intake. The lignin content of the browse is moderate and it's within the range reported by Njidda *et al*. (2016a) and Njidda *et al*. (2016b) for browse forages.

Growth Performance

Intakes (g d^{-1} and g kg^{-1} W0.75) of DM, CP, OM, NDF and ADF, and final LW, LW gain and average daily gain (ADG) were all significantly higher ($P > 0.05$) than the other treatment groups except for OMI which was observed to be lower ($P < 0.05$) in T_4 (Table 3). T_2, T_3 and T_4 had better FCR compared to the control group.

The higher DM intake of T_4 compared to other treatment groups is consistent with their higher CP content of the experimental diet. There is a positive correlation of CP content and a negative correlation of fibre with the voluntary feed intake (Olafadehan and Okunade, 2018; Njidda *et al*., 2018). Increased intake of CP and DM reflect the CP and DM concentrations of the dietary treatments. Nutrient intake is generally a function of the concentration of the nutrient and DM intake. The improved LW gains of T_4 were the consequence of their higher DM intake, CP content and intake and energy density in agreement with earlier findings of Olafadehan and Okunades (2018). The CP intake of 26.18 46.99 g kg^{-1} $W^{0.75}$ was above the minimum requirements for maintenance of 4.15 g CP/$W^{0.75}$ (NRC, 1981). Though the availability of these nutrients depends on several factors, including their digestibility, the dietary treatments in the present study provided adequate nutrients to support maintenance and moderate to high growth rate of 24.1 – 96.17 g d^{-1}. The difference in growth rates between T_1 and T_2; T_1 and T_3 and T_1 and T_4 is 18.10, 47.06 and 93.17 g d^{-1}. The growth of bucks (18.10g d^{-1}) at lowest level of substitution (10% GLM) observed in this study is lower than 19.6 – 25 g d^{-1} reported by Ayo (2002) but the growth rate of bucks (47.06 and 93.7) g d^{-1}) at higher level of substitution (20 and 30% GLM) recorded in this study is higher than the 19.32 g d^{-1} reported by Ntakwendela *et al*. (2002) for east African goats supplemented with leguminouis proteins. The differences in growth rate between studies could be due to differences in age, energy content of the diets and quality of feed offered between the current and other studies cited.

In the present study, the growth rate of goats was observed to increase with increasing level of GLM. Body weight is best in $T_4 > T_3 > T_2 > T_1$. The increase in body weight of bucks receiving GLM is in line with the report of Adamu *et al*. (2015) who recorded significant weight gain of Yankasa rams fed GLM. Similar trend was reported by Ukanwoko and Okehielem (2016) who fed GLM based diets on growth performance of West African dwarf bucks. Similarly, ADG and FCR of the goats show that substitution of soybean meal with GLM upto 100% improves growth performance and feed efficiency. The results show superior nutritive value of *Gmelina arborea* leaf meal at higher (30% level of inclusion). However, the positive LW gains in all goats receiving various level of *Gmelina arborea* leaf meal indicate that the browse fodders supplied more than the goats' maintenance CP and energy requirements.

Morphological characteristics

Body weight and all body measurements were significantly different ($p > 0.05$) across treatments (Table 3) for both initial and final measurements, except for rump height which showed no Significant difference ($P < 0.05$) for both initial and final rump height. Though not significantly affected, the increases in the final body measurements compared to initial measurements indicate positive linear correlations between linear body measurements and BW. Thus, lack of diet effect on body and testicular morphology may be related to similar final BW among the goats. These results contradict previous reports (Babale *et al*., 2015) on the same breed of goats where pronounced ($p < 0.05$) differences were recorded for all measured linear body parameters. Variation in results may be due to differences in nutritional regime and management of the animals. Linear body measurement is a more dependable index for estimating the changes in growth and live weight/BW of animals. Olafadehan *et al*. (2015) previously attributed increase in BW of Red Sokoto goats to increase in linear body measurements of the animals. Heart girth (HG), a more reliable predictor of the BW (Olafadehan *et al*., 2017), values were close to the range of 55.1 – 65.65 cm indicated by Babale *et al*. (2015) and Olafadehan *et al*. (2017) for the same breed of goat. The values for height at withers were lower than 58.19 cm reported for Red Sokoto goats (Jibir *et al*., 2013) and 62 – 72 cm reported by Devendra and McLeroy (1982). The variation in various body measurements in different reports may be due to differences in breeds, environment, size of data set and other management practices. Similar observation was made by Iqbal *et al*. (2013). The values of chest depth were higher than the overall mean chest depth value of 25.73 cm reported by Jibir *et al*. (2013). Variation in values could be attributed to differences in husbandry practices and strains of Red Sokoto goats breeds used in different experiments. The body length values were, however, similar to the reported overall mean body length of 48.84 cm (Jibir *et al*., 2013). The size of the scrotum has been identified to positively correlate with the fertility and reproductive efficiency of the male offspring genetically. Therefore, the similar ($p>0.05$) values for scrotal circumference and scrotal length among the diets indicate that complete substitution of soybean meal with *Gmelina arborea* leaf meal (100% substitution rate) did not affect the reproductive potential of the experimental bucks. Though, further studies can be conducted in the following areas (libido, fertility, semen volume and quality, and reproductive performance) of male goats fed diet containing up to 100% GLM so as to ascertain the current findings in this study.

Cost/Benefit analysis

There's reduction in feed cost/kg feed and this tend to reduce with increasing level of *Gmelina arborea* leaf meal. The results reveal that it is more economical to prepare feed with GLM than SBM. Cost of feed (N)/kg BW gain revealed that it was significantly cheaper and more economical to produce 1 kg of BW by replacing SBM with GLM. These results corroborate findings of Olafadehan, (2017) where unconventional feedstuffs were used to replace conventional ones. Reduction in feed cost was observed in T_4 (100% substitution of SBM with GLM) to be better than the other treatment groups. Based on this cost reduction, savings on the feeding cost were 2.14, 4.09 and 9.26% for 10, 20 and 30% GLM substitution relative to the control (0% GLMs).

Conclusion

The study shows that substitution of SBM with GLM up to 100% in a practical low cost goat ration without any adverse effect on feed consumption, body weight and linear body measurements of buckling goats. However, 100% inclusion level gave better economic returns than the other groups' inclusion rate.

References

Abdu, S.B., Hassan, M.R., Jokthan, G.E., Adamu, H.Y., Yashim, S.M. and Yusuf, K. (2012). Effect of varied inclusion levels of gmelina (*gmelina arborea*) leaf meal on intake, digestibility and nitrogen in red sokoto bucks fed on sorghum glum based complete diets. *Advances in Agriculture, Sciences and Engineering Research 2 (2): 79-84.* http://www.ejournal.sedinst.com

Adamu, H.Y., O.S. Lamidi, O.W. Ehoche, S.B. Abdu, M.R. Hassan and S.M. Yashim, (2015). Growth performance of Yankasa sheep fed varying proportions of white beech (*Gmelina arborea*) leaves.http://www.academia.edu/5831079/GROWTHPEROFRMANCE-OF-YANKASA-FED-VARY-PROPORTIONS-OFGmelina-arborea-LEAVES-1-3

Adu I. F., Aina A. B. J., Okeleye K. A. (1996). On-farm establishment and productivity of *Gmelina arborea* and Gliricidia as browse for goats. *Nigerian J. Anim. Prod.* 23(1):47-52.

Ahamefule, F.O., Ibeawuchi, J.A. and Ajala, A.A. (2002). Intake, digestibility and nitrogen balance studies of potato peels yeast slurry diet by West African Dwarf goats. *Proceeding of 27th Annual Conference. Nigerian Society for Animal Production* (NSAP). Federal University, Akure, Nigeria. Pp. 198-201.

Ahamefule. F.O., B.E. Obua, J.A. Ibeawuchi, and N.R. Udosen. (2006). "The Nutritive Value of some Plants Browsed by Cattle in Umudike Southeastern Nigeria". *Pakistan J. Nutri.* 5(5):404-409.

Amaefule, K.U. (2002). Evaluation of pigeon pea seeds C. cajan as protein source for pullets. Ph.D. Thesis, Department of Animal Science, University of Nigeria, Nsukka. Amata,

Amata, I. A. and Lebari, T. (2011). Comparative evaluation of the nutrient profile of four selected browse plants in the tropics, recommended for use as non-conventional livestock feeding materials. *African J. Biotech*. 10 (64):14230-14233.

AOAC. (2002). Official Methods of Analysis. 16th ed. Association of Official Analytical Chemists, Washington, DC.

Atta, S., A.O. Okubanjo, A.B. Omojola and A.O.K. Adesehinwa. (2004). Body and carcass linear measurements of goats slaughtered at different weights. *Livestock Research for Rural Development*. 16(8). www.lrrd.org/lrrd16/8/atta16062.htm

Ayo, E. (2002). The use of waste brewer's yeast as a protein supplement for growing Tanzania goats fed low quality hay. MSc Dissertation, SUA, Morogoro pp. 41-43.

Babale, D.M., Kibon, A. and Yahaya, M.S. (2015). Performance and linear body measurements of Red Sokoto male goats on replacement levels of corn cobs for maize bran with cowpea husk basal diet. *Net J. Agric. Sci.* 3(2): 35 – 40.

Cam, M.A., M. Olfaz and E. Soydan. (2010a). Possibilities of using morphometric characteristics as tools for body Weight production in Turkish hair goats (Kilkeci). *Asian J. Anim. Vet. Adv*. 5(1): 52-59.

Chukwuka, O.K., I.C. Okoli, M.N. Opara, A.A. Omede, I.P. Ogbuewu and O.O.M. Iheshiulor, (2010). The growing problems of mycotoxins in animal feed industry in West Africa: A review. *Asian J. Poult. Sci*., 4: 122-134.

Daramola, J.O. A.A. Adeleye, T.A Fatoba and A.O. Soladoye. (2005). Heamatological and biological parameters of West African Dwarf goats. *Livestock Res. Rural Dev*. 17(8). www.lrrd.org/lrrd17/8/dara17095.htm

Devendra, C. and Mcleroy, G. B. (1982). Goat and sheep production in the tropics. Intermediate Tropical Agriculture Series, Longman, London, 55 pp.

FAOSTAT. (2011). Food and Agriculture Organization Corporate Statistical Database.http://faostat.fao.org/default.aspx.

Hossain, S.M.J., M.R. Alam, N. Sultana, M.R. Amin and M.M. Rashid, (2004). Milk production from indigenous black Bengal goat in Bangladesh. J. Biological Sci., 4: 262-265. CrossRef (http://dx.doi.org /10.3923/ jbs.2004.262.265) | Direct Link (http://scialert.net/abstract/?doi=jbs.2004.262.265).

Iqbal, M., Javed, K. and Ahmad, N. (2013). Prediction of body weight through body measurements in beetal goats. Journal of Animal and Plant Sciences 65(4):458-461.

Ishaya, S. and I.B. Abaje, (2008). Indigenous people's perception on climate change and adaptation strategies in Jema'a local government area of Kaduna State, *Nigeria. J. Geo. Regional Plann*. 1(8): 138-143.

Jibir, M., Isa,A.M., Garba, S., Jibrila, I. and Omojola, A. B. (2013). Linear body measurements and slaughter characteristics of meat goats in the semi-arid zone of north- western Nigeria. *J. Anim. Sci. Advances* 3(6): 297 – 303.

Kakengi, A.M.V., M.N. Shem, R. Otsyina and E. Mtengeti, (2001). Performance of grazing cattle in semi+ arid areas of Western Tanzania and the marginal productivity of Leucaena leucocephala leaf meal supplement. *Agrofor. Syst*., 52: 73-82.

Lamidi, A.A., Aina, A.B.J., Sowande, S.O., and Johosho, A.O., (2009). Assessment of *Panicum maximum* (Jacq), *Gliricidia sepiuma* (Jacq) and *Gmelina arborea* (Roxb) based diets as all year round for West Africa Dwarf bucks. Proceedings of the 14th Annual Conference of Animal Science Association of Nigeria (ASAN) Sept 14-17, 2009. Ogbomosho, Nigeria.

Lawrence, T.L.J. and V.R. Fowler, (2002). Growth of Farm Animals. 2nd Edn., CABI Publishing, Oxon, UK., ISBN-13: 9780851994840, Pages: 347.

Makkar HPS. (2003). Quantification of tannins in tree and shrub foliage. In: Makkar HPS (ed.), A Laboratory Manual, p. 102. Kluwer Academic Publishers, Dordrecht, The Netherlands.

Meissner H.H, Viij, M.D, Van Neierkeki W.A. (1991). Intake and Digestibility by Sheep of Anthephora, Panicum Rhode and Smuts Finger Grass Pastures: proceedings of the 4th International Rangeland Congress, September, Montipellier, France. 1991, 648 – 649.

Minson, D.J, (1990). Forage in Ruminant Nutrition, Academic Pres, San Diego, U S A, 483 – 484.

Njidda, A.A. (2008). The effect of protein and energy supplementation on the growth performance of grazing sheep during the wet season. Nig. J. Exp. Applied Biol., 9: 17-22.

Njidda, A.A. (2010). Chemical Composition, Fibre Fraction and Anti-Nutritional Substances of Semi-arid Browse Forages of North-Eastern Nigeria. Nigerian Journal of Basic and Applied Science, 18(2): 181-188.

Njidda, A. A. (2011). Evaluation of the potential nutritive value of browse forages of semi-arid region of Nigeria. Ph D. Thesis, Ambrose Alli University, Nigeria. 219pp.

Njidda, A. A., Alabi, O. J. and Olafadehan, O. A (2016a). Rumen fermentation and energy utilization of red sokoto goats fed cowpea husk substituting *Daniella oliveri* foliage *J.* Journal of Anim. Prod. Res. 28(1):205-214.

Njidda, A.A., Olafadehan, A. O. and Alkali, H. A. (2016b). Dry matter degradability of five *ficus* species using *in situ* and *in vitro* techniques. *J. Anim. Prod. Res.* 28(2):11-27

Njidda, A.A., Olafadehan, O.A., Japhet, N., Omole, O.A. and Ofem, B.B. (2018). The effect of substituting cowpea husk with *daniellia oliveri* foliage on the performance of red sokoto goat. *Nigerian Agric. J.* 49(1): 1-10

NRC. (1981). Nutrient Requirement of Goats: Angora, Dairy and Meat Goats in Temperate and Tropical Countries, p. 93. No 15, National Academy of Sciences, National Research Council, Washington DC, USA

Ntakwendela L, Mtenga L A, Pereka A E, Chenyambuga S W, Laswai G H, Kimambo A E and Muhikambele V R M (2002). Effects of substituting sunflower seed cake with *Acacia tortilis* pods as protein source in supplementary diets of Small East African Goats. *Tanzania J. Agric. Sci.* 5(1): 39-48.

Okafor, E.C., Lakpini, C.A.M. and Fayomi, A. (2012). Dried gmelina *(Gmelina arborea roxb)* leaves as replacement forage to groundnut haulms in the diet of fattening Red Sokoto bucks. *International J. Agric. and Biosciences*, 1(1): 5-10.

Okagbare, G.O., Akpodiete, O.J. Esiekpe O. and Onagbesan, O. M. (2004). Evaluation of *Gmelina Arborea* Leaves Supplemented with Grass, *Panicum Maximum* and *Peniselum Purpureum* as Feed for West African Dwart Goats. *Trop. Anima. Health Pro*. 36: 593 – 598.

Olafadehan, O. A., Salihu, S. O. and Abubakar, G. S. (2015). Growth performance and linear body measurement of Red Sokoto goats fed concentrate partially replaced with *Piliostigma thonningii* forage. *Proceedings of the 40th Annual Conference of Nigerian Society for Animal Production, 15 – 19, March* Pp. 519 – 522.

Olafadehan, O. A., Okunade, S. A., Njidda, A. A., Shoyombo, A. J. and Okoye, G. C. (2017). Feed intake, morphological characteristics and economics of production of Red Sokoto goats fed urea treated ensiled cowpea husk based diets. *Nig. J. Anim. Prod*. 44(5): 218 – 226.

Olafadehan, O. A. and Okunade, S. A. (2018). Fodder value of three browse forage species for growing goats. King Saud University, *J. of the Saudi Society of Agric. Sci*. 17, 43-50.

Osakwe, I.I. and R.N. Udeogu, (2007). Feed intake and nutrient digestibility of West African Dwarf (WAD) goats fed Panicum maximum supplemented with Gmelina arborea. *Anim. Res. Int*., 4: 724-727.

Slippers, S.C., B.A. Letty and J.F. de Villiers. (2000). Prediction of the body weight of Nguni goats. *South African J. of Anim. Sci*. 30(1):127-128.

Statistical Package for the Social Sciences (SPSS). (2009). SPSS Base 17 for Windows. SPSS, Chicago, USA.

Ukanwoko, A.I., J.A. Ibeawuchi and A.N. Okeigbo, (2012). Effects of sex, breed and season on birth weight of kids and effect of season on kid mortality in south eastern Nigeria. J. Anim. Prod. Adv., 2: 469-472. Asian Journal of Animal Sciences Volume 10 (2): 154-158.

Ukanwoko, A.I. and Okehielem O.V. (2016). Effect of Gmelina arborea leaf meal based diets on growth performance of West African Dwarf bucks. *Asian J. Anim. Sci*. 10(2): 154-158.

Van Soest, P.J., Robertson, J.B., Lewi, B.A. (1991). Methods for dietary fibre, neutral detergent fibre and non-starch polysaccharides in relation to animal nutrition. 74: 3583-3597.

Table 1: Composition of the experimental diets (%)

Ingredients (%)	**T_1**	**T_2**	**T_3**	**T_4**
Gmelina leaf	0	10	20	**30**
Soya bean meal	30	20	10	**0**
Maize bran	20	20	20	**20**
Wheat offal	20	20	20	**20**
Groundnut cake	10	10	10	**10**
Cowpea husk	18	18	18	**18**
Premix	2	2	2	**2**
Total	100	100	100	**100**

Table 2: Chemical Composition of experimental diets (g kg^{-1} DM)

Parameters	**T_1**	**T_2**	**T_3**	**T_4**	**SEM**
DM	873.20^d	892.40^c	897.80^b	902.10^a	0.61
Ash	431.00^d	623.00^c	781.00^b	832.00^a	0.21
OM	442.2^a	269.4^b	116.8^c	70.10^d	1.31
CP	162.10^d	183.30^c	174.20^b	203.30^a	0.02
CF	111.80^a	100.21^b	91.12^c	83.31^d	0.11
EE	22.10^c	16.20^d	38.31^b	42.21^a	0.39
NDF	527.00^d	532.70^c	537.31^b	540.31^a	2.33
ADF	325.00^d	352.80^c	371.42^b	321.31^a	1.21
ADL	60.00^d	71.14^c	86.32^b	91.19^a	0.81
NFE	577.20^c	592.69^a	574.17^b	573.28^b	1.21
Cellulose	265.00^d	281.66^b	285.10^c	330.12^a	1.31
Hemicellulose	202.00^a	179.90^b	165.89^c	219.00^d	2.06
ME (MJ Kg^{-1} DM)	3.35	3.45	3.52	3.89	-

Means in the same row with different superscripts are significantly ($P < 0.05$) different. NDF=Neutral detergent fibre; ADF=Acid detergent fibre; ADL=Acid detergent lignin; NFE=Nitrogen Free Extract; SEM=Standard error of mean

Table 3: Intake and Performance of goats fed *Gmelina arboreah* leaf meal substituting soybean meal

	Treatments				
Growth performance	**T_1**	**T_2**	**T_3**	**T_4**	**SEM**
Initial body weight (kg)	6.38	6.25	6.27	6.25	NAS
Final body weight (kg)	8.26^d	9.50^c	11.75^b	13.65^a	1.21
Weight change (kg)	1.88^d	3.25^c	5.48^b	7.40^a	0.73
Average Daily Gain (g day^{-1})	24. 41^d	42.20^c	71.16^b	96.10^a	2.26
Metabolic weight (kg $W^{0.75}$)	1.60^d	2.42^c	3.58^b	4.48^a	0.96
FCR	2.55^a	1.72^b	1.34^b	1.12^b	0.87
Feed intake (kg)	4.80^d	5.60^c	7.36^b	8.34^a	0.02
Daily Feed Intake (g day^{-1})	62.33^d	72.72^c	95.58^b	108.31^a	2.14
DMI (g day^{-1})	419.13^d	499.74^c	660.78^b	752.32^a	1.27
DMI (g kg $W^{0.75}$)	92.63^d	105.69^c	130.32^b	143.64^a	3.26
Nutrient Intake					
CPI g kg^{-1}	77.80^d	102.64^c	142.93^b	169.55^a	2.16
CPI g kg^{-1} $W^{0.75}$	26.18^d	32.24^c	41.33^b	46.99^a	1.44
OMI g day-1	212.25^a	150.86^b	85.96^c	58.38^d	1.33
OMI g kg^{-1} $W^{0.75}$	55.60^a	43.04^b	28.23^c	21.12^d	1.34
NDFI g kg^{-1}	252.96^d	297.92^c	395.23^b	452.94^a	2.03
NDFI g kg-1 $W^{0.75}$	63.42^d	71.70^c	88.64^b	98.18^a	3.98
ADFI g kg^{-1}	156.00^c	197.12^b	273.05^a	267.71^a	3.21
ADFI g kg^{-1} $W^{0.75}$	44.14^c	52.60^b	67.17^a	66.18^a	1.76
ADLI g kg^{-1}	28.80^d	39.81^c	63.53^b	75.97^a	2.54
ADLI g kg^{-1} $W^{0.75}$	12.43^d	15.84^c	22.50^b	25.73^a	2.06

Means in the same row with different superscripts are significantly ($P< 0.05$) different. NDFI=Neutral detergent fibre Intake; ADFI=Acid detergent fibre Intake; ADL=Acid detergent lignin; FCR: Feed conversion ratio; SEM=Standard error of mean

Table 4: Body weight, morphology and testicular characteristics of red sokoto goats fed *Gmelina arborea* leaf meal substituting soybean meal

	Treatments				
Parameters	**T_1**	**T_2**	**T_3**	**T_4**	**SEM**
Initial body weight (kg)	6.38	6.25	6.27	6.25	NAS
Final body weight (kg)	8.26^d	9.50^c	11.75^b	15.65^a	0.23
Body length					
Initial	48.0^c	53.5^a	47.5^c	52.0^b	0.29
Final	51.0^c	55.0^a	49.0^d	52.2^b	1.21
Rump Height					
Initial	40.0	40.0	38.5	40.0	2.18
Final	41.0	41.0	39.0	41.0	1.57
Height at withers					
Initial	37.0^a	37.0^a	35.0^b	37.0^a	0.56
Final	38.0^a	38.0^a	36.3^b	38.0^a	0.21
Heart Girth					
Initial	47.0^b	50.0^a	46.0^b	46.0^b	2.11
Final	48.5^c	51.5^a	48.3^c	49.0^b	0.43
Neck Gait					
Initial	24.0^b	27.0^a	23.5^b	23.5^b	067
Final	26.0^a	27.5^a	25.0^{ab}	26.0^a	1.27
Pine Bone					
Initial	13.0^a	12.0^b	10.5^c	10.0^c	0.4
Final	13.5^a	13.0^a	12.0^b	11.0^c	0.2
Scrotal Length					
Initial	3.0^b	7.0^a	2.5^b	2.0^b	2.11
Final	13.0^b	17.0^a	7.5^b	6.0^b	2.26
Scrotal Circumference					
Initial	7.0^b	13.0^a	5.5^c	6.0^c	0.56
Final	12.0^b	23.0^a	10.5^{bc}	12.0^b	1.77

BD: Body length, RP: Rump height, WH: Wither height, NG: Neck girth, PB: Pine bone, SL: Scrotal Length, SC: Scrotal circumference

Table 5: Cost benefit analysis of feeding *Gmelina arborea* leaf meal substituting soybean meal to red sokoto goats

	T_1	**T_2**	**T_3**	**T_4**	**SEM**
Initial weight (kg)	6.38	6.25	6.27	6.25	NAS
Final weight (kg)	8.26	9.50	11.75	15.65	1.21
Total weight gain (kg)	1.88	3.25	5.48	9.40	2.26
Total feed intake (kg)	1.2	1.4	1.84	2.02	0.02
Feed cost/kg feed (₦)	118.35	123.35	93.32	80.82	-
Total feed cost (₦))	13.62	172.69	171.70	168.10	-
Feed cost/kg gain ((₦))	7.24	53.14	31.33	17.88	-
% Reduction in feed cost	-	633.97	332.73	146.96	-