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Performance of growing West African dwarf (wad) goats fed rice bran replacement for cassava peel in pelleted diets

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ABSTRACT

The selective picking of some non-conventional feedstuffs by goat during feeding called for pelleting technique to improve intake and performance. Sixteen growing (WAD) goats in complete randomized design were used to evaluate the replacement of cassava peel with rice bran in pelleted diets. The replacement of cassava peel by rice bran in the diets 1 to 4 are 0%, 15%, 25% and 35% respectively. The intake of rice bran increased ($p<0.05$) as cassava peel was replaced. The total feed intake reduced ($p>0.05$) but total weight gain increased ($p>0.05$) as indicated by the weight value range of 0.33 to 1.17kg obtained. The feed conversion ratio increased ($p>0.05$) alongside pelleted diets. Animals on Diet 4 showed highest; feed conversion efficiency (12.98%) and PCV value (31.67%). The blood evaluation showed red blood cell (RBC) and haemoglobin (HB) having same trend for all groups, comparability ($p>0.05$) values for white blood cell (WBC) values and serum biochemistry responses respectively. Therefore, pelleting of rice bran with cassava peels improved its consumption, utilization and the performance of growing goats at 35% replacement.

Keywords: Blood evaluation, Cassava peel, Growing wad goat, Pelleting technique, Rice bran

1. INTRODUCTION

Goats are among the relatively few ruminant species in the animal realm. The five (5) basic dietary requirements of goat like any other animal include crude protein, energy (in the form of fiber), fat and water-soluble vitamins and minerals. According to Kalio et al., (2018) forage crops provide for superior ruminant feed but they are not always accessible likewise the conventional concentrated ingredients like maize are main food for humans. As a result, the non-conventional feed resources (NCFRs) are advocated and being fed to the animals in their place. In tropical environment, goats have a diverse diet that includes many non-conventional feedstuffs. Given that goats are very selective feeders and

can switch from a diet that consists mostly of forbs (8–64%) to browse (35–88%) and this may also apply to concentrates (Mellado, 2016).

The eating habits of West African dwarf (WAD) goats are typical of the local husbandry method in which they scrounge for food to satisfy their daily nutritional needs (Daramola et al., 2005). But since there isn't nearly enough green vegetation for these natural browsers, particularly during the dry season, attempts are been undertaken to encourage goats in this ecozone to consume the abundant non-conventional feedstuffs such as rice bran that are always present. The shortage of good quality feeds to sustain ruminant animals during dry season has been a challenge to the ruminant production as reported by Ososanya et al., (2013). On this note, a feeding strategy is required to gear up the consumption of inexpensive, unpalatable and readily available feed resources in the mixture without selection. Rice bran among other stands better chance of effective and efficient utilization during feed scarcity because of the availability and storability.

Hence, the focus of this study s to assess the effectiveness of pelleting technique on intake and performance of growing goats fed rice bran in pelleted dried cassava peel-based diet.

2. MATERIALS AND METHODS

Study location

The location of this study was the sheep and goat unit of Teaching and Research Farm, Landmark University, Omu–Aran, Kwara State, Nigeria. The coordinates of Omu-Aran are Latitude 8.9N and Longitude 50.61E and is on approximate altitude of 306 above sea level. The temperature is uniformly high and range between 250^0C and 300^0C in the wet season and between 330^0C and 340^0C in dry season. The relative humidity is 75 to 80% in the wet season and about 65% in dry season.

Experimental diet

Mechanical grinder was used to grind dry cassava peel to finest. The four formulated diets used in this study were formed by replacing the proportion of grinded cassava peels with rice bran. The ingredients used were thoroughly mixed using mechanical mixer and the pelleting was done by mechanical pelletizer that fixed with die 8mm size. Thus; Pelleted diet 1 contained 100% cassava peel and 0% Rice bran; the pelleted diets 2, 3 and 4 contained 15%, 25% and 35% rice bran that replaced equivalent proportion of cassava peel meal in the formulated diets respectively (Table 1). Equal measured quantity of feed additives was added to each of the 4 diets prior mixing. Each of the diet was sprinkled with molasses solution that prepared by reconstituted 5kg molded molasses in 15 litres of water and used as binding agent for the pelleting.

Table 1 The composition of pelleted diet

Ingredient	Diet 1	Diet 2	Diet 3	Diet 4
dried cassava peel (kg)	100	85	75	65
Rice bran (kg)	0	15	25	35
Total	100	100	100	100
Constant additives				
Molasses (kg) in (15l H_2 0)	5	5	5	5
Bone meal (kg)	1	1	1	1
Salt (kg)	0.25	0.25	0.25	0.25
Vitamin premix	0.25	0.25	0.25	0.25

Experimental animals and management

A total of 12 growing WAD goats of ages between 5 and 6 months with initial average weight of 8kg were used. Each treatment comprised three replicates. Prior the commencement of the study the experimental animals were treated with ivermectin subcutaneously against ecto and endo parasite. Likewise, the long acting injectable oxytetraycline solution was equally administered intramuscularly against bacterial infections. The weight of the animals was taken before the takeoff of the trial to established the initial body weight and thereafter they were weighed weekly through the trial period. Experimental diets were served once daily at 8.00 hours in cleaned feed trough at 5% body weight on dry matter basis throughout the seventy (70) days of the experiment that included first 7-day adjustment period. Clean water and salt licks were also made available freely. Parameters assessed include; body weight, feed intake and feed conversion efficiency and blood profile. Feed efficiency ratio was calculated by

dividing the feed intake by weight gain while the haematology and serum biochemical indices analyses were evaluated in the laboratory.

Haematology and serum biochemical indices analyses

Two animals per dietary treatment were randomly picked for blood sample collection at the end of the trial. 10mls of blood sample was collected via jugular venipuncture using 20-gauge needle and syringe on the final day of a ten-week experimental study. Each blood collection of 5ml from each animal was divided into 2 lots; one part was transferred to Ethylene Diamine Tetracetic Acid (EDTA) bottles that contained anticoagulant for haematological assay (Jain, 1986) and other part free bottles that contain no anticoagulant for serum assessment. The samples were taken to university of Ilorin Central Laboratory where it was analyzed according to available clinical methods. Packed cell volume (PCV), Haemoglobin (HB), Red blood cell (RBC), White blood cell (WBC), Mean corpuscular volume (MCV), Mean corpuscular haemoglobin concentration (MCHC), Cholesterol (CHOL), Albumin (AL), Total protein (TP), Globulin (GL) WBC differentials; Monocytes (MONO), Neutrophils (Neutr) were assessed. The PCV was determined with wintrobe haematocrit method, Wintrobe (1993). WBC and RBC were determined using haemocytometer after the necessary dilution (Dacie and Lewis, 1994). Haemoglobin, mean corpuscular volume (Brown, 1976), Cholestero was measured Roshlan SIGMA Kits (Feteris, 1965).

Statistical analysis

The obtained data were subjected analysis of variance with SAS General Model (2000) and means were separated at p>0.05 using New Duncam Multiple range test (Obi, 2002).

3. RESULTS

The proximate composition of the feed utilized is shown in Table 2. The DM and MC mean values of the feed were respectively similar (p>0.05) across treatments. The CP mean value of diets 2 – 4 increased with increased rice bran in the diet and the values were comparable (P>0.05) but the high value (5.11%) recorded from diet 3 is significant different (P<0.05). The fat (EE) mean value of diet 3 was the highest among the treatments and significantly different (P<0.05) but comparable (p>0.05) to the mean value of diet 4. The highest crude fibre (CF) was recorded from diet 4 which contained 35% rice bran inclusion ration; however, all the values were comparable (p>0.05) across the treatment. The NFE mean values increased with increased rice bran inclusion in the diets. The NFE value (78.39%) of diet 4 was significant different (P>0.05) among the treatment group.

Table 2 Proximate composition of experimental diets

%	0% rice bran (Diet 1)	15% rice bran (Diet 2)	25% rice bran (Diet 3)	35% rice bran (Diet 4)	SEM ±
DM (%)	92.50^{a}	91.33^{a}	92.43^{a}	89.33^{a999}7.89^{b}	0.56
MC (%)	7.50^{a}	8.67^{a}	7.57^{a}	7.89^{a}	0.02
CP (%)	0.27^{c}	4.41^{ab}	5.11^{a}	4.91^{b}	0.58
EE (%)	4.50^{b}	2.40^{c}	6.0^{a}	5.24^{ab}	0.43
CF (%)	7.50^{ab}	8.46^{b}	9.01^{a}	9.50^{a}	2.24
ASH (%)	5.30^{b}	6.93^{a}	4.44^{bc}	3.49^{c}	0.41
NFE (%)	61.37^{c}	69.38^{b}	71.47^{b}	78.39^{a}	1.90

a, b= Means in the same row having different superscript differs significantly (P< 0.05).
DM-Dry matter, MC-Moisture content, CP- Crude protein, EE-Ether extract, CF- Crude fibre, ASH- Ash, NFE- Nitrogen free extract.

Table 3 Performance of growing WAD goats fed rice bran replacement for cassava peel in pelleted diet

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	SEM ±
Total feed intake (kg)	19.93^{a}	20.55^{a}	14.93^{b}	15.17^{b}	0.86
Average daily feed intake	0.28^{a}	0.29^{a}	0.21^{b}	0.22^{b}	0.01
Total water intake(ml)	22516.7b	27066.65b	31850ab	31616.70a	118.60
Daily water intake (ml)	2251.67b	2706.67b	3185ab	3161.67a	10.60

Total weight gain(kg)	0.33[b]	0.67[b]	0.67[b]	1.17[a]	0.17
Average daily weight gain (kg)	0.005[a]	0.010[a]	0.010[a]	0.017[a]	0
feed conversion ratio	60.39[a]	30.67[b]	22.28[bc]	12.98[b]	6.18

a, b= Means in the same row having different superscript differs significantly (P< 0.05)

Table 3 shows the performance of the growing WAD goats fed graded levels of rice bran in pelleted dried cassava diets. The total feed intake mean values followed the same trend with FCR mean values. The values decreased as rice bran inclusion increased in the diet and the mean values for diet 3 and 4 mean values were similar (p>0.05) respectively. The total weight gain mean values were similar (P>0.05) for diets 2 and 3 while the high mean value 1.17kg of diet 4 was significantly different (P<0.05) in the treatment groups. The total water intake increased with increased rice bran; however, water intake mean value (3161 ml) of diet 4 was significantly different (p<0.05) but comparable (P>0.05) to the mean values of diet 3.

Table 4 The effect of different levels of rice bran replacement for cassava peel in pelleted diet on the blood

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	SEM ±
PCV (%)	26[ab]	21.33[b]	30.33[a]	31.67[a]	1.60
WBC (X109/L)	9.23[b]	10.40[a]	9.37[b]	9.8[ab]	0.16
RBC (X1012/L)	2.7	2.33	2.6	2.74	0.69
HB (g/L)	29.33	24.40	24.77	27.30	1.40
PLAT (X109/L)	180.67	181	183.33	179.67	1.51
MCV (fl)	10.13	9.47	10.33	10.17	0.20
MCH (pg)	10.44[a]	7.79[b]	10.01[a]	10.57[a]	0.36
MCHC (g/dl)	10.63[a]	9.4[c]	10.06[b]	10.33[ab]	0.15
LYMPH (%)	44.67	43	43	40.67	0.93
NEUTR (%)	55.67	59	58.33	54.33	0.89
MONOCY (%)	0	0	0	0	0
EOSIN (%)	0	0.33	0.33	0.33	0.13
BASO (%)	0.33	0	0	0.33	0.11

a, b= Means in the same row with different superscript differs significantly (P< 0.05)
Legend: PCV= Packed cell volume, HB= haemoglobin, MCH= mean corpuscular haemoglobin, MCHC= mean corpuscular haemoglobin concentration, MCV= mean corpuscular volume, RBC= red blood cell, WBC= white blood cell, NUET= Neutrophils, LYMPH=. Lymphocyte, PLAT=platelets

Table 4, it shows the haematology parameters evaluated. The PCV mean values of diets 4 and 3 are similar (P>0.05) while the mean values of diet 2 was comparable (P<0.05) in the group. The PCV mean value increased with increased rice bran in the pelleted diet. However, the values obtained (21.3-31.7%) fall within the range reported by (Charles and Margi, 2007). The RBC values for all treatments shows no significant difference (P>0.05) but increased numerically as rice bran increased in the pelleted diet. However, the values range of 2.33 to 2.7 X1012/L from this trail were higher than value reported by Daramola et al., (2005) for healthy goat. The Haemoglobin (Hb) result followed the same trend as RBC and displayed increased values as the rice bran increased in the pelleted diets. The Hb values in this study (2.4-29.3 g/L) were higher than (11.88 to 12.20 g/L) reported by (Odoemelam, 2014) for healthy goats. The WBC mean values indicated reduction as the rice bran increased in the pelleted diets. However, there was observable similarity (P>0.05) in the means of diets 1, 2 and 3 but no observable harmful nutritional effect on the status of the animals used for the experiment. The MCV mean values increased as the rice bran increased in the diet but the obtained values across the groups were similar (P>0.05). The MCH mean values increased as the rice bran increased in the pelleted ration but only the mean values of diet 1 (pelleted cassava peel only), diet 3 and 4 were similar (P>0.05). The MCHC also increased as the rice bran increased but diet 3 and 4 mean values were comparable (P>0.05).

Table 5 The effect of different levels of rice bran replacement for cassava peel in pelleted diet on the biochemical indices

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	SEM ±
TP (G/L)	33.67	34.33	40	40	1.38
Alb (G/L)	18.67[b]	21.93[ab]	24.33[a]	22.43[ab]	0.8
Glob (G/L)	16.33[ab]	14.10[ab]	17.70[a]	13.83[b]	0.68

Crt (μMOL/L)	27[b]	31[ab]	33.33[a]	32.33[a]	0.98
Chol (MMOL/L)	1.65[a]	1.56[ab]	1.38[b]	1.45[b]	0.39
ALP (IU/L)	235.67[ab]	231.67[b]	246.67[a]	249.33[a]	2.90
AST (IU/L)	67.87[a]	58.87[ab]	48.47[b]	52.43[b]	2.87
ALT (IU/L)	20.33	67.73	13.5	12.23	12.46

[a, b]= Means in the same row with different superscript differs significantly (P< 0.05)
Legend: Chol= Cholesterol, Crt= Creatinine, TP= Total protein, Glob= Globulin,
ALB= Albumin ALP=Alkaline Phosphate, AST= Aspartate Amino transferase ALT= Alanine Transaminase

Table 5, shows the result of biochemical indices of goat treated. The total protein mean values showed no significant difference (P>0.05), but the value increased as rice bran increased in the pelleted diet. The Albumin means showed that diet 3 is significantly different (P<0.05) from diet 1. However, diet 3 albumin mean is comparable (P<0.05) to that of diets 2 and 4. The result also shows increased mean values of the albumin as the rice bran in the diet increased. The Globulin mean values increased from diet 3 to 4 without significant different (P>0.05), however, they are comparable (P>0.05) to mean values of diets 1 and 2. Creatinine mean values for diet 3 and 4 are similar (P> 0.05) but value of diet 1 was significantly different (P>0.05) from values of diet 3 and 4 and comparable (P> 0.05) to values from diet 2. The ALP mean values increased as the rice bran in the pelleted diet increased, however, the mean values of diet 3 and 4 were similar (P>0.05), while diet 2 is significantly different (P>0.05) from diet 3 and 4, but diet 1 is comparable (p>0.05) to diets 2, 3 and 4.

4. DISCUSSION

The nutrient composition of the experimental diets used in this study (Table 2), showed that dry cassava peel could be view as low protein and low energy crop by-products (diet 1 that contained 0%rice bran) as reflected in the calculated NFE obtained value (61.37%), CP (0.27%) and EE (4.50%) compared to values obtained from diet 2 to 4 that contained rice bran respectively. However, Norton, (1994) reported that feeds of less than 8% will not provide enough ammonia for maximum performance of rumen microbes. Likewise, the report of Yousuf et al., (2007) that relatively high ADF but low EE and CP content were indication of less nutritional quality. In this study, the contents of the nutrient of the pelleted diets 2 to 4 increased with the addition of rice bran and these results agreed with earlier reports Asaolu et al., (2012) and Asaolu et al., (2010) that nonconventional feedstuff could be used as alternative to other conventional basal diets to increase the feed resource base of ruminants.

The CP of pelleted diets were lower than the 8% level required for optimum microbial performance (Norton, 1994) and the values are also lower than the 11% to 13% viewed to supply known to provide adequate protein for both maintenance and moderate growth in goats (NRC 1981). However, the results from the study showed improvement in the nutrient availability as the rice bran increased in the diet, which in turn was reflected in the increased feed intake and moderate weight gains of the experimental animals. The findings were in agreement with report of Fredric and Robert, 2019 who narrated in their book that growing animals with insufficient protein uptake will have their efficiency with which they utilize metabolizable energy altered. The noticed improvement in the feed intake, water intake and weight gain by the animal fed with these pelleted rice bran in dried cassava peel diet is suggestive of the suitability of pelleting of rice bran that may not ordinarily accepted in a dried cassava peel-based diet for growing goats. All the experimental animals had adequate total feed intake.

However, the lowest level of feed intake (15.17kg) of the animal in diet 4 may be due to the fact that the palatability enhances value of feed for ruminants. The variation observed may also have been due to the CP level of the diet, as indicated in the report by Mtenga and Shoo, (1990), which states a positive correlation between crude protein intake and dry matter intake. The experimental goats in this study gained weight as rice bran increased in the pelleted diet. This observation was translated to an improvement in the final weight gain of the animal, probably as a result of the duration of the study (10 weeks). Although the values obtained in this study were lower compared to the values reported by authors like (Babayemi and Bamikole, 2006). However, the observed difference in weight gain with earlier studies may due to differences in the basal components of the diet, voluntary dry matter intake, feed intake, efficiency of feed utilization and the physiological state of the animal with increasing rice bran inclusion. Animals in diet 4 (35% rice bran inclusion) were indicated to be more efficient in converting feed to weight gain than those on less bran inclusion (diet 1-3).

An earlier similar observation was reported (Tripathi et al., 2006) between growth and feed conversion. The observed increased weight gain as rice bran increased could further be attributed to the better-quality protein available in the nutrition. The increased PCV, RBC and the Hbvalues as the rice bran increased in the pelleted diets, can be compared to the literature value showing the animals used for the study may not be prone to anemia. The high concentration of RBC and haemoglobin values obtained across

these treatments indicated the absence of toxic factors such as haemoglobin which has adverse effects on the blood formation as proved by Akinmutimi, (2004) for some exotic goats. The MCV and MCH values obtained in this study were comparable to 5-8pg for MCH and 16-25fl for MCV reported by Charles and Margi, (2007).

The mean value of RBC increased as the rice bran increased in the diets, this could be as a result of good ratio of haemoglobin to the PCV since both haemoglobin and PCV were higher than the PCV (21-38%) reported by Charles and Margi, (2007) and 7-15g/dl and 11.88 – 12 g/dl for Haemoglobin reported by Daramola et al., (2005) for healthy goat. The increased mean values of creatinine as the rice bran increased in the pelleted diets could be a reflection of good protein quality resulted from the pelleting as reported by Aletor et al., (1998). The comparable values of creatinine despite the increasing rice bran in the diets could also be attributed to the diet quality and prove that the tested animals were not prone to muscular wastage.

5. CONCLUSION

The pelleting technique as undertaken in this study resulted in an adequate intake of rice bran without indiscriminate selective feeding of the feedstuff. The pelleting technique predicted the adequate utilization of the rice bran by the growing WAD goat through weight gain and no deterioration health effect on the animal fed. The observed feed conversion efficiency and increased CP level with increased rice bran shows that pelleting technique will be better employed when feeding feedstuff of lesser palatability to goats.

Recommendation

The diet did not show any negative impact on the goat's development. It is therefore recommended that further replacement of rice bran for cassava peel above 35% in pelleted cassava peel-based diet should be carried out to establish an acceptable limit for growing WAD goat performance.

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Author's contribution

Olawoye Samuel - Conceptualization, provision of study materials and writing
Okeniyi Funmilayo - Review and editing
Olayinka Alabi – Provision of study materials, management and coordination
Razaq Animashahun – Investigation and validation of the experiment
Micheal Falana – Formal analysis
Precious Ocheli – Investigation and data collection
Yinka Omotosho – Investigation and data collection
Samuel Olatundun - Supervision
Moji Adeniran – Writing of original draft

Informed consent

Not applicable.

Ethical approval

The Animal ethical guidelines are followed in the study for species observation & experimentation.

Conflicts of interests

The authors declare that there are no conflicts of interests.

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Data and materials availability

All data associated with this study are present in the paper.

REFERENCES AND NOTES

1. Akinmutimi AH. Evaluation of sword bean (*Canavalia gladiata*) as an alternative feed resource for broiler chicks. Ph.D. Thesis, College of Animal Science and Animal health, Okpara University of Agriculture, Umudike 2004; 4-17.
2. Aletor VA, Agbede JO, Sobayo RA. Haematological and biochemical aspects of feeding broiler chicks conventional or underutilized protein sources NSAP proceedings held at Gateway hotel Abeokuta 1998; 157-160.
3. Asaolu V, Binuomote R, Akinlade J, Oyelami O. Intake and Growth Performance of West African Dwarf Goats Fed Moringa oleifera, Gliricidia sepium and Leucaena leucocephala Dried Leaves as Supplements to Cassava Peels. J Biol Agric Healthc 2012; 2(10):76-88.
4. Asaolu VO, Odeyinka SM, Akinbamijo OO, Sodeinde FG. Effects of moringa and bamboo leaves on groundnut hay utilization by West African Dwarf goats. Livest Res Rural Dev 2010; 22(1).
5. Babayemi OJ, Bamikole MA. Effects of Tephrosia candida DC Leaf and its Mixtures with Guinea Grass on in vitro Fermentation Changes as Feed for Ruminants in Nigeria. Pak J Nutr 2006; 5:14-18. doi: 10.3923/pjn.2006.14.18
6. Babayemi OJ, Bamikole MA. Nutritive value of Tephrosia candida seed in West African dwarf goats. J Cent Eur Agric 2006; 7:731-738
7. Brown BA. Haematology principles and procedure. In: 2nd edition. Philadelphia, USA: Lea and fabigor 1976.
8. Charles HMH, Margi S. Laboratory procedure for Veterinary Technicians. Elsevier Inc. Canada 2007; 338-340.
9. Daramola JO, Adeloye AA, Fatoba TA, Soladoye AO. Haematological and biochemical parameters of West African Dwarf goats. Livest Res Rural Dev 2005; 17(8):95.
10. Feteris WA. Aserum glucose method without precipitation. Am J Med Technol 1965; 31:17-21.
11. Fredric NO, Robert BH. Can net energy values be determined from animal performance measurements? A review of factors affecting application of the California Net Energy System. Transl Anim Sci 2019; 3(3):929–944. doi: 10.1093/tas/txy130
12. Jain NC. Schalm's Veterinary haematology. Lea & Febiger 4th edition Philadelphia, USA 1986.
13. Kalio GA, Amadi, Eucharia E. Hematology and Carcass Characteristics of West African Dwarf (WAD) Goats Fed Diets Incorporated with Non-Conventional Feed Stuffs in Nigeria. Direct Res J Vet Med Anim Sci 2018; 3(6):48-53. doi: 10.26765/ DRJVMAS.2018.4529
14. Mellado M. Dietary selection by goats and the implications for range management in the Chihuahuan Desert: A review. Rangel J 2016; 38(4):331-341.
15. Mtenga LA, Shoo RA. Growth rate, feed intake and feed utilization of small East African goats supplemented with Leucaena leucocephala. Small Rumin Res 1990; 3(1):9–18. doi: 10.1016/0921-4488(90)90026-3
16. Norton BW. Anti-nutritive and toxic factors in forage tree legumes. In: Gutteridge RC, Shelton HM (editors). Forage tree legumes in tropical agriculture. CAB International 1994; 202-2 15.
17. Odoemelam VU, Ahamefule FO, Ibeawuchi JA, Ezeokeke CT. Growth performance and Carcass Characteristics of West African Dwarf bucks fed Panicum maximum and Bambara nut (Vigna subterranean) seed meal supplemented diets. Niger J Anim Prod 2014; 24(1):155-165.
18. Ososanya TO, Inyanng UA, Shehu SA. Growth performance and blood profile of gestating wad ewes fed dietary supplementation of ammonium sulphate. Niger Soc Anim Prod 2016; 43(2):107-115.
19. Tripathi MK, Karim SA, Chaturvedi OH, Singh VK. Effect of ad libitum tree leaves feeding with varying levels of concentrate on intake, microbial protein yield and growth of lambs. Livest Res Rural Dev 2006; 18. http://www.lrrd.org/lrrd 18/12/trip18179.htm
20. Yousuf M, Belewu M, Gbadamosi A, Ogudun NI, Ogudun NI. Replacing Cotton Seed Cake with Cassava Leaf Meal in Corn Bran Based Diet Fed to the Goat 2007. https://www.seman ticscholar.org/paper/Replacing-Cotton-Seed-Cake-with-Cassava-Leaf-Meal-Yousuf-Belewu/7115bbc8c164923e23d6694874d 2d18fc9920a7