Haematological Characteristics and Blood Urea Nitrogen of Sokoto Red Goat Kids Fed Fore-Stomach Digesta as Replacement for Cowpea Husk

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ABSTRACT: A study was conducted to monitor the haematological characteristics and blood urea nitrogen of Sokoto Red kids fed varying levels of Fore-stomach digesta (FSD) replacing cowpea husk at 0, 10, 20 and 30 % levels of inclusion in complete experimental diets. Blood samples were collected prior to and after the feeding trial. The study lasted for 15 weeks. Results indicated that haematological values and blood urea nitrogen were within the normal range indicating no toxicity associated with the feeding of FSD to Sokoto Red goat kids. The study concluded that 20 % was the best inclusion level for better economic production.

INTRODUCTION

Rumen content also referred to as Fore-Stomach Digesta (FSD) is a by-product obtained from slaughtered ruminant animals. The rumen houses prodigious micro flora as well as fauna which are of fundamental importance in digestion and metabolism of feeds consumed by the animals. Rumen content has been shown to contain appreciable amounts of nutrients that support animal performance (Kumar, 1989; Boda, 1990; Maigandi and Tukur, 2002). However, variations in compositions of rumen content exist due to differences in feeding regime, which in turn is influenced by season (Kumar, 1989; Maigandi and Tukur, 2002). Thus in each locality, it is necessary to evaluate the chemical composition of rumen content in order to have an idea of its nutritional value.

Haematological indices and blood urea nitrogen are among the tissues to be affected when animals are fed with suspected unconventional feeds (Coles, 1986; Swenson, 1990) and FSD is one the unconventional feeds that might have effect unless verify. *In vivo* trial determines the extent to which FSD can be incorporated in the diets of different classes of livestock with a view to finding any health hazard associated with the feeding of the FSD. Maigandi *et el.* (2003) evaluated the effects of feeding FSD on haematological indices and blood urea nitrogen of uda sheep in Sokoto. However, no such information is available on goats in the same environment. In view of this, the present study was designed to achieve this formidable task.

MATERIALS AND METHODS

Pre-experimental Management of the Goats

The study was conducted at the Teaching and Research Farm of UDU Sokoto, Nigeria (Usman *et al.*, 2008). Twenty (20) male Sokoto Red goat kids with an average weight of 10.45 kg were purchased from different village markets in Sokoto State for the experiment. The animals were quarantined for three weeks in the Livestock Teaching and Research Farm of the Usmanu Danfodiyo University, Sokoto. They were also dewormed with Batmith II® dewormer, sprayed against ectoparasites by use of triatic and treated with oxytetracycline HCI (a broad spectrum antibiotic) administered by injection. During the quarantine period and prior to the commencement of the experiment, the animals were managed intensively and group fed with cowpea hay and wheat offal.

Preparation of Feed Ingredients

Fresh fore-stomach digesta (FSD) was collected from Sokoto abattoir. The FSD was obtained from the livestock slaughtered at the abattoir irrespective of the species as described in Usman *et al.* (2008) while the other feed ingredients were purchased from Sokoto central market. Maize was crushed before it was incorporated into the diet. Groundnut haulm was cut into pieces (of about 5 mm length) before it was included into the diets.

Formulation of Experimental Diets

Four complete diets in which FSD replaced cowpea husk at 0 (control), 10, 20 and 30 % levels were formulated. The gross composition of the diets is shown in Table 1. The proportions of other ingredients were constant.

Dietary Treatments

A completely randomized design was used for this experiment. The 20 animals were divided into four treatment groups of five animals each and balanced for body weight. Each animal was housed in disinfected individual pen measuring 2 x 1 m. Each group was assigned to one of the four experimental diets and fed at *ad libitum* in the mornings and evenings for 90 days. Water and salt lick were also offered *ad libitum.*

Table 1: Gross Composition of the experimental diets

Ingredient	Treatment (%)			
	A	B	C	D
Fore-stomach digesta (FSD)	0	10	20	30
Cowpea husk	30	20	10	00
Wheat offal	20	20	20	20
Maize	10	10	10	10
Cotton seed cake (CSC)	23	23	23	23
Groundnut haulm	15	15	15	15
Bone meal	1.5	1.5	1.5	1.5
Salt	0.5	0.5	0.5	0.5
Total	100	100	100	100

Sample and Data collection

Blood samples were collected from each animal before the commencement of the feeding trial and at the last week of the experiment. The samples were collected through the jugular vein (Coles, 1986). Bleeding was done early morning before feeding and an average of 10 ml of blood was collected from each animal. About 3 ml of each sample was placed in EDTA (anti-coagulant) bottles for haematological studies. The remaining 7 ml were placed in universal bottle and allowed to stand for about 2 hours at room temperature. This allowed coagulation to take place and thus separation of serum was followed after the universal bottles were centrifuged at 700 x g for 15 minutes. The serum was collected and stored in a freezer until required for analysis.

Chemical Analysis

Thoroughly mixed representative samples of the four experimental diets, fore-stomach digesta (FSD) and groundnut haulms were each analysed for proximate composition as outlined by AOAC (1990). Whole blood samples in EDTA bottles were analysed for haemoglobin (Hb) content using cyanmethemoglobin method (Coles, 1986). Packed cells volume (PCV), erythrocyte and leucocyte counts were also done according to the methods described by Coles (1986).

The blood urea nitrogen was estimated by the method of Tanis and Naylor (1968). Total proteins were estimated by the method of Henry and Stobel (1957). Albumin was determined by Bromo Cresol green method, while globulin was determined by differenced between total proteins and albumin.

Statistical Analysis

The data generated from the experiment were subjected to analysis of variance (ANOVA) using complete randomized design (CRD) as outlined by Steel and Torrie (1980). Where significant differences between the means were indicated, Duncan´s Multiple Range Test (DMRT) was used to separate the means (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical Composition of Experimental Diets and Test Ingredients

Dry matter (DM) content of the experimental diets ranged between 95.60 % for diet D and 96.30 % for diet A. Crude protein (CP) content ranged from 16.42 % (diet A) to 15.63 % (diet D), while ether extract (EE) varied from 4.50 % (diet A) to 4.90 % (diet D). For the crude fibre (CF), the highest value was obtained in diet B (32 %) and the lowest in diet D (31.50 %). Ash content ranged from 6.20 % (diet A) to 5.80 % (diet D). Nitrogen free extract (NFE) was highest in diet D (42.17 %) followed by diet C (41.70 %), while diet B had 41.40 % and the least (41.28 %) was obtained in diet A (Table 2). The chemical composition of the diets was fully described in Usman *et al.* (2008).

Haematological Characteristics and Blood urea Nitrogen

Values for the haematological parameters of the experimental animals are shown in Table 3. The initial packed cell volume (PCV) (before the start of the experiment) was higher for animals on diets A and B (33 %) as compared to those on diets C and D which had 32 % each. The final PCV at the 11th week of the experiment was lower for animals on fed diets A, C and D (33 %) than that of animals on diet B (34 %). Both initial and final values of the PCV were not statistically different (P > 0.05) across the treatment means.

Initial haemoglobin concentration (Hb) mean values did not differ significantly from one another for all the animals on the four diets (8.8 – 9.0 g/dl), but there were significant differences in the final values of the Hb. Goats fed diet D had the highest value (9.5 g/dl) (P < 0.05), followed by those fed diet B (9 g/dl), and those on diets A and C (8 g/dl) respectively. Hb concentration decreased from the initial values at the end of the feeding trial for goats fed diets A, B and C. Only those on diet D had an increase in the Hb concentration at the end of the trial.

Table 2: Chemical composition of the experimental diets

Parameter (%)	A	B	C	D	FSD	Cowpea husk
Dry Matter	96.30	95.82	96.00	95.60	97.20	94.86
Crude Protein	16.42	16.00	15.80	15.63	9.35	8.86
Either Extract	4.50	4.60	4.80	4.90	5.80	6.00
Crude Fibre	31.60	32.00	31.80	31.50	33.90	34.20
Ash	6.20	6.00	5.90	5.80	8.60	9.20
NFE	41.28	41.40	41.70	42.17	42.35	41.74

Table 3: Haematological characteristics of Sokoto Red kids fed varying levels of FSD

Parameter	Treatment				
	A	B	C	D	SE
Packed cell volume (%)					
Initial	33.4	32.8	32.4	32.4	1.12
Final	32.8	34.0	33.4	33.4	0.93
% Difference	-1.80	3.66	3.09	3.09	
Haemoglobin concentration (g/dI)					
Initial	8.80	9.00	8.94	8.80	0.56
Final	7.9^{c}	8.96^{b}	8.04^{c}	9.48^{a}	0.29
% Difference	10.23	0.44	10.07	-8.86	
RBC (x10^{12}/L)					
Initial	0.92	0.99	1.02	0.97	0.13
Final	1.07	1.04	1.08	1.00	0.11
% Difference	-17.39	-5.05	-5.88	-3.09	
WBC (x 10^{9}/L)					
Initial	7.00	6.70	7.46	7.50	1.02
Final	7.08	7.16	7.92	8.48	1.69
% Difference	-1.14	-6.87	-6.17	-13.07	

Means in the same row with different superscripts are significantly different (P < 0.05).
g/dL = grammes per decilitre; WBC = white blood cell; FSD = Fore-stomach digesta.

Initial RBC concentration was higher in animals on diet C (1.02 x 10^{12}/$_{L}$) compared to animals on the other diets though not significantly (P>0.05) different. The RBC concentrations for goats on diets B and D were almost similar (1.00 x 10^{12}/L).The least RBC was obtained in goats fed diet A (0.90 x 10^{12}/L). Final RBC values slightly (P > 0.05) for animals on diets C (1.08 x 10^{12}/$_{L}$) and A (1.07 x 10^{12}/$_{L}$) as compared to those on diets B and D that had 1.04 x 10^{12}/$_{L}$ and 1.00 x 10^{12}/$_{L,}$ respectively. At the end of the feeding trial, there was an increase in the RBC concentration in goats on all the diets. However, the increase is more pronounced in those fed diet A, followed by those on diet C and B while the least was on those fed diet D.

Initial WBC concentration of the experimental animals was higher for diets C (7.46 x $10^9/_L$) and D (7.50 x $10^9/_L$), followed by diet A while the least WBC concentration was obtained in diet B, even though the increase was not significant ($P > 0.05$). There were also no significant differences ($P > 0.05$) in final WBC values among the treatment means (Table 3).

Table 4 shows the differential counts of goats fed FSD. Initial neutrophil counts were similar ($P > 0.05$) for goats on diets A (52%), B (53%) and C (52%). Final neutrophils indicated higher values for diets C and D (38%) and lower values of 39% for diets A and B. Percentage differences showed that diet A was higher (32%) compared to 28% for diet B, 27% for diet C and 29% for goats on diet D.

Initial lymphocyte counts followed a similar pattern with neutrophils. However, final lymphocytes concentration in all the treatments increased from the initial, with the goats fed diets D having 58%, those fed diet C had 57% and those on diets B and A had 56 and 55% respectively. Higher % differences in the lymphocyte counts were higher for diet D followed by A, C and B.

Initial monocytes counts were not significantly different ($P > 0.05$) for all the treatment means. However, the final monocyte counts (at the end of the experiment) showed a significant increase ($P < 0.05$) in diet A (5.4 %) compared to others. Final monocyte counts were lowest in goats fed diet D, while those on diets B and C were statistically similar. Goats fed diets A and B showed slight increase in monocyte counts after the feeding trial while those fed diets C and D indicated a reduction.

Eosinophil counts at the start of the experiment were significantly higher ($P < 0.05$) in goats fed diets A and D (2.2 and 2.0 %) than in those fed diets B and C (1.4 and 1.6 %). In the final counts however, there were significant increases ($P < 0.05$) in diets A and B (2.4 and 2.2 %) than in diets C and D (1.6 and 1.4 %). Basophils were not detected both in the initial and final blood samples of the experimental animals.

Table 4: Differential Counts of Sokoto Red kids fed varying levels of FSD

Parameter	Treatment				
	A	B	C	D	SE
Neutrophils (%)					
Initial	53.2	52.0	51.6	53.2	1.92
Final	36.4	37.4	37.8	38.0	1.84
% Difference	31.58	28.08	26.74	28.57	
Lymphocytes (%)					
Initial	40.2	42.4	42.4	40.0	3.67
Final	55.2	56.0	56.8	58.2	3.98
% Difference	-37.31	-32.08	-33.96	-45.50	
Monocytes (%)					
Initial	4.4	4.2	4.2	4.8	0.83
Final	5.4^a	4.4^b	3.8^b	2.4^c	0.90
% Difference	-22.73	-4.76	9.52	50.00	
Eosinophils (%)					
Initial	2.2^a	1.4^b	1.6^b	2.0^a	0.51
Final	2.4^a	2.2^a	1.6^b	1.4^b	0.66
% Difference	-9.09	-57.14	0.00	30.00	

Means in the same row with different superscripts are significantly different ($P < 0.05$).
g/dL = grammes per decilitre; SE = Standard error.

Blood urea nitrogen and serum total protein are shown in Table 5. Initial urea concentrations indicated no significant differences (P > 0.05) amongst all the treatment means. However, the final urea concentrations were higher (P < 0.0.5) for animals on diet B (8.9 mmol/l) compared to those on the other diets whose values did not differ significantly (P > 0.05) between one another. There was an increase in the final urea concentration compared to initial values for diets B (8.9 mmol/L) and A (8.32 mmol/L) while there were no variations between initial and final urea concentrations in animals on diets C and D.

The initial and final values for total proteins were similar across treatment means. However, at the end of the feeding trial, total proteins slightly increased in all the treatments. Percentage increase was more in diet C followed by that of diet A and B while the least was obtained in diet D.

Initial albumin value varied significantly (P < 0.05) between all treatments with the highest value obtained in diet A (3.86 g/dl) followed by diet B (3.74), C (3.6) and D (3.36 g/dl) in that order. Generally, similar pattern was observed in the final albumin. The percentage differences in the albumin indicated highest increase in treatment A (-30%) which continued to drop as the level of FSD increased in the diet.

Prior to the feeding trial, globulin level was significantly higher (P < 0.05) in goats fed diets B, C and D which had similar values (2.2 – 2.3 g/dl) compared to those fed diet A (1.88 g/dl). However, after the feeding trial, only diets C and D maintained significantly higher (P < 0.05) levels, with increase in the globulin level observed in goats fed diet C (2.36 g/dl). Globulin level of goats fed diets A, B and D decreased compared to the initial levels.

The PCV and Hb concentrations reported in this trial were within the ranges for small ruminants (Coles 1986), though there were slight increases in the PCV of animals in the treatment groups, which were not significant. The increase in the PCV may be associated with improved nutrition as reported by Swenson (1990). The experimental feed might be better than what the goats were fed on prior to purchase. Similarly, there were decreases in the Hb concentration in the control, 10 % and 20 % FSD levels, but a significant rise in Hb level in treatment D. This is an indication that FSD might influence the production of Hb and therefore improve the health status of animals. This study contradicts the results obtained by Maigandi (2001) who observed reduction in Hb level when he fed FSD to lambs.

Initial and final RBC and WBC counts were within the normal values reported for goats (Jain, 1993). At the end of the trial, there was a slight increase in the RBC and WBC counts. The nutritional status of an animal can influence the erythrocyte and WBC counts as reported by Swenson (1990). These results buttressed the report of Coles (1986) who said that adequate nutrition is essential for erythrocyte and WBC production, which subsequently leads to the improvement in the PCV. This is an indication that though the inclusion of FSD in the diet of the experimental animals led to reduction in dry matter intake and live weight gain, the diets met the nutritional requirements of the animals.

Even though Pond *et al.* (1980) expressed concern over the possible toxic effect of feeding animal wastes to livestock, the results of the present study removed any fear of toxicity as a result of feeding FSD to goats. This claim can be confirmed from the values of differential counts, which are the possible indicators of ill health in animals (Frandson, 1981). The values obtained for the differential counts in this study were within the ranges reported for goats (Coles, 1986 and Jain, 1993). It can be seen that neutrophils and lymphocytes interchanged position in the sense that the former were higher prior to the start of the feeding trial while the latter took over this position at the end of the trial. This is in agreement with the reports that with age lymphocytes increase while neutrophils decreased (Coles, 1986; Swenson, 1990; Frandson and Spurgeon, 1992; Jain, 1993). The authors also reported that the presence of basophils in blood sample is an indication of disease condition. Incidentally, no basophils were detected both before and after the feeding trials, meaning that FSD is safe for consumption by goats.

The values for urea concentration, total proteins, albumin and globulin obtained before and after the feeding trials were within the normal ranges for West African Dwarf goats (Aina and Akinsoyinu, 1996) and other Caprine species

(Coles, 1986). This means that feeding FSD does not interfere with those parameters which are an indication that it is safer to be used as feed.

Table 5: Blood Urea Nitrogen (BUN) and Total protein in Serum of experimental animals

Parameter	Treatment				
	A	B	C	D	SE
Urea concentration (mmol/L)					
Initial	8.26	8.54	8.20	8.24	0.72
Final	8.32[b]	8.9[a]	8.20[b]	8.24[b]	0.58
% Difference	-0.73	-4.22	0.00	0.00	
Total Protein (g/dl)					
Initial	5.74	5.94	5.66	5.90	0.68
Final	5.88	6.04	5.96	5.96	0.28
% Difference	-2.44	-1.68	-5.30	-1.02	
Albumin (g/dl)					
Initial	3.86[a]	3.74[b]	3.36[d]	3.60[c]	0.10
Final	4.02[a]	4.02[a]	3.60[b]	3.70[b]	0.22
% Difference	-30.05	-7.49	-7.14	-2.78	
Globulin (g/dl)					
Initial	1.88[b]	2.20[a]	2.30[a]	2.30[a]	0.30
Final	1.86[c]	1.92[b]	2.36[a]	2.26[a]	0.26
% Difference	1.06	12.73	-2.61	1.74	

Means in the same row with different superscripts are significantly different ($P < 0.05$).
g/dL = grammes per decilitre; SE = Standard error.

CONCLUSION

Results of the study indicated that haematological values and blood urea nitrogen were within the normal range indicating no toxicity associated with the feeding of FSD to Sokoto Red goat kids. It could also be concluded that FSD utilization in the diets of the goats does not have any health hazard.

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