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Intake, growth performance and economics of production of Yankasa rams fed ammoniated ensiled threshed sorghum top supplemented with varying concentrate regimes

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Abstract

The effects of feeding different levels of a concentrate supplement to growing rams fed ammoniated ensiled threshed sorghum top (AETST) as basal diet on voluntary intake and body weight changes were evaluated. The experiment consisted of four treatments: 0, 300, 450 and 550 g/d in a completely randomized design using 16 growing Yankasa rams. Data collected include feed intake, growth performance and economy of production. Except for AETST intake, and dry matter (DM) intake (% BW) and feed/gain ratio (F/G) which were higher (P<0.05) for the non-supplemented control, total DM, crude protein (CP) and organic matter (OM) intakes and average daily gain (ADG) were greater (P<0.05) for the supplemented diets. Among the supplemented groups, intakes of DM, OM and CP were higher (P<0.05) and F/G lower (P<0.05) for 450 and 550 g/d concentrate levels compared to 350 g/d level. Concentrate intake and ADG followed this rank order: 350 g/d < 450 g/d < 550 g/d P<0.05). Total cost of feed consumed/ram, weight gain (mutton) and monetary value (Naira) of mutton were higher (p<0.05) for T4 than for T1, T2 and T3 diets. Net benefit was higher (p<0.05) for T1, differential and relative benefits were superior (p<0.05) for T2. The study suggests that feeding ruminant animals with AETST supplemented with lower level of concentrate can improve voluntary intake, body weight and economic benefits to farmers. However, diet with 350 g (T2) concentrate supplementation had better economic benefit than other dietary treatments.

Keywords: Ammoniated threshed sorghum top, concentrate level, feed intake, weight gain, economics production of sheep

Introduction

The common practice of placing ruminants on grazing and unimproved crop residues without supplementation, as observed among poor local farmers, causes reduced growth rate, poor reproductive performance and severe economic losses. The nutritive value of crop residues may, however, be enhanced using simple processing methods as urea treatment and ensilage. Threshed sorghum top (TST), the outer coverage of the sorghum grain after the grains have been removed through various threshing methods (Okunade *et al*., 2016), is one of the prominent crop residues in the savannah area of Nigeria which hosts majority of ruminant animals. Similar to other crop residues, TST is inherently high in fibre and low in minerals, protein and fermentable energy (Isah *et al.,* 2014). The nutritive value of crop residues may be enhanced using

several simple processing methods such as urea treatment and ensilage which has been strategically used especially to boost their crude protein and reduce their fibre components (Olafadehan and Adebayo 2016). Previous studies on feeding of untreated TST to goats showed negative growth effect (Isah *et al*., 2015). However, feeding ammoniated ensiled threshed sorghum top (ATST) may improve animal performance with or without supplementation. Urea treatment of crop residues increases the nutrient intake, digestibility as well as the rumen ammonia nitrogen concentration and microbial protein synthesis (Olafadehan and Adebayo, 2016). According to Sultana *et al*. (2012) and Kochapakdee *et al. (*1994) the importance of concentrate supplementation on performance of goats and sheep has been demonstrated. Okunade *et al.* (2014) opined feed intake is one of the indispensable indexes of nutritive value of a feed and is more reliable than digestibility in evaluation of the feeding value of a diet, because animals will digest only what they can consume. Determination of animal body weight gain suggests the market value of animals *ceteris paribus*. The cost of production of the experimental animals is necessary whenever unconventional ingredients are fed. This will help in evaluating the economic benefits of such practice (Olafadehan, 2011). The present study was therefore under taken to study the effect of feeding different concentrate regimes on the nutrient intake, growth performance and economics of production of growing ram lambs fed ATST as a basal diet.

Materials and methods

Study location

This study was conducted at the small ruminant unit of the Teaching and Research Farm, Federal College of Wildlife Management, New Bussa, Niger State, Nigeria. The study area location (latitude: 9° 53' and 0° 00fl fl N and longitudes 4° 31' and 40° 33fl fl E) is in the guinea savannah agro-ecological zone of North central of Nigeria in New Bussa. It has mean annual temperature of about 27.2 °C with relative humidity of about 60% and the mean annual rainfall value is about 1109mm (Osborn and Jone, 2014).

Procurement and preparation of feed ingredients

The threshed sorghum top (TST) used in this experiment was purchased from local farmers. Prior to urea treatment of the TST, it was chopped to about 4–5cm size. About 4kg of urea was dissolved in 100 litter of water and carefully sprinkled on 100 kg dry matter (DM) of TST, and thoroughly mixed together. The treated TST was filled into a large drum, compacted to make it air tight, sealed tightly with polyethylene sheets and then covered with a heavy object placed on the cover. The ammoniated ensiled TST (AETST) was left unopened under anaerobic fermentation for three weeks after which it was opened and aerated overnight under shade to eliminate volatile ammonia gas that causes ammonia toxicity if fed to animals without aeration (Olafadehan *et al*., 2017).

Experimental animals, management and treatment

Sixteen 9-month-old intact Yankasa ram-lambs (similar live weight (LW), 15.3 ± 0.68 kg), housed in individual rammed floor with bedding material, were used in a 63-d experiment excluding 14 d adjustment period. Before the commencement of the experiment, the animals were given prophylactic treatments through the administration of antibiotics (oxytetracycline) and also treated against endoparasites and ectoparasites using levamisole and diasuntol, respectively. Lambs were balanced for their LW. Lambs

were grouped into four and randomly assigned to one of four treatments comprising 0, 350, 450 and 550 g/d of concentrate supplementation levels to a basal diet of AETST in a completely randomized design. Animals in each group were randomly assigned to one of the four dietary treatments. Feeding was done twice daily, at 08:00 and 16:00 h, and water was made available *ad libitum*. Feed served and orts were measured daily to determine feed intake while the animals were weighed at beginning of the experiment and weekly before morning feeding to determine their growth performance.

Chemical compositions analysis

Samples of untreated and treated threshed sorghum and supplement were weighed and oven dried individually at dried at 60ºC for 48 h to determine DM. The oven-dried samples of both the untreated and treated threshed sorghum and supplement were subsequently milled to pass through 1mm sieve, bulked for individual treatment and stored in sealed polythene bags pending chemical analyses. Proximate compositions of tested samples and diets were analyzed according to the AOAC (2005). Dry matter was determined by drying at 100 °C for 24 hours. Ash concentrationwas determined after ignition at 550 °C for 4 hours in a muffle furnace and used to calculate organic matter (OM). NDF was analyzed according to Van Soest *et al.* (1991) while total carbohydrate was determined according to Sniffen *et al*. (1992): TC=100 - (CP+EE+Ash);

Economics analysis

Economic analysis was performed to evaluate the profitability of feeding AETST supplemented with graded levels of concentrate mix to lamb rams by considering the main cost components. Cost effectiveness of AETST utilization in small ruminant was assessed using prevailing market prices to cost the concentrate diet, basal diet and the mutton. The cost of the feeds consumed and the value of the weight gain by the animals throughout the feeding trial was computed for each sheep to quantify accruable net benefits (Yusuf *et al*., 2009). The variable cost of feeding the ram lambs was considered as the total cost of the feed consumed, as all other costs (i.e., labour, capital investment, housing) were the same for all the treatments.

Statistical analysis

All data collected were subjected to one way of ANOVA in completely randomized design using using version 6 of SAS software (SAS Institute, 2012). Significance difference between individual means was separated by Duncan's procedure of the same software. Mean differences was considered significant at $P<0.05$, while standard errors of means was computed from the residual mean square in the analysis of variance.

Experimental design model: $Y_{ij} = \mu + T_i + \Sigma ij$,

Where: Y_{ij} = each observed variation on i^{th} treatment due to j^{th} animal; μ = common population mean; T_i = effect of varying concentrate regime on feed intake, growth performance and economics of production *and* Σij, = random residual effects assumed to be normally and independently distributed.

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Results and discussion

Chemical composition of untreated threshed sorghum tops (UTST), Ammoniated ensiled threshed sorghum tops (AETST) and concentrate supplement are shown in Table 1. The CP content of TST was comparable with the results reported by Okunade *et al.* (2015) and Olafadehan and Adebayo *et al.* (2016), which were 6.7 and 7.3% CP, respectively. The lower CP content of TST was expected

because it is a typical roughage diet with more fibre. Ammonization and ensiling improve the nutritive value of TST by increasing the crude protein, organic matter, total carbohydrate and decreasing the NDF. Reduction in fibre fraction of AETST agrees with previous findings (Aregawi *et al.* 2014). Olafadehan *et al.* (2017) attributed reduction in fibre fraction of crop residues to dissolving effect of ammonization on the hemicelluloses fraction and subsequent removal from cell wall component. The supplementary concentrate diet met the requirements of growing sheep. The chemical composition of AETST was comparable with that of previous studies (Olafadehan and Adebayo 2016). The formulated concentrate diet used in the experiment was adequate in protein (16.84 % DM) to meet not only the maintenance but also the growth nutrient requirement of ruminant animals. The CP level of AEST and concentrate supplement are above the 7% CP for maintenance and 16% CP for growth requirement of ruminants that will provide ammonia required by rumen microorganism to support optimum microbial activity (MLA, 2007).

Table 1: Chemical composition (% DM) of untreated threshed sorghum top, ammoniated threshed sorgum top and concentrate supplement TST, AETST (basal diet) and concentrate supplement

	Untreated TST (UTST)	Ammoniated TST (AETST)	Concentrate
Dry matter	94.43	93.20	90.60
Organic matter	93.99	95.03	96.01
Crude protein	7.27	11.30	16.84
Ash	6.10	4.97	3.85
ether extract	7.03	6.39	4.04
Total carbohydrate	79.60	77.34	75.27
Neutral detergent fibre	74.42	58.02	50.65

Basal feed (ATST) intake of lambs of the control lambs was higher (P <0.05) than that of supplemented lambs (Table 2). Concentrate intake increased with increasing concentrate supplementation level (P<0.05) confirming that feed intake is a function of availability, palatability and fibre digestion and digesta flow rate (Olafadehan *et al*., 2017). Higher feed intake (P<0.05) of the supplemented groups relative to control group may probably due to more availability of concentrate supplements and the ability of the supplements to provide more CP and energy for the cellulolytic microbes on degradation in the rumen than the other treatments (Hirut *et al*., 2011). Higher CP and OM intakes (P <0.05) of the treatment diets indicate that nutrient intake is a function of feed intake (Olafadehan *et al*., 2014). However, overall feed intake and intake (% BW) were lower (P <0.05) for the control relative to the treatment diets. Intake (% BW) is similar to the range of 3.8 – 4.2% reported for growing lambs (MLA, 2007).

Final BW, weight gain (WG), average daily gain (ADG) and feed/gain ratio (F/G) were improved (P<0.05) in supplemented compared to those on AETST, indicating superior nutritive of the supplemented diets relative to the sole diet of AETST (Table 3). However, the weight gain of the control lambs is indicative of feed utilization and suggests that ammonization and ensiling can be used to enhance the nutritive value of low quality crop residue. This is because previous studies (Hirut *et al*., 2011; Isah *et*

Table 2: Voluntary intake of lambs fed varying concentrate level

Intake (g/day)	Concentrate supplementation level (g/day)				SEM
	0 (T1)	350 (T2)	450 (T3)	550 (T4)	
AETST	669.99[a]	497.64[b]	457.30[c]	442.69[c]	11.91
Concentrate	0.00[d]	289.35[c]	366.91[b]	390.48[a]	1.59
Total dry matter	669.99[c]	785.97[b]	824.21[a]	833.08[a]	11.37
Dry matter (% BW)	3.97[b]	4.62[a]	4.58[a]	4.30[a]	0.12
Organic matter	636.69[c]	750.65[b]	785.59[a]	795.50[a]	10.68
Crude protein	73.19[c]	104.33[b]	113.40[a]	115.71[a]	1.73
Neutral detergent fibre	388.68	377.37	377.78	375.50	6.81

[abc]*Means within the same row with different superscripts differ (P<0.05)*

al., 2015) with untreated barley straw and TST resulted in weight loss of the animals. Ammonization and ensiling of TST upgraded its CP to 11.3% which was able to supply CP above maintenance requirement and thus to supported a little weight gain. Getahun (2006) also indicated weight gain of 10.7 g/d in sheep offered sole urea treated wheat straw. Lower weight gain of the control lambs is obviously the consequence of the reduced feed intake and utilization. Among the supplemented lambs, ADG increased (P<0.05) with increasing concentrate level which implies that the higher the feed availability the better. The results indicate that AETST can serve as good basal diet to growing lambs on concentrate supplementation without compromising intake and growth.

Table 3: Growth performance of lambs fed varying concentrate level

Variable	Concentrate supplementation level (g/d)				SEM
	0 (T1)	350 (T2)	450 (T3)	550 (T4)	
Initial weight (kg)	15.33	15.32	15.31	15.30	0.00
Final weight (kg)	16.34[b]	18.67[b]	23.21[a]	24.23[a]	2.16
Total weight gain (kg)	1.00[d]	3.33[c]	7.92[b]	9.03[a]	0.23
Average daily weight gain (g/d)	13.00[d]	43.30[c]	102.85[b]	116.88[a]	3.09
Feed/gain ratio	55.83[a]	18.21[b]	8.01[c]	7.11[c]	0.53

[abcd]*Means within the same row with different superscripts differ (P<0.05)*

The least total cost (1156.00 naira) of feeding was evident for animal group fed un-supplemented AEST (control diet) relative to other diets. Cost of feed per kilogramme of mutton produced showed that 550 g concentrate supplementation (T4) was more economical since animals consumed less amount of feed to produce more flesh (Table 4). This could be attributed to the fact that the animals consumed the least amount of feed and produced highest quantity of mutton. The higher net benefits in AETST supplemented sheep over and above that of the un-supplemented AETST demonstrated the comparative cost advantage and effectiveness of concentrate supplementation of crop residues in the sheep ration. Differential benefits showed that sheep fed 350 -550 g concentrate supplemented diets (T2-T4) had higher benefits of N 3010.00, N 1741.00 and N1551.00 respectively than the sheep placed on AETST diet. Also, AETST supplemented diets resulted in benefits 356.0 0, N45.00 and N27.00 respectively, higher than the un--supplemented AETST which implies that benefits as much as 356%, 45% and 27% could be made by feeding AETST supplemented with 350 g,

450 g and 550 g concentrate respectively. However, the significantly higher differential and relative benefits for 350 g AETST supplemented animals than that of other supplemented groups implies that 350 g AETST supplemented diet is more profitable relative to other concentrate supplementary levels (Yusuf *et al*., 2009). Similar results were found by Nguyen and Mai (2004) who reported that groundnut oil supplementation improved profitability.

Table 4 Economics of production of lambs fed ammoniated threshed sorghum top ATST supplemented with concentrate

Parameters	Concentrate supplementation level (g/day)				SEM
	0 (T1)	350 (T2)	450 (T3)	550 (T4)	
Cost/kg concentrate feed (Naira)	90.00	90.00	90.00	90.00	0.00
Cost/kg of forage feed (Naira)	34.89	34.89	34.89	34.89	0.00
Concentrate consumed (kg)	0.00^{d}	12.00^{c}	16.50^{b}	22.00^{a}	0.20
Forage consumed (kg)	35.00^{a}	31.00^{b}	27.00^{c}	25.00^{d}	0.48
Cost of concentrate consumed (Naira/sheep)	0.00^{d}	1081.00^{c}	1485.00^{b}	1987.00^{a}	4.38
Cost of forage consumed (Naira/sheep)	1156.00^{a}	1062.00^{b}	918.00^{c}	872.00^{d}	0.41
Total cost of feed consumed Naira/sheep)	1156.00^{d}	2144.00^{c}	2403.00^{b}	2852.00^{a}	0.96
Total weight gain (mutton) (kg)	1.00^{d}	3.00^{c}	4.00^{b}	5.00^{a}	0.12
Cost/kg of mutton (Naira)	2000.00	2000.00	2000.00	2000.00	0.00
Cost of feed (Naira) / kg of mutton	1156.00^{a}	715.00^{b}	600.00^{c}	570.00^{d}	0.25
Value of mutton (Naira)	2000.00^{d}	6000.00^{c}	8000.00^{b}	10000.00^{a}	4.25
Net benefit (Naira)	844.00^{d}	3856.00^{c}	5597.00^{b}	7147.00^{a}	1.25
Differential benefit (Naira)	-	3010.00^{a}	1741.00^{b}	1551.00^{c}	1.87
Relative benefit (%)	-	356.0 0^{a}	45.00^{b}	27.00^{c}	0.45

^{abcd}*Means within the same row with different superscripts differ (P<0.05)*

Conclusion

Though positive weight gains and feed efficiency of the control lambs indicate feed utilization, AETST can be better utilized when supplemented with concentrate diet. However, 550 g daily concentrate supplementation level appears superior, due to reduced feed utilization efficiency and higher weight gain, relative to other concentrate supplementation levels.

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