Nigerian J. Anim. Sci. 2013, vol. 15:113-124

Performance Evaluation of West African Dwarf (WAD) Goats fed unripe plantain peels as replacement for *Pennisetum purpureum.*

***Okoruwa, M.I[1]., Obiku, .A.[2] and Agbonlahor, .I.[2]**

[1]Department of Animal Science, Ambrose Alli University, Ekpoma, Edo State, Nigeria
[2]Department of Animal Science, Edo State College of Agriculture, Iguoriakhi, Edo State, Nigeria.
*Corresponding author: odionokos@yahoo.comor okosmich@gmail.com

Target Audience: Ruminant Nutritionists, Goat farmers, Forage Scientists.

Abstract

This study investigated the effect of replacing Pennisetum purpureum with unripe plantain peels on the performance of West African Dwarf Goats. Thirty buck kids with an average weight of 7.00 ± 0.55kg were randomly assigned to three dietary treatment groups with ten bucks per treatment in a completely randomized design. The three compared diets were, A(solely Pennisetum purpureum that served as the control group), B (equal ratio of Pennisetum purpureum and unripe plantain peels i.e. 34:34) and C (solely unripe plantain peels). Parameters studied included growth, nutrient digestibility and nitrogen retention of the bucks. Results obtained showed that finial body weight, total weight gain, daily weight gain, daily feed intake, digestibility of dry matter, crude protein, crude fibre, ash, neutral and acid detergent fibre, with nitrogen intake, nitrogen balance and retention were significantly (P<0.05) highest in dietary treatment A. Bucks on dietary treatment C were significantly (P<0.05) best in terms of feed conversion ratio, digestibility of ether extract and faecal nitrogen output. No significant (P>0.05) difference exist in bucks with regards to initial body weight and urinary nitrogen. It can be concluded that equal ratio of Pennisetum purpureum and unripe plantain peels (34:34) improved growth, nutrient digestibility and nitrogen retention in West African Dwarf goats.

Keywords: Unripe plantain peels, growth, digestibility, Nitrogen retention, Goats.

Description of problem

The adaptive capacity of small ruminants to survive and produce under harsh tropical environment together with their efficiency in feed conversion and their relative resistance to diseases make their keeping by the rural populace more profitable in Nigeria. Small ruminants (goats and sheep) occupy an important position in the farming system of southern Nigeria because of their unique ability and adaptation to the prevailing condition of weather and available range of grasses with browse plants (1). West African Dwarf goat is the most predominant small ruminant in southern Nigeria that is kept chiefly for meat, milk and house-hold income most especially during festive seasons. Their small size relative to cattle contributes to their wide

distribution and easy management among ruminant farmers. The Nigerian small ruminant industries is faced with the problem of meeting the nutritional requirement of the animals even were herbage resources are abound, seasonal fluctuation in nutritive values make sustainable gains in production from good management and disease controlled programs unrealistic (1). Under the extensive system of management in which goats are usually kept, their levels of nutrition at different times of the year are closely parallels with the seasonal variation in rainfall and temperature. Hence herbage availability is highest during the wet season and least during the dry season (2). Shortage of animal feed has been recognized to be one of the major constraints in the production of small ruminant animals in Nigeria (1). The supply and quality of herbage for ruminant animals during the dry months of the year declines substantially and lead to poor body conditions of animals unless supplement or total replacement to the poor quality and inadequate pastures especially during the dry season is considered (3). This factor has seriously affected the small ruminant livestock industry in Nigeria. Hence, this has necessitated the need to focus some research attention on the utilization of identified unconventional feed resources as alternative feedstuffs for small ruminants especially goats.

Plantain (*Musa paradisiaca*), peel a by-product of plantain is one of such alternative feed resources which are readily available and relatively cheaper than the conventional feeds and at the same time not important as an item of human food. Plantain peel is observed to have some nutritional values as it contains about 12%CP, 16%CF and 1300kcal/kg energy on dry matter basis (4). This peel is known to constitute a menace to the society thereby adding to the worse problem of environmental pollution particularly in places where ruminants are not allowed to roam about. It has been reported by (5) that 50% based plantain peels in place of maize was found to be most suitable and increased growth performance of rabbit. Though information are available on the utilization of plantain peels by ruminants (6), there is no sufficient information in literature on the utilization of plantain peels as replacement for *Pennisetum purpureum* by West African Dwarf goats. This present study was conducted to determine the performance of WAD goats fed unripe plantain peels as replacement for *Pennisetum purpureum.*

Materials and Methods

Experimental Site:

This research was conducted at the Teaching and Research Farm of Ambrose Alli University, Ekpoma, Nigeria. The site was located on longitude 6.09^0E and latitude 6.42^0N with a temperature range of between 26^0C -34^0C. The mean annual rainfall was about 1556mm.

Preparation of experimental diets

Pennisetum purpureum was harvested from a pasture land within the Teaching and Research Farm. They were rinsed with water to remove all attached dust

and allowed to wilt overnight before being chopped manually using matchet to lengths of approximately 4-5cm. Unripe plantain peels were collected from plantain processing points located within Ekpoma. They were chopped and immediately dried under shade for several days before milled. Concentrate supplement ingredients that comprised 78% wheat offal, 20% brewery dried grain, 0.75% limestone, 0.5% dicalcium phosphate, 0.5% salt and 0.25% vitamin premix were purchased in Ekpoma. The experimental diets consist of basal and concentrate supplement which were offered at the rate of 5% (dry matter basis) of their body weight in a ratio of 68:32, respectively. *Pennisetum purpureum* and unripe plantain peels constituted the basal diets. The comparative dietary treatment groups comprised A (solely *Pennisetum purpureum 68%* (PP) which served as control group), B (constituted equal ratio of *Pennisetum purpureum* and unripe plantain peels i.e 34:34) and C (constituted only the unripe plantain peels 68%). Concentrate supplement 32% was offered to all animals in their respective dietary treatment groups.

Experimental animals and design

Thirty (30) growing buck kids of West African Dwarf goats, aged between 8 and 9 months with means body weight of 7.00 ± 0.55kg were used for the study. The experimental animals were sourced from villages and local markets within Ekpoma. They were balance for weight and randomly assigned to three dietary treatment groups (A, B, and C) of ten animals per treatment. In the completely randomized design.

Management of experimental animals

Prior to the commencement of the experiment, the pens were cleaned thoroughly, disinfected with Diazintol ® and allowed to dry. Antibiotics were offered to the animals before the experiment as prophylactic treatment against bacterial and viral infections and they were also dewormed with abendarole® against the helminthes. Animals were housed individually in dwarf wall pens with concrete floors and roofed with asbestos sheets. Each pen was provided with feed and water troughs for daily provision of feed and fresh cool water. Animal were fed once daily in the morning at 8.00am. They equally had free access to mineral salt lick. The quantities of feed supplied were weighed every morning and the left over were weighed as well to compute feed intake. The initial body weight of each animal was taken before administering the experimental diets. Subsequently, live weight measured at weekly intervals. Data derived from the daily feed intake and daily weight gains were computed and feed conversion ratio was calculated as the ratio of feed intake over the body weight gain. The experiment lasted for 84 days after a 14-day adjustment period.

Digestibility and nitrogen retention studies

Five bucks were randomly selected from each treatment at the end of the feeding trial. The bucks (totaling 15) were then housed in individual metabolic cages

with slated floors adapted for faecal and urine collection. The bucks were fed with their weighed treatment diets for 7-day adjustment period which followed by 7-days of total faecal, urine and left over feed collection. Feed intake, faecal and urinary outputs were determined. Five percent of faecal samples were dried at 65^0C to constant weight, milled and kept in airtight containers while 5% of the urine samples were kept in a deep freezer at – 5^0C until they are both required for analysis. Apparent nutrient digestibility of the diets were calculated as the difference between nutrient intake and excretion in faeces, expressed as a percentage of nutrient intake. Nitrogen balance by the animals were calculated as the difference between nitrogen intake and nitrogen excreted from faeces and urine while nitrogen retention percentage were computed from nitrogen balance expressed as a percentage of nitrogen intake.

Chemical and statistical analysis

Samples of the experimental diets offered and faecal outputs were analyzed for proximate composition using the procedures of (7). Neutral and acid detergent fibre of the samples were determined as prescribed by (8). Urine samples were analyzed for nitrogen using (7). Data obtained on growth performance, apparent nutrient digestibility and nitrogen retention parameters were subjected to analysis of variance (ANOVA) to determine the significance of treatment effects following the methods described by (9) and significant difference between means were separated using the Duncan's Multiple Range Test.

Results and Discussion

The chemical composition of the experimental basal and concentrate supplements diets are presented in Table 1. The highest value for dry matter was recorded for unripe plantain peels (90.31%), followed by *Pennisetum purpureum* (87.65%) and the least in concentrate supplements (86.24%). The chemical composition values of *Pennisetum purpureum* (PP) and unripe plantain peels (UPP) obtained in this present study were similar to those reported by (10) for *Pennisetum purpureum* and (11;12) for plantain peels respectively. The crude protein range values (8.11 to 19.98%) recorded were compared favorably with 10 to 12% CP moderate level required by ruminants for minimum growth performance (13). Neutral and acid detergent fibre recorded ranged from 48.21 to 67.02% and 19.32 to 32.10%, respectively with *Pennisetum purpureum* recorded the highest and unripe plantain peels the least.

Table 1: Chemical Composition (% dry matter basis) of the experimental basal and concentrate supplement diets

Nutrient	*Pennisetum purpureum* (PP)	Unripe Plantain Peels (UPP)	Concentrate Supplements (CS)
Dry matter (DM)	87.65	90.31	86.24
Crude protein (CP)	8.11	10.25	19.98
Ether extract (EE)	1.15	5.50	1.06
Crude fibre (CF)	29.55	9.05	12.06
Ash	11.95	11.25	7.95
Nitrogen free extract (NFE)	49.24	63.95	58.95
Neutral detergent fibre	67.02	48.27	66.00
Acid detergent fibre	32.10	19.32	23.00

Table 2: Growth parameters of West African Dwarf goats fed unripe plantain peels as replacement for *Pennisetum purpureum*.

Parameters	Treatments			
	A (PP68%+CS32%)	B (PP34%+UPP34%+CS32%)	C (UPP68%+CS32%)	SEM ±
Initial body weight (g)	7550	7540	7560	0.41
Final body weight (g)	9619[b]	9982[a]	8982[c]	0.32
Total weight gain (g)	2069[b]	2442[a]	1422[c]	1.43
Daily weight gain (g/day)	206.90[b]	244.20[a]	142.20[c]	0.96
Daily feed intake (g/day)	298.26[b]	330.18[a]	249.66[c]	1.32
Feed conversion ratio	1.44[b]	1.32[b]	1.76[a]	0.62

[a,b,c] Means within the same row with different superscripts differ significantly (P<0.05), SEM = Standard Error of Means

Table 3: Apparent nutrient digestibility (%) and nitrogen retention of WAD goats fed experiment diets

Parameters	A (PP68%+ CS32%)	B (PP34%+UPP34%+CS32%)	C (UPP68%+CS32%)	SEM±
Dry matter	81.25b	83.34a	79.42[c]	0.56
Crude protein	60.35[b]	65.23[a]	57.26[c]	0.43
Ether extract	52.27[b]	45.36[c]	60.29[a]	0.38
Crude fibre	62.56[b]	75.39[a]	56.38[c]	0.45
Ash	64.28[a]	67.42[a]	57.64[b]	1.06
Neutral detergent	68.02[b]	72.06[a]	60.36[c]	1.28
fibre	29.09[b]	39.38[a]	21.32[c]	0.32
Acid detergent fibre				
Nitrogen retention	7.29[b]	8.35[a]	6.23[c]	0.89
Nitrogen intake	2.49[b]	2.47[b]	3.12[a]	0.21
(g/day)	1.90	1.98	1.32	0.16
Faecal nitrogen	2.90[b]	3.90[a]	1.79[c]	0.38
(g/day)	0.40[a]	0.47[a]	0.29[b]	0.03
Urinary nitrogen	39.78[b]	46.71[a]	28.73[c]	1.09
(g/day)				
Nitrogen balance				
(g/day)				
Nitrogen retention				
(g/day)				
Nitrogen retention				
(%)				

[a,b,c] Means within the same row with different superscripts differ significantly (P<0.05), SEM = Standard Error of Means

The growth performances indices of the WAD goats are indicated in Table 2. Significant differences (P<0.05) were observed for all the parameters measured except initial body weight (IBW) of the goats that were not significantly (P>0.05) influenced. The non-significant difference observed for IBW indicated that the weights of goats at the commencement of the experiment were in close ranged. The final body weight (FBW) values of 9619, 9982 and 8982g were obtained for treatments A ,B and C respectively, with goats on dietary treatment B being significantly (P<0.05) highest and C the lowest. The FBW values observed decreased significantly (P<0.05) in the dietary treatment C as the inclusion level of UPP increased in the diet. This could probably due to the presence of some residual toxic components in UPP that could have acted as anti-nutritional factors and then interfered with nutrient utilization and final body weight (5). Similarly, total weight gain (TWG) was significantly highest (P<0.05) in goats on treatment B (2442g), followed by A (2069g) and C

(1422g) was the least. The higher TWG observed in goats on dietary treatments A and B compared with C was an indication of nutrient intake from the diets that were well utilized consequently improved TWG. This corroboration with the earlier report of (14) that good level of diets supplementation will leads to better utilization of the diets by goats. Daily weight gain (DWG) followed a similar pattern of variation as observed in TWG. Daily weight gain values ranged from 142.20 to 244.20g/day and differed significantly ($P<0.05$) among dietary treatments. The observed low DWG value with goats on treatment C might be as a result of the inability of the goats to properly utilize the diet for body weight gain when compared with either of the other dietary treatments. This is in agreement with the reports of (15) that an efficient utilization of nutrients that supply adequate energy and protein are required for optimum growth performance in small ruminants. The DWG values obtained in this study were in consonance with the range of values (248.26 to 332.17g/day) obtained in previous study of (16).

Feed intake is an important factor in the utilization of feed by ruminant livestock and is a critical determinant of energy and protein as well as performance in small ruminants (17). The daily feed intake (DFI) was significantly ($P<0.05$) highest on treatment B (330.18g/day), followed by A (298.26g/day) while the least was on C (249.66g/day). The comparative high DWG and DFI observed in goats on treatments A and B compared with C could probably be attributed to the associative digestive effect of PP and combination of PP and UPP that led to efficient utilization of the nutrients in the diets. Several reports indicated that supplementation with grass as basal diets will improved feed intake and live weight gain (14;17). Feed conservation ratio (FCR) values observed did not increase significantly ($P<0.05$) across the dietary treatment as the inclusion level of UPP increased in the diets. Hence the FCR was best on treatments B (1.32) and A (1.44) than on treatment C (1.76). The efficiency at which goats convert feeds for body weight in the present study compared unfavourably with the previous study of (16) when WAD goats of similar body weights were fed shed leaves based diets.

Table 3, shows apparent digestibility of WAD goats fed experimental diets. Dry matter (DM) digestibility decreased significantly ($P<0.05$) with 68% increased levels of UPP inclusion in the diets with 79.42% for treatment C to 83.34% for treatment B. The low digestibility coefficients of DM observed in goats on dietary treatment C could be associated with low rate of degradation of nutrients in the UPP. The DM digestibility values of the present study were lower than the values reported by (18) but comparable with 76.43 to 84.42% DM digestibility values found by (19) for WAD sheep .Crude protein (CP) digestibility was significantly ($P<0.05$) affected across dietary treatments with goats on treatment B (65.23%) being significantly ($P<0.05$) higher than those

on treatments A (60 35%) and C (57.26%). The decreased trend in CP digestibility as the inclusion level of UPP increased to 68% in the diets, could probably be attributed to the presence of residual toxic substances in the test material (UPP) that might have binded with the dietary nitrogen and enzymes and also inhibit several enzymes catalyzed reaction (20) that influenced protein digestibility by forming an indigestible complex which reduces the digestibility of nutrients. The CP digestibility values obtained were higher than the findings of (16) whose values ranged between 42.87 and 46.25% when they fed shed leaves based diets to WAD goats. Either extract (EE) digestibility values ranged from 45.36 to 60.29% with goats on treatment C being significantly ($P<0.5$) highest, followed by treatment A and the least was treatment B. The higher values observed in goats on treatments A and C could probably be a reflection of the higher EE in UPP and PP. This agrees with the speculation of (17) that digestibility of nutrients varies with nutrient composition of the diets. Crude fibre (CF) digestibility values were 62.56, 75.39 and 56.38% for treatments A, B and C respectively with goats on dietary treatment B being significantly ($P<0.05$) highest, followed by A and C was the least. Crude fibre digestibility followed a similar trend with DM digestibility showing that DM digestibility of the diets were largely a reflection of fibre digestibility in the diets and improved microbial activity in the rumen of goats on treatment A and B than C. Apparent digestibility of ash did not vary significantly ($P>0.05$) between dietary treatments B (67.42%) and A (64.28%) but C (57.64%) was significantly ($P<0.05$) lower than treatment A or B .This implies that ash digestibility coefficient in goats on dietary treatment B and A were more effective in improving the utilization of ash than those on treatment C. Neutral detergent fibre (NDF) digestibility was generally high among the dietary treatments but significantly ($P<0.05$) best in goats on treatment B (72.06%) compared to treatments A (68.02%) and C (60.36%) the high NDF digestibility observed in goats among dietary treatments might be due to the ecology of the rumen of the goats fed on the diets which favours digestion. It has been published in literature that NDF account for cellulose portion of diets and the more it is digested, the greater the energy made available for animal performance (16). The higher significant ($P<0.05$) values of NDF digestibility in goats on dietary treatments A and B indicated that more energy were supplied to them than those in treatment C. Acid detergent fibre (ADF) digestibility values followed a similar pattern of variation as observed in NDF. (17) reported that ADF is also an energy factor in feeds, hence the same reason given for higher digestibility observed for NDF also accounted for the higher ADF digestibility in goats on dietary treatments B(39.38%) and A (29.09%) compared with C (21.32%). However, nutrient digestibility observed in this study was further buttressed by the fact that weight gain dependent on the digestibility of nutrients. Hence studies

on digestibility are therefore said to be important as they allow the estimation of nutrients really available for animal performance (19).

Table 3, also outlined the nitrogen retention of WAD goats fed experimental diets. Nitrogen (N) intake decreased significantly ($P<0.05$) with increased level of 68% UPP in the dietary treatment C. This could be as a result of residual toxic substances and astringent factors associated with UPP. This agreed with the reports of (19) who observed decreased significant ($P<0.05$) difference in nitrogen intake with increased level of 70% dried pineapple pulp in diets of WAD sheep. This could be due to residual toxic components associated with diets. However, goats on treatment B recorded the highest N- intake value of 8.35g/day, followed by treatment A with value of 7.29g/day and the least value of 6.23g/day was obtained on treatment C. Faecal nitrogen (N) output values ranged from 2.47 to 3.12g/day with goats on treatment C being significantly ($P<0.05$) difference from those on treatment B or A. The higher faecal N-output observed in goats on treatment C could largely be a reflection of UPP that was not well utilized and thus excreted by the goats. Urinary nitrogen (N) output was not significantly ($P>0.05$) affected by treatment diets. The higher values found in goats on treatments B (1.98g/day) and A (1.90g/day) compared with treatment C (1.32g/day) could probably due to the concentration of ammonia and hence nitrogen in the rumen depend on the quantity and solubility of the diets fed to the goats. This was in consonance with the reports of (21) that nitrogen excreted in urine would depend on urea recycling and the efficiency of utilization of ammonia produced in the rumen by microbes for microbial protein synthesis. Nitrogen balance also followed a similar trend as observed in N-intake. Goats on treatment B (3.90g/day) promoted the highest nitrogen balance, followed by A (2.90g/day) and C (1.79g/day) was the least. The positive values obtained for all the goats on the comparative dietary treatment groups suggested that the protein requirements of the experimental goats were adequately met by the diets and this was buttressed by the fact that none of the experimental goats experienced weight loss during the feeding trial.

Nitrogen retention is the proportion of nitrogen utilized by farm animals from the total nitrogen intake for body processes, hence the more the nitrogen consumed and digested the more the nitrogen retained and vice versa (22). Nitrogen retention differed significantly ($P<0.05$) among goats subjected to different dietary treatments with goats on treatments B (0.47g/day and 46.71%) and A (0.40g/day and 39.78%) significantly better than those on treatment C (0.29g/day and 28.73%). The low nitrogen retention resulting from increased nitrogen losses through faeces could probably be attributed to low nitrogen utilization as noted by (22) in WAD goats fed urea maize Stover based diets as dry season feeds. The nitrogen retention values observed in this study

were lower than the range of 57.17 to 69.36% obtained by (23) for sheep fed shrimp waste meal and soya bean Stover basal diets.

Conclusion and Applications

(a) Unripe plantain peel (UPP), a by –product of plantain, which has a great potential to improve productivity of ruminants and *Pennisetum purpureum (*PP) could be fed to WAD goats as basal feeds.

(b) Results obtained in the study, indicated that equal proportion of *Pennisetum purpureum. (*PP) and unripe plantain peels (UPP) in a ratio of 34:34 with concentrate supplement (CS) enhance nutrient digestibility and nitrogen retention in WAD goats without any adverse effect on the goats.

(c) The performance of the experimental goats showed that, the same equal proportion of *Pennisetum purpureum.* (PP) and unripe plantain peels (UPP) in a ratio of 34:34 with concentrate supplement (CS) made them to utilize diet more, thereby gaining weight faster than those on diet containing solely unripe plantain peels (UPP) with concentrate supplement (CS).

References

1 Onyeonagu, C.C. and Asiegbu, J. E. (2008). Estimation of availability and distribution of browse species and number of small ruminant animals farmers in selected communities of Nsukka Area of Enugu State . *Nig .J. Anim .Prod*.35 (2) :252-258.

2 Taiwo, B.B.A, Buvanendran, V. and Adu, I.F.(2005). Effects of body condition on the reproductive performance of Red Sokoto goats. *Nig .J .Anim. Prod*.32 (1): 1-6.

3 Oloyo, R.A and llelaboye, N.O.A. (2002). Nutritive quality evaluation of seeds of some, lesser-known crops .*Journal of Aninual Production Research 18 (1and 2):11-18.*

4 Ajasin, F.O.,Omole, A.J., Oluokun, J.A., Obi, O.O. and Owosibo, A. (2004). Performance characteristics of weaned rabbits fed plantain peels as replacement for maize. *W .J. Zoology* I (1): 30-32.

5 Ogunsipe, M.H and Agbede J.O. (2010). The replacement value of unripe plantain peels on the growth performance, carcass characteristics and cost implication of rabbit production in the tropical region. *Researcher*, 2(11):24-29.

6 Baiyeri, K.P. and Unadike, G.O. (2001). Ripening stages and days often harvest, influenced some bio-chemical properties of two Nigerian plantains (Musa species AAB) cultivars. *Plant Product Research Journal* (6): 11-19.

7. AOAC (1990). Association of Official Analytical Chemists. *Official Methods of Analysis.* AOAC, Washington, DC.

8. Van Soest, P.J, Robertson, .J.B. and Levis, B.A. (1991). Methods for dietary fibre, neutral detergent fibre and non- starch polysaccharide in relation to animal nutrition. *J .Dairy Sci.*74: 3583 – 3597.
9. SAS (1999). Statistical Analysis System. SAS User's Guide. Cary, NY: SAS Institute.
10. Arigbede, O.M., O.J. Bolaji, I.M. Sonusi, J.A. Olanite and A.O.Jolaosho (2010). Nutrient intake and performance of West African Dwarf sheep graded levels of wild yam (*Anchomanes difformis*) and *Pennisetum purpureum. Proc .35th conf, Nig, Soc, for Amin .Prod. Univ. of Univ. of Ibadan Nigeria.* Pg 485-488.
11. Ajosin, F.O., Omole, A.J., Oluokun, J.A, Obi O.O. and Owosibo, A. (2004). Performance characteristics of weaned rabbits fed plantain peels as replacement for maize .*W.J .Zoology* 1: (1) 30 -32.
12. Ogunsipe, M.H. and Agbede, J.O. (2010). The replacement value of unripe plantain peels on growth performance, carcass characteristics and cost implication of rabbit production in the tropical region. *Researcher*, 2(11):24-29.
13. Gatemby, R. M. (2002). Sheep revise edition. Tropical Agricultural Series. Macmillan Publishers Ltd. Pp 8-9.
14. Baiden, R. Y., S.W.A Rhule, H. R. Otsyina, E.T. Sottie and G. Ameleke (2007). Performance of West African Dwarf sheep and goats fed varying levels of cassava pulp as a replacement for cassava peels. *Livestock Research for Rural Development 19(13) htt://www.irrd.org/irrd 19/3/baid 19035. Htm.*
15. Shalu, T.A.L., Goetsch, J Luo, I.V. Nsahlai, J.E. More, M.L. Galyean, F.N. Owens, C.L. Ferrell and Johnson, Z.B. (2004). Nutrient requirement of goats. Developed equations, other considerations and future research to improve them. *Small Ruminant Res*. 53:191 -219.
16. Yousuf, M.B and A.A. Adeloye (2010). Performance response of goats fed shed leaves (*Vitellaria paradoxa, Gmelina arborea and Daniella Oliveri*) based diets. *Nig. J. Amin. Prod.* Pp 99 -105.
17. Ososanya, T.O. (2010). Effect of varying levels of broiler litter on growth performance and nutrient digestibility of West African Dwarf lambs. *Nigeria .J. Anim. Sci*. Vol. 12 Pg 123-128.
18. Jokthan, G.E. Braimah, Y., Muhammad, I.R., Abdu, S.B. and Mohammed, R.H. (2010). Evaluation of the performance of Yankasa Sheep fed *Acacia Sayel Del* (Chenchilo) pods as replacement for cotton seed cake. *Nigerian .J. Amin*. Sci. Vol.12 Pg 129 – 140.

19. Okoruwa, M.I. and Adewumi, M.K. (2010). Effect of replacing *Panicum maximum* with dried pineapple pulp on nutrient digestibility and nitrogen balance of West African Dwarf Sheep. *Nigerian. J. Anim. Sci.* 12:103 - 109.
20. Abdu, S.B, Yashim, S.M. Adamu, S.B, Hassan, M. R. and Adamu, H.V. (2009). Nutrient digestibility and nitrogen balance in rabbits fed graded levels of Roselle (*Hibiscus sabdariffa*) seed meal. *Trop .J. Anim. Sc*. 11:129 – 134.
21. Ahamefule, F.O. and M.D. Udo (2010). Intake and digestibility of West African Dwarf Goats fed raw or processed pigeon pea (*Cajanus cajan*) seed meal based diets. *Proc. 15th conf. Anim. Sci . Assoc. of Nig. Univ. of Uyo. Nigeria.* Pg 626-629.
22. Okeniyi, F.A., Aina, A.B.J., Onwuka, C.F.I and Sowande, S.O. (2010). Nutrient digestibility of urea maize stover – based diets as dry season feed in West African Dwarf goats. *Proc. 15th Conf. Anim. Sci. Assoc. of Nigeria (ASAN). Univ. of Uyo, Nigeria.* Pg 663 – 665.
23. Oduguwa, B.O. and Adu, I.F. (2010). Feeding value of shrimp waste meal for West African Dwarf Sheep fed soybean Stover basal diets. *Nig. J. Anim. Prod.* 37(1): 71-84.