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PERFORMANCE OF SOKOTO RED GOAT FED UREA TREATED GROUNDNUT (*ARACHIS HYPOGAEA*) SHELL

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ABSTRACT

The study that assessed the impact of treatment of groundnut shell on performance, nutrient digestibility, and nitrogen utilization by Sokoto red goats was carried out at Professor Lawal Abdu Saulawa Livestock Teaching and Research Farm, Federal University Dustin-Ma, Katsina State. Fifteen growing male goats used for the experiment were allotted to three treatments at five for each treatment in a Completely Randomized Design (CRD) with each one serving as a replicate. The experiment comprised of three treatments namely T1, T2 and T3 at inclusion levels of urea treated GNS at 0%, 10% and 20% respectively. The feeding trial was carried out for 84 days. Growth, digestibility, and nitrogen utilization parameters were measured. The proximate analysis revealed slight increase in crude protein while crude fibre decreased with increased level of inclusion of GNS. Lignin composition also slightly reduced from 11.90% in T1 to 10.90% (T3). There were significant differences ($P<0.05$) in weight gain per day, daily feed intake and feed efficiency. Average daily weight gain (75g/day) and feed efficiency (0.15) were higher in treatment T3 than those of other treatments but with lower average dry matter intake (490.83g/day). The nitrogen intake, faecal nitrogen, urine nitrogen, nitrogen absorbed, nitrogen balance, and nitrogen retained were significantly different ($P<0.05$) across the treatments. Treatment T3 which contained 20% inclusion level of UGNS was the best among all the diets because it contained 86.90% CPD, 95.66% EED, 92.76%, CFD 17.45%, 14.27 g/day nitrogen balance and 81.82% nitrogen retention. The feed cost per kg liveweight gain was significantly less ($P<0.05$) in treatment T3. The conclusion of the study was that treatment T3, which contained 20% urea treated GNS performed better than others.

Key Words: Ruminants, livestock, groundnut shell, urea

INTRODUCTION

Production of small ruminants constitutes a vital aspect of livestock because of the notable advantages it possesses. Lebbie (2004) stated that goats and sheep play a unique role in the food chain and overall livelihood of rural households. Small ruminants also contribute provide income to households, besides being store of wealth and security during periods of lack etc. According to Ozung *et al*. (2011), they can be reared for income generation, religious purposes, household consumption, hobby and as security against crop failure. Aruwayo and Muhammad (2018) reported that goats possess excellent potentials at alleviating the dearth of protein consumed by humans in Nigeria and can survive on consumption of feeds with poor quality and crop remains, possess short conception period and are known for numerous births. Nevertheless, harnessing the inherent potentials in goat production has always been a mirage. The productivity is low, and it has been adduced to dearth of feeds and feeding materials among other factors such as disease outbreaks, climate change, limited access to credit, low breed capacity etc. Aruwayo *et al*. (2016) stated that fluctuation in feed supply constitutes one of the causes of low productivity in goats in Nigeria which is attributed to the erratic weather situation. The scarcity of traditional livestock feed stems from the fact that food grains are nearly entirely needed for human use, hence roughages of poor quality make up a significant portion of the feed that ruminants can access for a significant portion of the year. Roughages are characterized by poor nutritive value leading to obvious reduced productivity of ruminant animals (Otaru *et al.*, 2011). Oftentimes ruminant animals depend on pastures, crop residues and other agro-industrial by-products as main sources of feed. Additionally, ruminants derive energy from these crop residues and other farm wastes during the dry season and the post-harvest period when available forage is of low-quality. The shortage of feed has adversely affected the performance of these animals. Available conventional feed materials are costly with consequent increase in cost of production (Abdel Hameed *et al.*, 2013; Aruwayo *et al.*, 2007; Maigandi, 2001). Consequently, Animal scientists are concentrating on finding unconventional feed sources to address the feed scarcity issue, which inevitably results in high cost of small ruminants like goats.

Groundnut shell (GNS) is a vital groundnut by-product derived from its threshing in most part of northern Nigeria. Groundnut is a vital cash crop (Alu *et al.*, 2012) and produced largely (1.3 million tonnes) in the northern Nigeria (Akinfemi, 2010). The shell is usually considered as waste when the nut is processed for consumption (Alu *et al.*, 2012) and is poor in nutritive value. Millam (2016) reported that it is of poor nutritional status with 60% fibre and low digestibility. The shell is high in lignin, and this makes it beneficial to properly process the shell prior to being fed to animals. GNS contains 0.50% crude protein (CP), 59.0% crude fibre (CF), 2.50% ash and 4.43%

carbohydrates (Abdulrazak *et al*., 2014). Atasie *et al*. (2009) reported that GNS is rich in minerals such as Na (42.00 mg/100 g), K (705.11 mg/100 g), Mg (3.98.00 mg/100 g), Ca (2.28 mg/100g), Fe (6.97 mg/100 g), Zn (3.20 mg/100 g) and P (10.55 mg/100 g). There have been series of research efforts to improve its nutritive value, degradability and digestibility. Millam *et al*. (2017) reported that treatment of groundnut shell with urea and/ or lime improved the quality of groundnut shells while Muhammad *et al*. (2017) stated that the utilization of varied levels of urea treated groundnut shells improved the consumption of feed, digestibility of nutrients, retention of nitrogen and body weight gain in the animals used in the experiments. This study therefore examined performance of growing Sokoto red buck goats fed urea treated groundnut (*Arachis hypogaea*) shell.

MATERIALS AND METHODS

Experimental Site

Professor Lawal Abdu Saulawa Livestock Teaching and Research Farm, Federal University Dustin-Ma, Katsina State was the site of study, which falls within Latitude 12˚27'18'N and Longitude 7˚27'29'E (Weather and Climate, 2024).

Source and Processing of Groundnut Shells (GNS)

Groundnut shells used in this experiment were obtained from groundnut processors in Dawanau, Kano state. Urea was dissolved at the rate of 0.05kg/litre of water, then applied to 50 kg of GNS that was ground with the use of a hammer mill that was fitted with 1cm screen. The mixture was properly mixed to enhance fermentation. The mixture was stored in a plastic container, pressed very well to expel air in it and overlaid with polythene sheet that rendered it impermeable to air and kept for 21 days to allow fermentation to occur. The product was afterward allowed to dry under a shade for 21 days.

Preparation of the Experimental Diets

Table 1 displays the overall composition of the diets used in the study. The treatments comprised of the test ingredient (Urea treated groundnut shell) at 0%, 10% and 20% levels of inclusion in treatments A, B and C respectively. Other ingredients were maize offal, cotton seed cake, cowpea husk, groundnut haulms, bone meal and salt. Treatment A was the control diet which did not include urea treated groundnut shell while treatments B and C contained10% and 20% inclusion levels of urea treated ground shell respectively

Table 1: Composition of the experimental diets

Ingredient (%)	Treatments		
	T1	T2	T3
Maize offal	60	57	45
Cotton seed cake	15	15	10
UTGNS	0	10	20
Cowpea husk	15	7	15
Groundnut haulm	8	9	8
Bone meal	1	1	1
Salt	1	1	1
Calculated value			
Crude protein	14.34	14.83	14.95
Crude fibre	20.16	21.20	20.98
Energy (ME (kcal/kg)	2896.67	2827.65	2805.05

UTGNS: urea treated groundnut shells

Experimental Animals and Management

The animals were purchased from Dutsin-Ma Market, Katsina State. They were dewormed with Bannath IIR dewormer against endoparasite, and injectable Oxytetracycline (a broad-spectrum antibiotic) was administered to them. The animals were also sprayed against ectoparasite and given other necessary prophylactic treatments within the two (2) weeks of quarantine period. For the experiment, fifteen (15) growing Red Sokoto bucks of comparable weight were utilized and then randomly assigned to the three (3) treatments T1, T2 and T3 at five (5) experimental animals per treatment with each of them constituting a replicate. The experimental design was Completely Randomized Design (CRD). The animals were housed in cleaned and disinfected individual pens (2 x 1 m^2) of concrete floor in the animal house that was well ventilated.

Data Collection

Weighing of the experimental animals was carried before the beginning of the study early in the morning before feed was offered. They were well-adjusted for weight before being allotted to the experimental treatments and subsequently weighed at weekly intervals after overnight fasting between 7am and 8am through the eighty-four (84) days period of the feeding trial. The total weight gain and the average weight gain were calculated from the obtained data. The treatment diets were fed to the experimental animals *ad libitum* and the leftover was weighed the following day in morning throughout the period of the feeding trial.

Total Weight gain = Final weight – Initial weight

Average weight gain = Total weight gain/ number of days of the feeding trial

Feed intake (FI) = feed given (g) – left over (g)

Feed efficiency (FE) was calculated using the average weight gain and average feed intake,

FE = weight gain/feed intake

Digestibility Trial

Three bucks were chosen at random from each group for the digestibility trial and nitrogen balance at the completion of the feeding trial. Following a period of fourteen days in the metabolic cages for effective adaptation, their faeces were collected for seven days using faecal bags. The faeces were weighed and 10% collected from each experimental animal for oven drying before being stored for chemical analysis. Using a urinary funnel channeled into a vial having 2 ml of 10% sulfuric acid that prevented the nitrogen component from escaping. Urine was also collected for seven days while the animals were still in the metabolic cage. Ten percent (10%) of the urine was taken and kept inside the freezer for the analysis of the chemical content.

Chemical Analysis

Proximate composition analysis of thoroughly mixed experimental diets and faeces were carried out on dry matter basis using AOAC (2005) method. The crude fibre fraction for these samples was also determined by the method of Van Soest (1957). Urine samples from each of the treatment groups were analyzed for total nitrogen according to Marsden *et al*. (2020).

Data Analysis

Data obtained were analysed using analysis of variance (ANOVA) in a Completely Randomized Design (CRD) in accordance with Steel and Torrie (1980) with SPSS statistical software package (version 2000), significantly different means of the treatments were separated with Duncan Multiple Range Test (DMRT) (Duncan, 1955).

Results

Proximate composition and crude fibre fraction of the experimental diets (%)

Table 2 displays the results of the experimental diets' proximate and composition crude fibre fraction. As indicated in Table 2, it was discovered that dry matter (DM) content ranged from 90.96% to 90.61%. Content of crude protein (CP) was lower (17.06%) in treatment T1 and higher (17.95%) in treatment T3. Ether extract ranged between 4.92% and 4.08% for T2 and T1, respectively. In the study, T1 had the greatest value of nitrogen free extract, while T2 had the lowest value. Treatment T2 had the lowest amount of ash, whereas treatment T3 had the greatest. In treatment T1, crude fibre had the highest value (18.69%). NDF value (58.63%) in treatment T1 is higher than those of other treatments. In the case of ADF, treatment T3 had a higher value of 31.14% than T1 and T2 while lignin was higher in treatment T1 than T2 and T3.

Table 2: Proximate Content and Contents of the cell wall of the diets (%)

Parameters	Treatments		
	1	2	3
Dry matter	90.61	90.94	90.96
Crude protein	17.06	18.50	18.45
Crude fibre	20.08	18.03	17.18
Ether extract	4.08	4.92	4.84
NFE	51.28	51.17	51.80
Ash	7.50	7.38	7.63
NDF	58.63	58.70	56.96
ADF	30.47	30.38	31.14
Lignin	11.90	10.92	10.90

ADF=Acid Detergent fibre; NDF=Neutral Detergent Fibre; NFE=Nitrogen Free Extract

Effect of Urea treated groundnut shell on Growth Performance of Red Sokoto goats

Table 3 displays the findings on the impact of urea-treated groundnut shell on Red Sokoto goat growth performance. Final weights of T1 (16.05 kg) and T2 (16.55 kg), which were much greater than T2, did not differ significantly (P>0.05). Nonetheless, there were notable variations (P<0.05) in the overall weight increase and daily weight gain across the treatments, with T3 exhibiting the highest values of 6.30kg and 75.00g for the former and the latter, respectively. Treatment T3 had a considerably reduced total feed intake and average daily feed intake (p<0.05) than treatments T1 and T2. Nonetheless, T3's feed efficiency value (0.15) was noticeably superior to those of the other treatments (P<0.05).

Table 3: Effect of Urea treated groundnut shell on Growth Performance of Sokoto red goats

Parameters	Treatments			
	T1	T2	T3	SEM
Initial Weight (kg)	10.35	10.40	10.25	0.0410
Final Weight kg	16.05^{a}	15.65^{b}	16.55^{a}	0.408
Total Weight Gain (kg)	5.7^{b}	5.25^{c}	6.30 ^{a}	0.00577
Daily Weight Gain (g/day)	67.85^{b}	62.50 ^{c}	75.00^{a}	0.009
Total Feed Intake (kg)	49.52^{a}	47.62^{b}	45.35^{c}	0.00707
Feed Intake(g/day)	589.55^{b}	566.88^{b}	539.91^{c}	0.004
Average Dry matter Intake (g/day)	535.95^{a}	514.88 ^{b}	490.83 ^{c}	0.00707
Feed Efficiency	0.13 ^{b}	0.12 ^{b}	0.15 ^{a}	0.00707

Means within rows with different superscripts (a-c) are significantly different (P<0.05)

Nutrients Digestibility

The results of nutrients digestibility are presented in the Table 4. Dry matter digestibility was considerably greater (P<0.05) in T3 (77.36%) than those of T1 and T2 which had 72.30% and 75.31% respectively. Digestibility of crude protein was significantly higher (P<0.05) in T3 and was trailed by those in T2 and then treatment T3. This was the trend in the digestibility of the other nutrients. Ether extract digestibility value was significantly higher in treatment T3 than T2 (P<0.05) with treatment T1 having lowest value. Nitrogen free extract coefficient (NFE) also recorded significantly higher (P<0.05) value of 63.63% in T3, T1 was 52.63% and T2 (60.84%). For crude fibre digestibility, T3 value was higher considerably (P<0.05) when compared with T1 and T2. The crude protein digestibility of the nutrients ranged between 81% and 86.90%, crude fibre digestibility was between 90.63% and 92.76%, and ether extract digestibility was between 93.93 and 95.66%.

Table 4: Nutrients Digestibility of Growing Sokoto Red Bucks Fed Complete Diets Containing Urea Treated Groundnut Shell (%)

Parameters	Treatments			
Nutrients	T1	T2	T3	SEM
Dry matter digestibility	72.30^{C}	75.31^{b}	77.36^{a}	0.005
Crude protein digestibility	81.25^{c}	84.20^{b}	86.90^{a}	0.0058
Ether extract digestibility	93.93^{b}	95.27^{a}	95.66^{a}	0.0453
Nitrogen free extract digestibility	52.63^{c}	60.84^{b}	63.63a	0.014
Crude fibre digestibility	90.63^{c}	91.93^{a}	92.76^{a}	0.014

Means within rows with different superscripts (a-c) are significantly different (P<0.05)

Nitrogen Balance

The results of nitrogen utilization of growing Sokoto red bucks are shown in Table 5. The nitrogen intake of the experimental animals varied considerably (P<0.05) between treatments T1 and T3, ranging from 16.39g/day to 17.45g/day, respectively. Treatment T1 had the least (P<0.05), followed by treatment T2. The value of the faecal nitrogen for all the treatments were different (P<0.05) from each, another, T1 possessed the highest, followed by T2 and T3. The experimental animals' urinary nitrogen level was lower in T3 than in T1 and T2, which did not differ from each another statistically (P>0.05). Treatment T3 outperformed the other treatments with considerably higher (P<0.05) nitrogen absorption and nitrogen balance values of 15.15g/day and 14.27g/day, respectively. The nitrogen retained values in T1 and T2 were significantly less (P<0.05) than that of T3.

Table 5: Nitrogen Utilization of Growing Sokoto Red Bulks Fed Complete Diets Containing Urea Treated Groundnut Shell (%)

Parameters	T1	T2	T3	SEM
Nitrogen intake(g/day)	16.39^{c}	17.06^{b}	17.45^{a}	0.064
Feacal nitrogen (g/day)	3.065^{a}	2.67^{b}	2.28^{c}	0.022
Urinary nitrogen (g/day	0.93^{a}	0.93^{a}	0.87^{b}	0.0123
Nitrogen absorbed (g/day)	13.36^{c}	14.37^{b}	15.15^{a}	0.015
Nitrogen balance (g/day	12.41^{c}	13.37^{b}	14.27^{a}	0.0224
Nitrogen retained (%)	75.55^{c}	78.37^{b}	81.82^{a}	0.058

Means within rows with different superscripts (a-c) are significantly different (P<0.05) SEM=Standard error mean.

Cost per kg live weight of Red Sokoto goats (bucks) fed urea treated groundnut shell

Table 6 shows the price of feed per kilogram. Feed cost was greater (P<0.05) in T1 (0.23#/kg), then dropped in T2 and followed by T3. That was the trend in the daily feed cost and the daily feed cost per kilogram of live weight gain. According to the results, T3 had the lowest feed cost per kilogram of live weight gain (1.38#/kg), followed by T2 (1.81#/kg) and T1 (1.77#/kg). This can be attributed to the lower cost of feed per kilogram for T2 (#0.22) and T3 (#0.21) as well as the animals' improved usage of the urea treated diets.

Table 6: cost per kg live weight of red sokoto goats (bulks) fed urea treated groundnut shell

Parameters	Treatments			
	T1	T2	T3	SEM
TWG (kg)	5.70[b]	5.25[c]	6.30 [a]	0.00577
DBWG (g/day)	67.85[b]	62.50[c]	75.00[a]	0.009
TFI (kg)	49.52[a]	47.62[b]	45.35[c]	0.00707
ADFI (g/day)	535.95[a]	514.88[b]	490.83[c]	0.00707
Cost of feed (#/kg)	0.23[a]	0.22[a]	0.21[b]	0.817
Cost of feed consumed (#/day)	0.12	0.11	0.19	
Cost of feed/LWG/kg	1.77[b]	1.81[a]	1.38[c]	0.008

Means within rows with different superscripts (a-c) are significantly different (P<0.05) SEM=Standard error mean.

DISCUSSION

Proximate Composition and Crude Fibre Fraction

The dry matter requirement for the animals used in the experiment was met. The crude protein was adequate for growing buck and within the ARC protein requirement for growing goat (ARC, 1990). The high crude protein content of the feed could have influenced higher feed intake as was reported by Aruwayo *et al.* (2022) and Chriyaa *et al*. (1997). Table 2 demonstrated that the experimental treatments' approximate compositions were similar, despite T2 and T3 having somewhat larger levels of crude protein, ether extract, and nitrogen free extract than T1. For a growing male goat, the ether extract observed in the study was sufficient. Aruwayo *et al*. (2022) reported a similar value. The nitrogen free extract obtained in the research ranged from 51.28% to 51.80% and is adjudged adequate for nutritional requirement of growing buck. These values are similar to report of Aruwayo *et al.* (2022) and Hassan *et al.* (2016).

However, crude fibre value was lower in T1 than other treatments. These observations could be adduced to the ability of urea to hydrolyse the fibrous structure in groundnut shell. This is in line with report of Millam *et al*. (2020) that urea is effective in hydrolysing the fibrous structure of GNS which resulted in the release available nutrients from the cell wall. The findings of this study are corroborated by Aruwayo *et al*. (2022), that ensiling rice milling waste-a fibrous substance, with urea altered the chemical makeup of the fibrous feeding material. However, the crude fibre content of the experimental diets compares with the report of Hassan *et al.* (2016) and is sufficient for the upkeep of the rumen microorganisms of a growing goat.

Growth Performance of Red Sokoto goats fed Urea treated Groundnut Shell

Table 3 shows the growth performance of male growing Sokoto red goat growing served urea treated groundnut shell. The final weight in treatments T3 and T2 were higher than that treatment T1. However, the total weight gain and daily weight gain was higher in treatment T3 which contained 10% urea treated groundnut shell. This in accordance with the reports of Millam *et al*. (2016) and Kade (2020) in which rams fed urea treated groundnut shell had better daily weight gain than those fed untreated. Similarly, Aruwayo *et al*. (2022) also reported better average daily weight gain in Sokoto red growing bucks in a research that tested urea treated and untreated rice milling waste. However, feed intake decreased with increased inclusion urea treated GNS. This could have been due better palatability. Yulistiani *et al*. (2015) and Millam *et al*. (2016) also observed lower daily dry matter intake in rams fed urea treated groundnut shell than the untreated. This is at variance with the report of higher feed intake in dairy cows by Gunun *et al*. (2013a, 2013b) and Wanapat *et al*. (2013), who fed urea treated groundnut shell in which the dry matter improved when evaluated with untreated rice straw. The variation in the report of these authors with the findings of this study could be due to individual animal responses to urea treatment and the age of the animals. The feed efficiency of the treatment groups was best in treatment T3, followed by treatment T2. The better feed efficiency in the diets with urea treatment could have resulted from improved nutritive value due to hydrolysis of cell wall content. The outcome of this research is in harmony with that of Kade (2020) with ram lambs and Millam (2016) with Yankassa rams.

Nutrients Digestibility and Nitrogen Utilization

The reports of this study revealed that urea treatment of groundnut shell improved nutrient digestibility of all the nutrients. This is could have resulted from urea’s ability to break down the strong bonds that exist in the cell wall contents. This finding is corroborated by Simon *et al.* (2014) who stated that the chemical constituents of rice milling waste was influenced and modified when treated with urea. Getahun (2014) also reported that the nutrient digestibility in lambs fed *Leucaena leucocephala* foliage improved when treated with urea. Aruwayo and Muhammad (2018) also reported improved digestibility of urea treated rice milling waste with Sokoto red goats.

Nitrogen utilization and retention improved with urea treatment of groundnut shell in this study. Aruwayo and Muhammad (2018) reported that rice milling waste treatment with urea improved nitrogen utilization and retention by growing Sokoto red bucks. Getahun (2014) also reported improved nitrogen utilization and balance in lambs fed *Leucaena leucocephala* foliage treated with urea. The report of Belewu and Babalola (2009) revealed that treating rice milling waste with urea improved the utilization and degradation of the fibre fraction.

The findings in this study showed that the experimental animals which received diets with urea treatment had lower costs per kilogram of live weight. This could have resulted from cheaper cost of feed per kilogram and more efficient feed utilization. The investigation's outcomes concur with those of Aruwayo and Muhammad (2018), which examined the nitrogen utilization and digestibility of rice milling waste treated with urea versus untreated in Sokoto red goats. It was also confirmed by Mesfin and Ktaw (2010) that wheat based straw diet fed to cow resulted in better net return than when treated with urea. It can then be implied that treating fibrous feed ingredients with urea could improve digestibility, nutrient utilization and feed cost reduction and ultimately increase the amount of animal product that is produced.

CONCLUSION

The study explored the benefits derivable from the use of urea for treating groundnut shell which is considered to very fibrous with poor digestibility and utilization. It can be concluded based on the better weight gain, higher feed efficiency and better returns on investment resulting from improved digestibility and nutrient utilization that including urea treated groundnut shell at 10% level in growing Sokoto red buck is desirable.

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