EFFECTS OF SOURCE AND LEVEL OF NITROGEN ON THE UTILIZATION OF SORGHUM STOVER BY YANKASA RAMS

F. OLALERU and T.A. ADEGBOLA

Animal Production Programme,

Abubakar Tafawa Balewa University, P.M.B. 0248, Bauchi

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ABSTRACT

The effects of cotton seed cake (CSC) or urea in supplying either 12% or 16% crude protein on sorghum stover utilization by Yankasa rams was studied for twelve weeks, using a 2 x 2 factorially designed experiment. Nutrient intake, digestibility, weight gain and feed conversion ratio (FCR) were monitored. *In vitro* volatile fatty acid (VFA) and ammonia-nitrogen ($\text{NH}_3\text{-N}$) concentrations were also determined. The result of the study indicated that the source and/or level of nitrogen (or crude protein) significantly ($P<0.05$) affected crude protein intake (CPI), digestible crude protein intake (DCPI) and *in vitro* $\text{NH}_3\text{-N}$ concentration. Total feed intake, live weight gain (LWG), FCR and DCPI were significantly ($P<0.05$) affected by source x level interaction. Acid detergent fibre (ADF) and neutral detergent fibre (NDF) intakes, CP, ADF and NDF digestibilities, digestible ADF and NDF intakes, stover intake and *in vitro* VFA concentration were not significantly ($P>0.05$) affected by either main effects of CP source and level or their interaction. The rams on the 16% CSC and 12% urea ration gained more weight and had lower FCR than those on the 12% CSC and 16% urea. The 16% CSC ration gave the best result in terms of sorghum stover supplementation. The 12% urea treatment which also had a good result in terms of weight gain and FCR could also be recommended for use.

Keywords: Source, level, nitrogen, stover, utilization, rams

INTRODUCTION

During the rains, natural forage having 10-12% crude protein (CP) is capable of sustaining ruminant animals' nutritional requirement. The nutritional quality of natural forage falls rapidly during the dry season. This necessitates supplementation of the animals with concentrates or high quality forages in order to step up the nutritional plane of the animals (Umunna and Lufadeju, 1985).

Most of Nigeria's small ruminants are concentrated in the semi arid areas (World Bank and Nigerian consultants, 1981). Ewes usually lamb during the dry and early rainy season when there is scarcity of feedstuff. The ewes need adequate feed to produce sufficient milk for their lambs. The dry season forages cannot supply the needed nutrients therefore supplementation with protein and/or energy concentrates becomes necessary until high quality forages are available in the rainy season. The performance of ruminant animals is affected by the source of dietary nitrogen, which may be from protein or non-protein sources, and level of inclusion in the diet (Adegbola *et al.*, 1985).

The present experiment was conducted to study the effect of diets containing cotton seed cake or urea at 12% or 16% crude protein levels on feed intake, daily weight gain, nutrient digestibility and *in vitro* ammonia and volatile fatty acid production in rams.

MATERIALS AND METHODS

Sixteen Yankasa rams with average weight of 17kg were assigned into four groups of four animals per group and kept in individual pens where there was a daily access to fresh water

and proprietary salt lick. Each animal was given 340g of concentrate at 0800h in the morning and 500g of chopped sorghum stover at 10.00h daily throughout the eighty-four days experimental period. Animals were weighed fortnightly.

Two feedstuff types were used, the basal feed, which was chopped sorghum stover and concentrate supplement made up of crushed corn, corn bran and cotton seed cake (CSC) or urea according to the treatment (Table 1). Proximate composition of diets is also shown in Table 1.

***In vitro* ammonia-nitrogen and volatile fatty acid determination**

The first stage of Tilley and Terry (1963) method was used for $\text{NH}_3\text{-N}$ and VFA production.

Analytical Procedure

Crude protein and ash components of the feed and faecal samples were determined using AOAC (1980) methods, while acid detergent fibre and neutral detergent fibre were determined by the method of Goering and VanSoest (1970). Dry matter was determined by drying at 105°C for 24 hours. The *in vitro* total VFA and $\text{NH}_3\text{-N}$ concentrations were

determined using the methods of AOAC (1980) and Whitehead *et al.* (1976) respectively.

Statistical analysis

Analysis of variance (ANOVA) was carried out on the data obtained using the methods described by Steel and Torrie (1980). Where significant differences between means existed, Least significant difference (LSD) method was used to separate the means.

RESULTS

The effects of source and level of nitrogen on sorghum stover and total feed intakes, LWG and FCR are presented in Table 2. Animals on treatments 1 and 4 had significantly ($P<0.05$) higher feed intake and FCR than those on treatment 2. However, animals on treatments 1 and 4 had significantly ($P<0.05$) lower LWG than those on treatment 2.

Nutrient digestibility (%) values were not affected by level and source of nitrogen (Table 3). There were very high positive correlations ($P<0.01$) between DMD and each of ADFD ($r=0.96$) and NDFD ($r=0.87$). The regression equations relating the values were:

$$\text{DMD} = 34.19 + 1.39 \text{ ADFD} \dots\dots\dots (1)$$

$$\text{DMD} = 4.96 + 0.99 \text{ NDFD} \dots\dots\dots (2)$$

TABLE 1: COMPOSITION OF CONCENTRATE SUPPLEMENT FED TO RAMS

Concentrate component (%)	Basal Feed	Treatments			
		1	2	3	4
Crushed corn		10.0	10.0	10.0	10.0
Corn bran		84.1	68.7	89.5	88.1
Cotton seed cake		5.9	23.1	-	-
Urea		-	-	0.53	1.93
Total		100.00	100.00	100.00	100.00
Chemical analysis					
Dry matter	93.80	87.74	89.58	88.88	88.90
Crude protein	2.88	13.09	15.84	12.21	15.96
Acid detergent fibre	55.60	14.67	15.74	13.11	11.86
Neutral detergent fibre	80.13	45.85	43.85	44.56	36.66
Ash	4.14	6.76	6.18	6.18	5.72

TABLE 2: FEED INTAKE (g/day), LIVE WEIGHT GAIN (g/day) AND FEED CONVERSION RATIO OF RAMS FED SORGHUM STOVER SUPPLEMENTED WITH CONCENTRATE

Item	TREATMENTS ¹			
	1	2	3	4
Stover intake	274.05 ^a	271.43 ^a	267.35 ^a	270.74 ^a
Total feed intake	582.05 ^{ab}	556.43 ^a	568.35 ^{ab}	579.74 ^a
Live weight gain	56.55 ^a	107.15 ^b	79.33 ^{ab}	47.60 ^a
Feed conversion ratio	10.29 ^a	5.19 ^b	7.16 ^{ab}	12.18 ^a

¹Means in a row bearing different superscripts are significantly different ($P < 0.05$).

The highest in vitro $\text{NH}_3\text{-N}$ concentration was obtained from treatment 4 while in vitro VFA concentration had its highest value on treatment 3.

DISCUSSION

Sorghum stover intake from all the treatments were not significantly different, indicating that neither source nor level of CP in supplement affected the stover intake. This is similar to the observation made by Brosh *et al.* (1990) where silage intake was not affected by increasing protein level of supplement. Total feed intake (TFI) was also not affected by source or level of CP. This agrees with the report of Adegbola *et al.* (1985) that types of protein had no effect on the feed intake of sheep. The highest TFI obtained from the 16% urea-based diet agrees with that of Owen (1983) where urea in straw-based diets increased the feed intake of steers. Since urea is highly hydrolysed in the rumen, the 16% urea-based diet could have furnished the rumen environment with $\text{NH}_3\text{-N}$ which

was used for microbial protein synthesis. The increase in microbial population could have enhanced cell wall breakdown, thereby leading to an increase in feed intake. Neither source nor level of crude protein alone affected LWG but their interaction effect did. This is similar to the result of Small and Gordon (1990).

The 16% CSC based diet gave higher LWG than the 16% urea-based diet. The former, a true protein, supplies amino acids directly to the host animal while the utilisation of the latter by ruminants is through microbial synthesis and subsequent digestion by the microbes in the lower gut. There was a highly significant interaction effect indicating that FCR was dependent on both source and level of supplementary nitrogen. The FCR range of 5.19 – 12.18 obtained in this work is similar to 9.2 – 11.9 FCR values obtained by Adu and Brinckman (1981) with sheep fed varying concentrate levels though their basal diet was grass hay.

TABLE 3: EFFECT OF SOURCE AND LEVEL OF CONCENTRATE NITROGEN ON NUTRIENT DIGESTIBILITY (%) OF RAMS FED SORGHUM STOVER

Item	TREATMENTS			
	1	2	3	4
DM digestibility	81.40	82.19	81.55	85.78
CP digestibility	78.19	79.03	77.36	85.15
ADF digestibility	77.90	82.05	78.41	84.28
NDF digestibility	83.97	89.94	84.38	82.39

DM = Dry matter; CP = Crude protein; ADF = Acid detergent fibre; NDF = Neutral detergent fibre

Dry matter digestibility (DMD) values obtained in this work ranged from 81.4 – 88.78% for animals on the 12% CSC and 16% urea based diets respectively. There was an increase in crude protein digestibility (CPD) with increasing CP level from both sources. This agrees with what Ikhatua and Adu (1981) obtained where nitrogen digestibility increased as CP level increased from 10 to 20%. Animals on urea- based diet gave better CPD than those on CSC-based diet. This agrees with the report of Owen (1983) where CPD of steers fed straw increased with urea supplementation. The animals on 16% urea-based diet gave the highest ADFD of 84.28%. This diet had the lowest ADF content. There was an increase of 8.98% in NDFD with higher CP level over the lower level. This result is similar to that obtained by Badamana *et al.* (1990) when goats were fed rye grass hay with increasing protein concentrate levels. However, both ADFD and NDFD values obtained in this work are higher than the corresponding values they obtained.

The significant main effect due to level of CP and interaction effect on DCPI indicates that DCPI was affected primarily by CP level in the diet.

Chesworth (1992) gave the DCP recommendation for sheep gaining 100g/day to be 43g/day while for those gaining 80g/day it was 29g/day. The rams on the 16% CSC-based diet had a DCP value similar to that recommended by Chesworth (1992).

The concentration of *in vitro* VFA obtained in this work for all the diets were within the same range. In an *in vitro* study with roughage plus full-fat rice polishings of 0.25 and 0.50 full fat levels, Garcia *et al.* (1992) obtained total VFA concentration (Mmol) of 52.5 and 75.5 respectively.

Digestible nutrient intake, and *in vitro* NH₃-N and VFA are presented in Table 4. Generally, the animals on treatments 2 and 4 had higher digestible nutrient intake than those on treatments 1 and 3. Except for digestible crude protein intake (DCPI), all the other digestible nutrient values were similar for the diets.

The high concentration of NH₃-N from urea-based diets confirms the fact that urea is easily hydrolysed to NH₃ (Preston and Leng, 1987). The result obtained also agrees with that of Tagari *et al.* (1976) where NH₃ was released at a higher rate with urea addition than with urea phosphate. In an *in vitro* study, Lee *et al.* (1987) obtained NH₃-N concentration of 172

TABLE 4: DIGESTIBLE NUTRIENTS INTAKE (g/day) AND IN VITRO TOTAL NH₃-N AND VFA CONCENTRATION IN RAMS FED SORGHUM STOVER SUPPLEMENTED WITH CONCENTRATES⁺

Item	TREATMENTS			
	1	2	3	4
Digestible DMI	465.91	463.07	461.32	505.09
Digestible CPI	41.57 ^{ab}	45.57 ^a	38.06 ^b	53.05 ^c
Digestible ADFI	153.75	154.26	141.70	162.18
Digestible NDFI	303.44	312.91	281.26	295.02
NH ₃ -N (Mg/100ml)	21.52 ^a	18.08 ^a	24.97 ^{ab}	39.61 ^b
VFA (Mmol/100ml)	4.68	4.80	4.85	4.48

⁺ Means in each row bearing different superscripts are significantly different (P<0.05)

DMI = dry matter intake; CPI = Crude protein intake; ADFI = Acid detergent fibre intake; NDFI = Neutral detergent fibre intake.

mg/l in young cattle on low quality hay supplemented with urea and crushed corn. The $\text{NH}_3\text{-N}$ concentration values obtained in this work are within the recommended concentration given by Satter and Slyter (1974) and Preston and Leng (1987) of 5mg/100ml and 20mg/100ml respectively for efficient microbial activity and degradation of fibrous materials respectively.

The results showed that at 16% CP level, CSC-based diet gave the highest LWG. The lowest feed intake was from the 16% CSC-based diet. This was followed by the 12% urea-based diet. The lower FCR was from the 16% SCS-based diet. The 12% urea-based diet also had a low FCR. All the concentrate diets gave adequate in vitro $\text{NH}_3\text{-N}$ concentration, indicating that all the four diets were capable of supporting microbial population and metabolism in the rumen.

It may be concluded from this study that sorghum stover could be better utilised by ruminants if supplemented with SCS-based concentrate at 16% or urea-based concentrate at 12% crude protein level. The benefit of using either CSC or urea will depend on their relative availability at the time of need.

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