ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 22 No. 5
July 2022
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Afr. J. Food Agric. Nutr. Dev. 2022; 22(5): 20426-20438 https://doi.org/10.18697/ajfand.110.20945

PERFORMANCE OF SOKOTO RED GOATS (BUCKS) FED UREA TREATED AND UNTREATED RICE MILLING WASTE IN NORTH WESTERN NIGERIA

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July 2022
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ABSTRACT

The study was carried out at the Livestock Teaching and Research Farm of Federal University Dutsin-Ma to monitor the performance of Sokoto red bucks fed urea treated and untreated rice milling waste. Twenty entire male Sokoto red bucks were used. The experimental animals were allotted (n=5) in a completely randomized design (CRD) to diets A and B with 15% and 30% inclusion levels of untreated rice milling waste, respectively, while C and D contained 15% and 30% inclusion levels of urea treated rice milling waste, respectively, in a completely randomized design (CRD). The feeding trial lasted for 84 days while the digestibility trial lasted for 14 days. Three randomly selected experimental bucks from each experimental treatment were housed in the metabolic cages and their faeces collected for seven days using faecal bag after the seven days adaptation period. The faeces were weighed and bulked 10% collected and oven-dried before they were stored in polythene bags until required for analysis. Urine was also collected for seven days inside the metabolic cages using urinary funnel piped into the bottle containing 2 ml 10% sulphuric acid to trap the nitrogen content. 10% of the urine was sampled and stored in freezer at -2C for chemical analysis. The dry matter intake was significantly higher ($P<0.05$) in treatments A and B than other treatments. However, this did not result in significantly better ($P<0.05$) performance (feed efficiency and Cost of feed/ live weight gain) as shown with treatment C and D that had significantly better ($P<0.05$) weight gain, feed efficiency, nutrients digestibility and nitrogen retention. The cost of feed per kg live weight was shown to be significantly lower ($P<0.05$) in treatments C and D compared to treatment B which was significantly lower ($P<0.05$) than treatment A. The study concluded that diet D which contained 30% inclusion level of urea treated rice milling waste was the best among all the diets because of the lowest cost per feed live weight of 1.40 USD/kg and feed efficiency of 0.10.

Key words: Nutrients, productivity, ruminant, urea, digestibility, buck, goat, Nigeria

INTRODUCTION

Small ruminants' production has been given a pride of place in animal production in Nigeria in view of its multipurpose roles [1]. It contributes immensely to animal protein supply in Nigeria. Goat production plays dominant role in meat and skin production in Nigeria. Goats are small ruminants with excellent potentials at mitigating the shortage of human protein consumption in Nigeria [2]. Goats provide about 30% of all meat consumed by Nigeria populace [3]. They are found all over Nigeria in large population and very popular among the small holder farmers. Nigeria livestock population is estimated to be about 13.9 million cattle, 22.1 million sheep and 34 .5 million goat [4], while the National Agricultural Sample Survey of 2011 indicated that Nigeria was endowed with an estimated 19.5 million cattle, 72.5 million goats, 41.3 million sheep, 7.1 million pigs and 28,000 camels. However, goat population stands out among them [5]. It has been documented that goats are the principal domesticated small ruminants in terms of total numbers and production of food and fibre products [6]. This large population could be well adduced to reasons such as being excellent browsers and hardy, ability to survive on poor quality feed stuff, the relatively small size compared to large ruminants which results in lower feed requirement and required lower initial investment capital.

However, the productivity of goat has been adjudged to be low despite the large population. This has resulted in gap between demand and supply of goat meat and other products [7]. This low productivity is caused majorly by shortage of feed and feeding stuff among other factors, especially during the dry season of the year. Natural pastures and crop residue constitute the major source of feed for ruminants and their availability is seasonal. Ruminants which feed mainly on forages and crop residues are affected by seasonality [8]. This challenge is further aggravated by high cost of concentrates like maize, groundnut, soybean et cetera because of increase in population and competition for consumption of these concentrate sources by humans [7].

Improvement of goat productivity in order to eradicate the existing gap between demand and supply of goat products will need improvement in feed supply both in quantity and quality. This scarcity of feeds and feedstuffs can be remedied through the use non-conventional feed and agro allied waste [7]. Rice milling waste is an example of agro allied waste that is readily available in the area of study and has been proved to be promising when fed to ruminants along with other ingredients. Rice bran (as rice milling waste) was analysed and found to contain 11.5% crude protein, 2100 kcal/ ME energy and minerals such as calcium and phosphorus required for animal growth [9]. Rice milling waste is believed to contain various nutrients that would enable it to serve as animal feed but with major challenges of high level of fibre, low protein and energy [10]. However, the nutritive value can be improved upon. One of the more successful procedures available to improve the digestibility and therefore nutritional value of fibrous feeds is urea treatment [10]. Chemical treatment of rice milling waste with urea can lead to significant improvement in nutritional qualities and therefore greater utilization [11], [2] reported 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. This study was then aimed at improving nutritive value of rice

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milling waste through treatment with urea. The growth performance of Sokoto red goat fed untreated and urea treated rice milling waste was determined along with the nutrient digestibility, nitrogen balance and cost per kilogram live weight gain.

MATERIALS AND METHODS

Rice milling waste collection

The study was conducted at the Teaching and Research Farm of Federal University Dutsin-Ma. The rice milling waste was sourced from rice millers in Katsina State. Random sampling technique was employed to collect samples of the waste taken at depths of 10 cm from different points using a clean plastic container and shovel. The sub-samples were pooled together, mixed thoroughly and packed into an empty 10 kg polyethene bags which were conveyed to an animal laboratory**.**

Sources of feed and experimental animals

The other feed ingredients as well as the experimental animals comprising of twenty Sokoto red goat bucks were bought from a local market in Dutsin-Ma. The experimental animals were quarantined for two weeks during which Bannath IIR dewormer (12.5g/kg body weight) was administered, sprayed against ectoparasite and treated with oxytetracycline (broad spectrum antibiotics) by injection. Other husbandry management practices were strictly adhered to.

Sample treatment

The urea treated rice milling waste was prepared by dissolving 2.5kg of urea in 50 litres of water (5%) and applied to 50 kg of rice milling waste, stored in a plastic container and covered with polythene sheet to make it airtight. The treated rice milling waste remained in such condition for three weeks to allow fermentation to take place and subsequent sun drying for fifteen days before been used as test ingredient.

Feed preparation

Four diets were prepared using the test ingredients (untreated rice milling waste and urea rice milling waste) and other ingredients as treatments A and B which consisted of 15 and 30% levels of untreated rice milling waste, respectively while treatments B and C contained 15 and 30% urea treated rice milling waste, respectively, as shown in table 1 along with gross composition.

Experimental design

The twenty Sokoto red goats (bucks) were allotted into four groups of A, B, C, and D consisting of five goats per group with each one serving as a replicate in a completely randomized design (CRD) [12].

Data collection

The experimental animals in groups A, B, C, and D were fed ad libitum with diets A, B, C and D in the morning and evening throughout the 84 days of the experiment. The animals were weighed prior to the commencement of the experiment and at weekly intervals between 8.00 and 9.00 am after an overnight fasting. Daily record of feed intake was taken throughout the 84 days of feeding trial.

Digestibility trial
At the end of the feeding trial, three bucks were randomly selected from each of the experimental group for digestibility and nitrogen balance trial. The experimental animals were housed in the metabolic cages and their faeces collected for seven days using faecal bag after the seven days adaptation period, weighed, bulked, 10% collected and oven-dried before they were stored in polythene bags until required for analysis. Urine was also collected for seven days inside the metabolic cages using urinary funnel piped into the bottle containing 2 ml 10% sulphuric acid to trap the nitrogen content. 10% of the urine was sampled and stored in freezer at -2C for chemical analysis.

Chemical analysis
Thoroughly mixed representative samples of the experimental diets and urea treated rice milling waste were be analysed for proximate composition according to AOAC [13]; and neutral detergent fibre (NDF), acid detergent fibre (ADF) by Van Soest [14] while cellulose was obtained from the difference between ADF and lignin. The faeces and urine were analysed for proximate composition and nitrogen content respectively.

Statistical analysis
The data obtained were subjected to analysis of variance (ANOVA) in a completely randomized design (CRD) according to Steel and Torrie [12] using Statistical Package for Social Sciences (SPSS). Where significant differences between the means were indicated, Duncan Multiple Range Test (DMRT) was used to separate the means [15].

RESULTS AND DISCUSSION

Proximate Composition and Crude Fibre Fraction of the Experimental Diets
The dry matter (DM) contents of the experimental diets varied between 96.01% and 92.15% as shown in Table 2. Crude protein (CP) content was higher in treatment C and lower in treatment A. Crude fibre (CF) content increased from treatment 1 to treatment 4. Ether extract (EE) content of the experimental diet was higher in treatment A while crude fibre was higher in treatment C. Crude fibre was higher in treatments C and lower in A. For ash, treatment C had the highest while treatment B had the lowest. The crude fibre fraction comprising of acid detergent fibre (ADF), neutral detergent fibre (NDF) and lignin had higher content in treatments B, A and D while cellulose values were lower in treatments D and C.

The dry matter content of the feed that had a range of 96.01% and 92.15% as shown in table 2 is adequate for amount required by the experimental animals. This is higher than the dry matter range of 92.12% to 90.4% by Hassan *et al.* [16] in Sokoto Red bucks fed graded levels of Lablab (*Lablab purpureus L. sweet)* hay as a supplement to maize (*Zea mays*).

The crude protein level of the study that ranged from 13.13% in treatment A to 13.63% in treatment C falls within the range of 10-13% prescribed by ARC [17] that is capable of supplying adequate protein for maintenance and moderate growth. The high level of crude protein could have influenced a higher intake of feed. High CP could increase voluntary feed intakes [18]. The crude fibre ranged from 20.01% to in treatment A to

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20.98% in treatment C. This is comparable to the estimated CF range of 22% to 25% [19] for ruminants and 17.32 % to 19.57% reported [16]. The CF is adequate for the maintenance of the rumen environment. Crude fibre (CF) functions in maintaining micro-ecological balances of the gut, promoting digestive system development and raising reproductive performance [17]. The ether extract range of 4.02% - 4.76 were higher than the report of 2.62% – 3.63 % [16] and are adequate for ether extract required by the experimental animals. The nitrogen free extract that ranged from 52.23% in treatment A to 58.07% in treatment D is comparable with the report of Hassan *et al.* [16] with a range of 57.61% - 62.49%. The crude fibre fraction (neutral detergent fibre, acid detergent fibre, ligin and cellulose) as recorded in the study is adequate for the experimental animals. However, the values of ADF, lignin and cellulose in treatments D and E are shown to be lower than those of A and B. This might be attributed to the effect of ensiling of the rice milling waste with urea which have been reported to possess the capacity to modify the chemical composition of fibrous feeding stuff. This was supported by studies on urea treated rice milling waste and its application as animal feed by Simon [20] and the report the research carried out by report of Aruwayo and Muhammad [2] in Sokoto red kid fed with urea treated rice milling waste.

Feed intake and weight gain of the Experimental Animal

The results in Table 3 showed that total weight gain and average daily weight in animals on treatments D was significantly higher (P<0.05) than other treatments except treatment C. Treatments C was not significantly different (P>0.05) from B but higher (P<0.05) than treatment A, while treatments A and B did not differ significantly (P>0.05) . The result of the study also showed that the dry matter intake is significantly higher (P<0.05) in treatment A than other treatments. This was followed by treatments B and C that were similar (P>0.05) though the values of treatment C was similar (P>0.05) to that of D. The feed efficiency recorded in the study showed significantly higher (P<0.05) value in treatments C and D though treatment C was similar (P>0.05) to B and B was not significantly different (P>0.05) from treatment A.

The average daily weight gain obtained in the study for all the treatments was better than that of Hassan *et al.* [16]. This could be due the experimental animals' ability to utilize the feed very efficiently. The better average daily gain of animals on treatment C and D despite the lower dry matter intake than that of treatment A and B could have been due to the better feed efficiency in treatments C and D as shown the study that could have resulted from better digestibility of all the nutrients and nitrogen retention. This in consonance with report of Zhang *et al*. [21] reported that urea pretreatment is an efficient strategy to improve fibre digestibility of low quality roughages for ruminants and the report of Aruwayo and Muhammad [2] when urea treated rice milling waste was fed to Sokoto red kid.

Digestibility and nitrogen balance of the Experimental Animal

The digestibility coefficients for the nutrients in the study showed that crude protein digestibility was significantly higher (P<0.05) in treatment D, followed by D, then B with treatment A having the lowest value. Ether extract digestibility values in treatments D and C were similar (P>0.05) and significantly higher P<0.05) than that of treatments A and B which were not significantly different from each other. Treatments

C and D had similar but significantly higher (P<0.05) digestibility value than other treatments. The values for treatment B were significantly higher (P<0.05) than that of B. Crude fibre digestibility coefficients of treatment C and D were not significantly different P>0.05) from each other and significantly higher (P<0.05) than that of treatments A and B that were not significantly different (P>0.05) from each other. The nitrogen intake by the experimental animals in the treatments was not significantly different (P>0.05) from each other. Faecal nitrogen in all the treatments were significantly different from each other with A having the highest, followed by B, then C with treatment D having the lowest. Urinary nitrogen for the experimental animals in all the treatments were not significantly different (P>0.05) from each other. This trend was also observed in nitrogen absorbed and nitrogen balance.

From the result of the study, in can be inferred that treating rice milling waste with urea has improved the nutrient utilization of treatments C and D. This is supported by the report of Belewu and Babalola [22] that the strong bonds are 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 qualities and therefore greater utilization [11].

Cost per kg live weight of the Experimental Animals
The cost of feed per kilogram is presented in Table 4. The cost of feed was highest (USD 0.20) in treatment A and decreased down to E. The cost of feed consumed per day and the cost of feed consumed per kilogram live gain also followed the same trend. The results of the study revealed that the cost of feed per kilogram live weight gain was lowest in treatment D (USD 2.31), followed by C (USD 1.56) although these values were not significantly different from each other. This can be adduced to the cheaper cost of feed per kilogram for treatments C (USD 0.19) and D (USD 0.19); and the better utilization by the animals as a result of the treatment with urea.

CONCLUSION

Experimental animals on treatments D which contained 30% urea treated rice milling waste performed better with ADG of 81.66g/day, respectively, along with feed efficiency of 0.10. This treatment had better nutrient digestibility and nitrogen retention with the lowest cost per kg live weight gain of 1.40 USD, and was more preferable. Therefore, urea treated rice milling inclusion in feed of Sokoto red goat up to 30% was concluded to be the best.

This study was approved by the ethics committee of Federal University Dutsin-Ma (Approval no. 1013 TETfund 2013).

Conflict of interest
"The authors declare that there are no conflicts of interest".

ACKNOWLEDGEMENTS
I hereby acknowledge the support of Tertiary Education Trust Fund (TETfund) and the authority of Federal University Dutsin-Ma for sponsoring the research.

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ISSN 1684 5374

Table 1: Gross Composition of the Experimental Diets (%)

Ingredients	Treatments			
	A	B	C	D
Maize	6	6	6	3
CSC	4	7	4	4
UTRMW			15	30
RMW	15	30		
Groundnut haulm	17	17	17	17
Cowpea Husk	36	29	22	21
Wheat offal	20	9	34	23
Bone meal	1	1	1	1
Salt	1	1	1	1
Energy(Kcal/kg)	2066.63	2087.17	2035.55	2108.57

Table 2: Proximate Composition and Crude Fibre Fraction of the Experimental Diets (%)

Parameters	Treatments			
	A	B	C	E
-Dry matter	96.01	92.15	94.17	93.05
Crude protein	13.13	13.58	13.63	13.51
Ether estract	4.76	4.02	4.25	4.50
Crude fibre	20.01	20.21	20.98	20.66
Ash	6.11	5.81	6.38	5.66
NFE	52.23	55.08	55.76	58.07
NDF	62.31	68.07	59.88	61.48
ADF	36.20	39.41	29.90	28.79
Lignin	13.08	12.19	11.88	12.50
Cellolose	23.12	27.22	18.10	16.29

NFE= Nitrogen free Extract; ADF = Acid detergent fibre; NDF= Neutral detergent fibre

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ISSN 1684 5374

Table 3: Feed intake and weight gain of Sokoto red goats (Bucks) fed untreated and urea treated rice milling waste

Parameter	Treatments			
	A	B	C	D
Initial body weight (Kg)	10±0.11	10±0.11	10±0.11	10±0.11
Final body weight (Kg)	14.77±0.26	15.58±0.33	16.33±0.29	16.86±0.36
Total Body weight Gain(Kg)	4.77^{c}±0.23	5.58^{bc}±0.38	6.33^{ab}±0.30	6.86^{a}±0.31
Average daily Gain (ADG) (g/day)	56.78^{c}±2.67	66.43^{bc}±4.57	75.35^{ab}±3.58	81.66^{a}±3.70
Total Feed Intake(kg)	71.03^{a}±0.95	71.40^{a}±0.80	68.63^{b}±0.41	68.21^{b}±0.31
Feed Intake(g/day)	845.60^{a}±11.26	850.00^{a}±9.49	817.00^{b}±4.90	812.00^{b}±3.74
Average Dry matter intake(g/day)	811.86^{a}±10.81	783.27^{b}±8.74	769.37^{bc}±4.61	755.57^{c}±3.48
Feed Efficiency	0.07^{c}±0.03	0.09^{b}±0.06	0.10^{ab}±0.05	0.10^{a}±0.05

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

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Table 4: Digestibility and nitrogen balance of Sokoto red goats (Bucks) fed untreated and urea treated rice milling waste

Parameter	Treatments			
	A	B	C	D
Nutrient Digestibility (%)				
CPD	83.60^{d}±0.25	85.60^{c}±0.25	88.60^{b}±0.51	91.00^{a}±0.67
EED	90.00^{b}±0.71	89.40^{b}±0.25	92.00^{a}±0.45	92.80^{a}±0.50
NFED	65.00^{c}±0.63	68.00^{b}±0.71	75.00^{a}±0.32	75.00^{a}±0.71
CFD	92.00^{b}±0.32	92.80^{b}±0.37	95.00^{b}±0.32	95.00^{a}±0.32
Nitrogen Utilization				
N-intake (g/day)	17.02±0.10	17.00±0.11	16.77±0.3	16.32±0.11
FEN(g/day)	2.76^{a}±0.79	2.48^{b}±0.89	1.78^{c}±0.65	1.70^{d}±0.78
URN(g/day)	1.41±.071	1.30±0.071	1.24±0.032	1.39±0.031
NAB (g/day)	14.28±0.31	15.52±0.33	14.99±0.30	14.62±0.32
NBL(g/day)	12.850±0.32	13.22±0.33	13.75±0.30	13.32±0.0.33
NRT (%)	75.50^{c}±0.32	77.76^{b}±0.34	81.99^{a}±0.31	79.08^{a}±0.32

Means within rows with different superscripts (a-d) are significantly different (P<0.05)
CPD = Crude protein digestibility; EED = Ether extract digestibility; NFED = Nitrogen free extract digestibility; CFD = Crude fibre digestibility; FEN = Feacal nitrogen; URN = Urinary nitrogen; NAB = Nitrogen absorbed; NBL = Nitrogen balance; NRT = Nitrogen retained

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Table 5: Cost per kg live weight of Sokoto red goats (Bucks) fed untreated and urea treated rice milling waste

Parameter	Treatment (Means±)			
	A	B	C	D
Total feed consumed (kg)	0.20 ± 0.95	0.20 ± 0.80	0.19 ± 0.41	0.19 ± 0.31
Cost of feed (USD/kg)	0.15	0.15	0.14	0.14
Cost of feed consumed (USD/d)	0.13a ± 0.62	0.125b ± 0.60	0.18c ± 0.25	0.11c ± 0.19
Cost of feed/ live weight gain (USD/kg)	2.31 ± 31.95	1.92b ± 47.79	1.56 ± 29.19	1.40c ± 19.57

a,b,c = means (*n* = 3) within rows with different lowercase superscripts are significantly ($p < 0.05$) different

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