

## Dry matter intake, nutrient digestibility and nitrogen balance in growing Red sokoto bucks fed *Sorghum bicolor* hay supplemented with concentrate

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### Abstract

During the dry season, forages are low in quantity and quality; hence lacks the essential nutrients that are prerequisite for growth in ruminants, suggesting a supplemental feeding. Thus, this study was conducted to investigate the dry matter intake, nutrient digestibility and nitrogen balance in growing Red Sokoto bucks fed *Sorghum bicolor* hay supplemented with concentrate. Eight growing Red Sokoto bucks with average body weight of  $15 \pm 1.0$  kg were randomly allotted to two dietary treatments containing *S. bicolor* hay/concentrate mixture (100:0 and 60:40). The bucks were individually fed at 3.5% body weight daily for a period of 21 days in a completely randomised design with four replicates per treatment. The parameters measured were dry matter intake, water intake, amount of faeces voided, volume of urine and costs of feeding. Total dry matter intake (424.64g/day) was significantly ( $p < 0.05$ ) higher in 60:40 dietary treatment than 100:0 treatment (353.57g/day). The digestibility coefficients of crude fibre (92.34 %), acid detergent fibre (71.46 %) and neutral detergent fibre (69.77 %) were significantly ( $p < 0.05$ ) higher in Red Sokoto bucks fed *Sorghum bicolor* hay:concentrate ratio of 100:0 compared to bucks fed 60:40 diet with crude fibre (87.25 %), acid detergent fibre (59.67 %) and neutral detergent fibre (60.08 %) digestibility coefficient values. However, crude protein (78.49 %) and ash (70.04 %) digestibility coefficients in bucks fed 60:40 diet were significantly ( $p < 0.05$ ) higher than those fed 100:0 diet with 38.14 % crude protein and 21.45 % ash digestibility coefficients. There was an increasing trend ( $p < 0.05$ ) in all parameters measured when concentrate was supplemented. The nitrogen retained (7.55 g/day), nitrogen retained as % intake (68.76 %) and nitrogen absorbed as % intake (78.46 %) were significantly ( $p < 0.05$ ) higher in Red Sokoto bucks fed 60:40 diets when compared with that of 100:0 diet which recorded 0.69 g/day nitrogen retained, 23.87 % nitrogen retained as % intake and 38.15 % as nitrogen absorbed as % intake, respectively. Total costs per kg of feed (N78.13K) and costs of feeding per buck (N696.72K) were significantly ( $p < 0.05$ ) higher for 60:40 diet than 100:0 diet with N45.83K total costs per kg feed and N340.29K costs of feeding per buck. It is therefore, concluded that concentrate supplementation on *Sorghum bicolor* hay enhances its utilisation by growing Red Sokoto bucks in terms of increased dry matter intake, nutrient digestibility and nitrogen retention in Northern Guinea Savannah of Nigeria.

**Keywords:** Intake, digestibility, nitrogen balance, *Sorghum bicolor* hay and concentrate

### Introduction

Livestock plays a significant role in the economy of the developing and developed countries; supporting agriculture in form of critical inputs, contributing to the health and nutrition of the household,

supplementing incomes, offering employment opportunities and being a dependable source of high quality meat. Goat production is an integrated economic activity which contributes 55% of the total number of ruminant livestock in Nigeria

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(Ahamefule, 2005). Lawal-Adebowale (2012) ranked goat as the nation's greatest supplier of animal protein (34.5 million goats, 22.1 million sheep and 13.9 million cattle). However, goat production has been hampered primarily by the high cost and unavailability of good quality and quantity of feed (Onwuka, 1999). During the dry season, the little forage and natural pastures available are low in quantity and quality, hence lacks the essential nutrients required for increased rumen microbial fermentation and results to weight losses, low birth weights, lowered resistance to diseases, poor digestibility and overall poor performance of the animal (Jiwuba *et al.*, 2016). Recent researches are therefore geared towards the use of cheaper and readily available alternative feed resources that can possibly provide all season supplements for ruminants. Sources of cheaper high quality alternative forages for ruminant livestock production have been a subject of research in the recent years (Alan *et al.*, 2013), especially for small scale livestock producers in tropical areas during the dry season.

Sorghum is adapted to a wide range of environmental conditions and hence is widely grown in different ecological zones of Nigeria especially in the drier ecological zones (Aba *et al.*, 2004). It has a number of morphological and physiological characteristics that contribute to its adaptation to dry conditions. These include: an extensive root system, waxy bloom on the leaves that reduces water loss, ability to stop growth in periods of drought and resume when conditions are favourable as well as tolerance to some level of water-logging (FAO, 1995). The crop equally grows on a wide range of soils: sand, loam, sandy loam, saline and alkaline soils with a pH range of 4.0-8.5 (Aba *et al.*, 2004).

Small ruminants are usually reared with the

aims of getting products such as meat, milk, wool and skin. The four products assume varying degrees of importance in different countries, depending on the existing agro-ecological conditions, production system, choice or interest of the producers (Paez Lama *et al.*, 2013). However, out of these four products, meat is the most important preferred product, especially in Nigeria where there is no taboo against consumption of goat meat (Alikwe *et al.*, 2011).

Despite the availability of information on general feeding management of goats, there is little information on the effective utilisation of *Sorghum bicolor* hay in the feeding of Red Sokoto bucks. Therefore, there is a need to evaluate the use of *Sorghum bicolor* hay as a feed resource, so as to address the lingering feed shortages under the smallholder production systems. In order to achieve that, *Sorghum bicolor* hay supplemented with concentrate was used in this study to investigate the possibility of improving the productivity of Red Sokoto bucks under the smallholder production system at least cost. Hence, this study was conducted to determine the dry matter intake, nutrient digestibility and nitrogen retention in growing Red Sokoto bucks fed *Sorghum bicolor* hay supplemented with concentrate.

### ***Materials and methods***

#### ***Experimental site***

The experiment was conducted at the experimental unit of Small Ruminant Research Programme, National Animal Production Research Institute (NAPRI) Shika, Ahmadu Bello University, Zaria. The farm is located on Latitude 11°12' W, Longitude 07°33' E at an altitude of 660m above sea level, along Zaria-Funtua Road in the Northern Guinea Savanna zone of Nigeria (Ovimap, 2015). The climate is characterised by a defined wet and dry

season. Wet season starts from April to early May and ends in late September to early October while the dry season lasts from October to April. The total annual rainfall ranges from 748.6–1156.7 mm with a long-term average of 1058.60 mm. Maximum air temperature of 37°C are recorded in May and minimum air temperature of 11.5°C recorded in December/January and relative humidity of approximately 70% during the rainy season (IAR, 2016).

**Hay preparation**

Forage materials were harvested from the farm at 14 weeks after sowing using machete. The harvested forage materials were chopped to 2 cm with machete and allowed to air-dry under a shade and stored in jute bags. The cured forage was chopped with a forage chopper at the Engineering Unit of Division of Agricultural Colleges (DAC), Samaru, Ahmadu Bello University, Zaria. The harvested forages were used as basal diet for nutrient digestibility studies in growing Red Sokoto bucks.

**Experimental animals and their management**

Eight growing Red Sokoto bucks weighing between 15±1.0 kg were used for the experiment with each goat serving as a replicate. The goats were sourced from Small Ruminants Research Programme NAPRI, Zaria. Each goat was placed in a separate metabolic cage. The pen, metabolic cages, feeding troughs and drinkers were thoroughly washed and disinfected before the arrival of the goats. The goats were dewormed with albendazole oral suspension at 1 mL per kg and treated against any sign of disease during the adjustment period of 14 days.

**Experimental design, treatments and feeding**

The bucks were initially balanced for their weights and allotted to two dietary treatments with four goats per treatment in a completely randomised design experiment. The composition of the concentrate supplement is shown in Table 1. The experimental treatments (Table 2) were sole sorghum forage (100:0) and sorghum forages + concentrates (60:40). The costs of ingredients and feeds were determined.

**Table 1: Composition of concentrate supplement fed to Red Sokoto bucks**

Ingredients	Percentage (%)
Maize	40.0
Wheat offal	31.5
Cotton seed cake	25.0
Bone meal	2.5
Salt	1.0
<b>Total</b>	<b>100.0</b>
<b>Calculated analysis (%)</b>	
Crude protein	13.63
Metabolisable energy (Kcal/kg)	2679.00
Cost/ Kg (₦)	126.58

**Table 2: Proximate composition of experimental feedstuff**

Parameter (%)	T <sub>1</sub>	T <sub>2</sub>
Dry matter	95.20	93.38
Crude protein	5.36	16.13
Crude fibre	28.66	18.40
Ether extract	2.14	3.19
Ash	2.36	6.56
NFE	61.48	55.72
ADF	29.87	20.06
NDF	52.22	38.67

NFE = Nitrogen Free Extract, ADF = Acid Detergent Fibre, NDF = Neutral Detergent Fibre, T<sub>1</sub> = Sole Sorghum Forage Diet, T<sub>2</sub> = Sorghum Forages + Concentrates (60:40)

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### **Digestibility and nitrogen balance study**

The bucks were housed in individual metabolism crates ideal for easy collection of urine and faeces as described by Osuji *et al.* (1993). Four bucks were assigned to each of the experimental diet and fed once daily in the morning. Each goat was given 3.5% of its body weight of feed daily and water was given without restriction. For treatment 2 (60 % *Sorghum bicolor* hay: 40 % concentrate) the concentrate was fed first and then the forage given after the concentrate has been consumed. The bucks were fed the experimental diets for 21 days. The first 14 days were for acclimatisation and then followed with faecal and urinary collections for the subsequent seven days of digestibility study (Osuji *et al.*, 1993).

Feed intake of the goats was determined by subtracting the refused feed (ort) from the total feed offered daily. Total faecal output from individual goats was collected daily in the morning, weighed, mixed thoroughly and 10% sub sample taken for DM determination. The total faecal samples collected over the seven days period were bulked and sub sampled for laboratory analysis. The total urine output for 24 hours was collected from individual goat for a period of 7 days. This was done by using graduated plastic containers containing 10mls 0.1N H<sub>2</sub>SO<sub>4</sub> which was placed under metabolism crates. 10% of the daily urine output (aliquot) was taken from each buck and the total bulked and stored in a freezer at 0°C (Osuji *et al.*, 1993).

### **Laboratory analysis**

Faeces were analysed for dry matter (DM), crude fibre (CF), crude protein (CP), ether extract and ash using the AOAC (2005) procedure. Nitrogen Free Extract (NFE) was calculated by difference NFE = 100 – (CF + CP + EE + Ash). Acid detergent fibre (ADF) and neutral detergent fibre (NDF)

were determined according to the method of Van-Soest *et al.* (1991). Urine was analysed for urinary nitrogen and crude protein using Kjeldahl procedure (AOAC, 2005). Samples of experimental diets, orts and faeces were ashed by charring in Muffled Furnace at 500°C for 6 hours. Organic matter (OM) was obtained as the difference between the dry matter and ash content.

### **Statistical analysis and models**

Data collected on daily nutrient intake and coefficients of apparent digestibility were analysed by ANOVA using General Linear Model Procedure of SAS (2005). Significant treatment means were separated using Duncan Multiple Range Test (Duncan, 1955) of the SAS package.

Model:

$$Y_{ij} = \mu + I_j + E_{ij}$$

Where:

Y<sub>ij</sub> = Record of observations

μ = Population mean

I<sub>j</sub> = Effect of treatment (j = 1, 2)

E<sub>ij</sub> = Random error

## **Results and discussion**

**Chemical composition and metabolisable energy of the experimental diets fed to growing Red Sokoto bucks:** The proximate composition of the experiment diets (*Sorghum bicolor* hay/concentrate) mixture and concentrate supplement used in the experiment is presented in Table 3. The concentrate supplement used for the experiment had a CP content of 18.94 %, DM of 91.11 %, OM content of 85.22 %, CF of 8.01 %, NFE of 62.56 % and ME of 11.68 MJ/kg DM.

The DM contents of the experimental diets containing *Sorghum bicolor* hay/concentrate mixtures at 100:0 and 60:40 ratio are 95.20 % and 93.38 %, respectively. The CP content was 5.36 % in 100:0 diet and 16.13 % in 60:40 diet. The CF content was 28.66 % in 100:0 and 18.40 % in 60:40. Ether extract and

ash contents for 100:0 and 60:40 were 2.14 and 3.19 % and 2.36 and 6.56 %, respectively. The NFE content was 61.48 and 55.72 % for 100:0 and 60:40, respectively. The ME contents were similar in all treatments with 11.53 MJ/kg DM in 100:0 and 11.56 MJ/kg DM in 60:40. However, the highest values of 29.87 % acid detergent fibre, 52.22 % neutral detergent fibre and 16.70 % lignin were observed in 100:0 diet. While low values of 20.06 % acid detergent fibre, 38.67 % neutral detergent fibre and 8.44 % lignin were observed in 60:40 diet.

The DM content of *Sorghum bicolor* hay/concentrate mixtures were above 91.0%. This might be due to the fibrous nature of the sorghum forage and cotton seed cake. The value of DM observed was higher than 92.5 and 91.56 % reported by Ishiaku (2016) for sole *Sorghum almum*. The CP content of *Sorghum bicolor* hay/concentrate mixture increased with the inclusion of concentrate. The CP ranged

from 5.36-16.13 % in sole *S. bicolor* hay and *S. bicolor* hay supplemented with concentrate. Crude protein is one of the quality parameters used in pasture evaluation. The CP values reported in this study for 100:0 was lower than the requirement of 10-12 % CP for sheep and goats (Wada *et al.*, 2016) but above the requirement in 60:40 diet. The low CP for 100:0 may be attributed to the stage at harvest of the forage because CP content reduces as the plant advanced in age while the cotton seed cake in the concentrate is responsible for the high CP in 60:40 diet. The CF and its fractions of the diets were greater than the report of Ishiaku (2016) probably due to varietal difference. The neutral detergent fibre (NDF) was below 60.0% suggested by Muia (2000) as critical limit for efficient utilisation of roughages. The ME obtained ranged from 11.53-11.56 MJ/kg but lower than 12.17 MJ/kg when compared with the ME of sole sorghum reported by Ishiaku (2016).

**Table 3: Chemical composition and metabolisable energy of experimental diets fed to growing Red Sokoto bucks**

Parameter (%)	<i>Sorghum bicolor</i> : concentrate		
	100:0	Concentrate	60:40
Dry matter	95.20	91.11	93.38
Organic matter	92.84	85.22	86.82
Crude protein	5.36	18.94	16.13
Crude fibre	28.66	8.01	18.40
Ether extract	2.14	4.60	3.19
Ash	2.36	5.89	6.56
Nitrogen free extract	61.48	62.56	55.72
ME (MJ/kg)	11.53	11.68	11.56
Acid detergent fibre	29.87	26.12	20.06
Neutral detergent fibre	52.22	48.37	38.67

ME (MJ/kg DM) = 11.78 + 0.0064 CP + (0.00065 EE)<sup>2</sup> - CF (0.00414 EE) - 0.0118 A (Alderman, 1985)

**Dry matter intake of growing Red Sokoto bucks fed *Sorghum bicolor* hay: concentrate ratio**

The DM intake of growing Red Sokoto bucks is presented in Table 4. The DM intake of concentrate, forage hay and total dry matter intake were significantly

(p<0.05) different across dietary treatments. Concentrate DM intake was 200.0 g/day for 60:40. Hay DM intake was 353.57 g/day which was higher for 100:0 while 60:40 had 224.64 g/day. However, total dry matter intake recorded in 60:40 diet was 17 % higher (p<0.05) than that of 100:0 diet.

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Water intake obtained in 60:40 diet was 12% higher than that of 100:0 diet.

Dry matter intake (Table 4) is an important factor in the utilisation of feeds and a critical determinant of energy and performance in small ruminants (Devant *et al.*, 2000; Abdu *et al.*, 2015). The mixture of *sorghum bicolor* hay/concentrate of 60:40 seemed more acceptable to the bucks. The variations observed in feed intake may be as a result of improvement in the nutrient composition of the feed which enhanced rumen microorganism profile and

encouraged a more rapid and thorough digestion of ingesta leading to assimilation. Lanyasunya *et al.* (2007) in a study in China reported that increase in intake is attributed to increase in nitrogen in the diet and available fermentable fibre. According to Olafadehon *et al.* (2014) nutrient intake is a function of dry matter intake. The water intake observed in this study (60:40) increased with increase in the dry matter intake because generally water intake increases with increase in CP content of the diet.

**Table 4: Dry matter intake of growing Red Sokoto bucks fed *Sorghumbicolor* hay: concentrate ratio**

Parameter	<i>Sorghumbicolor</i> : Concentrate		SEM	P-Value
	100:0	60:40		
Concentrate DM Intake (g/day)	-	200.0	-	<0.0001
Hay DM Intake (g/day)	353.57 <sup>a</sup>	224.64 <sup>b</sup>	18.62*	0.0027
Total DM Intake (g/day)	353.57 <sup>b</sup>	424.64 <sup>a</sup>	18.62*	0.0356
Water Intake (ml/day)	855.0 <sup>b</sup>	975.0 <sup>a</sup>	55.30*	0.1758

<sup>abc\*</sup>Means with different superscripts within rows differed significantly (p<0.05), SEM = Standard Error of Mean; DM=dry matter

### Apparent nutrient digestibility

The result of apparent nutrient digestibility study (Table 5) showed that there was significant (p<0.05) difference in digestibility of CP, CF, ash, NDF and ADF. The apparent digestibility coefficients of CF, NDF and ADF were significantly (p<0.05) higher in Red Sokoto bucks fed *Sorghum bicolor* hay: concentrate ratio of 100:0 compared to bucks fed 60:40 diet. On the other hand, the CP and ash digestibility coefficients in bucks fed 60:40 diet were 51 % and 69 % higher (p<0.05) than that of 100:0 diet. However, CF, ADF and NDF digestibility coefficients in bucks fed 100:0 diet were 6 %, 14 % and 16 % higher (p<0.05) than that of bucks fed 60:40 supplemented diet. There was no significant (p>0.05) effect of dietary treatment on DM, OM, EE and NFE digestibility coefficients.

The apparent digestibility of CP and ash were found to increase with concentrate supplementation (60:40) when compared

with sole *Sorghum bicolor* hay (100:0). This is attributed to the concentrate which had higher CP and therefore improved the digestibility of sorghum forage. The greater CF digestibility and its fractions obtained in this study for (100:0) might be as a result of high hay DM intake and low ether extract content of the diet because increase in fat content appears to decrease the digestibility of other nutrient especially carbohydrates and crude fibre.

### Nitrogen balance

The result of nitrogen balance study is presented in Table 6. The results showed that there were significant (p<0.05) differences in nitrogen balance parameters across all the treatments. There was an increase (p<0.05) in all parameters measured when concentrate was supplemented. There were 72 %, 19 %, 58 %, 31 %, 87 %, 91 %, 65 % and 51 % increase in nitrogen intake, faecal nitrogen loss, urinary nitrogen loss, total nitrogen outgo, nitrogen absorbed, nitrogen retained, nitrogen retained as % of intake and nitrogen

absorbed as % of intake in Red Sokoto bucks fed 60:40 diets when compared with Red Sokoto bucks fed 100:0 diet.

Nitrogen retention (Table 6) is the major indicator for assessing the protein nutritional status of ruminant livestock (Abdu *et al.*, 2012; Hassan *et al.*, 2016). It is also the proportion of nitrogen utilised by farm animals from the total nitrogen intake for the body process, hence the more nitrogen consumed and digested the more nitrogen retained and vice versa (Okeniyi *et al.*, 2010). The higher nitrogen absorbed and retained in bucks fed (60:40) *sorghum bicolor* hay/concentrate could be attributed to higher nitrogen intake of (10.96 g/day). It may be logical to infer that superior nitrogen absorbed and retained in the 60:40 hay/concentrate mixture compared to the control (100:0) might be due to the efficient nitrogen utilisation. Also, higher nitrogen

retention (7.55 g/day) observed in bucks fed 60:40 hay/concentrate mixture indicated the favourable role of concentrate in post ruminal nitrogen metabolism and utilisation compared to 100:0 (0.69 g/day). This provides the fermentable nitrogen for efficient synthesis of essential amino acids and positive nitrogen balance in Red Sokoto bucks (Trinh *et al.*, 2009; Hassan *et al.*, 2016). The nitrogen retention and absorbed as percentage intake were above 68.0 % higher than 47.98 % reported by Yashim *et al.* (2014) but lower than 95.84 % and 74.24 % reported by Wada *et al.* (2016) and Ishiaku (2016), respectively. Generally, the results of this study agreed with the findings of Hassan *et al.* (2016) and Abdu *et al.* (2015) who reported supplementation of protein source improved microbial nitrogen yield and retention with subsequent increase in the performance of growing Red Sokoto bucks.

**Table 5: Apparent nutrient digestibility of Red Sokoto bucks fed *Sorghum bicolor* hay: concentrate ratio**

Parameter (%)	<i>Sorghum bicolor</i> : Concentrate			P-Value
	100:0	60:40	SEM	
Dry matter	66.02	63.89	2.82 <sup>NS</sup>	0.6122
Organic matter	67.15	63.42	2.75 <sup>NS</sup>	0.3742
Crude protein	38.14 <sup>b</sup>	78.49 <sup>a</sup>	4.36*	0.0006
Crude fibre	92.34 <sup>a</sup>	87.25 <sup>b</sup>	1.08*	0.0156
Ether extract	79.45	80.66	2.69 <sup>NS</sup>	0.7627
Ash	21.45 <sup>b</sup>	70.04 <sup>a</sup>	6.00*	0.0012
Nitrogen free extract	53.59	47.22	4.06 <sup>NS</sup>	0.3095
Acid detergent fibre	71.46 <sup>a</sup>	59.67 <sup>b</sup>	3.61*	0.0604
Neutral detergent fibre	69.77 <sup>a</sup>	60.08 <sup>b</sup>	3.13*	0.0713

<sup>abc</sup>Means with different superscripts within rows differed significantly (p<0.05), SEM = Standard Error of Mean, NS = Not Significant

**Table 6: Nitrogen balance of Red Sokoto bucks fed *Sorghum bicolor* hay: concentrate ratio**

Parameter (g/day)	<i>Sorghum bicolor</i> : Concentrate			P-Value
	100:0	60:40	SEM	
Nitrogen intake	3.03 <sup>b</sup>	10.96 <sup>a</sup>	0.21*	<0.0001
Faecal nitrogen loss	1.90 <sup>b</sup>	2.36 <sup>a</sup>	0.20*	0.1527
Urinary nitrogen loss	0.45 <sup>b</sup>	1.06 <sup>a</sup>	0.20*	0.0722
Total nitrogen output	2.35 <sup>b</sup>	3.42 <sup>a</sup>	0.34*	0.0657
Nitrogen absorbed	1.14 <sup>b</sup>	8.60 <sup>a</sup>	0.20*	<0.0001
Nitrogen retained	0.69 <sup>b</sup>	7.55 <sup>a</sup>	0.33*	<0.0001
Nitrogen retained as % intake	23.87 <sup>b</sup>	68.76 <sup>a</sup>	6.71*	0.0032
Nitrogen absorbed as % intake	38.15 <sup>b</sup>	78.46 <sup>a</sup>	4.31*	0.0006

<sup>abc</sup>Means with different superscripts within rows differed significantly (p<0.05), SEM = Standard Error of Mean

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### Costs analysis

The result of costs analysis shown in Table 7 revealed a significant ( $p < 0.05$ ) increase in total costs per kilogram feed with increased concentrate supplement in the diet. The costs per kg of feed was significantly ( $p < 0.05$ ) higher (N78.13K) in bucks fed 60:40 diets while 100:0 diet has the least costs of (N45.83K). The costs of

feeding per buck (N/buck) was significantly ( $p < 0.05$ ) higher (N696.72K) in bucks fed 60:40 diet than 100:0 diet which recorded N340.29K.

High total cost per kg feed and costs of feeding per buck in 60:40 diet was attributed to the costs of ingredients used in formulating and compounding the concentrate which has high CP content.

**Table 7: Cost analysis of feeding *Sorghum bicolor* hay: concentrate mixture to Red Sokoto bucks under small holder system**

Parameter	<i>Sorghum bicolor</i> : Concentrate		SEM	P-Value
	100:0	60:40		
Cost/ kg of feed (₦)				
Concentrate	0.00 <sup>b</sup>	50.63 <sup>a</sup>	-	<0.0001
Hay	45.83 <sup>a</sup>	27.50 <sup>b</sup>	-	<0.0001
Total	45.83 <sup>b</sup>	78.13 <sup>a</sup>	-	<0.0001
Total DMI (g/day)	353.57 <sup>b</sup>	424.64 <sup>a</sup>	18.62	0.0356
Total feed consumed (kg)	7.43 <sup>b</sup>	8.92 <sup>a</sup>	0.39	0.0356
Cost of feeding (₦/ buck)	340.29 <sup>b</sup>	696.72 <sup>a</sup>	19.33	<0.0001

<sup>abcde</sup> Means with different superscripts within rows differed significantly ( $p < 0.05$ ), SEM = Standard Error of Mean, Cost of Concentrate = a, Cost of Hay = b, Total Cost = a + b = c, Total feed consumed (kg) = d, Cost of feeding (₦/ buck) = (c x d) = e; DMI= dry matter intake

### Conclusion

The results of this study showed that feeding *Sorghum bicolor* hay alone was not adequate to meet the nutritional need of Red Sokoto bucks. However, supplementation of *S. bicolor* hay with concentrate at 60:40 ratio increased dry matter intake, nutrient digestibility and nitrogen retention. Notwithstanding, supplementing *S. bicolor* hay with concentrate at 60:40 was more expensive than sole *S. bicolor* hay (100:0). Thus, it could be recommended that *Sorghum bicolor* hay supplemented with concentrate at 60:40 ratio be fed to Red Sokoto bucks for better DM intake, nutrient digestibility and nitrogen retention.

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