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Intake and growth performance of growing Uda rams fed diets containing different proportions of urea-treated millet husk as a replacement of cowpea husk

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Abstract

A sixty-three-day feeding trial investigated the nutrient intake and growth performance of growing Uda rams fed diets containing different proportions of urea-treated millet husk to replace cowpea husk. Sixteen growing Uda rams with a mean weight of 18 kg and aged 12 – 18 months were used for the study. Animals were balanced for weights and allotted into four dietary treatments with four (4) animals per treatment in a Completely Randomized Design. Urea-treated millet panicle husk proportions of 0:30, 10:20, 20:10, and 30:0 to replace cowpea husk was formulated as a complete diet consisting of wheat bran, cowpea husk, soybeans mill, and salt. The diets were designated as T1, T2, T3 and T4 respectively. The animals were fed the complete diets *ad libitum* at 1.5% of individual body weight. Data generated were subjected to analysis of variance. Differences in means were compared using Duncan's Multiple Range Test. The results revealed that animals fed 10% and 20% Millet husk diet were better compared to those placed on 30% millet husk in terms of, dry matter intake, weight gain, and nutrient digestibility. The findings also show that Millet husk could be supplemented in the diets of sheep up to 20% without detrimental effects on the growth performance of Uda rams.

Keywords: Intake; Performance; Uda rams; Urea treated millet husk; Cowpea husk

1. Introduction

1.1. Description of Problem

Nigeria has an estimated population of 41.3 million sheep, 72.5 million goats, and 19.5 million cattle (Aruwayo, 2018). Small ruminant rearing supports the livelihoods of poor farmers, generating income for smallholder livestock farmers (Nayawo *et al.*, 2017; Shittu *et al.*, 2008). However, small ruminant production is limited by inadequate year-round feed availability (Fasae *et al.*, 2012; Nayawo *et al.*, 2017). In the Savannah zone, ruminants' basal diets during the dry season are based on crop residues and dry grasses, which are nutritionally imbalanced and vary yearly (Sodeinde *et al.*, 2007). Rangeland forages, the primary forage source, decline in quality and quantity during the dry season, reducing animal productivity.

The scarcity of energy and protein feedstuffs during the dry season is a major setback to ruminant livestock production in the tropics(Aruwayo, 2018). Available forages are dry with low protein content, decreasing voluntary intake and digestibility (Kwaido *et al*. 2019). Grasslands in the tropics are the cheapest nutrient source for ruminants but cannot supply nutrients year-round, necessitating supplementation with agro-industrial by-products and crop residues for optimal productivity and growth. These residues include maize stover, rice straw, sorghum straw, and millet straw, but they have not been optimally utilized for ruminant feeding (Aruwayo, 2018). Alternative feed resources, such as

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nutritionally improved millet husk, need to be explored. Millet, highly cultivated in Kebbi State, produces a by-product available year-round.

Millet husk, a by-product of dehulled millet grains, is fibrous and often used as filling material but rarely as livestock feed. However, it has been tested in ruminants, pigs, and poultry feeding (Heuzé *et al.*, 2015). Urea can supplement ruminant diets, maximizing the benefit of poor-quality grazing by optimizing digestion, particularly in the dry season, and improving rumen function in cattle (Aruwayo, 2018). Urea treatment enhances straw's nutritional quality by increasing nitrogen content, palatability, and digestibility. Ammonia generated from urea forms ammonium hydroxide in the presence of water. Urea supplementation aims to improve rumen function and animal performance(Nayawo *et al.*, 2017). Urea treatment of crop residues can improve their nutritional value, reduce feed cost and wastage, and have practical applications at the smallholder level in developing countries (Flamy and Mathew, 2012). Information on millet husk utilization in sheep diets is scanty (Schiere *et al.*, 1988). Millet panicle husk usage could improve ruminant livestock production if its nutrients are enhanced. This study aimed to evaluate the value of different proportions of urea-treated millet husk on feed intake and growth performance of growing Uda rams

2. Material and methods

2.1. Study Area

The study was conducted at the Livestock Teaching and Research Farm of Adamu Augie College of Education, Argungu, Kebbi State. Argungu is the headquarters of Argungu Local Government Area of Kebbi State, created in 1976. Argungu is also the headquarters of Argungu Emirate council which existed since the year 1515 founded by Muhammadu Kanta. Argungu LGA is located between latitude $12^0$30'0" N to $12^0$50'0"N and longitude $4^0$10'0"E to $4^0$50'0"E on an elevation of 241 meters above sea level (Usman *et al*. 2022) .

2.2. Experimental Animals and Management

Sixteen Uda rams aged 12 –1 8 months with a mean live weight of 18 kg were used for the study. The rams were given prophylactic treatments, before the commencement of the experiment, consisting of intramuscular application of Oxytetracycline and Vitamin B complex at 1ml/10 kg body weight of the animal. The animals were drenched with 1ml/10 kg body weight of Albendazole and treated against ectoparasites with 0.5 ml/10 kg of Ivomec. The animals were ear-tagged for identification and quarantined for 2 weeks. Adequate feed and clean fresh water were provided to the animals *ad libitum*.

2.3. Silage Preparation

The millet husk was ensiled with urea following a specific procedure (Roy and Rangnekar, 2006). Urea was dissolved in water and sprinkled on the husk, which was then ensiled for 21 days in a 500-liter capacity water reservoir as silos. The silos were sealed with polythene sacks and left open for three days to allow ammonia gas to escape before being mixed with other ingredients for animal feed.

2.4. Experimental Treatments, Design, and Feeding of Animals

The experimental diets consisted of varying levels of urea-treated millet husks, replacing cowpea husks, alongside wheat bran, cowpea mill, and salt. The diets were designated T1, T2, T3, and T4 and were used to feed growing Uda Rams for 9 weeks in a completely randomized design. Each diet was fed to four animals housed individually in a pen equipped with feeding and watering facilities. The animals were fed the complete diet at 1.5% body weight throughout the trial and provided with clean, fresh water *ad libitum.*

2.5. Data Collection

Daily feed intake records were collected by weighing the feed offered and the leftovers the next morning. Feed intake was calculated for each animal by subtracting the leftover feed from the amount offered. The animals' weights were measured at the beginning of the trial after an overnight fast, and subsequently at weekly intervals. Weight gain was calculated by subtracting the initial weight from the final weight within the feeding period.

2.6. Chemical Analysis

Feed samples were analyzed for proximate composition using the procedure (AOAC, 2007). Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF), and Acid Detergent Lignin (ADL) were analyzed by the Method of Van Soest *et al.* (1991).

2.7. Statistical Analysis

The data generated were subjected to analysis of variance (ANOVA) using the General Linear Model Procedure of (SAS, 2001). Means that were significantly different, Duncan's Multiple Range Test (DMRT) was used to compare them (Duncan, 1955).

3. Results and discussion

3.1. The gross composition of experimental diets

Table 1 shows the gross composition of experimental diets. It includes the ingredients and their percentage inclusion levels for four treatment groups (T1, T2, T3, and T4). The ingredients included are urea-treated millet husk, cowpea husk, wheat offal, soybean meal, and salt. The inclusion levels of these ingredients vary for each treatment group. For urea-treated millet husk, the inclusion levels are 0% for T1, 10% for T2, 20% for T3, and 30% for T4. Cowpea husk inclusion levels are 30% for T1, 20% for T2, 10% for T3, and 0% for T4. Wheat offal inclusion levels remain constant at 40% across all treatment groups. Similarly, soybean meal inclusion levels are consistent at 29% for all treatment groups. Salt has an inclusion level of 1% across all treatment groups.

Table 1 Gross composition of experimental diets

Ingredients %	**Inclusion levels**			
	T1	**T2**	**T3**	**T4**
Urea Treated Millet husk	0	10	20	30
Cowpea husk	30	20	10	0
Wheat offal	40	40	40	40
Soybean meal	29	29	29	29
Salt	01	01	01	01
Total	100	100	100	100
Crude protein (CP)	13.21	12.70	12.23	11.59
Metabolizable Energy (ME) (Kcal/kg)	2146.14	2060.27	1587.03	1573.75

3.2. The Chemical composition of Experimental diets

The chemical composition and fiber fraction of different experimental diets (T1, T2, T3, and T4) are provided in Table 2. The parameters include Dry Matter (DM), Organic Matter (OM), Crude Protein (CP), Ether Extract (EE), Ash, Nitrogen-Free Extract (NFE), and Metabolizable Energy (ME) in kcal/kg. The Dry Matter (DM) content ranges from 90.67% to 91.50% across the treatments, and the Crude Protein (CP) content decreases from 13.21% in T1 to 11.59% in T4. The Ether Extract (EE) content also decreases from 4.13% in T1 to 3.33% in T4, and the Ash content increases slightly from 9.23% in T1 to 10.41% in T3 before dropping to 9.63% in T4. The Nitrogen-Free Extract (NFE) decreases from 37.17% in T1 to 35.02% in T3. Neutral Detergent Fiber (NDF) ranges from 34.76% to 35.80%, while Acid Detergent Fiber (ADF) ranges from 31.16% to 32.33%.

Table 2 Chemical composition of Experimental diets

Parameters (%)	T1	T2	T3	T4
	0:30	10:20	20:10	30:0
DM	91.39	90.67	91.50	91.45
OM	82.16	80.85	81.09	81.82
CP	13.21	12.70	12.23	11.59
NDF	35.80	34.76	35.55	35.00
ADF	32.0	32.16	31.67	32.33
ADL	11.18	11.10	11.91	11.20

DM=dry matter, CP=crude protein, CF= crude fibre, EE=ether extract, ADF= acid detergent fibre, NDF=nutrient detergent fibre, ADL=acid detergent lignin

3.3. Effect of different proportions of urea-treated millet panicle husk on feed intake and weight gain of growing Uda rams

Table. 3 presents the effects of different proportions of urea-treated millet panicle husk on the feed intake and weight gain of growing Uda rams: Dry Matter Intake (DMI g/day): The daily dry matter intake decreases as the proportion of millet panicle husk increases, with T1 (0:30) having the highest intake (14.60 g/day) and T4 (30:0) the lowest (11.51 g/day). Similarly, the total dry matter intake follows the same trend, with T2 (10:20) showing a slightly higher intake (74.98 g) compared to T1 (73.62 g), but overall, the intake decreases with higher millet husk proportions. The total dry matter intake per metabolic weight (TDMI/kgW^0.75) also decreases from T1 (916.75) to T4 (725.39).

Table 3 Effect of different proportions of urea-treated millet panicle husk on feed intake and weight gain of growing Uda rams

Proportion of Treated Millet Husk: Cowpea husk (%)					
Parameters	**T1**	**T2**	**T3**	**T4**	**SEM**
DMI (g/day)	14.60	13.33	12.15	11.51	0.21
Total DMI	73.62	74.98	72.22	70.31	1.75
TDMI/kgW $^{0.75}$	916.75	840.00	765.16	725.39	13.81
CP intake	159.22^{a}	148.75^{b}	150.22^{b}	152.30^{ab}	0.58
NDF Intake	70.11	71.86	70.85	72.45	1.45
Initial Wt. (kg)	18.50	18.60	18.50	18.50	1.25
Final Wt. (kg)	28.45^{a}	27.68^{ab}	27.50^{ab}	26.00^{b}	0.52
Wt. gain (kg)	9.95^{a}	9.08^{ab}	9.00^{b}	7.50^{c}	0.31
ADG (g)	155.47^{a}	141.89^{ab}	140.63^{ab}	117.19^{b}	7.87
FCR	6.98^{b}	7.07^{ab}	7.03^{ab}	8.32^{a}	0.48

a,b,c,d: Means with different superscripts along the row differed significantly (P<0.05),; DMI= Dry matter intake, TDMI= Total dry matter intake, CP= Crude protein, NDF= Neutral detergent fibre, Wt= weight, ADG= Average daily gain, FCR= Feed conversion ratio, SEM= Standard error of means.

Crude Protein (CP) and Neutral Detergent Fibre (NDF) Intake: The crude protein intake is highest in T1 (159.22 g) and decreases in T2 (148.75 g) and T3 (150.22 g), with T4 (152.30 g) showing a slight increase but still lower than T1. The differences are statistically significant (P<0.05). The neutral detergent fibre (NDF) intake remains relatively stable across all treatments, with slight variations but no significant (P>0.05) differences.

Weight Gain and Feed Conversion Ratio (FCR): Initial and Final Weight: All groups start with similar initial weights (~18.50 kg). The final weight is highest in T1 (28.45 kg) and lowest in T4 (26.00 kg), indicating that higher proportions of millet husk negatively impact weight gain. The weight gain follows a similar pattern, with T1 showing the highest

gain (9.95 kg) and T4 the lowest (7.50 kg). The differences are significant (P<0.05). Average Daily Gain (ADG) is highest in T1 (155.47 g) and decreases with increasing millet husk proportions, with T4 having the lowest ADG (117.19 g). The feed conversion ratio (FCR) is best (lowest) in T1 (6.98) and worst (highest) in T4 (8.32), indicating that rams in T1 convert feed to body weight more efficiently.

4. Discussions

4.1. Characteristics of the Experimental Diets and the Test Ingredients

In this trial, the crude protein (CP) content of the diets varies from 11.59% in treatment 4 to 12.70% in treatment 2. These values align with previous reports: ARC (1998) suggested 11% CP for fattening sheep (30-55 kg), and Roberts (2021) recommended 12% CP for growing rams. The lower CP content in the experimental diets likely results from the fibrous combination of cowpea husks, millet husks, and wheat bran, which may have influenced feed intake.

Across treatments, the cellulose and hemicellulose levels increase due to the high cellulose content in millet panicle husk (37.33%), consistent with Dhakad *et al.* (2002). Ether extract (EE) values (3.33% - 4.13%) are comparable to Maigandi *et al.* (2002) findings when feeding 20% FSD as a cowpea husk replacement in Uda sheep diets. Nitrogen-free extract (NFE) values range from 35.45% (treatment 4) to 35.88% (treatment 2), slightly lower than Aruwayo *et al.* (2011) reported range (39.02% - 41.15%).

4.2. Performance Characteristics of Uda Rams Fed Diets with Graded Levels of Urea-Treated Millet Panicle Husk

Total feed intake (TFI) was highest in Treatment 2 (10% urea-treated millet husk) compared to Treatments 3 and 4, decreasing as millet panicle husk levels increased. Daily feed intake values (0.98 – 1.0 kg/ram/day) were similar to those reported by Mainasara (2022) for sheep in Kebbi State (0.72 – 1.02 kg/ram/day). The crude protein (CP) content likely contributed to good intake levels (Babayemi, 2007). Shehata and Nour (1986) found that concentrate fed with rice straw had superior feeding value compared to concentrate alone. Total dry matter intake (TDI) was similar across Treatments 1, 2, and 3, suggesting that substituting millet panicle husk up to 20% does not affect diet palatability (Nayawo *et al.*, 2017). Average daily weight gain (ADG) ranged from 141.89 g/day to 117.19 g/day per ram, higher than the 53 g/day per ram reported by Abii *et al.* (1993) and the 65 g/day reported by Adu and Benckman (1981). Treatments 2 and 3, with the highest live weight gain, also recorded the highest ADG compared to Treatment 4, indicating that lower ADG in Treatment 4 was due to lower feed intake. The high live weight gain in animals fed millet panicle husk suggests it can be effectively mixed with other feed ingredients. There was a significant (P<0.05) difference in feed conversion ratio (FCR) across treatments. FCR values ranged from 6.98 to 8.32, comparable to Mainasara (2022) but lower than (Aruwayo, 2018). Animals on the control diet converted feed to weight gain more efficiently than those fed millet panicle husk, possibly due to phytochemicals limiting nutrient digestibility. The best feed intake recorded for animals on Diet 2 aligns with Nayawo *et al.* (2017). Dry matter intake as a percentage of body weight (74.98 – 70.31) decreased as millet husk inclusion increased, suggesting that including millet husk beyond 20% could lower dry matter intake below the standard range of 2 – 4%.

The study shows a clear link between the proportion of urea-treated millet husks in the diet and the growth performance of Uda rams. These findings align with similar studies showing that urea treatment of low-quality feeds like millet straw can improve feed intake and animal performance (Aruwayo (2018); Ehoche (2002); Nayawo *et al.* (2017). However, it is crucial to balance these treatments to meet dietary requirements without compromising feed intake and growth. The study emphasizes the importance of evaluating the nutritional content and digestibility of treated feeds to maximize their benefits in livestock diets.

5. Conclusion

From the result obtained, it is concluded that animals fed T2 (10:20) and T3 (20:10) Millet husk diets compared favorably with animals placed on T1 (0:30) diets in terms of dry matter intake, weight gain, and nutrient digestibility. Therefore it is concluded that urea-treated millet husk can be used as a suitable supplementary feed material for sheep during feed scarcity in the ecological zone.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

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