Effect of feeding regime on growth performance of growing Yankasa rams fed basal diet of sorghum hay or silage supplemented with concentrate

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Abstract

Smallholder farmers in sub-Saharan Africa offer their stocks little or no supplementary feed but depend mostly on native pastures which are in low nutrient quality. The study was aimed at evaluating the effect of feeding regime on growth performance, nutrient metabolism, rumen indices and economics of production of Yankasa rams fed basal diets of grain sorghum hay or silage supplemented with concentrate. Sixteen growing Yankasa rams weighed 17.0 ± 0.2 kg were randomly assigned to four feeding regime treatment: T_1 = Sorghum hay + concentrate daily, T_2 = Sorghum silage + concentrate daily, T_3 = Sorghum silage + concentrate after 1-day and T_4 = Sorghum silage + concentrate after 2-days. The parameters measured were hay intake, concentrate intake, total feed intake, daily feed intake, initial weight, final weight, weight gain, daily weight gain, feed conversion ratio (FCR), apparent nutrient digestibility, nitrogen balance and costs-benefit. The result showed that hay intake (25.28 – 29.23 kg), concentrate intake (6.19 – 19.41 kg), total feed intake (35.41 – 48.47 kg), daily weight gain (0.04 – 0.05 kg) and weight gain (2.85 – 3.35 kg) were significantly ($P < 0.05$) affected by the feeding regime with rams fed silage + concentrate daily recording higher values. Better FCR was obtained in rams fed silage + concentrate after 2-days. Dry matter (79.22%), crude protein (85.59%), NDF (75.30%) and ADF (78.02%) digestibility coefficients were higher ($P < 0.05$) for rams fed silage + concentrate after 1-day (every other day). The percentage of nitrogen absorbed and retained were higher ($P < 0.05$) in rams fed silage + concentrate after 1-day (85.62 and 82.72%, respectively). The cost per kg gain of N1046.40 for rams fed hay + concentrate daily was significantly ($P < 0.05$) lower than the cost per kg gain of other feeding regimes. It can be concluded that sorghum silage could be fed alongside concentrate daily for improved feed intake and weight gain, but for better cost-efficiency, it is recommended that farmers should feed hay and supplement concentrate daily to rams.

Keywords: Concentrate, Feeding regime, Growth, Hay, Silage, Sorghum and Performance

L' Effet du régime alimentaire sur la performance de croissance des beliers 'yankasa' en croissance nourris au régime basal de foin de sorgho ou d'ensilage complétés par du concentré

Résumé

Les petits exploitants agricoles d'Afrique subsaharienne offrent peu ou pas d'aliments

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supplémentaires à leurs stocks, mais dépendent principalement de pâturages indigènes de faible qualité nutritive. L'étude visait à évaluer l'effet du régime alimentaire sur la performance de croissance, le métabolisme des nutriments, les indices rumen et l'économie de la production de béliers Yankasa nourris à des régimes basaux de foin de sorgho de grain ou d'ensilage complétés par du concentré. Seize béliers Yankasa en croissance pesaient $17,0 \pm 0,2$ kg ont été assignés au hasard à quatre traitements du régime alimentaire : T1 = foin de Sorgho + concentré tous les jours, T2 = ensilage de Sorgho + concentré tous les jours, T3 = ensilage de Sorgho + concentré après 1 jour et T4 = ensilage de Sorgho + concentré après 2 jours. Les paramètres mesurés étaient l'apport en foin, l'apport en concentré, la consommation totale d'aliments pour animaux, l'apport quotidien en aliments pour animaux, le poids initial, le poids final, le gain de poids quotidien, le rapport de conversion des aliments pour animaux (FCR), la digestibilité apparente des éléments nutritifs, l'équilibre azoté et les coûts-avantages. Le résultat a montré que l'apport en foin (25,28 à 29,23 kg), l'apport en concentré (6,19 à 19,41 kg), la consommation totale d'aliments (35,41 à 48,47 kg), le gain de poids quotidien (0,04 à 0,05 kg) et le gain de poids (2,85 à 3,35 kg) ont été considérablement ($P < 0,05$) affectés par le régime d'alimentation avec des béliers nourris à l'ensilage + concentré enregistrant quotidiennement des valeurs plus élevées. Un meilleur FCR a été obtenu dans l'ensilage alimenté par bétail + concentré après 2 jours. Matière sèche (79,22 %), protéines brutes (85,59 %), NDF (75,30 %) et ADF (78,02%) les coefficients de digestibilité étaient plus élevés ($P < 0,05$) pour les béliers nourris à l'ensilage + concentré après 1 jour (tous les deux jours). Le pourcentage d'azote absorbé et retenu était plus élevé ($P < 0,05$) chez les béliers nourris à l'ensilage + concentré après 1 jour (85,62 et 82,72 %, respectivement). Le gain par kg de N1046,40 pour les béliers nourris quotidiennement au foin + concentré était significativement ($P < 0,05$) inférieur au coût par kg de gain des autres régimes alimentaires. On peut conclure que l'ensilage de sorgho pourrait être alimenté aux côtés du concentré quotidien pour améliorer l'apport alimentaire et le gain de poids, mais pour une meilleure rentabilité, il est recommandé que les agriculteurs nourrissent le foin et complètent le concentré quotidiennement aux béliers.

Mots-clés: Concentré, Régime alimentaire, Croissance, Foin, Ensilage, Sorgho et Performance

Introduction

Productivity of small ruminants in many tropical areas is often poor because they are subjected to various kinds of diseases, poor feeding and housing management techniques. Survey reports (Shiawoya and Tsado, 2011; Adeleke, 2015) indicated that smallholder farmers that own over 70% of the livestock population in sub-Saharan Africa offer their stocks little or no supplementary feed but depend mostly on native pasture. Yet because of low nutrient quality, pasture alone and more specifically tropical grasses cannot provide growing animals sufficient amount of energy to attain appropriate growth rate for higher

slaughter weight and dressing percentage (Humphreys, 1991). Several works had shown that young animals raised on forages alone had lower daily gains, dressing percentage and carcass quality than those supplemented with concentrate (Johson *et al.*, 2005; Adeleke, 2015).

Sheep and goats are domestic animals that have been associating with humans for a very long time. In traditional setting, they serve as means of ready cash and a reserve against economic and agricultural production hardship (Hamito, 2008). They play a significant role in the food chain and overall livelihoods of rural households, where they are largely the property of

women and their children (Lebbie, 2004). They are good producers of meat for human consumption. The short gestation interval of sheep and goats and the absence of religious bias against their meat (Ozung *et al.*, 2011) are among the reasons why they are kept by peoples of various cultures, religions and races.

Concentrate feeds promote rapid growth of sheep and cattle (McDonald *et al.*, 1996), increase propionate production and reduce ruminal methane production, thereby lowering energy losses and contributing to higher overall efficiency of utilization of dietary energy for body weight gain (Mandebvu and Galbraith, 1999). According to Mtenga and Kitalyi (1990), increase in meat output resulting from concentrate supplementation can improve access to animal protein and income to households in the traditional sector. The appropriate ratio of concentrate to roughage to be fed to ruminants had been studied (Zervas *et al.*, 1999). A ratio of 40:60% concentrate to hay had been recommended (Liu *et al.*, 2005). Feeding regime is used to describe a regulated system/pattern of what meals are being offered, how frequently they are offered, what sequence is followed, and during which particular period they are offered. Studies done by Yashim (2014) indicated that feeding every other day was better than feeding daily in terms of total feed intake, weight gain and decrease in methane nitrogen losses. Adeoye (2018) reported that feeding Yankasa rams supplements containing Shea-nut cake either daily or every other day resulted in similar weight gained. The author further reported that daily supplementation of Yankasa rams resulted in better digestibility of crude protein, ether extract and higher nitrogen retention than every other day supplementation. Hence, the study on the effect of feeding regime on growth performance, nutrient digestibility, nitrogen balance and costs-benefits of

growing Yankasa rams fed a basal diet of grain sorghum hay or silage supplemented with concentrate.

Materials and methods

Experimental site

The experiment was conducted at the Sheep Unit Teaching and Research Farm, of the Department of Animal Science, Ahmadu Bello University, Zaria, Kaduna State. Zaria is located between two latitude of 11° 14' 14"N and two Longitude 7° 38' 65"E at an altitude of 610m above sea level (Ovimaps, 2016), within the Northern Guinea Savanna Zone of Nigeria. The climate is relatively dry with a mean annual rainfall of 700-1400mm. The rain starts between late-April and early-May to mid-October. The dry season begins around the middle of October, with cold weather that ends in February. This is followed by relatively hot-dry weather between March and April just before the rain begins. The mean maximum daily temperature ranges from 14 °C to 24 °C during the cold season while the mean maximum daily temperature ranges from 19 °C to 36 °C during the hot season. The mean relative humidity during dry and wet seasons is 21% and 72%, respectively (IAR, 2016).

Silage preparation

Samsorg-17 grain sorghum planted on the 15th June, 2019 was conserved as silage. The sorghum plants were harvested at soft dough stage with the aid of forage chopper and harvester. The sorghum was chopped after which they were compressed in PICs (Purdue Improved Crop Storage) bags and properly tied so as to allow anaerobic fermentation process. The bags were stored until required for feeding.

Experimental animals and their management

Sixteen growing Yankasa rams aged between 12 and 15 months with an average body weight of 17.0±0.20 kg were used for the study. The animals were purchased from

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Anchau market, Kaduna State. The animals were given prophylactic treatment against internal and external parasites. All rams received 0.1 mg/kg body weight of *Tetranor* (*Oxytetracycline Dehydrate*, 20% weight/volume injectable solution). Other routine management practices were carried out and deworming against intestinal parasites using *Albendazole*® 10% solution was administered orally. *Amitics*® solution was sprayed on the animals using Knapsack sprayer against external parasites prior to the commencement of the study. The animals were pen-housed individually to protect them from sun. The pens were cleaned daily.

Experimental design, treatments and feeding

The rams were balanced for their weights and allotted to four dietary treatments with four rams per treatment in a completely randomized design. Grain sorghum hay and silage supplemented with concentrate were used at 60:40 hay/concentrate ratio. The composition of the concentrate supplemented is shown in Table 1. The rams were pen-fed individually at 4 % of their body weight for a period of 90 days. Feeding regime was used as the treatment consisted of T_1 = Sorghum hay + concentrate supplemented daily, T_2 = Sorghum silage + concentrate supplemented daily, T_3 = Sorghum silage + concentrate supplemented after every other day and T_4 = Sorghum silage + concentrate supplemented after two days. Feed was offered once in the morning at 8:00 am. Daily records of feed offered and left-over were recorded to determine the voluntary feed intake. Water was provided *ad-libitum* to the rams. During the experiment, rams were weighed fortnightly to determine their live weight changes and adjust for feed offered accordingly.

Metabolism study

At the end of the feeding trial, three rams from each of the treatment groups were

randomly selected and housed in individual metabolism crates ideal for easy collection of urine and faeces as described by Osuji et al. (1993). The rams were maintained on the same treatment diets fed in the feeding trial. The animals were allowed 14 days adjustment period to the feed and crates then followed by 7 days collection period for urine and faeces. The orts of previous day's feed was collected and weighed each morning at 8:00 am.

The total faecal output from individual animals was collected daily in the morning, weighed; mixed thoroughly and 10% sub sample was taken for dry matter determination. The total faecal sample was collected over the 7 days period, bulked and sub sampled for laboratory analysis after treating with 20% formaldehyde to prevent further bacterial activity. The total urine output for 24 hours was collected from individual animal for a period of 7 days. This was done using graduated plastic containers containing 10ml of 0.1M H_2SO_4 which was placed under the metabolism crates. An aliquot (10%) of the daily urine output was taken from each ram, bulked and stored in a freezer at (0°C) until required for analyses as described by Osuji *et al.* (1993).

Costs-benefit analysis

Costs-benefit analysis was carried out to determine the profitability of feeding growing Yankasa rams basal diet of grain sorghum hay or silage supplemented with concentrate at different feeding regimes. Parameters considered included cost of concentrate, total concentrate intake, cost of hay, total hay or silage intake, total feed cost per ram, live weight gain and cost per gain. All calculations of feed cost and output were based on averages per head, and at the prevailing prices.

Chemical analysis

Samples of the feed offered, orts and faeces were analyzed for proximate components of all the samples to determine dry matter and Nitrogen (N) for crude protein

determination (Nx6.25) according to AOAC, (2005) in the Biochemical Laboratory, Department of Animal Science, A. B. U., Zaria. Neutral detergent fibre (NDF) and acid detergent fibre (ADF) were determined by the method of van-Soest *et al.* (1991) in the Central Laboratory of NAPRI, Shika, Zaria, Nigeria.

Statistical analysis

Data collected on daily feed intake, average daily gain, final weight, coefficient of nutrient digestibility, nitrogen retention, rumen metabolites, and cost-benefit analysis were analyzed using the General Linear Model Procedure of SAS (2005). Significant means were compared using the Duncan's Multiple Range Test (Duncan, 1955).

Table 1: Ingredient composition of concentrate supplement fed to growing Yankasa rams

Ingredients	Percentage (%)
Maize offal	40.00
Wheat offal	31.50
Cotton seed cake	25.00
Bone meal	2.50
Salt	1.00
Total	100.00
<i>Calculated analysis (%)</i>	
Crude Protein	13.63
Metabolizable energy (kcal/kg)	2679.00
Cost/kg diet (₦)	93.40

Results and discussion

Chemical composition of the experimental diets fed to growing Yankasa rams

Chemical composition of the experimental diets fed to growing Yankasa rams (Table 2) revealed that the dry matter (DM) contents of the concentrate, hay and hay + concentrate daily were above 91.0 %. This might be due to dryness of the concentrate and fibrous nature of the hay. The value of DM observed in this study for the silage was higher than 57.00 and 68 % reported by Adewumi (2019) for indigenous sweet sorghum and Samsorg-17 silages. The crude protein contents reported in this study were above 10 – 12 % CP requirement for sheep and goats (Wada *et al.*, 2016). The neutral detergent fibre (NDF) was below the 60.00% suggested by Muia (2000) as critical limit for efficient utilization of roughages. The acid detergent fibre (ADF) reported was below 30.00% thus indicating that the diets were of very good quality in

line with the report of Blezinger (1999).

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Effect of feeding regime on growth performance of growing Yankasa rams fed a basal diet of grain sorghum hay or silage supplemented with concentrate is presented in Table 3. Diets containing silage were consumed better than the diet which contained hay. Consumption of concentrate by rams fed silage + concentrate daily was 7.93%, 45.03% and 68.11% higher than rams fed hay + concentrate daily, silage + concentrate supplement after every other day and silage + concentrate supplement after 2-days. Total feed intake by rams fed silage + concentrate daily was 10.98%, 18.75% and 26.94% higher than rams fed hay + concentrate daily, silage + concentrate supplement after every other day and silage + concentrate supplement

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after 2-days. However, the findings disagree with the result obtained by Fadel-Elseed (2004) who stated that intake of dry matter was not influenced by feeding frequency of protein supplement. The significant ($P<0.05$) increase in intake by rams fed concentrate supplement daily could be as result of the daily supplementation of the concentrate. Weight gain for rams fed silage + concentrate daily was 6.57%, 8.06% and 14.93% higher than rams fed silage + concentrate supplement after every other day, silage + concentrate supplement after 2-days and hay + concentrate daily, respectively. It also disagrees with Yashim (2014) who obtained

a higher ($P<0.05$) weight gain and the average daily gain for skip-a-day frequency when *Ficus sycomorus* leaf meal was fed to Yankasa sheep. The significantly ($P<0.05$) higher weight gained by rams fed silage + concentrate daily may be attributed to the amount of feed consumed by the rams and the better utilization of the feed by the rams. Better performance of the rams fed silage + concentrate supplementation after every other day and after 2-days when compared with rams fed hay + concentrate daily despite their high intake of feed revealed the better feed conversion ratio of the feeds with much retention time of the diet in the gastro intestinal tract (GIT).

Table 2: Chemical composition of the experimental diets fed to growing Yankasa rams

Parameters (%)	Concentrate	Hay	Silage	Hay + Conc daily	Silage + Conc daily	Silage + Conc Skip-a-day	Silage + Conc Skip-2-days
Dry matter	97.31	94.41	75.36	95.57	84.14	84.14	84.14
Crude protein	14.77	11.35	10.42	12.72	12.16	12.16	12.16
NDF	14.66	70.03	54.01	47.88	38.27	38.27	38.27
ADF	2.64	39.90	40.32	25.00	24.19	24.19	24.19

NDF = Neutral detergent fibre, ADF = Acid detergent fibre

Table 3: Effect of feeding regime on growth performance of growing Yankasa rams fed a basal diet of grain sorghum hay or silage supplemented with concentrate

Parameters (kg)	Feeding Regime				SEM
	Hay + Conc daily	Silage + Conc daily	Silage + Conc Skip-a-day	Silage + Conc Skip-2-days	
Hay Intake	25.28 ^b	29.06 ^a	28.71 ^a	29.23 ^a	0.67*
Concentrate Intake	17.87 ^b	19.41 ^a	10.67 ^c	6.19 ^d	0.39*
Total Feed Intake	43.15 ^b	48.47 ^a	39.38 ^c	35.41 ^d	1.04*
Daily Feed Intake	0.65 ^b	0.73 ^a	0.60 ^c	0.54 ^d	0.02*
Initial Weight	18.75	18.75	18.75	18.88	0.43 ^{NS}
Final Weight	21.60	22.10	21.88	21.95	0.40 ^{NS}
Weight Gain	2.85 ^c	3.35 ^a	3.13 ^b	3.08 ^b	0.08*
Daily Weight Gain	0.04	0.05	0.05	0.05	0.01 ^{NS}
FCR	15.40 ^b	14.54 ^b	12.76 ^a	11.65 ^a	0.57*

^{abcd}Means with different superscript within rows differed significantly ($P<0.05$), SEM = Standard error of mean, NS = Non- significant, FCR = Feed conversion ratio

Apparent nutrient digestibility by growing Yankasa rams fed a basal diet of grain sorghum hay or silage supplemented with concentrate as influenced by feeding regime

Feeding regime significantly ($P<0.05$)

influenced the apparent nutrient digestibility by growing Yankasa rams (Table 4). Dry matter digestibility coefficient obtained in this study for rams fed silage + concentrate

supplement after every other day was 5.64%, 6.32% and 8.62% higher ($P<0.05$) than rams fed silage + concentrate supplement daily, silage + concentrate supplement after 2-days and hay + concentrate daily. Similar trend was observed for crude protein, in which the digestibility coefficient for rams fed silage + concentrate supplement after every other day was 4.36%, 4.49% and 7.26% higher ($P<0.05$) than rams fed silage + concentrate supplement daily, silage + concentrate supplement after 2-days and hay + concentrate daily. Higher digestibility values obtained could be attributed to the crude protein content of the diet which in turn improved the digestibility of the diet (Abdu *et al.*, 2015; Hassan *et al.*, 2016). Higher apparent digestibility of the nutrients (dry matter, crude protein, NDF and ADF) for rams fed silage + concentrate supplement after every other day and silage + concentrate supplement daily may be responsible for the higher weight gained by the animals in these treatments. The digestibility coefficients recorded in this study for the rams were higher than the values reported by Adewumi (2019)

for Red Sokoto goats fed concentrate + indigenous sweet sorghum silage and concentrate + Samsorg-17 sorghum silage.

Effect of feeding regime on nitrogen retention of growing Yankasa rams fed a basal diet of grain sorghum hay or silage supplemented with concentrate

Effect of feeding regime on nitrogen retention of growing Yankasa rams fed a basal diet of grain sorghum hay or silage supplemented with concentrate is presented in Table 5. Nitrogen retention is the major indicator used to assess the protein nutritional status of ruminant livestock (Abdu *et al.*, 2012; Hassan *et al.*, 2016). All animals were in positive nitrogen balance which indicates that growing Yankasa rams received adequate amounts of nitrogen from the diets fed. Higher ($P<0.05$) nitrogen absorbed and retained and as percentage of the intake in rams fed both silage + concentrate daily and silage + concentrate after every other day were in agreement with the report of Sarwar *et al.* (2003) and Bello (2017) which suggested that nitrogen retention depends on good digestibility of nutrients and/or utilization. Also, nitrogen excreted in the faeces and urine is related to the digestion and absorption of nitrogen. High excretion of urinary nitrogen is associated with high rumen nitrogen degradability (McDonald *et al.*, 2002).

Table 4: Apparent nutrient digesti bility by growing Yankasa rams fed a basal diet of grain sorghum hay or silage supplemented with concentrate as influenced by feeding regime

Parameters (%)	Feeding Regime				SEM
	Hay + Conc daily	Silage + Conc daily	Silage + Conc Skip-a-day	Silage + Conc Skip- 2-days	
Dry matter	72.39 ^c	74.75 ^b	79.22 ^a	74.21 ^b	0.87*
Crude protein	79.38 ^c	81.86 ^b	85.59 ^a	81.75 ^b	0.63*
NDF	72.83 ^a	75.28 ^a	75.30 ^a	67.86 ^b	1.24*
ADF	73.54 ^b	79.19 ^a	78.02 ^a	69.47 ^c	0.78*

^{abc}Means with different superscript within rows differed significantly ($P<0.05$), SEM = Standard error of mean, NDF = Neutral detergent fibre, ADF = Acid detergent fibre

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Table 5: Effect of feeding regime on nitrogen retention of growing Yankasa rams fed a basal diet of grain sorghum hay or silage supplemented with concentrate

Parameters (g/day)	Feeding Regime				SEM
	Hay + Conc daily	Silage + Conc daily	Silage + Conc Skip-a-day	Silage + Conc Skip-2-days	
Nitrogen Intake	13.38 ^d	21.62 ^a	20.65 ^b	18.17 ^c	0.41*
Faecal Nitrogen Loss	2.71 ^c	3.76 ^a	2.96 ^b	3.20 ^b	0.12*
Urinary Nitrogen Loss	0.95 ^a	0.92 ^a	0.56 ^b	0.72 ^{ab}	0.12*
Total Nitrogen Loss	3.65 ^b	4.67 ^a	3.52 ^b	3.92 ^b	0.22*
Nitrogen Absorbed	10.67 ^c	17.86 ^a	17.69 ^a	14.97 ^b	0.38*
Nitrogen Retained	9.73 ^c	17.13 ^a	16.95 ^a	14.25 ^b	0.44*
N ₂ Absorbed as % intake	79.41 ^c	82.71 ^b	85.62 ^a	82.41 ^b	0.66*
N ₂ Retained as % intake	72.16 ^c	78.56 ^b	82.72 ^a	78.44 ^b	1.22*

^{abcd}Means with different superscript within rows differed significantly (P<0.05), SEM = Standard error of mean

Costs-benefit analysis of growing Yankasa rams fed a basal diet of grain sorghum hay or silage supplemented with concentrate at different feeding regime

The variations obtained in the total concentrate intake and total hay intake was as a result of the feeding frequency of the concentrate. Higher (P<0.05) total feed cost of N4718.70 recorded for rams fed silage + concentrate daily was attributed to the amount of feed consumed and the cost of silage per kg (N100.00), while the low total feed cost obtained for rams fed hay + concentrate daily was attributed to the cost

of hay per kg (N50.00). The least cost per kg gain was recorded for rams fed hay + concentrate daily (N1046.40), followed by rams feed silage + concentrate after 2-days (N1151.50). This implies that when feeding sorghum silage, concentrate supplement should be administered after 2-days. This concurs with the findings of Adewumi (2019) who reported least cost per gain for Red Sokoto bucks fed concentrate + *Digitaria smutsii* hay against Red Sokoto bucks fed concentrate + indigenous sweet sorghum silage and concentrate + Samsorg-17 silage.

Table 6: Costs -benefit analysis of growing Yankasa rams fed a basal diet of grain sorghum hay or silage supplemented with concentrate at different feeding regime

Parameters	Feeding Regime				SEM
	Hay + Conc daily	Silage + Conc daily	Silage + Conc Skip-a-day	Silage + Conc Skip-2-days	
Cost of Conc. (₦/kg)	93.40	93.40	93.40	93.40	0.00 ^{NS}
Total Conc. Intake (kg)	17.87 ^b	19.41 ^a	10.67 ^c	6.19 ^d	0.39*
Cost of Hay/Silage (₦/kg)	50.00	100.00	100.00	100.00	0.00 ^{NS}
Total Hay/Silage Intake (kg)	25.28 ^b	29.06 ^a	28.71 ^a	29.23 ^a	0.67*
Total Hay/Silage Cost/ram (₦)	1263.90 ^b	2905.50 ^a	2870.80 ^a	2922.70 ^a	55.03*
Total Conc. Cost/ram (₦)	1669.30 ^b	1813.20 ^a	996.80 ^c	577.90 ^d	36.75*
Total Feed Cost/ram (₦)	2933.20 ^d	4718.70 ^a	3867.60 ^b	3500.60 ^c	88.67*
Live Weight Gain (kg)	2.85 ^c	3.35 ^a	3.13 ^b	3.08 ^b	0.08*
Cost/kg gain (₦)	1046.40 ^d	1415.30 ^a	1253.00 ^b	1151.50 ^c	47.23*

^{abcd}Means with different superscripts within rows differed significantly (P<0.05), SEM = Standard Error of Means, NS = Not significant, Cost of concentrate = a; Total concentrate intake = b; Cost of Hay = c; Total Hay intake = d; Total feed cost/ram = [(a * b) + (c * d)]; Cost/gain = Total Feed Cost / Weight gain

Conclusions

The study showed that improved total feed intake and weight gain were obtained in Yankasa rams fed silage supplemented with concentrate daily. Feeding Yankasa rams silage and concentrate supplement after every other day or after 2-days gave similar weight gain. Feeding silage and concentrate supplement after every other day boosted the digestibility of dry matter, crude protein, neutral detergent fibre and acid detergent fibre and led to an increase in the percentage of nitrogen absorbed and retained in Yankasa rams. The least cost per kg gain (N1046.40) was recorded in rams fed hay + concentrate daily. Also, when feeding sorghum silage, concentrate supplement should be administered after 2-days.

References

- Abdu, S. B., Adamu, H. Y., Hassan, M. R., Abdulrashid, M., Musa, A. and Yusuf, S. 2015. Effect of varying ratios of *Panicum maximum*: *Centrosema pascourum* mixtures on voluntary intake, nutrient digestibility and nitrogen balance of Red Sokoto bucks. *Journal of Animal Production Research*, 27: 162-169.
- Abdu, S. B., Ehoche, O. W., Adamu, A. M., Bawa, G. S., Hassan, M. R., Yashim, S. M. and Adamu, H. Y. 2012. Effect of varying levels of *Zizyphus* (*Zizyphus mauritiana*) leaf meal inclusion in concentrate diet on performance of growing Yankasa ram lambs fed maize stover basal diet. *Iranian Journal of Applied Animal Science*, 2(4): 253-256.
- Adeleke, R. A. 2015. Effect of sequence and interval of feeding concentrate supplement and roughage on performance of Yankasa weaner rams. MSc. Dissertation. Department of Animal Science, Ahmadu Bello University, Zaria. Pp 1-123.
- Adeoye, O. E. 2018. Growth response of Yankasa rams fed diets containing varying levels of shea nut cake at different feeding frequencies. MSc. Dissertation, Department of Animal Science, Ahmadu Bello University, Zaria. Pp 1-93.
- Adewumi, A. 2019. Growth, biomass and quality of two sorghum varieties (*Sorghum bicolor* L. Moench) ensiled and fed to Red Sokoto Bucks. Seminar paper presented at postgraduate seminar series, Department of Animal Science, Ahmadu Bello University, Zaria. Pp 1-25.
- AOAC 2005. *Official Method of Analysis*. International, Association of Official Analytical Chemists, 24th edition Washington D.C. USA. Pp 200-210.
- Bello, M. D. K. 2017. Growth and fattening performance of Yankasa rams fed complete diets containing urea and lime treated ground nutshell (*Arachis hypogaea*) shell. Ph.D Thesis, Department of Animal Science, Ahmadu Bello University, Zaria. Pp 1-167.
- Blezinger, S. 1999. Developing sound forage analyses program.
- Duncan, D. B. 1955. Multiple range and multiple F-test. *Biometrics*, 11: 1-42.
- Fadel-Elseed, A. M. A. 2004. Effect of supplemental protein feeding frequency on ruminal characteristics and microbial N production in sheep fed treated rice straw. *Small Ruminant Research*, 57(1): 11-17.
- Hamito, D. 2008. Preface. In: Hirpa, A. and

- Abebe, G. (Eds.), *Sheep and Goat Production Handbook for Ethiopia*. Pp. 5. Retrieved December 18, 2011, from <http://www.Inform.und.edu.EdRes>.
- Hassan M. R., Muhammad, I. R., Amodu, J. T., Jokthan, G. E., Abdul, S. B., Adamu, H. Y., Yashim, S. M., Taofik, I., Tamburawa, M. S. and Musa, A. 2016. Growth performance of Red Sokoto bucks fed graded levels of Lablab (*Lablab purpureus* L. Sweet) hay as supplemented to maize (*Zea mays*) stover basal diet. *Journal of Animal Production Research*, 28(1): 283-298.
- Humphreys, L. R. 1991. *Tropical Pasture Utilization*. Cambridge University Press, Cambridge, UK, Pp. 206.
- Institute for Agricultural Research 2016. Meteorological data. Meteorological unit, Ahmadu Bello University, Zaria, Kaduna. Nigeria.
- Johson, P. L., Purchas, R. W., Mcewan, J. C. and Blair, H. T. 2005. Carcass composition and meat quality differences between pasture-reared ewes and ram lambs. *Meat Science*, 71(2): 383-391.
- Lebbie, S. H. B. 2004. Goats under Household Conditions. *Small Ruminant Research*, 51: 131-136.
- Liu, X., Wang, Z. and Lee, F. 2005. Influence of concentrate level on dry matter intake, N balance, nutrient digestibility, ruminal flow rate, and nutrient degradability in sheep. *Small Ruminant Research*, 58(1): 56-62.
- Mandebyu, P. and Galbraith, H. 1999. Effect of sodium bicarbonate supplementation and variation in the proportion of barley and sugar beet pulp on growth performance and rumen, blood characteristics in young entire lambs. *Animal Feed Science and Technology*, 82: 37-49.
- McDonald P., Edwards R. A., Greenhalgh J. F. D. and Morgan C. A. 2002. *Animal Nutrition*. 6th Edition, Pearson Education LTD. Essex. UK.
- McDonald, P., Edward, R. A., Greenhalgh, J. F. D. and Morgan, C. A. 1996. *Animal Nutrition*. Longman Scientific and Technical, Harlow, UK. 155pp.
- Mtenga, L. A. and Kitalyi, A. J. 1990. Performance and carcass composition of Tanzania goats fed *Chloris gayana* hay with supplements containing different levels of protein. *Small Ruminant Research*, 3(1): 1-8.
- Muia, J. M. K. 2000. Use of Napier grass (*Pennisetum purpureum*) to improve smallholder milk production in Kenya. PhD. Thesis. Wageningen Agricultural University. Netherlands.
- Osuji, P. U., Nsahlai, I. V. and Khalili, H. 1993. *Feeds Evaluation*. ILCA Manual 5: ILCA, Adis Ababa, Ethiopia. Pp 1-40.
- Ovimaps. 2016. Ovi location map: Ovi earth imagery data.
- Ozung, P. O., Nsa, E. E., Ebegbulem, V. N. and Ubua, J. A. 2011. The potentials of small ruminant production in Cross River Rain Forest zone of Nigeria: A review. *Continental Journal of Animal and Veterinary Research*, 3(1): 33-37.
- Sarwar, M., Iqbal, M. A., Ali, C. S., and Khaliq, T. 2003. Growth performance of buffalo male calves

- as affected by using cowpeas and soybean seeds as a source of urease during urea treated wheat straw ensiling process. *Egyptian Journal of Animal Production*, 2:179–185.
- SAS. 2005.** Statistical Analysis Software (CD-ROM), Version 8.1, SAS Institute Inc., Cary, N.C., USA.
- Shiawoya, E.L. and Tsado, D.N. 2011.** Forage and fodder crop production in Nigeria: Problems and Prospects. *World Journal of Life Science and Medical Research*, 1(4): 88-93.
- Van Soest, P. J., Robertson, J. B. and Lewis, B. A. 1991.** Method for directory Neutral detergent fibre and Non-starch polysaccharides in relation to Animal Nutrition. *Journal of Dairy Science*, 74: 3583-3597.
- Wada, N. I., Njidda, A. A. Olafadehon, O. A. and Bello, B. 2016.** Effect of graded level of *Parkia biglobosa* in concentrate diets on growth performance, digestibility and nitrogen utilization of Yankasa rams. *Nigerian Society for Animal Production*, 43(1): 231-238.
- Yashim, S. M. 2014.** Effects of inclusion levels of fig (*Ficus sycomorus*) leaf meal in concentrate diets on the performance of Yankasa rams fed *Digitaria smutsii* hay. A Ph.D Dissertation submitted to the School of Postgraduate Studies, Ahmadu Bello University Zaria, Nigeria.
- Zervas, G., Zarkadas, L., Koutsotolis, K., Goulas, C. and Mantzios, A. 1999.** The effect of altering the hay to concentrate ratio and concentrate composition on the rumen fermentation of dry sheep and milk production of lactating dairy ewes. *Animal Production*, 69: 637-645.

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