GROWTH PERFORMANCE OF YANKASA RAM LAMBS FED UREA AND LIME TREATED GROUNDNUT (ARACHIS HYPOGEAE) SHELL IN A COMPLETE DIET

[1]MARU, L.M, [2]BELLO M. D., [3]LAMIDI, O. S., [4]AUDU, S. B., [5]TANKO, R. J

[1,2]College of Education, Maru Zamfara State, Nigeria
[3,5]National Animal Production Research Institute (Napri) Zaria, Nigeria
[4]Ahmadu Bello University, (ABU) Zaria, Nigeria.
E-mail: bdogonkade78@gmail.com

Abstract - The study was conducted to determine the effect of untreated and urea, lime and urea/lime treated groundnut (Arachis hypogaea) shells in a complete diet fed to growing Yankasa ram lambs. Four treatment diets were formulated containing 40% untreated, 40% urea treated, 40% lime treated and 40% urea and lime treated groundnut shell. Twenty Yankasa ram lambs were used and randomly assigned to the four treatments with five animals per treatment in completely randomized design (CRD). The diet was formulated to have 15% crude protein (CP) content. The growth trial lasted for 90 days.Organic matter (OM) among the treatment diets ranged from 85.18 to 86.53% and lime treated diet has the highestbut crude protein content was more in urea/lime/ treated diet, and least CP was in urea treated diet. Parameters measured were daily weight gain, feed intake, feed conversion ratio, nutrients digestibility, nitrogen balance, blood metabolites cost and apparent profit. The growing ram lambs on urea/lime treated diet had the highest average daily weight gain (94.66g/d). In feed conversion ratio ram lambs on lime treated diet had the least mean values (8.94) and were significantly ($P<0.05$) different to those on urea and urea/lime treated diets.Three ram lambs from each of the treatment groups were randomly selected and housed in individual metabolism crates for digestibility. Urea treated diet showed better digestibility coefficient among the treatment diets (49.99%). The result of nitrogen intake was significantly ($P<0.05$) higher in rams lambs fed urea/lime treated diet compared with the other treatment groups. Nitrogen retained as percent intake was significantly ($P<0.05$) higher in the urea, lime and urea/lime treated diets than the untreated. Results of the economic analysis of growing ram lambs showed that ram lambs on lime treated diet had the highest feed cost (N4987.03) and those on urea/lime treated diet had the highest total weight gain (8.58Kg), followed by those fed lime treated diet but a better apparent profit was realized from ram lambs fed untreated diet (N1,893.22). It can be concluded that feed intake, nutrient digestibility and the growth performance of growing Yankasa ram lambs fed untreated and treated groundnut shells in a complete diet are encouraging. The use of ground groundnut shell in the diet of growing Yankasa ram lambs at 40% inclusion, treated or untreated is recommended.

I. INTRODUCTION

Small ruminants play a very important role in the socioeconomic life of the people of Nigeria and the country has the second largest goat population in the World next to India (Mahadi, 2002). Bourn et al. (2002) have estimated Nigerian livestock population to about13.9 million cattle, 22.1 million sheep 34.5million goats. In spite of these impressive statistics on sheep and goat, their potentiality is not fully realized due to low productivity from high mortality, low growth rate, low productive performance among others (Mahadi, 2002).

FAO, (1982) reported sheep to contribute 16% of the total domestically produced meat in Nigeria. Yankasa sheep are perhaps the most widely and most numerous breed of sheep in the Northern part of Nigeria, they are found in the Sahel, Sudan and Guinea Savannah zones of the Country (Adu and Ngere, 1979).Feed is one of the important factors that limit livestock production in the tropics especially during the dry season when high quality forages are scarce (Adebowale and Taiwo, 1996). The cost of livestock feeds and feed ingredients in recent years has increased tremendously. Hence, the cost of feeding has become a major problem of livestock production in the developing countries. Aduku, (1993) reported cost of feed to account for about 70% of the total cost of animal production. This therefore necessitates the need and interest in exploring neglected or underutilized feedstuff materials, such as groundnut shells which are left after the groundnut was processed and is very much available in the western zone of the country.

Groundnut shell (Arachis hypogaeaa) is of the legume or 'bean' family (Fabaceae). The crop is known with many other names such as groundnut, peanut, monkey nut, earthnut, goober nut and pygmy nut. Groundnut (Arachis hypogaea L.) is among the important crops grown in Sub-Saharan Africa (Nigam et al., 1991).

Jumia, (2012) reported groundnut shell to have dry matter accounted to about 90.3% of which 4.8-7.2 is crude protein, 1.0-1.1% is crude fat and 65.7-79.3% is cellulose. Carbohydrate is 10.6-21.2%, crude ash is 1.9-4.6%, calcium is 0.24%, and phosphorus is 0.08-0.09%. The dry matter per kilogram contains digestible energy of 4.605-5.108 KJ for cow, 4.438-4.898 KJ for sheep, including digestible protein as 15-17grams/Kg. The shell also contains vitamins and part of the amino acids after microbial

process.Groundnut shells were reported to contain 65.7% cellulose, 21.2% carbohydrates, 7.3% protein, 4.5% minerals and 1.2% lipids, since the processed shells from shelling machines contain bits and skins of nuts, the actual protein and lipid contents of this waste material are probably much higher (Abdurrazak et al., 2014).

II. JUSTIFICATION OF THE STUDY

Utilization of crop residues as animal feed ingredients is attracting intense research focus and interest by many researchers, as conventional feedstuff remained unaffordable to low income farmers because of the cost (Bello, 2008). The problem raised the need to search for alternative feed sources that can economically supplement the conventional feed ingredients used in ration formulation without any adverse effects on the health and performance of the animals.

Information on the utilization of groundnut shell as ingredient for feeding ruminants such as sheep is very scarce. Most of the earlier researches conducted were on groundnut haulms (Malau-Aduli et al.,2003 and Arslan, 2005). The shell is left in the processing area after the nut has being removed, constituting environmental problem to the agro-industries. It takes longer period for shell to decompose; farmers therefore do not appreciate it as composed manure. It sometimes results to environmental hazard as it blocks drainage in over flooding.

OBJECTIVES OF THE STUDY

The general objective is to:
Investigate the effect of adding untreated and urea/lime treated groundnut shell in complete diet of growing Yankasa ram lambs.

The specific objectives are to:
1. Determine feed intake and nutrient digestibility of growing Yankasa ram lambs fed complete diet containing untreated and urea, lime and urea/lime treated groundnut shell.
2. Evaluate the growth performance and some blood metabolites of growing Yankasa ram lambs fed untreated and urea, lime and urea/lime treated groundnut shell in a complete diet.
3. Determine cost benefit of growing Yankasa ram lambs on complete diet containing untreated and urea, lime and urea/lime treated groundnut shell.

III. MATERIALS AND METHODS

The study was conducted at the Teaching and Research Farm (Small Ruminants Unit) of Animal Science Department, Faculty of Agriculture, Ahmadu Bello University, Zaria. Located in the Northern Guinea Savannah of Nigeria, on Latitude $11^0 12^{'}$ N and Longitude 7^0 $33^{'}$ E at an altitude of 610m above sea level (GPS, 2012). Annual rainfall of 1100 - 1200mm and temperature that fluctuates within the range of 14.5-39.5^{0}C (IAR, 2015),

Source and Processing of Experimental Material
Groundnut shell used in the experiment was obtained from groundnut processing unit in Wanke, Zamfara state. It was ground using hammer mill machine fitted with 2.5mm sieve to ease mixing with other ingredients.

Ensiling
Each kilogram of groundnut shell was treated with 5% urea and 5% lime for urea and lime treated respectively, for urea/lime treated, 1 kg of groundnut shell was treated with 2.5% urea and 2.5% lime). The urea and lime were diluted in water at 1kg in 20 litres of water and sprayed on the groundnut shell. The treated shells were ensiled in persue cowpea improved sacks (PICS) for a period of two weeks) then dried for a day and packed into bags till the period of the feed formulation.

Experimental diets
Four treatment diets were formulated to contain 15% CP with inclusion of the test ingredients untreated and urea, lime and urea and lime treated groundnut shell of 40% in each of the treatment diet. Other ingredients in the complete diet are:maize offal, cotton seed cake, bone meal, salt and ruminant premix (Table 1).

Twenty Yankasa ram lambs between the ages of 6-8 months purchased from Giwa market close to NAPRI in Shika, Kaduna state were used in the experiment. The animals were given prophylactic treatment and quarantined before the commencement of the experiment. They were dewormed with anthelmintic (albendazole) to control endoparasites and dipped in ascaride solution (ivomec$^{(R)}$) to control ectoparasites, the ram lambs were also given intramuscular injection of oxytetracycline and B-complex at the dosage of 1ml/10kg body weight.

Experimental design
The 20 ram lambs were weighed and randomly assigned to the four treatment diets with five animals per treatment in a completely randomized design (CRD). They were housed individually incleaned and disinfected pens of 2x1x2m dimension using septol.

Growth feeding trial
The complete diet was formulated using Modified Pearson Square Method and was done after proximate analysis was conducted to determine protein content of the untreated, urea treated, lime treated and urea and lime treated groundnut shells. For other ingredients used in the formulation, their nutrient requirement values from literature were used. After

the formulation of the complete diets, proximate analysis was carried out to determine the proximate composition of each treatment diet. The ingredients compositions of the growth diets are presented in Table 1. A daily allowance of the complete diet at the rate of 4% body weight per head was offered. Fresh and clean water was given ad libitum. The diets were formulated to contain 15% crude protein (CP) content. Daily feed intake was taken throughout the period of the experiment by weighing the feed offered each day and the left over (orts) the following day. Daily intake of the diets was estimated for each animal by subtracting the left over from the quantity served to the animal. Daily water intake and temperature were recorded. The experiment lasted for 90 days. The animals wereweighed at the onset of the trial after an overnight fasting to obtain their initial weights and subsequently at 2 weeks intervals between 8:00-9:00am throughout the feeding trial period. Weight gain was determined by subtracting the initial weight from the final weight within the periods. Feed conversion ratio was also determined, by dividing feed intake by weight gain.

Digestibility trial

At the end of the growth trial, three animals from each of the treatment groups were randomly selected and housed in individual metabolism crates, ideal for easy collection of urine and faeces as described by (Osuji et al. 1993). The experimental animals were allowed for 7 days to adjust to the diets and experimental conditions in the metabolism crates, followed by seven days of total faecal and urine collection to determine nutrient digestibility of the experimental diets and nitrogen retention in the experimental animals. During the trial, animals were maintained on same treatment diets as in feeding trial.Total faecal output was collected daily in the morning, weighed and mixed thoroughly and sub-samples were taken. The total faecal samples collected over the 7 days collection period was bulked and sub sampled for laboratory analysis after treating with 20% formaldehyde to prevent further microbial activity. The samples were stored in a freezer at (- 20^0 C) and were taken to Animal Science Biochemical Laboratory for analysis The total urine output for 24 hours was collected. This was done by using graduated plastic containers acidified with 100mls 0.1N H_2SO_4 which was placed under the metabolism crates. Ten percent of the daily urine output (aliquot) was taken during the collection from each animal bulked and stored in a freezer at (- 20^oC) till it was ready for analysis. Both faecal and urine analysis were carried out at the Animal Science Biochemical Laboratory.

Laboratory Analysis

Treated and untreated groundnut shells, experimental diet, faecal samples were analyzed for dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE), ash and nitrogen free extract (NFE), according to the method of AOAC (2005). The fibre fractions such as: acid detergent fibre (ADF) and neutral detergent fibre (NDF) and lignin were determined according to the method described by Van Soest (1982). Urine samples were analyzed for nitrogen using the simple micro-Kjeldahl distillation method of AOAC (2005).

Statistical Analysis

All the data collected on the growth, blood metabolites, digestibility and cost benefit analysis were subjected to analysis of variance (ANOVA), (SAS, 2002). Differences among treatment means, were compared using the Duncan multiple range test (DMRT) of SAS software.

The general linear model was used:

$X_{ij}=\mu+t_i+e_{ij}$

Where:

X_{ij}=Observation measured

μ= Population mean

t_i=Treatment effect (control, urea, lime, urea/lime treatment)

e_{ij}=Experimental error

Cost Benefit Analysis

Profitability of inclusion of treated groundnut shell in the diet of the growing Yankasa ram lambs fed urea/lime treated groundnut shell based diets was determined. Input and output costs were based on prevailing market prices of the commodities.

IV. RESULTS AND DISCUSSION

Chemical Composition of the Treated Groundnut Shell

The proximate composition of the treatment material (groundnut shell) is presented in table 2 and the results revealed that, dry matter content was high in untreated shell (96.79%) followed by urea treated shell and urea/lime treated shell has the least value (85.91%). Organic matter followed similar trend only that lime treated shell recorded 86.83% little bit higher than urea treated shell (86.55%). The proximate analysis indicated that crude protein (CP) content of the urea treated shell has 10.88%, urea/lime 8.93%, lime treated shell 6.31% and the least was the untreated shell with 5.38%. Acid detergent fibre ranged from 21.45%-25.71 with lime treated shell recording the highest value of 25.71% and least was urea/lime treated shell. In both ADF and NDF lime treated shell has the highest percentages while urea/lime recorded least value.

Results of chemical composition of groundnut shell obtained from this study indicated that the protein content of the untreated shell is within the range (4.8-7.2%CP) reported by Jumia, (2012), however, it was slightly lower than the 7.3% CP content reported by Abdurrazak et al. (2014). The difference may be due

to the methods involved in processing the groundnut; shells from shelling machines may contain bits and skins of nuts. These may add the protein and lipid contents of this waste material.

Chemical Composition of Growth Experimental Diets

The chemical composition of the treatment diets in Table 3 indicated dry matter (DM) content of 91.56, 91.22, 91.15 and 90.56% for untreated, lime treated urea treated and urea/lime treated diets respectively. However, crude protein (CP) content was higher in urea/lime treatment diet (15.30%) with the least in lime treated diet (14.68%). The results showed more of ether extracts (EE) in untreated shell diet (4.31%) and the least was in lime treated diet (3.86%). Acid detergent fibre (ADF) and neutral detergent fibre (NDF) were like in the treated groundnut shell, lime treatment diet had the highest value of 25.11% and 47.77% respectively.

Organic matter content obtained from the treatment diets was similar to the work of Aduku (2005) but higher than 79.85-83.54% reported by Hassan, (2014) and is in the normal range required for animal growth. Crude protein content was also within the values of 13-15% CP requirements for sheep (Aduku, (2005).

Growth Performance of Growing Yankasa Ram Lambs Fed Untreated and Urea and Treated Groundnut Shell in a Complete Diet.

Table 4 presents the growth performance of Yankasa ram lambs with mean values of the initial weight that ranged between 16.18-16.56kg indicating no significant differences (P>0.05) among the ram lambs fed the different treatment diets. The final weight showed higher significant difference (P<0.05) between ram lambs fed untreated, lime and urea/lime treated diets and those onurea treated diet. The results in the table showed that ram lambs in lime treated diet had the highest daily weight gain of 94.66g which was better than those on urea/lime treated and untreated treatment diets, though there were no significant differences (P>0.05) among the animals on the three treatment diets, but they were significantly (P<0.05) higher than those fed urea treated diet (68.42g).

On daily feed intake there was no significant difference (P>0.05) among ram lambs fed untreated and urea/lime diets but they differed significantly (P<0.05) with ram lambs on urea treated and urea/lime diets which were significantly (P<0.05) higher than those on lime treated diet. However, ram lambs on lime treated diet showed a better feed conversion ratio of 8.94 which was significantly (P<0.05) higher than those fed urea/lime treated diet but similar (P>0.05) to those on untreated diet. Ram lambs on urea treated diet had the highest feed conversion ratio (13.12), which was significantly (P<0.05) lower compared to the other treatment groups, as least value in feed conversion ratio (FCR) indicate better feed conversion efficiency.

Daily dry matter intake recorded in this study has indicated that the ram lambs ate more of the diets when the shells were grounded. This was in conformity with the report of McDonald et al. (2002) that grinding of roughages has been shown to increase voluntary feed intake, since intake seems to be limited by restriction placed upon the rate of passage of food out of the rumen through the reticulomasal orifice.

Daily weight gain recorded was higher than the one reported by Bibi-Farouk and Osinowo (2006) who reported a daily weight gain of 46 - 68g/day for Yankasa sheep fed fresh Ficus thonningi leaves and (28 to 47g//d) reported by Lamidi et al. (1998) for Yankasa sheep fed graded levels of Ficus thonnigii leaves as replacement for fresh Hyparrhenia rufa. This result is similar to what Osinowo et al. (1994) reported a growth rate of 92.9g/day for Yankasa sheep. However, the result was lower than 112g/day and 139g/day reported by Hassan (2014) and Mohammed (2012) who worked on farm managed Uda lambs in Zamfara reserve of North western Nigeria and Yankasa sheep fed Columbus grass (Sorghum alum) respectively and 130.7g/day, when lambs were fed chopped groundnut haulms reported (Adu and Lakpini, 1983)

Feed conversion ratio of the ram lambs fed untreated and differently treated groundnut shell in a complete diet of 13.12-8.94 in order of efficiency was better than the one (16.75-16.16) reported by Adamu, (2015) who fed different varieties of groundnut haulm and D smutsii hay as basal diet to growing Yankasa rams.

Nutrients Digestibility and Nitrogen Retention

The results of the nutrient digestibility are summarized in Table 5. Ram lambs fed urea treated diet recorded the highest dry matter digestibility (DMD) of 50.79% closely followed by 48.33% for ram lambs fed urea/lime treated diet, though there is no significant difference (P>0.05) between the two. Ram lambs fed untreated diet (45.90%) recorded similar DMD with those on urea/lime treated diet, but was significantly lower (P<0.05) compare to ram lambs on urea treated diet (50.79%). Ram lambs on lime treated diet had the least DMD (41.48%) and statistically lower than ram lambs on the other treatment diets. Crude protein digestibility in ram lambs fed urea/lime treated diet showed the highest value (66.00%) and were significantly (P<0.05) higher than the animals on the other diets. The results revealed that, there was no significant difference (P>0.05) between ram lambs fed untreated (59.91%) and those on urea (62.88%) and lime treated diets

(57.03). Animals on urea treated diet (62.88%) were significantly (P<0.05) higher than those on lime treated diet. Ether extract digestibility (EED) showed that ram lambs on untreated and urea treated diets had the highest EED and had statistically differed (P>0.05) with those on lime and urea/lime treated diets. Acid detergent fibre digestibility (ADFD) and neutral detergent fibre digestibility (NDFD) followed similar trend as in EED.

Table 6 shows the results of intake, loss and retention of nitrogen among the ram lambs fed the different treatment diets. The results indicated that animals on urea/lime treated diet had the highest nitrogen intake (22.70g/day) and were significantly (P<0.05) higher than those in the other treatment groups. Ram lambs on lime treated diet had the higher total nitrogen lost, though, not different from those on untreated diet, but had significant difference (P>0.05) with those on urea and urea/lime treated diets. However, animals on urea/lime diets had the highest nitrogen balance (13.92g/day) than those on untreated and lime treated diets which were statistically similar, but significantly (P<0.05) higher than those on lime treated diet.

Nitrogen retained as percent intake was in range of 52.81-61.18%, with animals fed urea/lime treated diet having the highest nitrogen, though not significantly different (P>0.05) from those on urea treated diet but statistically higher than those on untreated and lime treated diets. Ram lambs fed urea/lime treated diet absorbed more nitrogen (g/day) and were significantly (P<0.05) higher than those on all the other treatments. Nitrogen absorption in ram lambs on untreated and urea treated diets was significantly (P<0.05) lower than those fed lime and urea/lime treated diets.

Increased digestibility of DM, OM, EE, ADF, NDF and NFE recorded in rams fed urea treated diet is conformity with report of McDonald et al. (1995) that treatment of crop residue with urea increased digestibility and was attributed to the effect of urea in loosening lignocelluloses complex and consequently some of the cellulose might have been freed for microbial digestion.However crude protein digestibility was higher in ram lambs fed urea/lime treated diet this was in line with findings of other researchers who reported that the treatment of crop residues with the combination of both urea and lime solution increase digestibility of DM, lignin, ADF, NDF, CP and NFE (Fadel Elseed, 2005, Wanapat et al. 1996 and Yulistiani et al. 2015).

Nitrogen retention is the major indicator used to assess the protein nutrition status of ruminant livestock (Abdu et al., 2012). Increase in nitrogen absorbed and retained as percentage intake in rams fed both urea/lime and urea treated diet was in agreement with the report of Sarwar et al. (2003) that nitrogen retention depends on good digestibility of nutrients and / or utilization. In some cases this effect is sufficient to maintain an adequate N balance.

Cost Benefit Analysis

Analysis of the expenses and accruable revenue results are shown in Table 7. The results showed that average feed intake among the animals in the treatment groups ranged from 73.74-79.82kg the highest value came from animals fed urea/lime treated diet. Similarly, animals fed urea/lime treated diet have the highest total weight gain (8.58kg) and the least 6.16kg was from ram lambs fed urea treated diet. Cost of feed per kg weight was higher (N65.02) in lime treated diet then urea/lime treated diet, the least was untreated diet (N38.40). The highest accruable income was obtained from ram lambs on lime treated diet butthe highest apparent profit was recorded from ram lambs fed untreated diet (N1,893.22).

V. CONCLUSION

- Urea and Urea/lime treatment improved digestibility coefficient of DM, OM, ether extract acid detergent fibre, neutral detergent fibre and nitrogen free extract in the growing ram lambs by 10%.
- Urea/lime treatment improved the total weight gain of the ram lambs by 5%.
- better apparent profit was realized from ram lambs fed untreated diet, because of the cost of lime and the urea and ram lambs fed lime treated diet had better feed conversion ratio (8.94)

RECOMMENDATIONS

- Farmers are recommended to grind/crush/chop groundnut shell and incorporated it in diet formulation for growing Yankasa ram lambs, treated or untreated.
- Other treatment materials cheaper than urea and lime should be sourced and tried in order reduce total production cost experienced in the urea and lime treated diets.
- Further researches should be carried out to investigate other means of treating groundnut shells and incorporate it in the diet of small ruminants.

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Ingredient	Treatments diets			
	Untreated	Urea	Lime	Urea/Lime
Groundnut shell	40.00	40.00	40.00	40.00
Maize offal	14.00	27.00	16.50	22.00
C S C	44.00	31.00	41.50	36.00
Bone meal	1.25	1.25	1.25	1.25
Salt	0.50	0.50	0.50	0.50
Rumen Premix	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated CP %	15	15	15	15

CSC-Cotton Seed Cake, CP-Crude Protein

Table 1: Ingredients percentage composition of the experimental diets fed to growing Yankasa ram lambs

Parameters	Treatment material			
	Untreated	Urea	Lime	Urea/Lime
Dry matter	96.79	91.42	89.21	85.91
Organic matter	92.59	86.55	86.83	83.79
Crude protein	5.38	10.88	6.31	8.93
Ether extract	2.01	2.42	2.38	2.12
Lignin	8.39	9.01	8.41	7.40
ADF	24.31	24.76	25.71	21.45
NDF	47.71	48.43	48.64	21.45
NFE	18.01	18.01	17.54	16.90

ADF= acid detergent fibre NDF= neutral detergent fibre NFE=nitrogen free extract

Table 2:Proximate composition of untreated and urea, lime and urea/lime treated groundnut shell.

Parameters (%)	Treatment diets			
	Untreated	Urea	Lime	Urea/Lime
Dry matter	91.56	91.15	91.22	90.56
Organic matter	85,23	85.37	85.18	86.53
Crude protein	15.25	14.75	14.68	15.30
Ether extract	4.31	3.97	3.86	4.03
Lignin	9.39	10.01	9.41	8.40
ADF	23.48	24.21	25.11	19.86
NDF	46.60	45.62	47.77	44.84
NFE	55.15	55.84	56.88	56.06

ADF= acid detergent fibre NDF= neutral detergent fibre NFE=nitrogen free extract

Table 3: Proximate composition of untreated and urea, lime and urea/lime treated groundnut shell experimental diets fed to growing Yankasa ram lambs.

Parameters	Treatment diets				
	Untreated	Urea	Lime	Urea/lime	SEM
Initial weight (Kg)	16.40	16.56	16.28	16.18	0.28
Final weight (Kg)	24.50^{a}	22.50^{b}	24.60^{a}	24.76^{a}	0.64
Total weight gain (Kg)	8.10^{a}	6.16^{b}	8.52^{a}	8.58^{a}	0.55
Daily weight gain (g/d)	90.02^{a}	68.42^{b}	94.66^{a}	94.44^{a}	6.13
Total feed intake (Kg)	77.04	73.74	75.04	79.82	3.23
Daily feed intake (g/d)	858.42^{ab}	819.36^{c}	833.7^{b}	886.92^{a}	17.54
Feed conversion ratio	9.68^{ab}	13.12^{c}	8.94^{a}	10.20^{b}	0.61

Means within the same rows with different superscripts differ significantly ($P<0.05$) SEM=Standard error of means

Table 4: Growth performance of Yankasa ram lambs fed untreated and urea, lime and urea/lime treated groundnut shell in a complete diet..

Parameters	Treatment diets				SEM
	Untreated	Urea	Lime	Urea/Lime	
Dry matter	45.90[b]	50.79[a]	41.48[c]	48.33[ab]	1.84
Organic matter	44.99[b]	49.99[a]	49.91[a]	48.12[ab]	1.92
Crude protein	59.91[bc]	62.88[b]	57.03[c]	66.00[a]	1.51
Ether extract	88.24[a]	88.56[a]	84.53b	85.84b	0.79
Lignin	54.46[bc]	59.48[a]	56.94[a]	55.65[ab]	1.51
ADF	54.33[b]	57.60[a]	54.30[b]	50.82[c]	1.24
NDF	52.36[b]	56.84[a]	51.37[b]	52.09[b]	1.45
NFE	32.28[ab]	38.90[a]	28.12[b]	35.40[a]	2.28

ADF=acid detergent fibre NDF=neutral detergent fibre NFE=nitrogen free extract
Means within the same rows with different superscripts differ significantly (P<0.05)
SEM=Standard error of means

Table 5: Nutrient digestibility (%) of growing Yankasa ram lambs fed untreated and urea, lime and urea/lime treated groundnut shell in a complete diet.

Parameters	Treatment diet				SEM
	Untreated	Urea	Lime	Urea/Lime	
Nitrogen intake g/day	21.38[b]	20.63[b]	20.33[b]	22.70[a]	0.54
Faecal nitrogen g/day	8.46[a]	7.60[b]	8.71[a]	7.69[b]	0.18
Urine nitrogen g/day	0.90[b]	.90[b]	0.86[b]	1.09[a]	0.03
Total nitrogen lost g/day	9.34[a]	8.50[b]	9.57[a]	8.78[b]	0.19
Nitrogen balance g/day	12.02[b]	12.13[b]	10.76[c]	13.92[a]	0.62
Nitrogen absorbed g/day	12.92[b]	13.03[b]	11.62[c]	15.02[a]	0.62
N retained as % intake	55.64[b]	58.49[ab]	52.81[c]	61.18[a]	1.60

Means within the same rows with different superscripts differ significantly (P<0.05) SEM=Standard error of means

Table 6:Nitrogen balance of growing Yankasa ram lambs fed untreated and urea, lime and urea/lime treated groundnut shell in a complete diet.

Parameters	Treatment diets			
	Control	Urea	Lime	Urea/lime
Initial weight (Kg)	16.40	16.56	16.28	16.18
Final weight (Kg)	24.50	22.50	24.60	24.76
Total feed intake	77.26	73.74	76.79	79.82
TWG (Kg)	8.10	6.16	8.52	8.58
Price per $(Kg)^{LW}$	600.00	600.00	600.00	600.00
Cost of feed /Kg (N)	38.40	46.45	65.02	55.72
Cost of total feed consumed (N)	2966.78	3425.22	4987.03	4447.57
Income accruable (N)	4860.00	4004.00	5112.00	5148.00
Apparent profit (N)	1893.22	578.00	125.00	700.00

TWG-Total Weight Gain, Kg-Kilogram. LW-Live Weight N-Naira

Table 7: Cost benefit analysis of growing Yankasa ram lambs fed untreated and urea, lime and urea/lime treated groundnut shell in a complete diet.

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