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Feeding Responses and Stoichiometric Implications of Urea-treated Sorghum stover Diets Fed to *Yankasa* Rams

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ABSTRACT

A feeding trial of 84 days was conducted with a view to evaluating fermentation dynamics manifested in feeding responses of growing Yankasa rams. Urea-treated Sorghum Stover (SS) was supplemented with blood meal (BM), cotton-seed cake (CSC), groundnut cake (GNC) and maize bran (MB). The results showed that there was significant difference ($P<0.05$) in the mean apparent digestibility (MAD) of dietary treatments. There was also significant difference ($P<0.05$) across the diets in their digestible dry matter intake (DMI), mean live weight gain (LWG) and mean feed conversion ratio values. The results further showed that while CSC diets might not have had the highest MAD values, they nevertheless recorded the best performance in animal response as reflected by the significantly higher ($P<0.05$) mean daily LWG. This implied that the inferior digestibility of CSC compared with the other protein supplements was not sufficient to overturn the advantage of microbial contribution to the net nitrogen absorbed in the lower gut of the rams. This is consistent with the theory that, for increased production, a source of escape nitrogen in the form of cotton-seed cake alone or in mixtures with bran to supply glycogenic precursors will be required. It was obvious that feeding response of the experimental rams was dependent on the stoichiometry of the dietary ingredients as reflected in the rumen fermentation characteristics of sorghum stover as well as those of the protein and energy supplements.

INTRODUCTION

Post-weaning growing rams adjust gradually but fully to high fibre diets. The rate of adjustment may, however, depend on many factors, notably age of the rams, pre-experimental feeding regime, age at weaning, level and type of protein, energy and mineral supplementation (Orskov, 1992). Chemical treatment of commonly-available high fibre basal feedstuffs like sorghum stover generally tend to enhance nutritive value, dry matter intake (DMI) and digestibility to the benefit of animals feeding on them. Generally, chemical treatment enhances fibre digestion

through delignification or swelling of plant cell walls such that rumen cellulolytic enzymes will gain easy penetration (El-shazly and Naga, 1981; Theander, 1981). Theses chemicals include sodium hydroxide (Sundstol, 1981; Moss *et al.*, 1990); anhydrous ammonia (Sundstol, 1984; Silva *et al.*, 1989); urea-NH_3 (williams *et al.*, 1984) as well as organic ashes (Adebowale, 1985). Where ammonia is used, there is also an increase in the crude protein content of feedstuffs from 2 to 10%, thereby improving the nutritive potential of the feed.

In the rumen as well as post-ruminal digestive physiology, metabolic changes give rise to numerous measurable metabolites. These stoichiometric changes are predictable and quantifiable, with many of them having predictable relationships. These metabolic indices could be variously and collectively predicted using fermentation indices, including stoichiometric indices like nutrient degradation, quantity and proportion of metabolites, among others.

However, feeding response by experimental animals to feedstuffs under nutritional evaluation remains the most reliable means of confirming the nutritive value of such feedstuffs. It is always an important complement of other nutritive value estimation of most diets and feeds.

MATERIALS AND METHODS

Animal Management and feeding trial

A feeding trial of 84 days was conducted. Thirty Yankasa ram lambs with mean age and weight of 9 months and 17kg respectively were allocated to six dietary treatments. They were bought from neighbouring local markets and housed in individual pens. They were quarantined and conditioned for four to eight weeks. The pre-experimental conditioning included the feeding of mixed legume crop residues and chopped sorghum stover (Table 1).

Table 1. Chemical composition of treated and untreated sorghum stover (g/kgDM)

Nutrient	*u-SS*	*t-SS(5d)*	*t-55(10d)*	*t-SS(15d)*	*S.E.D.*	*F(P<0.05)*
DM	931.11	920.0	949.40	937.50	6.14	NS
CP	48.80	101.10	138.10	137.90	21.28	S
NDF	674.50	681.60	650.30	698.80	10.02	ND
ADF	682.30	670.60	692.40	698.80	6.16	NS
OM	898.10	913.10	906.20	911.40	3.37	NS
Ash	69.20	68.40	69.00	60.80	2.02	NS
Ca	4.40	4.10	3.80	4.20	0.13	NS
P	1.50	1.60	1.20	1.90	0.14	NS
CF	342.20	303.30	354.00	316.60	11.60	NS
HC	290.00	265.40	248.20	234.20	11.86	NS
CIL	443.60	63.80	358.40	316.70	27.15	S
LG	63.80	63.80	67.60	60.10	4.02	NS

Key: DM= Dry Matter; CP= Crude Protein; NDF= Neutral Detergent Fibre; ADF= Acid Detergent Fibre; OM= Organic Matter; CF= Crude Fibre; HC= Hemicellulose; CLL= Cellulose; LG= Lignin; NS=Not Significant; S=Significant

u-SS= untreated sorghum stover

t-SS(5)= Treated sorghum stover (5 days)

t-SS(10d)= Treated sorghum stover (10 days)

t-SS(15d)= Treated sorghum stover (15 days)

It also involved the deworming of all of them using *Benzal*. Deworming during the full experimental period was done every four weeks. The diets (Table 2) comprised urea-treated versus untreated SS as the basal material. These were supplemented with three protein types (table 3), namely blood meal (BM), cotton seed cake (CSC) and groundnut cake (GNC)/CSC (60:40) at 13%, 25% and 23% (W/W) of dietary dry matter (DM) respectively. Mineral block and water were served *ad-libitum*. Animals were weighed every ten days. Daily feed intake and refusals were recorded for each ram. Lower ratios of the GNC:CSC combination during pre-experimental observations led to mortality rate of up to 65%. This experience informed the adoption of 60:40 ratio for GNC:CSC in diets 3 and 6 (Table 2). The diets were analyzed for DM, crude protein (CP), Ash and crude fibre (CF) as described by Van Soest (1994).

Digestion trial

The feeding trial was followed by a digestion trial in which eighteen rams (three per treatment) were used. There was a collection period of 14 days. During the collection period, the rams were weighed at the beginning and every seven days thereafter. The faeces were collected daily just before feeding in the mornings. Collection was done with polyethene bags tied under the tail of the rams and flexible enough to cover the genital region. Faeces were then bulked and stored in a refrigerator pending analysis. Daily feed intake and refusals were also recorded. The faecal samples were then oven-dried at the temperature of 70^0C and analyzed according to the method of Van Soest (1994) for DM, CP, CF and organic matter (OM), thereby determining the mean digestibility of these constituents.

Statistical Analysis

Analysis of variance (ANOVA) and all other statistical analyses of the data were done using Kalaidagraph (1994) and SPSS for Windows

RESULTS

Chemical compostion of diets

The organic matter (OM) content of the experimental diets (Table 2) varied only slightly, from 947.70 to 954.90g/kgDM. The crude fibre (CF) contents of the same diets ranged widely, from 245.00g/kgDM to 305.30g/kgDM (diet 6). The crude protein contents of diets 1 to 6 were 160.49, 145.49, 151.22, 157.86, 149.69 and 166.43g/kg respectively. Their corresponding values for **Rumen Degradable Protein (RDP)** and **Digestible Rumen Undegraded Protein**

Table 2. Composition of experimental diets **(g/kgDM)**

D I E T S

Ingredient Composition:

	Urea-treated Sorghum Stover (t-SS):			Untreated Sorghum stover (u-S	
	Diet 1	**Diet 2**	**Diet 3**	**Diet 4**	**Diet**
Untreated-SS	---	---	---	810	650
Urea-treated-SS	810	650	670	---	---
Maize bran	60	100	100	60	100
GNC/CSC (60:40)	---	---	230	---	---
CSC	---	250	---	---	250
BM	130	---	---	130	---
Salt Lick	*Ad Lib*	*Ad Lib*	*Ad Lib*	*Ad Lib*	*Ad Li*

Chemical Composition:

DM	920.00 ± 11.00	933.30 ± 10.00	917.40 ± 8.00	924.30 ± 12.30	900.30 ±
Ash	45.10 ± 0.30	51.30 ± 0.00	50.20 ± 0.60	69.10 ± 0.10	52.30 ±
CF	280.00 ± 8.20	263.10 ± 11.00	245.00 ± 2.30	280.30 ± 3.20	294.40 ±
OM	954.90 ± 23.00	948.70 ± 40.00	949.80 ± 40.10	950.90 ± 25.00	947.70 ±
RDP	115.10	90.6-	108.90	110.40	92.20
DUP	45.39	54.89	42.32	47.46	57.49
CP	155.59	145.49	151.22	157.86	149.69

Key: RDP= Rumen Degradable Protein; DUP= Undegradable Protein; CP= Crude Protein; OM=Organic Matter;

CF= Crude Fibre; DM= Dry Matter; BM= Blood Meal; CSC= Cottonseed Cake

(DUP) were 115.10, 90.60, 108.90, 110.40, 92.20, 129.30g/kgDM and 45.39, 54.89, 42.32, 47.46, 57.49, 37.13g/kgDM respectively. Furthermore, the proximate composition of cotton seed cake (CSC), groundnut cake (GNC) and maize bran (MB) (which were incorporated into the diets) are shown in Table 3. The CP contents of CSC, GNC and MB were 247.00, 596.90 and 964.00g/kgDM respectively.

Mean Intake and Mean Apparent digestibility

As shown in Table 4, there was significant difference ($P<0.01$) in the mean intake of DM, CP, CF and OM between dietary treatments. The mean DM intake values for diets 1 to 6 were 224.77, 360.85, 207.54, 302.77, 386.77 and 165.69g/day respectively. The main intake of CP with corresponding values of 41.60, 70.58, 39.20, 48.56, 58.56 and 26.39g/day showed similar trend. There was significant difference ($P<0.05$) between dietary treatments in their mean apparent digestibility (MAD) values. The MAD values for DM were 505.50, 533.40, 540.80, 410.30, 433.70 and 480.10g/kg for diets 1 to 6 respectively. The corresponding values for CP were 461.00, 480.00, 472.20, 400.10, 412.00 and 413.00g/kg respectively. There was significant gain and mean feed conversion ratio values as shown in Table 4. As reflected in the values for DM, CP, CF and OM, there was no definite trend and relationship between mean intake and MAD across the diets.

Stoichiometric implications based on a Fermentation Model

Rumen fermentation of feedstuffs leads to the partitioning of organic components of diets. In the case of the CP fraction of diets, it is normally fragmented into the Rumen Degradable Protein (RDP) and Digestible Undegraded Protein (DUP) in portions that vary according to the type and quality of the dietary protein. Thus, based on the dietary protein fractions and the subsequent proportion of CP to that of the rest of total organic matter, a ***Rumen Fermentation Model*** could be proposed as shown in fig. 1.

DISCUSSION

Chemical and Ingredient Composition of Experimental Diets

The six experimental diets as shown in Table 2 comprised of urea-treated SORGHUM STOVER (Diets 1 to 3) and untreated SORGHUM STOVER (Diets 4 to 6). The groundnut cake (GNC), cottonseed cake (CSC) and Bloodmeal (BM) were in the proportions of 230, 250 and 130g/kgDM respectively. The diets were made to supply RDP of similar amounts (165.60 to 188.90g/kgDM) for the urea-treated SORGHUM STOVER diets as significantly ($P<0.05$) contrasted with that of 138.20 to 160.40g/kgDM for the untreated SORGHUM STOVER diets. Thus, the basis for comparison between the sorghum stover types was to be the net nitrogen gain as a consequence of anaerobic fermentation as well as the differences in degradability rates and soluble carbohydrate contents of the diets. In other words, no two diets comprised the same dietary characteristics and was also meant to allow for independent assessment of each diet in response to the experimental rams feeding on them. Since RDP values were between 138.20 and 188.90g/kgDM it showed that the diets met ruminal requirements of the experimental animals given that even lower values have been reported as adequate for microbial growth in the rumen of sheep (Yan *et-al.*, 1996).

Nutritional Implications

The supplementation of the experimental diets with BM, CSC, GNC and Maize bran (MB) and the chemical treatment of sorghum stover was aimed at meeting both microbial and host