Nigerian J. Anim. Sci. 2018, 20 (4): 540-551

Effects of varying inclusion levels of inoculants-treated soybean residues on nutrient intake and digestibility of uda rams

[+]Audu, R., [**]Maigandi, S.A., [*]Ibrahim, A.A., [*]Amin, A.B., [*]Tijjani, A. and [*]I.A. Gumel**

[*]Department of Animal Science, Federal University Dutse, Jigawa State, Nigeria
[**]Department of Animal Science, Usman Dan-Fodio University, Sokoto State, Nigeria

[+]***Corresponding Author:*** auduramatu28@gmail.com ***Phone No.:*** 08063595401

Target Audience: Ruminant Nutritionists, Livestock Extensionists, Farmers

Abstract

An experiment was conducted to evaluate the effect of feeding varying inclusion levels of inoculants-treated soybean residues (ITSR) on nutrient intake and digestibility of Uda sheep. A twelve weeks (12) feeding trial was conducted using thirty-five (35) Uda rams which were allotted to diets as T_1, T_2, T_3, T_4, T_5, T_6 and T_7 having 0%, 10%, 20%, 30%, 40%, 50% and 60% inclusion levels of ITSR respectively, in a completely randomized design. The findings of the study revealed that the values obtained for nutrient intake and digestibility were significantly ($P<0.05$) influenced by treatment. The nutrient intake and digestibility assessed increased from T_2 (10% ITSR inclusion level) to T_4 (30% ITSR inclusion level), although, there was a decline in nutrient intake and digestibility as the inclusion level of ITSR increased from 40%, the results obtained showed that the parameters assessed compared favorably with the control. It was concluded that for optimum growth performance or weight gain, inclusion of ITSR in the diet of Uda rams should not exceed 30%. It is recommended that ITSR could be used as feed supplement in the diets of sheep as it has the potential of meeting the protein requirements of sheep.

Key words: Soybean residue, Inoculants-treated, Uda sheep, Nutrient Intake, Digestibility

Description of the Problem

The role of ruminants in the livelihoods of farmers in developing countries cannot be overemphasized (1). Nigeria has a high livestock population with about 22 million sheep (2) and most of them are raised extensively on natural grazing lands, crop residues and a times supplemented with agro-industrial by-products (3). These animals which depend on natural vegetation (grazing lands and ranges) for their nutrition and survival suffer great losses during the dry season as the forages available are seasonal in supply (4) in terms of quantity and quality; thus the productive performance of ruminants is therefore affected (5). The supply of animal feed in adequate quantity and quality is a major setback in animal production due to un-ending competition between humans and livestock for conventional feeds, irregular supply of these conventional feeds as well as their increasing cost (6, 7). This incited the use of non-conventional feedstuffs that are potential sources of energy and protein such as crop residues and agro-industrial wastes in livestock production (8, 9). Soybean is a useful crop that is widely cultivated for grain and forage production (10). Soybean is an important fodder crop (11, 12) and the haulms and husks are extensively used as supplementary feeds. Currently in Nigeria, soybean is grown mainly for the grain, threshing of the grains result in the accumulation of copious straws or residues consisting of stems, leaves and pod husk which are mostly left on the farm to waste, are burnt or are left to be scavenged by ruminant animals in the farmlands where they are grown (13).

Farmers and livestock owners have recognized the importance of residues from groundnut and cowpea, consequently these residues are normally sold at high prices, however, residues from soybean is not popular but could be a novel feed if properly harnessed. Little research exists on determining the nutritive value of soybean straw and means for its utilization by livestock. The coarseness, low palatability and minimal information on the nutritive value of soybean straw make farmers accord less importance to its use as a supplement in ruminant diet (14). The little amount of one or more major nutrients present in cereal crop residues hinder their intake and utilization by livestock (15), however, leguminous crop residues are usually better utilized by these animals and if available in abundance, may be used to complement forages (16). Various methods can be used to upgrade the nutritive value of residues, different treatment procedures (17) such as physical, chemical and biological treatments have been used for several decades to improve the nutritive value of straws for livestock (18). The main objective of the study is to evaluate the nutrient intake and digestibility of Uda rams fed diets containing graded levels of inoculants-treated soybean residues (ITSR).

Materials and Methods

Experimental Location

This study was carried out at the Livestock Teaching and Research Farm of Bayero University, Kano. Kano State lies on longitude 9°30' and 12°30' North and latitude 9°30' and 8°42' East. The area has a tropical type of vegetation (19). The dry season is from October to April while the wet season is from May to September. Annual rainfall and annual temperature is in the range of 21°C and 39°C (20).

Preparation of Experimental Material

The experimental material was prepared on the Research Farm of International Institute of Tropical Agriculture (IITA). 100g of Legume-fix inoculants was dissolved in water and sprinkled on 25kg of soybean seeds prior to planting. The soybean was harvested at 85% pod maturity, just before the leaves started falling off and at this time, the seeds were already matured. The grains were threshed and residues (comprising of leaves, stem and pod husk) arising from the threshing of the inoculants-treated soybean were sundried on large tarpaulin sheets. The dried inoculants-treated soybean residues (ITSR) were milled using hammer mill and stored for future use.

Collection of other Feed Ingredients and Processing

Wheat offal, cowpea husk, maize, rice bran and salt were purchased from Kano Central Market. Soybean meal was obtained by milling soybean grains to produce a meal. All the listed ingredients in addition to the ITSR were used in preparation of the experimental diets.

Experimental Procedure

Seven (7) experimental diets were formulated with varying inclusion levels of inoculants-treated soybean residues (ITSR). The treatments comprised of T_1 = 0% inclusion level, T_2 = 10% inclusion level, T_3 = 20% inclusion level, T_4 = 30% inclusion level, T_5 = 40% inclusion level, T_6 = 50% inclusion and T_7 = 60% inclusion level of ITSR (Table 1).

Experimental animals were offered feed 3% of their body weights which was divided into two and offered in the morning and evening at 0900 and 1400 hours respectively. Total weekly allowance was adjusted on the basis of the previous week's feed intake. Experimental animals were provided with fresh drinking water *ad libitum*. Records of daily feed intake were kept for each animal while leftovers were collected and weighed every morning to obtain an estimate of intake. Feed intake was determined as the difference between the weight of feed offered and the weight of leftovers.

Animal Management and Experimental Design

Thirty-five (35) Uda rams with average body weight of 20±3kg were purchased from Unguwa Uku Livestock Market in Kano State were used for this research. The animals were dewormed using Albendazole® (2.5% oral solution), treated with Ivermectin 0.5% Pour-on and administered Oxytetracycline (a broad spectrum antibiotic) at 1ml/50kg body weight. A group of five (5) Uda rams were assigned to each treatment in a completely randomized design. Salt licks were provided throughout the experimental period and water was provided *ad libitum.*

Digestibility Study

The experimental animals were maintained on their respective treatment diets for a 7-day adjustment period which was followed by a 7-day feed, faeces and leftovers collection period. Harnessing bags were used for fecal collection. Faeces voided daily by each animal were collected in polythene bags, weighed and oven-dried at 65^0C for 24 hours. At the end of the collection period, all samples from each sheep were bulked, thoroughly mixed and a 25% sub-sample was taken for chemical analysis. Digestibility coefficient of the diet was calculated as the difference between nutrient intake and excretion in the faeces expressed as a percentage of the nutrient (Marshal, 2001(21). Weight gain was calculated as the difference between the initial body weight and the final body weight.

Proximate Analysis of Feed and Fecal Samples

Feeds and fecal samples were oven-dried, milled to pass through 1.0 mm screen using a Tecator Cyclotec 1093 Sample Mill and subsamples taken for analysis. The milled samples were used for proximate analysis to determine nitrogen (N) for use in crude protein determination (N x 6.25), crude fiber (CF), ether extract (EE) and ash according to (22). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were analyzed according to procedures outlined by (23).

Statistical Analysis

Data generated were subjected to analysis of variance (ANOVA) of SAS (24) Linear Model. Differences between means were separated using Student-Newman Keul's Multiple Range Test and considered significant at probability level of 0.05.

Results and Discussion

The proximate composition (%) of experimental diets is shown in Table 2. All parameters observed were significantly ($P<0.05$) influenced by treatments except DM and EE. The DM values obtained in the present study were similar ($P>0.05$) in all the treatments. The DM values ranged from 95.35% in T_5 to 96.59% in T_6. The CP values ranged from 15.11% in T_1 to 16.89% in T_4. The dry matter (95.35-96.59%) content of the experimental diets obtained in the present study were higher than range (84.20 - 94.09%) and (92.80 - 93.00%) reported by (25) and (26) respectively, but were in agreement with the study of (27) who reported a range of 95.40 - 95.93% when they studied the performance of growing Uda sheep fed diets containing similar energy and varying protein levels in a semi-arid environment. The high DM values observed might be due to the fact that the feed materials used were all dried. (28) reported that a high DM indicates a good source of energy and roughage that enhances rumination and prevents digestive upset in the rumen. The CP values (15.11 - 16.89%) of the experimental diets obtained in the current study were similar to CP values reported by (29) when he assessed the quantity, quality and utilization of rice milling waste in the diet of growing sheep. The values were in agreement with the range (13.50 - 19.70%) reported by (27) when they studied the performance of growing Uda sheep fed diets containing similar energy and varying protein levels in a semi-arid environment. The crude protein content of the experimental diets were within recommended values of 15-18% CP by (30) for growing sheep, thus the experimental diet would supply adequate nitrogen required by rumen micro-organisms to maximally digest the components of dietary fibre which will result in the production of volatile fatty acids.

The values obtained for nutrient intake differed significantly (P<0.05) across the treatments (Table 3). The DM, CP and ADF intake values were significantly (P<0.05) higher in T_4 (0.83 kg/day, 0.20 kg/day and 0.39 kg/day respectively) and T_3 (0.80 kg/day, 0.19 kg/day and 0.39 kg/day respectively) compared to other treatments. CF intake for T_4 was significantly (P<0.05) higher while NDF was significantly (P<0.05) higher in T_3. EE was significantly (P<0.05) higher in T_4, though similar to T_2 and T_3 while ash intake was significantly (P<0.05) higher in T_4 (0.16 kg/day), T_5 (0.16 kg/day) and T_3 (0.15 kg/day). The DM intake (0.46 - 0.83kg/day) observed in the present study was higher than 0.39 - 0.54kg/day reported by (31) when they studied the effect of varied inclusion levels of *Mangifera indica* leaves in Red Sokoto bucks on intake, digestibility and nitrogen balance. DM intake was also higher than 0.20 - 0.37kg/day reported by (32) but lower than DM intake values (0.82 - 1.06 kg/day) reported by (27). The higher DM intake observed in the present study could be due to supplementation with inoculants-treated soybean residues. (33) reported an increase in DM intake when legume hay was used as a supplement. The CP intake values obtained were similar to the values (0.12 - 0.16 kg/day) obtained by (34) except for T_3 and T_4 which were slightly higher; but higher than what was reported by (32) in their study of the effect of processing on nutritive value of corncobs fed to WAD rams. The CP intake values were also higher than intake values of 0.031 - 0.080 kg/day and 0.02 - 0.10 kg/day reported by (35) and (36) respectively. There was an increase in the CPI by the experimental animals except those fed on T_6 and $T_{7.}$ The improvement observed in the CP intake of animals on T_2 to T_5 could be attributed to the positive influence of the inoculants treatment administered and other ingredients in the diets. The ADF and NDF intake values (0.21 - 0.39 kg/day and 0.32 - 0.59 kg/day respectively) recorded in this study were higher than reported values of 0.050 - 0.226 kg/day for ADF intake and 0.070 - 0.293 kg/day for NDF intake by (37) when they studied the performance of West African Dwarf goats fed *Panicum maximum* and urea treated *Cajanus cajan* haulms silage. The higher values of ADF and NDF intakes obtained suggest that the nutrients in the treatments with varying inclusion levels of ITSR were better utilized. (38) reported high intake of ADF and NDF in lactating cows fed urea treated corncobs and attributed the higher nutrients intake to improved digestibility of fibre fractions.

The result of nutrient digestibility of the experimental animals is also presented in

Table 3. From the results, significant (P<0.05) differences were observed in all the parameters evaluated. Crude protein (CP) digestibility was significantly (P<0.05) higher in T_4 (74.35%). Significantly (P<0.05) higher digestibility values were also observed in T_4 for DM, CF, EE and Ash. T_1 (control) had significantly (P<0.05) lower digestibility value for ADF whereas T_1 (82.24%) and T_7 (83.57%) had significantly (P<0.05) lower values of NDF digestibility. The DM digestibility values obtained in this study for the varying inclusion levels of ITSR were much higher than reported range of 49.09 - 55.87% and 21.31 - 30.48% by (39) and (31) respectively, but lower than the range 86.49 - 91.90% as reported by (36) in their study of the performance of growing Yankasa rams fed graded levels of *Tamarindus indica* leaves. The CP digestibility value (46.38 - 74.35%) obtained was higher than the findings of (31) in their study of the effect of varied inclusion levels of *Mangifera indica* leaves in red Sokoto bucks on intake, digestibility and nitrogen balance, but was comparable to the findings of (40) who reported a range of 60.10 - 77.69%, except for T_6 and T_7 which were slightly below the range. The CP digestibility of the experimental animals increased from T_2 (10% ITSR inclusion in the diet) to T_4 (30% ITSR inclusion in the diet), afterwards, there was a decline in digestibility coefficient as the ITSR inclusion in the diet increased from 40%. The same trend was observed in the digestibility of DM, CF, ADF, NDF and Ash. The higher digestibility of nutrients observed from T_2 to T_4 could be attributed to improved palatability as a result of an increase in the nitrogen content of the soybean residues resulting from the inoculation treatment administered. (41) stated that rhizobial inoculation of seeds with *Bradyrhizobium japonica* is beneficial to nodulation, plant growth and nitrogen fixation and can therefore provide more consistent nodulation and higher yields. Research by (42) also stated that inoculation increased soybean grain yields, thus, increased soybean grain yields resulting from treatment of soybean seeds with inoculants could also invariably increase the nitrogen content of the forages or residues obtained thereby improving their protein content. Leguminous haulms are good supplements and can be used to improve feeding value due to their higher protein content ranging from 13 to 19% (43). Inoculation will therefore further improve the protein (nitrogen) contents of the forage; perhaps, this explains the higher crude protein digestibility observed in the present study. The decline in the digestibility of nutrients observed in this study as ITSR inclusion level exceeds 30% (T_5 to T_7) could be attributed to increasing lignin levels as soybean residue is highly fibrous and has high lignin content which can impede its rate of digestion. (44) reported that soybean stalk is high in lignin. Soybean residue has high lignin content which can impede fibre digestion and limit feed digestibility (45). The values obtained for CF digestibility were higher than the findings of (40) and (31) and values obtained for ADF and NDF digestibility were also higher than reported range of 50.15 - 53.99% ADF digestibility and 43.47 - 59.73% NDF digestibility by (39). Although, there was a decline in the digestibility of nutrients as the ITSR inclusion level increased from 40%, the results obtained showed that the rate of digestibility was higher across the treatments compared to the control.

Table 4 presents the growth performance and feed conversion ratio of uda rams fed graded levels of ITSR. The weight gain and average daily weight gain of animals on T_4 (10.66 kg and 126.90 g/d respectively) were significantly (P<0.05) higher compared to those on other treatments. Higher values of feed conversion ratio were also recorded in T_6

(12.28) and T_7 (11.82) and differed significantly (P<0.05) from other treatments except T_2 (9.29) and T_4 (8.35). Results of the present study indicated that the average daily weight gain (ADG) of the experimental animals was higher in T_4 (126.90 g/day) with 30% inclusion level of ITSR in the diet. The ADG values (52.86 – 126.90 g/day) obtained were in agreement with the findings of (27) in their study of the performance of growing Uda sheep fed diets containing similar and varying protein levels in a semi-arid environment. These values were also comparable to the range (78 – 183 g/day) reported by (46) when they fed fattened sheep with varying levels of guinea corn and groundnut cake with *Digitaria smutsii* hay as source of roughage. The high and significant weight gain recorded by the animals in T_4 could indicate that the experimental animals were more efficient in utilizing the nutrients. The values (8.35 – 12.28) obtained for feed conversion ratio were within and slightly below the range of values reported by (40) when goats were fed complete diets containing sugar cane peels. These values were in agreement with the report of (47). Feed conversion ratio recorded was lower in T_4 (8.35) compared to other treatments suggesting that these animals were better in converting feed to flesh; thus, the lower the feed conversion ratio, the better.

Conclusion and Applications

1. Inoculants-treated soybean residue (ITSR) could be incorporated into the diets of Uda sheep up to 60% inclusion level without affecting performance.
2. ITSR has the potential of being a good feed supplement and can therefore meet the nutritional (especially protein) requirements of sheep due to its high nitrogen content.
3. For best results, inclusion level of ITSR should not exceed 30% in the diets.

Acknowledgement

The authors are grateful to the Centre for Dryland Agriculture, Bayero University Kano for providing funds for the conduct of this research work.

References

1. Maheri-Sis, N., Abdollahi-Ziveh, B., Salamatdoustnobar, R., Ahmadzadeh, A., Aghajanzadeh-Golshani, A. and Mohebbizadeh, M. (2011). Determining nutritive value of soybean straw for ruminants using nylon bags technique. *Pakistan Journal of Nutrition*, 10(9): 838-841
2. Garba, M.G., Maigandi, S.A and Muhammad, I.R. (2012). Performance of Yankasa ram lambs fed graded levels of RMW and SBMR combination in the semi-arid zone, Nigeria. *Scientific Journal of Animal Science*, 1(4): 146-153
3. Malami, B.S., Hiernaux, P.H.Y., Tukur, H. M. and Steinbach, J. (2006). Effect of supplementation on feed intake and liveweight of Sheep grazing natural range and crop fields of Zamfara Reserve in semi -arid Nigeria. *Tropical Journal of Animal Science*, 9(2): 107-117
4. Malgwi, I.H. and Mohammed, I.D. (2015). Development of dry season supplements for ruminants and their degradation characteristics in the semi arid of Nigeria. *Global Journal of Animal Scientific Research*, 3(2): 403-411.
5. Fialho, E.T., Barbosa, H.P. and Albino, L.R.T. (1995). Chemical composition, digestible protein and energy values of some alternative feedstuffs for pigs in Brazil. *Animal Feed Science and Technology*, 55(3-4): 239–245

6. Ahamefule, F.O., Ibeawuchi, J.A. and Ajala, A.A. (2002). Intake, digestibility and nitrogen balance studies of potato peels, yeast slurry diets by WAD goats. In: Aletor, V. A. and Onibi, G. E. (Eds). Proceedings of the 27th Annual Conference of the Nigerian Society of Animal Production held on 17th - 21st March at Federal University of Technology, Akure, Ondo State, Nigeria.
7. Akinmutimi, A.H. (2004). Evaluation of sword bean *Canavalia gladiata* as an alternative feed resource for broiler chickens. Ph.D. Thesis, Michael Okpara Univesity of Agriculture, Umudike, Nigeria.
8. Okonkwo, A.C., Isaac, L.J., Solomon, L.P. and Uyoh, G.D. (2008). Effects of dietary cassava leaf-meal on growth performance of weaner rabbit. Proceedings of the 33rd Annual Conference of the Nigerian Society of Animal Production held on 17th – 20th March at Ayetoro, Nigeria. Pp 142-144
9. Ndubueze, A.I., Ukachukwu, S.N., Ahamefule, F.O. and Ibeawuchi, J.A. (2006). Milk yield and composition of grazing White Fulani cows fed poultry waste-cassava peel based diets. *Pakistan Journal of Nutrition,* 5: 436-440.
10. Muhammad, I.R., Kallah, M.S., Tanko, R.J., Balarabe, A., Lemu, N.M. and Magaji, S.I. (2001). Performance of dual purpose cowpea genotypes in the Northern Guinea Savannah of Nigeria. *Journal of Agriculture and Environment,* 2(2): 213-220. ISSN 1595 – 465X.
11. Nandanwar, R.S. and Patil, A.N. (1990). Phenotype stability analysis in fodder cowpea. *Annals of Plant Physiology,* 4: 254 – 256.
12. Tarawali S.A., Singh B.B., Peters, M. and Blade, S.F. (1997). Cowpea haulms as fodder. In: Singh, B.B., Mohan Raj, D.R., Dashiell, K. and Jackai, L.E.N. (Eds.), *Advances in Cowpea Research,* IITA (International Institute of Tropical Agriculture), Ibadan, Nigeria, and JIRCAS (Japan International Center for Agricultural Sciences), Tsukuba, Japan. Pp. 313–325.
13. Sruamsiri, S. and Silman, P. (2008). Nutritive composition of soybean by-products and nutrient digestibility of soybean pod husk. *Maejo International Journal of Science and Technology,* 2(3): 568-576
14. Mule, R.S., Barbind, R.P., Baswade, S.V., Samale, D.T. and Adangale, S. B. (2008). Nutritive Value of Soybean Straw in Osmanabadi Kids. *Veterinary World*, 1(10): 314-316.
15. Sundstol, E. and Owen, E. (1984). Straw and other Fibrous By-Products as Feed. Elsevier, Amsterdam.By Achi Patrick Neyu.
16. Preston, T.R. and Leng, R.A. (1987). Matching ruminant livestock production systems with available resources in the tropics and sub-tropics. Penambul Books, Armidale, Australia, 245 pp. http://www.utafoundation.org/P&L/preston&leng.htm.
17. Doyle, P. T., Devendra, C. and Pearce, G. R. (1996). Rice straw as a feed for ruminants. International Development Program of Australian Universities and Colleges Limited (IDP), Canberra, Australia.
18. Rangnekar, D. V. (2005). Change in paradigm of animal nutrition research needed to benefit resource poor livestock producers. Proceedings of 12th Animal Nutrition Conference at Anand Agril University Anand, Gujarat held on 7th – 9th January.
19. Ahmed, K. (1998). The Kano physical environment. http//www.

Kanostate.net/physical.html

20. KNARDA (2001). Kano Agricultural and Rural Development Authority Meterological Station Reports. Temperature Record Book and Management Unit. 11: 1-3.
21. Marshal, H.J. (2001). Animal Feeding and Nutrition. 9th Edn. Kendall Hunt Publishing Co., Nigeria
22. Association of Official Analytical Chemists (1999). Official Methods of Analysis of the Association of Official Analytical Chemists. 14th Edition. Association of Official Analytical Chemists, Washington D.C., USA, 1094 pp.
23. Van Soest, P.J., Robertson, J.B. and Lewis, B.A. (1991). Methods for dietary fibre, neutral detergent fibre and non-starch polysaccharides in relation to animal nutrition. *Journal of Dairy Science*, 74: 3583-3597.
24. SAS (1999). Statistical Analytical Systems. SAS/STAT User's Guide Statistical Analysis Institute Inc. ,Version 6, 3rd Edition, Cary, North Carolina, USA. 943 pp.
25. Bello, A.A. and Tsado, D.N. (2013). Feed Intake and Nutrient Digestibility of Growing Yankasa Rams fed Sorghum Stover supplemented with Graded Levels of Dried Poultry Droppings based diet. *Asian Journal of Animal Sciences,* 7: 56-63.
26. Chakeredza, S., te-Meulen, U. and Ndlovu, I.R. (2002). Effect of cowpea hay, groundnut hay, cotton seed meal and maize meal supplementation to maize stover intake, digestibility, microbial protein supply and acetate kinetics in weaner lambs. *Tropical Animal Health and Production,* 34(11): 49-64.
27. Muhammad, N., Tukur, H. M., Maigandi, S. A., Daneji, A. I. and Usman, H. B. (2013). Performance of growing Uda sheep fed diets containing similar energy and varying protein levels in a semi arid environment. In: B. M. Oruwari, J. P. Alawa, U. I. Oji, O. J. Owen and O. S. George (Eds.), *Animal Agriculture: A Tool for Sustainable Economic Transformation*. Proceedings of the 38th Annual Conference and 40th Anniversary of the Nigerian Society for Animal Production (NSAP), 17th - 20th March, held at the Department of Animal Science, Faculty of Agriculture, Rivers State University of Science and Technology, Port Harcourt. Pp 232 – 235.
28. Van Soest, P. J. (1982). Nutrition ecology of the ruminant. O and B Books corvalis Oregon Cornell University Press, Ithaca, NY. Pp 292-294.
29. Muhammad, N. (2005). Assessment of Quantity, Quality and Utilization of Rice Milling Waste in the diet of growing sheep. MSc. Dissertation, Faculty of Agriculture, Usman Danfodio University, Sokoto. Pp 76.
30. Adu, I.F. (1985). Utilization of graded levels of brewer's dried grain by growing sheep. *Journal of Animal Production Research,* 5(1): 59-66.
31. Adamu, H.Y., Yusuf, M., Abdu, S.B., Hassan, M.R. and Yashim, S.M. (2012). Effect of varied inclusion levels of *Mangifera indica* leaves in red sokoto bucks on intake, digestibility and nitrogen balance. In: Bitto, I.I., Kaankuka, F.G. and Attah, S. (Eds). *Sustainable Animal Production for National Food Security and Poverty Alleviation.* Proceedings of the 37th Conference of the Nigerian Society for Animal Production held on 18th – 21st March at University of Agriculture,

Makurdi, Benue State, Nigeria. Pp 450-452

32. Chineke, C.M., Fajemisin, A.N., Adedeji, A.E., Fajemisin, A.J. and Olaiya, O. (2013). Effect of processing on nutritive value of corncobs fed to West African Dwarf rams. Proceedings of the 38th Conference of the Nigerian Society for Animal Production held on 17th - 20th March at Rivers State University of Science and Technology, Port Harcourt, Rivers State, Nigeria.
33. Mosi, H.K. and Butterwofh, M. H. (1985). The voluntary intake and digestibility of combination of cereal crop residues and legume hay for sheep. *Animal Feed Science Technology,* 12: 241-251
34. Muhammad, N. and Abubakar, A.A. (2012). Influence of supplemental methionine on growth performance of uda lambs in a semi-arid environment. *International Journal of Applied Agricultural and Apicultural Research,* 8(1): 16-23
35. Aderinola, O.A., Farinu, G.O., Akinlade, J.A., Olayeni, T.B., Ojebiyi, O.O. and Ogunniyi, P.O. (2007). Nutritional potential of *Blighia sapida* K Kong (Ackee ackee) leaves as a dry season feed resource for West African Dwarf goats in the Derived Savanna Zone of Nigeria. *Livestock Research for Rural Development.* 19:78 http://www.lrrd.org/lrrd19/6/ader19078.htm Retrieved 12/03/2015.
36. Garba, Y. and Jinjiri, A. (2013). Performance of growing yankasa rams ed graded levels of *Tamarindus indica* leaves. *International Journal of Applied Agricultural and Apicultural Research,* 9(1-2): 196-202
37. Fajemisin, A.N., Olaiya, O., Fadiyimu, A.A. and Alokan, J.A. (2012). Performance of West African Dwarf goats fed *Panicum maximum* and urea treated *Cajanus cajan* haulms silage. In: Bitto, I.I., Kaankuka, F.G. and Attah, S. (Eds). Sustainable Animal Production for National Food Security and Poverty Alleviation. Proceedings of the 37th Conference of the Nigerian Society for Animal Production held on the 18th – 21st March at University of Agriculture, Makurdi, Benue State, Nigeria. Pp 438-441
38. Nisa, M., Sawar, M. and Khan, M. A. (2004). Nutritive value of urea treated wheat straw ensiled with or without corn steep liquor for lactating Nili-Ravi buffaloes. *Asian-Australian Journal of Animal Science,* 17: 825-829.
39. Dutta, N., Sharma, K. and Hasan, Q.Z. (1999). Effect of supplementation of rice straw with *Leucaena leucocephala* and *Prosopis cineraria* leaves on nutrient utilization by goats. *Asian-Australian Journal of Animal Science,* 12(5): 742-746
40. Ochepo, C.O., Ochepo, G.O. and Ayoade, J.A. (2012). The utilization of complete diet containing sugar cane peels by goats. In: Bitto, I.I., Kaankuka, F.G. and Attah, S. (Eds). *Sustainable Animal Production for National Food Security and Poverty Alleviation.* Proceedings of the 37th Conference of the Nigerian Society for Animal Production held on 18th – 21st March at University of Agriculture, Makurdi, Benue State, Nigeria. Pp 4
41. Upfold, R.A. and Olechowski, H.T. (1994). Soybean Production. Ontario Ministry of Agriculture and Food Publication, 173, Queen's Printer for Ontario, Toronto, ON.
42. Coutinho, H.L.C., Oliveira, V.M., Lovato, A., Maia, A.H.N. and Manfio,

G.P. (1999) Evaluation of the diversity of rhizobia in Brazilian agricultural soils cultivated with soybeans. *Journal of Applied Soil Ecology,* 13: 159–167 https://www.researchgate.net/publication/225265498_Symbiotic_Nitrogen_Fixation_in_Tropical_Food_Grain_Legumes_Current_Status [Accessed Aug 14, 2018].

43. Carangal, V.R. and Calub, A.D. (1987). Crop residues and fodder crops in rice-based systems. In: Dixon, R.M. (Ed.) *Ruminant feeding systems utilizing fibrous agricultural residues*. Proceedings of 6th Annual Workshop of the Australian-Asian Fibrous Agricultural Residues Research Network held in the University of Philippines at Los Banos, 1st – 3rd April, IDC, Canberra.
44. Gupta, B. S., Johnson, D. E. and Hinds, F. C. (1978). Soybean straw intake and nutrient digestibility by sheep. *Journal of Animal Science,* 46: 1086-1090.
45. Ayres, J. F., Denney, G. D. and Lowe, R. F. (1986). The nutritive quality and feeding value of soybean stubble. Proceedings of the Australian Society of Animal Production, 16: 139-142.
46. Adu, I.F. and Brinkman, W. L. (1981). Feed lot performance and carcass characteristics of sheep fed varying concentrate levels. *Journal of Animal Production Research* 1(1):1-2.
47. Maigandi, S.A. and Nasiru, A. (2006). Replacement value of *Faidherbia albida* pods (FAP) fed to Uda sheep in a semi-arid zone, Nigeria. In: Muhammad, I.R., Muhammad, B.F., Bibi-Farouk, F. and Shehu, Y. (Eds.), *Application of Appropriate Technology in Overcoming Environmental Barriers in Animal Agriculture in Nigeria*. Proceedings of the 31st Annual Conference of the Nigerian Society for Animal Production (NSAP), 12th – 15th March, held at Bayero University, Kano. Pp 439 – 443.

Table 1: Gross composition (%) of experimental diets

	Treatments						
Ingredients	T_1	T_2	T_3	T_4	T_5	T_6	T_7
ITSR	0.00	10.00	20.00	30.00	40.00	50.00	60.00
Maize	20.00	19.00	19.00	17.00	17.00	17.00	9.00
SBM	18.00	17.00	19.00	20.00	23.00	25.00	30.00
C/husk	10.00	10.00	5.00	4.00	0.00	0.00	0.00
W/offal	23.00	23.00	18.00	18.00	10.00	7.00	0.00
R/bran	28.00	20.00	18.00	10.00	9.00	0.00	0.00
Salt	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total (%)	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated ME (Kcal)	2244.00	2202.00	2188.00	2147.00	2138.00	2140.00	2019.00
Calculated CP (%)	16.30	15.70	15.60	15.60	15.60	15.70	16.40

ITSR = Inoculants-Treated Soybean Residue; SBM = Soybean Meal; C/husk = Cowpea Husk; W/offal = Wheat Offal; R/bran = Rice Bran; ME = Metabolizable Energy; CP = Crude Protein; T_1 = 0% ITSR; T_2 = 10% ITSR; T_3 = 20% ITSR; T_4 = 30% ITSR; T_5 = 40% ITSR; T_6 = 50% ITSR, T_7 = 60% ITSR

Table 2: Proximate composition (%) of experimental diets

Parameters	Treatments (Inclusion levels of ITSR %)							
	T_1(0)	T_2 (10)	T_3 (20)	T_4 (30)	T_5 (40)	T_6 (50)	T_7 (60)	SEM
DM	96.45	96.13	96.40	96.17	95.35	96.59	95.96	0.20
CP	15.11^{b}	16.52^{a}	16.47^{a}	16.89^{a}	15.14^{b}	15.48^{ab}	15.31^{ab}	0.20
CF	23.35^{e}	29.10^{c}	32.30^{b}	36.00^{a}	25.78^{d}	24.30^{de}	24.35^{de}	0.18
EE	3.11	5.52	3.97	4.74	4.64	4.48	4.31	0.35
ADF	25.35^{c}	28.31^{b}	32.13^{a}	30.67^{ab}	32.70^{a}	28.49^{b}	33.10^{a}	0.26
NDF	37.93^{c}	34.46^{d}	48.46^{a}	42.90^{b}	47.64^{a}	43.90^{b}	43.44^{b}	0.24
Ash	10.42^{c}	10.51^{c}	12.04^{bc}	12.56^{b}	15.61^{a}	11.96^{bc}	14.56^{ab}	0.25

^{a,b,c,d,e}: means in the same row with different superscripts differ significantly (P<0.05); ITSR = Inoculants-Treated Soybean Residues; DM = Dry Matter; CP = Crude Protein; CF = Crude Fiber; EE = Ether Extract; ADF = Acid Detergent Fiber; NDF = Neutral Detergent Fiber; SEM = Standard Error of Mean; T_1 = 0% ITSR; T_2 = 10% ITSR; T_3 = 20% ITSR; T_4 = 30% ITSR; T_5 = 40% ITSR; T_6 = 50% ITSR; T_7 = 60% ITSR

Table 3: Nutrient intake (kg/day) and digestibility (%) of uda rams fed graded levels of ITSR

Parameters	Treatments (Inclusion level of ITSR %)							
	T_1(0)	T_2(10)	T_3(20)	T_4(30)	T_5(40)	T_6(50)	T_7(60)	SEM
Nutrient Intake (Kg/day)								
DM	0.55^{bc}	0.64^{ab}	0.80^{a}	0.83^{a}	0.60^{ab}	0.52^{bc}	0.46^{c}	0.03
CP	0.12^{c}	0.15^{b}	0.19^{a}	0.20^{a}	0.15^{b}	0.11^{c}	0.10^{c}	-
CF	0.20^{d}	0.31^{c}	0.39^{b}	0.45^{a}	0.26^{c}	0.21^{d}	0.18^{d}	0.17
ADF	0.21^{d}	0.30^{bc}	0.39^{a}	0.39^{a}	0.33^{ab}	0.24^{cd}	0.25^{c}	0.01
NDF	0.32^{c}	0.36^{c}	0.59^{a}	0.54^{ab}	0.48^{b}	0.37^{c}	0.32^{c}	0.01
EE	0.07^{c}	0.11^{ab}	0.11^{ab}	0.12^{a}	0.10^{b}	0.07^{c}	0.07^{c}	-
Digestibility (%)								
DM	93.02^{bc}	94.53^{ab}	94.81^{ab}	95.58^{a}	93.79^{bc}	93.21^{bc}	92.56^{c}	0.15
CP	52.26^{cd}	63.80^{b}	67.66^{ab}	74.35^{a}	60.87^{bc}	51.34^{cd}	46.38^{d}	0.98
CF	71.15^{d}	81.94^{b}	84.51^{ab}	88.68^{a}	77.02^{c}	73.01^{cd}	70.69^{d}	1.67
ADF	73.43^{c}	81.43^{ab}	84.43^{a}	86.71^{a}	81.89^{ab}	76.98^{bc}	78.44^{b}	4.52
NDF	82.24^{c}	84.75^{bc}	89.67^{a}	90.50^{a}	87.57^{ab}	85.06^{bc}	83.57^{c}	3.25
EE	16.94^{c}	50.04^{ab}	44.22^{ab}	58.15^{a}	38.55^{b}	22.65^{c}	23.34^{c}	3.72

^{a,b,c,d,}: means in the same row with different superscripts differ significantly (P<0.05), DM = Dry Matter; CP = Crude Protein; CF = Crude Fiber; EE = Ether Extract; ADF = Acid Detergent Fiber; NDF = Neutral Detergent Fiber; SEM = Standard Error of Mean; ITSR = Inoculants-treated Soybean Residue; T_1 = 0% ITSR; T_2 = 10% ITSR; T_3 = 20% ITSR; T_4 = 30% ITSR; T_5 = 40% ITSR; T_6 = 50% ITSR; T_7 = 60% ITSR

Table 4: Growth performance and feed conversion ratio of uda rams fed graded levels of ITSR

	Treatments (Inclusion level of ITSR %)							
Parameters	T_1(0)	T_2(10)	T_3(20)	T_4(30)	T_5(40)	T_6(50)	T_7(60)	SEM
Initial weight (kg)	21.50	20.33	20.67	20.67	20.75	21.00	20.83	0.83
Final weight (kg)	27.10	28.30	29.13	31.33	27.25	25.85	25.27	0.72
Weight gain (kg)	5.60^{b}	7.97^{ab}	8.46^{ab}	10.66^{a}	6.50^{b}	4.85^{b}	4.44^{b}	0.36
Av. daily weight gain (g/d)	66.67^{b}	94.88^{ab}	100.71^{ab}	126.90^{a}	77.38^{ab}	57.74^{b}	52.86^{b}	4.29
Feed conversion ratio	10.65^{ab}	9.29^{bc}	10.08^{abc}	8.35^{c}	11.01^{ab}	12.28^{a}	11.82^{a}	0.17

^{a,b,c,}: means in the same row with different superscripts differ significantly ($P<0.05$); SEM = Standard Error of Mean; ITSR = Inoculants-treated Soybean Residue; T_1 = 0% ITSR; T_2 = 10% ITSR; T_3 = 20% ITSR; T_4 = 30% ITSR; T_5 = 40% ITSR; T_6 = 50% ITSR; T_7 = 60% ITSR