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NUTRIENTS DIGESTIBILITY, NITROGEN RETENTION AND ECONOMICS OF SOKOTO RED GOAT (KID) FED UNTREATED AND UREA TREATED RICE MILLING WASTE

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ABSTRACT

This study was conducted at the Teaching and Research Farm of Federal University Dutsinma in Katsina State to assess the nutrient digestibility and nitrogen retention along with the cost per live weight gain. Twenty five Sokoto red goats (kids) were allotted to five experimental treatments A , B , C, D and E in a completely randomized design (CRD) with five animals (n=5) per treatment. The feeding trial lasted for 84 days in which feed intake was measured by weighing feed given and the leftover the following morning for all the experimental animals with which the cost per live weight was calculated.The digestibility trial was conducted using three randomly selected experimental kids that were used in feeding trial for 14 days consisting of 7 days of adaptation and 7 days of collection of feaces and urine from the treatments. Statistical Package for Social Sciences (SPSS) was used to analyse the data. The study showed that the digestibility of treatments D with crude protein (91.0%), ether extract (92.60%), nitrogen free extract (72.60%) and crude fibre (94.0%) and E crude protein (92.10%), ether extract (93.60%), nitrogen free extract (73.20%) and crude fibre (89.60%) was significantly better (P<0.05) than other treatments. Treatments D (81.04%) and E (82.34) were better in nitrogen retention and cost of feed per live weight gain (D=₦896.10, C=₦796.53) than treatments A, B and C. However, treatment E is more preferable among all the treatments. It was concluded that urea has improved the nutrient utilization of rice milling waste.

***Keywords**: Ruminant, goat, nutrient, digestibility*

INTRODUCTION

Goats are small ruminants with excellent potentials at mitigating the shortage of human protein consumption in Nigeria. It can thrive on low quality feeds and crop residues, possess short gestation period and noted for multiple birth. However, it has been shown that the inherent potentials have not been fully harnessed. FAOSTAT (2011) reported that the world goat meat production in 2008 was 5 million tonnes which was far less than that of mutton, beef, and pork with 8.3, 65.7 and 103 million tonnes respectively. Goat then contributed 2.7% of the world red meat production. Nigeria resources have not been well harnessed in producing goat to meet the yearning of the available market as shown in 53,800,400 heads of goat in 2008 representing 6.24% of the world population. This could be attributed to less developed production and marketing systems (Mahgoub *et al*., 2012). Shortage of feeds and feeding stuff has also been recognized as one of the major challenges of improved goat production. Aruwayo *et al*. (2016) reported that one of the reasons for the poor productivity of goat in Nigeria is the supply of feed which fluctuates as a result of vagaries of weather condition. Agro allied wastes have been recognized as one of the ways of improving ruminant feeding in terms of quality and quantity. However, these agro allied wastes like rice milling waste is poor in nutrient hence the need to improve the nutritional content. Simon *et al.* (2014) reported that the major challenges of rice milling waste are the high level of fibre; and low protein and energy content. Urea has been one of the means of improving the nutrient utilization of high fibre feedstuff. Belewu and Babalola, (2009) reported that urea treatment increases rice milling waste utilization and fibre fraction degradation. The study then aimed at using urea to ensile rice milling waste in the area of study and feeding it to Sokoto red goat kid to assess the digestibility, nitrogen retention and cost per kilogram live weight gain.

MATERIALS AND METHODS

Description of Experimental Site

The study was conducted at the Teaching and Research Farm of Federal University Dustinma, Katsina state. The Farm is located in Dutsinma Local Government area, about 5 Kilometres to the Take of Campus and almost 15km to main campus. Dustin-ma lies between 12°27ʼ18ʽ north, 7°29° ʽ29°´´East. It experiences rainfall basically between May and September (Meteoblue Weather, 2017). Twenty five entire males Sokoto red goats (kids) were used for the study. They were quarantined for three weeks, dewormed using Bannath IIR dewormer (12.5g/kg body weight), oxytetracyline (a broad spectrum antibiotics) was administered by injection and were also sprayed against ectoparasite. The experimental animals were apportioned to five treatments consisting of A, B, C, D and E of five goats per treatment with one goat representing a replicate in a completely randomized design (CRD) by Steel and Torrie (1957). Treatment A served as the control (A) without rice milling waste, treatments B and C contained 15% and 30% untreated rice milling waste respectively while D and E consisted of 15 % and 30% urea treated rice milling waste respectively. The experimental animals were fed ad libitum twice a day in the morning and evening for the 84 days period of the study. Other management practices were strictly observed.

DATA COLLECTION

Three kids were randomly chosen from each of the experimental group and were used for digestibility and nitrogen balance trial studies. The experimental animals were accommodated in the metabolic cages, adapted to it for a 14 days period after which their feaces and urine were collected for seven days. Feacal bags were used to collect the feaces, weighed, bulked with 10% of it collected, oven-dried and kept in polythene bag ready for analysis while the urine was collected using urinary funnel piped into the bottle containing 2 ml 10% sulphuric acid to trap the nitrogen content.

The experimental diets and urea treated rice milling waste were sampled after being mixed thoroughly and analysed for proximate composition, acid detergent fibre (ADF), neutral detergent fibre, ADL by AOAC (2000). The feaces and urine were subjected to proximate composition and nitrogen content analysis respectively.

Statistical Analysis

Statistical Package for Social Sciences (SPSS) was used to analyse the data obtained after being subjected to analysis of variance (ANOVA) in a completely randomized design (CRD) (Steel and Torrie, 1980). Duncan Multiple Range Test (DMRT) was used to compare the means (Duncan, 1955) in cases of existence of significant differences between the means. Data were analyzed using the model

$Y_{ijk} = \mu + M_i + A_j + P_k + e_{ijk}$.

Where Y_{ijk} observation from animal j, receiving diet i, in period k; μ is the overall of mean, M_i is the mean effect of inclusion level of urea treated rice milling waste (i = 1, 2, 3, 4, 5), A_j is the effect of animal (j = 1, 2, 3, 4), P_k ,is the effect of period (k = 1, 2, 3, 4), e_{ijk} is the residual effect

The gross composition of the experimental diets is shown in tables 1.

Table 1: Gross composition of experimental diets

Ingredients	Control	RMW (%)	RMW (30%)	UTRMW (15%)	UTRMW (30%)
Maize	10	10	10	10	10
Cotton Seed Cake	10	12	15	11	14
Groundnut Hay	17	17	17	17	17
Cowpea Husk	24	24	17	19	12
Wheat offal	35	20	9	26	12
RMW		15	30		
UTRMW				15	30
Bone Meal	1	1	1	1	1
Salt	1	1	1	1	1
Total	100	100	100	100	100

RMW = rice milling waste, UTRMW = urea treated rice milling waste

RESULTS AND DISCUSSION

Proximate Analysis and Crude Fibre Fraction

The proximate analysis and crude fibre fraction is shown in table 2. The dry matter (DM) composition of the experimental diets ranged from 92.01% in treatment A to 94.5% in treatment C while Crude protein (CP) content was highest in treatment A with 15.69% and lowest in treatment D (15.42%). Ether extract (EE) recorded highest content of 5.7% in treatment D and lowest in treatment A (5.2%). Crude fibre (CF) content of the experimental diets ranged from 20.11% in treatment A to 25.45% in treatment B. For ash, treatment C had the highest while treatment B had the lowest. Nitrogen free extract (NFE) was highest in treatment A and lowest in diets B. The proximate analysis revealed that treatment B had the highest Ash content of 9.52% while treatment C had the lowest. The crude fibre fraction comprising of lignin, acid detergent fibre (ADF), neutral detergent fibre (NDF) are shown in table II.

The dry matter value shown in the result was able to meet up with the dry matter requirement of the experimental animal. The crude protein was within ARC protein requirement of a growing of (ARC, 1990). The proximate compositions of the experimental diets (Table II) showed that the five dietary treatments had comparable nutrient compositions. This has resulted from the balancing of the ingredient composition of the diets.

Table 2: Proximate composition and crude fibre fraction

Parameters	Treatments				
	A	B	C	D	E
Dry matter	92.01	93.0	94.5	93.5	94.0
Crude protein	15.69	15.43	15.47	15.42	15.48
Ether extract	5.2	5.5	5.6	5.7	5.5
Crude fibre	20.11	25.45	24.11	21.13	20.61
NFE	51.53	38.62	48.09	49.99	49.24
Ash	7.47	9.52	6.73	7.76	9.17
Neutral Detergent Fibre	42.86	40.88	46.12	39.88	39.99
Acid Detergent Fibre	19.84	21.16	25.77	20.14	21.81
Lignin	9.64	11.06	11.87	10.04	8.78

Digestibility and nitrogen balance of Sokoto red goat (Kid)

The result of the digestibility and nitrogen balance of the experimental animals are shown in Table 3. The result of the study revealed that the dry matter digestibility of the dietary treatments were significantly different (P<0.05) among the treatments. It was significantly higher (P<0.05) in treatment E than other treatments. For crude protein digestibility, it was discovered that the values were significantly different (P<0.05) among the treatments. Treatments D (91.0%) and E (92.10%) were not significantly different (P>0.05) but significantly higher (P<0.05) than treatment C (86.40) which is in turn significantly higher than that of B and A that were not significantly different (P<0.05). The ether extract digestibility recorded in the study showed that treatments E and D had the highest values of 93.60% and 92.60% respectively although treatment D was significantly similar (P>0.05) to that of A (90.0%) and B (89.0%). Treatments A, B and C were not significantly different (P>0.05) from each other. Nitrogen free extract digestibility was not significantly different (P>0.05) in all the treatments [C (68.20%), D (72.60%) and E (73.20)] except treatment A with 66.80%. However, treatments A, B, C and D were not significantly different (P>0.05) from each other. The crude fibre digestibility did not show any significant difference (P>0.05) among the treatments.

The nitrogen intake by the experimental animals did not differ significantly (P>0.05) among the treatments. The feacal nitrogen was significantly higher (P<0.05) in treatment A (92.81g/day), followed by treatment B (2.50g/day) and then C (2.30g/day), E (1.76g/day) and D (1.73g/day). Urinary nitrogen for the experimental animals was not significantly different (P>0.05) in treatments A (1.41g/day), B (1.30g/day), E (1.27g/day) and C (1.24g/day) although treatments A and E were significantly higher than treatment C (1.24g/day). Nitrogen absorbed and nitrogen balance for the experimental animals in all the treatments were not significantly different (P>0.05) among treatments. However, nitrogen retention did not differ significantly (P>0.05) among the treatments E (82.34%), D (81.04%) and C (78.89%).

Table 3: Digestibility and nitrogen balance of Sokoto red goat (Kid) fed untreated and urea treated rice milling waste

Parameter	Treatments				
	A	B	C	D	E
Nutrient Digestibility (%)					
DMD	73.67^{d}±0.72	76.20c±1.05	74.30d±1.40	80.81b±1.41	82.40a±0.96
CPD	81.60c±2.88	84.20bc±2.94	86.40b±4.21	91.0a±0.71	92.10a±2.01
EED	90.0bc±1.58	89.0bc±1.30	87.20c±3.96	92.60ab±1.14	93.60a±1.34
NFE	66.80b±1.79	69.0ab±2.74	68.20ab±4.09	72.60a±4.56	73.20a±4.71
CF	89.20±3.42	89.80±3.56	93.0±2.24	94.0±0.89	89.60±8.44
Nitrogen Utilization					
N-intake (g/day)	16.41±1.82	16.80±1.92	16.77±1.87	16.53±1.43	17.20±0.74
FEN(g/day)	2.81^{a}±0.05	2.50^{b}±0.02	2.30^{c}±0.01	1.73^{c}±0.03	1.76^{c}±0.06
URN(g/day)	1.41^{a}±0.16	1.30^{ab}0.16	1.24^{b}±0.07	1.39ab±0.07	1.27^{a}±0.07
NAB (g/day)	13.60±1.78	14.31±1.94	14.47±1.88	14.80±1.42	15.44±0.80
NBL(g/day)	12.19±1.85	13.00±2.01	13.23±1.83	13.41±1.42	14.16±0.80
NRT (%)	74.02^{b}±3.33	77.12^{b}±3.51	78.89^{ab}±1.82	81.04^{a}1.62	82.34^{a}±1.03

Means within rows with different superscripts (a-d) are significantly different (P<0.05), CPD = crude protein digestibility, EE = ether extract, NFE = nitrogen free extract, CF = crude fibre, FEN = feacal nitrogen, URN = urinary nitrogen, NAB = nitrogen absorbed, NBL = nitrogen balance, NRT = nitrogen retention, % = percentage

Cost of Feed per Kilogram Live Weight

The cost per kg live weight of Sokoto red goat (kid) fed untreated and urea treated rice milling waste are shown in table 4. Cost of feed consumed by the experimental animals was higher in treatments A (N34.70) and B (N33.14) than treatments C, D and E with N29.93, N29.93 and N29.40 respectively. The cost of feed for one kilogram live weight gain was lowest in treatment E (N796.53) although not significantly different (P>0.050 from the values of treatments D (N896.10). The cost of feed per live weight of these two treatments were significantly higher than treatments A, B and C.

Table 4: Cost of feed per kg live weight of Sokoto red goat (Buck) fed untreated and urea treated rice milling waste

Parameter	**Parameters**				
	A	**B**	**C**	**D**	**E**
Total Feed consumed (kg)	52.10^{d}	58.00^{bc}	56.00^{c}	60.00^{b}	65.00^{a}
Average Feed Intake(g)	630.90^{d}	690.47^{bc}	666.67^{c}	712.69^{b}	773.74^{a}
Cost of feed (₦/kg)	55.0	48.0	44	42	38
Cost of feed consumed (₦/day)	34.70^{a}±1.38	33.14^{a}±1.33	29.33^{b}0.56	29.93^{b}0.42	29.40^{b}1.14
Cost of feed (₦/kg) /live weight gain	1278.55^{a}±71.44	1221.08^{a}±50..87	1210.98^{a}±65.26	896.10^{b}±43.76	796.53^{b}±44.94

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

DISCUSSION

Table 2 revealed that the nutrient composition of the experimental diets were adequate for the nutritional requirement of the animals. The dry matter content (92.0% to 94.5%) obtained in this study is similar to the report by Hyelda *et al*. (2017) with 91% dry matter when maize stover was treated with urea. The crude protein level 15.43% to 15.69% obtained in this experiment is in accordance with the crude protein requirement of 15-18% for a growing kid (ARC, 1990) which is capable of supplying adequate protein for maintenance and moderate growth. This could also have increased voluntary feed intakes as reported by Chriyaa *et al.* (1997). The crude fibre ranged from 20.01% in treatment A to 20.98% in treatment C. Ether extract of 5.2%-5.7%, nitrogen free extract of 38.62% to 51.53%

and ash of 6.73% to 9.52% compared favourably with the reported value in ether extract of 5.23% to 5.83%, nitrogen free extract of 45.65 to 49.82% and ash of 8.58 % to 8.79% respectively by Pin and Wanwisa (2008). However, neutral detergent fibre and acid detergent fibre obtained in this study was higher than that of Pin and Wanwisa (2008). The relatively high fibre in the experimental diet is important for maintenance of the rumen environment and microbial population. Gu (2002) reported that crude fibre functions in maintaining micro-ecological balances of the gut, promoting digestive system development and raising reproductive performance.

The study showed better digestibility by experimental animals fed urea treated rice milling waste in all the nutrients. This could have been due to the ability of urea to improve the nutrient value through breaking of strong chemical bonds that exist between lignin and many plant polysaccharides and cell wall proteins, which render these compounds unavailable during digestion. Belewu and Babalola (2009) reported from these bonds are however, broken by chemical treatment thereby increasing the digestibility of fibrous feeds. Chemical treatment of rice milling waste with urea can lead to significant improvement in nutritional quality and therefore greater utilization (Taiwo *et al*., 1992). Simon *et al.* (2014) also reported that the chemical composition of rice milling waste can be highly varied when treated with urea which resulted in modification of the chemical composition of the waste. It was also reported by Getahun (2014) that nutrient digestibility improved in lambs fed Leucaena leucocephala foliage treated with urea.

Higher nitrogen retention in the experimental animals on treatments D (81.04%) and E (82.34%) indicated that urea treatment possess the capacity to improve nitrogen utilization of feedstuff. Sahoo *et al*. (2002) reported that urea treated straw improved in nitrogen utilization. This was reported by Abdu *et al*. (2012) when ficus foliage was supplemented as a protein source on urea treated maize stover.

Cost per kg live weight of the experimental animals in the study was lowest in treatment E and then followed by treatment D. This could be adduced to the cheaper cost of feed per kilogram and better nutrient digestibility of urea treated rice milling waste. Belewu and Babalola (2009) reported that urea treatment increases rice milling waste utilization and fibre fraction degradation. Mesfin and Ktaw (2010) also reported that urea treated wheat based straw diet in cow had better net return than the untreated diet. This then showed that urea treated diets is able to reduce cost of feed and improve return in terms of the product from the animals.

CONCLUSION

The result of the research showed that treatment of rice milling waste with urea improved the digestibility and nutrient utilization by Sokoto red goat as well as lowering of cost per kilogramme live weight. Therefore, urea treated rice milling waste use will make feeding of Sokoto red goat (kid) cheaper.

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