RUMEN METABOLITES, HAEMATOLOGY AND SERUM BIOCHEMICAL INDICES OF RED SOKOTO BUCKS DURING RAINY SEASON GRAZING SUPPLEMENTED WITH DIFFERENT PROTEIN AND ENERGY SOURCES

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ABSTRACT

An experiment was conducted to determine the effect of supplementing rainy season grazing with two protein and two energy sources on the rumen metabolites, haematology and serum biochemical indices of Red Sokoto bucks (RSB). 24 RSB with an average weight of 13.99 kg were used (6-9 months of age). The experiment was conducted in a completely randomized design of four treatments with six replications. The diets were cottonseed cake/wheat offal –CSC/WO, groundnuts cake/ wheat offal- GNC/ WO, groundnuts cake/ maize bran- GNC/MB and cottonseed cake/maize bran-CSC/MB (diet i, ii, iii, & iv, respectively). Data were taken on rumen metabolites, haematology and serum biochemical indices. Data were analyzed using SPSE. Results showed that all the rumen metabolites were significantly ($P<0.05$, $P<0.01$ & $P<0.001$) affected by the dietary treatments before feeding (BF) and after feeding (AF). Haematological parameters indicated that, pack cell volume (BF & AF), white blood cell (BF), glucose (BF), total protein (AF), were significantly ($P<0.001$) different among the various treatments. However, red blood cell –BF ($P<0.01$) and blood urea AF ($P<0.05$) were significantly different. Results of serum biochemical indices revealed that iron (BF & AF), calcium (BF), Phosphorous (BF) and magnesium (BF & AF) were significantly affected by the dietary treatments. It could be concluded that rainy season grazing of RSB can best supplemented using mixture of groundnuts cake with maize bran.

Keywords: *RSB, GNC, WO, MB, CSC, rumen metabolites, haematology, serum biochemical indices*

INTRODUCTION

Small ruminants rank second among important grazing livestock. This suggests the relative importance of small ruminants within the livestock economy of Nigeria. Goats are widely distributed in the tropics and sub-tropics where they play very important role in agriculture and in various social obligations. The Red Sokoto goats are the most predominant small ruminants in Northern Nigeria. They are kept chiefly for meat, although their hide is valued for its high quality 'Morocco' leather (Taiwo *et al.,* 2005). The increasing demand for dietary protein in Nigeria due to population increase places more emphasis on small ruminants for production of meat (Trimnel *et al* 1985), because they have certain advantages over cattle production. Their production is less capital intensive; require less land and they are usually more prolific. They are generally termed as 'poor man's cow' (Abubakar *et al*., 2005). The adoption of the use of herbicides by most farmers, recent incidence of insurgency and clashes between farmers and herdsmen have dislodge many herdsmen from where they get abundant grasses for their animals to an area where they are limited pasture. This therefore necessitated supplementation during the rainy season since the pasture is below the carrying capacity of the animals. It therefore becomes necessary to source for readily available and cheap protein source and cereal by-products, including appropriate concentrate supplement to grazing animals that will not only aim at reducing the over- head cost of producing these animals, but also avoid compromising the quality of the animal products. This study therefore sought to evaluate the effect of supplementing rainy season grazing on rumen metabolites and blood/serum biochemical indices of Red Sokoto bucks .

MATERIALS AND METHODS

Experimental Site

The study was conducted at the Livestock Teaching and Research Farm of Federal Polytechnic Mubi, Adamawa State, Nigeria. Mubi lies on latitude 10^0 16′ 8″ N of the equator and longitude 13^0 16′ 14 ″ E of Green-wich Meridian (Anonymous, 2015).

Mubi is the second largest to Yola, the state capital. Mubi LGA is located at the northern part of old Sardauna Province which now forms Adamawa north senatorial district as defined by INEC (2006). Mubi region is bounded to the north by Borno state, to the west by Hong and Song LGA and to the south and east by the Republic of Cameroon. It has a land area of about

4,728,77 km^2 and human population of about 151,000 going by 2006 census projected figure (Ajawara, 2006).

Animals and their Management

Twenty four (24) Red Sokoto bucks approximately 6-9 months of age, with an average weight of 13.99 kg (13.45 to 14.42 kg) were used for the experiment. The animals were purchased from Mubi international cattle market and neighbouring villages. The animals were quarantined for a period of two weeks during which they were given prophylactic treatments. They were dewormed with Ivermectin, against endo-parasites and ecto-parasites and then injected with oxytate-long acting broad spectrum antibiotics. Rectal temperatures of the animals were taken, which ranged between 38.27^0C and 39.2^0C. During this period of quarantine, the animals were vaccinated against *Pestes Des Petits Ruminants* (PPR). During the quarantine, the animals were taken out for grazing on natural vegetation in the grazing area of the institution. They were provided with clean drinking water *ad libitum*. Animals were monitored daily, treatment were administered where necessary. Animals were housed in pens made of concrete floors and sufficient ventilation. Each animal was provided with a feeding/drinking container (Rubber plastic). The pens were cleaned daily. The experiment lasted for 91 days between June/July to September, 2011 (late rainy season).

Experimental Diets and Animal Feeding

Four supplements containing 15% crude protein were formulated. The supplements designated as I, II, III, IV contained cotton seed cake/ wheat offal (CSC/WO), groundnut cake/maize bran (GNC/MB), groundnut cake/wheat offal (GNC/WO) and cotton seed cake/ maize bran (CSC/MB) respectively. Each animal was offered 200g of the respective supplement every day at about 7:00 am; they were allowed to consume the feed for two hours (7:00 am to 9:00 am). By 9:30 am, they were taken out for grazing natural vegetation at the Polytechnic grazing area (which is about 200 hectares) for about six to seven hours (10:00 am to 4:00 pm). Feed refusals were collected and weighed immediately after the animals were released for grazing. On returning from grazing, they were kept in their individual pens. Species of grass and legume usually found in the grazing area were *Pennisetun purpureum*, *Panicun*

maximum, Adropogon gayanus, Ipomoea eriocapa, Centrosema pubsescens Commelina bengalensis. Clean drinking water was provided *ad libitum* for the duration of the experiment. Animals were weighed at the beginning of the experiment and weekly thereafter. Chemical composition of the experimental supplements is shown in Tables 1.

Experimental Design

The experiment was conducted in a completely randomized design (Steel and Torrie, 1980) with four treatments replicated six times (six animals per treatment).

Chemical Analysis

The experimental diets, feed ingredients and grass samples were analyzed for dry matter, crude protein (AOAC, 2005), while ash content was determined by combustion in a furnace at 500^0C following the procedure of AOAC (2005). Organic matter was assumed to be the result of subtracting the percentage of ash from 100. Neutral detergent fibre and acid detergent fibre of the samples were determined as prescribed by Van Soest. (1991).

Statistical Analysis:

Data collected were subjected to analysis of variance (balanced ANOVA) method as described by Steel and Torrie (1980) using Statistical Package for Scientists and Engineers -SPSE (2012); where significant difference existed between means. Duncan's multiple range test-DMRT (Duncan, 1955) was used to separate them. Pearson correlation coefficient was used to show relationship between parameters measured.

RESULTS AND DISCUSSION

Rumen Metabolites of RSB Grazing Natural Vegetation and Supplemented with Protein and Energy Sources

There was highly significant ($P<0.001$) difference among the dietary treatments on acetic acid. The mean values BF and AF ranged from 22.53 to 26.14 mm/100 ml and 21.45 to 32.19 mm/100 ml respectively. These values were not similar to the values of 48.00 to 49.00 mm/100 ml BF and 51.00 to 55.00 mm/100 ml obtained by Yusuf *et al.* (2013) for cattle fed hay based diets. This difference

may be due to differences in animals (species) and experimental diets used in the two experiments. Defauntion which occurs at pH below 5.5 (Slyter, 1976) didn't occurred, although usually encountered with concentrate diets (Adegbola, 1988), since there was no defaunation, the acetic acid concentration obtained with these diets are adequate, since aceate and butyrate are major fermentation end products of protozoa (Yusuf *et al*., 2013).

The ruminal NH_3-N concentration BF and AF (9.13 to 13.40 mg/100 ml and 10.00 to 14.33mg/100 ml) fell in the range of value reported by Adegbola *et al.* (1989). The author reported that ruminal NH_3 –N concentration had a good profile, with values between 9.40 to 14.75 mg/100 ml BF and 8.60 to 15.60 AF for maximum microbial growth in the rumen. The values obtained on CSC based diets BF and AF were higher than 8.5 mg/100 ml for optimal protein yield (Okorie, 1981) and 8.0 mg/100 ml which was the critical ammonia concentration for rumen function (Leng *et al*., 1977).

Concentration of propionic acid was significantly ($P<0.001$) different among the treatments (BF and AF). Propionic acid which is predominates on a high concentrate diet, was predominates on CSC based diets BF and AF with a minimum value of 12.74 mm/100 ml (BF) and a maximum of 14.89 mm/100 ml (BF). The concentration was significantly lower when compared with a minimum of 21.90 mm/100 ml (BF) and maximum of 23.80 mm/100 ml (BF) reported by Yusuf *et al.*, 2013) for cattle. This difference may be due to type and plant material as well as pH in the rumen of the animals in the two experiments (Van Soest, 1994).

Butyric acid was significantly ($P<0.001$) different among the treatments (BF and AF). The range of Butyric acid reported in the present study (4.85 to 6.66 mm/100 ml and 4.17 to 7.13 mm/100 ml BF and AF, respectively) is not comparable with 12.00 to 12.75 mm/100 ml before experiment (BE) and 15.00 to 18.00 mml/100 ml end of experiment (EE) reported by Yusuf *et al.* (2013). The probable reason for this variation may be due to activities of protozoa in the rumen, since butyric acid is one of the end products of protozoa fermentation (Nagaraja and Lechtenberg, 2007). Total volatile fatty acids (TVFA) was significantly ($P<0.001$) affected by the dietary treatment BF and AF. The concentration was higher AF than BF and was on CSC based diets. This may be due to the fibrous nature of CSC than GNC which enhance microbial growth and hence provide more VFA (Shua, 2008). TVFA value (49.32 to 54.86

mm/100 ml BF) reported in this study is similar to 86.90 to 87.90 mm/100 ml BE obtained by Yusuf *et al*. (2013).

The rumen pH was affected (P<0.01 and P<0.05) across the treatments BF and AF respectively. The pH ranged (5.40 to 6.65 BF and 5.81 to 6.60 AF) obtained in this study further confirms the earlier work of Shua *et al*. (2011) with Red Sokoto bucks fed CSC or urea (5.80 to 6.33). The pH increased after feeding and was higher for CSC/MB (high fibre diet). It has been shown that high fibre diets increased rumination hence production of salvia (pH 6.31 to 6.60 AF) which elevates the pH of rumen fluid (Kaufman *et al*., 1980). The low pH on GNC/MB indicates that it has a high level of soluble carbohydrates which produces acid on fermentation and results in low pH (Adegbola, 2002).

Blood and Serum Biochemical Indices of Red Sokoto Bucks Grazing Natural Vegetation and Supplemented with Protein and Energy Sources

The packed cell volume (PCV) gives an indication of the nutritive value of the experimental diets and were significantly (P<0.001) different across the dietary treatments. The PCV in this study ranged between 21.69 to 28.17 % BF was higher than 21.94 to 26.00 % report for Red Sokoto bucks (Shua *et al*., 2011) and 25.7 ± 3.1%, reported for Red Sokoto goats (Tambuwal *et al*., 2002). The variation could be attributed to the nutrients in the experimental diets and environmental conditions. Similarly, results reported by Okunlola *et al*. (2012) for Red Sokoto goats was higher (27.25 ± 25 to 32.75 ± 2.1 %) than those in the present study. Bucks fed GNC/MB gave the highest PCV value of 28.17 %. This implies that the health status of the bucks was stable and that the diet met the nutrient requirement of the animals or could be due to variation in nutrient utilization within an individual animal (Zagi *et al*., 2011). The PCV after feeding was slightly higher and ranged between 21.02 to 29.44 % than BF. This result confirms the earlier report of Zagi *et al.* (2011) who obtained a higher PCV values AF than BF.

White blood cells (WBC) was significantly different (P<0.001) BF. The WBC BF ranged from 8.28 to 11.94 µ/l. This value was in conformity of the previous work of Fasae *et al.* (2007) with WAD goats (11.96 to 12.60 µ/l). Tambuwal *et al.* (2002) obtained WBCs with Red Sokoto goats (10.60 ± 3.80x10^3 µ/l) and Okunlola *et al.* (2012) obtained WBC values of 11.98 ± 2.0 to 18.90 ± 1.8x10^9 /l. There was no death recorded in this study, which is in accordance with the

results of Fasae *et al.* (2007) who reported good performance with WAD goats fed cassava peels. The result of WBC also indicates that the animals were in good health throughout the experiment, because there was no depression in their immune system.

Red blood cells (RBC) which have important job of carrying oxygen was significantly ($P<0.01$) different AF among the treatments. The non- significant difference observed with RBC BF agreed with the findings of Zagi *et al*. (2011) who observed non-significant difference in RBC BF in Yankasa ram. The result of the RBC which was significant in this study disagreed with the former author who reported a non- significant difference in RBC values AF. The values obtained in the present study of 12.21 to 12.79 µ/l BF and 11.50 to 12.92 µ/l are comparable with the values of 13.20 to 13.92 µ/l obtained by Fasae *et al.* (2007) for WAD goats. However, the values of 1.80 ± 0.9 to $2.83 \pm 0.1x10^{12}$/l obtained by Okunlola *et al.* (2012) for Red Sokoto bucks is appreciably lower than that of present study. This difference may be due to methods of RBCs count used in the two experiments.

The blood glucose was not significantly different BF, but was significantly ($P<0.001$) affected by the dietary treatments AF. The mean blood glucose of bucks in the present study (3.32 to 3.52 mm/l BF and 2.23 to 3.46 mm/l AF) are similar to those observed by Fasae *et al*. (2007) for WAD goats (2.93 to 3.75 mm/l). Oduguwa *et al.* (2012) reported a blood glucose level of 60.30 to 67.45 mg/dl for WAD goats, this difference may be attributed to the differences in the method of analysis of blood glucose, experimental diets and breed of animals used in the two experiments. The blood glucose increase slightly after feeding; this agrees with normal occurrence with blood glucose, which may normally increases slightly after feeding. The result agrees with the report of Oduguwa *et al*. (2012), with WAD goats.

The total blood protein (TBP) BF was not significantly ($P<0.05$) different but, AF was significantly ($P<0.001$) different among treatments. The mean values ranged between 4.92 to 5.44 mg/l BF and 3.61 to 5.56 g/l AF. The TBP obtained in this study compares well with the ranged of 6.75 to 6.97 mg/l (Fasae *et al.*, 2007), 5.30 to 6.06 mg/l (Adedeji *et al.*, 2013) for WAD goats. However, Oduguwa *et al.* (2012) reported a value of 57.50 to 66.20 mg/l for WAD goats fed cassava peels and pineapples fruit waste. This value is appreciable higher than the one obtained in the present study, this may probable be explained due

to difference in experimental diets, breed of animals and method of analysis employed in the two experiments.

Haemoglobin which is the protein molecule in red blood cells that carries oxygen from the lungs to the body`s tissue and returns carbon dioxide from the tissue back to the lungs, was not significantly ($P<0.05$) affected by the dietary treatments (BF and AF). The mean haemoglobin concentration (11.12 to 11.55 mg/100 ml BF and 10.25 to 10.99 mg/100 ml AF) obtained in this study further confirms previous work of Okunlola *et al.* (2012) with Red Sokoto goats (8.55 ± 0.6 to 12.58 ± 2.2 g/dl. The concentration of blood urea-nitrogen (BUN) was not significantly different BF, but was significantly ($P<0.05$) different AF. The significant difference (BUN) obtained in this study agrees with the earlier report of Shua (2008) in his work with Red Sokoto bucks. Mean values reported in the present study (5.59 to5.99 mg/100 ml BF and 5.47 to 6.29 mm/l AF) is similar to those reported by Shua *et al.* (2011) of 4.75 to 6.76 mg/100 ml and Fasae *et al.* (2007) of 4.19 to 5.19 mm/l for RSB and WAD goats respectively. The result further indicates that, the kidney and liver of the animals were working normally, since the BUN was within the normal range of goats (Puls, 1994). And also the diets were relatively balanced in nitrogen.

Iron (fe) is a mineral needed for haemoglobin and was significantly ($P<0.001$) affected across the dietary treatments. The iron mean values in the present study ranged from 30.12 to 33.34 mg/100 ml BF and 28.24 to 34.43 mg/100 ml AF. These values are lower than 57.50 to 68.00 µg/dl report by Okunlola *et al*. (2012) for Red Sokoto goats, which implied that irrespective of the plane of nutrition, the diets were nutritionally adequate to provide the blood cells with adequate iron. Calcium (Ca) in the blood checks the calcium level in the body that is not stored in the bones. The level in the blood was significantly ($P<0.001$) different BF, but was not different AF across the dietary treatments. The level reported in the present study of 10.07 to 11.54 mg/100 ml BF was appreciable higher than 1.70 to 2.60 mm/l reported by Girgiri *et al.* (2013) for Yankasa rams. The lower level of calcium obtained by CSC based diets portrays the deficiency of calcium in the cake (Ibrahim, 1998). The result also reveals that the diets were adequate in calcium and there was no hypocalcemia or hyper calcemia in the animals (Anonymous, 2015).The blood phosphorus ranged from 3.21 to 4.93 mg/100 ml BF and 3.72 to 4.17 mg/100 ml AF. The level was significantly ($P<0.001$) different BF and was affected after feeding of the

supplements. The level reported in the present study was not comparable with 37.00 to 40.20 µ/l reported by Girgiri *et al*. (2013) for Yankasa ram fed Doum palm meal. These outstanding differences may be due to animal's species, experimental diets, location and method of analysis for phosphorus used in the two experiments. The result however agreed with the finding of Tizhe (2011) for Red Sokoto goats (4.70 ± 0.4 mg/ 100 ml).

Magnesium (Mg) was significantly ($P<0.001$) different among the dietary treatment BF and AF. The levels of magnesium in the present study ranged from 50.89 to 54.20 mg/100 ml BF and 59.09 to 65.81 mg/100 ml AF. These values are not comparable with 2.82 ± 0.9 to 3.16 ± 0.9 mg/100 ml reported by Tizhe (2011) for Red Sokoto goats. The probable reason for this difference may be attribute to be differences in the level of magnesium in the ingredients used to formulate the diets and sphere of the two experiments, because the latter was physiological experiment.

Cholesterol which is a waxy, fat-like substance that is found in all cells of the body was not affected by the treatments (BF and AF). The mean values reported in the present study (1.83 to 2.13 mg/dl) is not similar to those reported by Girigiri *et al.* (2013) for Yankasa rams, (1.42 to 4.50 mm/l) The report did not agree with the findings of Okunlola *et al.* (2012) with Red Sokoto goats (60.95 ± 5.1 to 73.25 ± 4.6 mg/dl) and Oduguwa *et al.* (2012 for WAD goats (41.00 to 62.80 mg/dl). This variation in the cholesterol level may be due to function of the liver in the animals used in the two experiments, since cholesterol is being produced in the liver. Also, nutritional status of the animals may probably be another reason.

Table 1: Chemical Composition of the Supplements and Grass Sample Grazed to Red Sokoto Bucks

	Supplements				Basal feed
	I	II	III	IV	
Parameter	CSC/WO	GNC/WO	GNC/MB	CSC/MB	Grass sample
Dry matter	95.08	94.23	93.04	94.47	88.06
Organic matter	86.60	88.61	87.50	86.22	85.84
Crude protein	15.18	14.93	15.30	14.78	7.46
Ash	13.40	11.39	12.50	13.78	14.16
Neutral detergent fibre	35.49	34.89	33.14	35.60	36.12

Acid detergent fibre	29.01	28.13	27.43	27.97	26.03
Hemicelluloses	6.48	6.76	5.71	7.63	10.09

CSC= Cotton seed cake, GNC= Groundnut cake, WO= Wheat offal, MB= Maize bran

Table 2: Rumen Metabolites of Rainy Season Grazing of RSB Supplemented with Protein and Energy Sources

Supplements

Parameters		I CSC/WO	II GNC/MB	III GNC/WO	IV CSC/MB	±SEM	LOS
Total volatile fatty acid (mm/100ml)	BF	54.86^{a}	53.01^{b}	50.40^{c}	49.32^{c}	0.82	***
	AF	59.70^{a}	40.00^{d}	49.64^{c}	52.86^{b}	0.76	**
Acetic acid (mm/100ml)	BF	26.14^{a}	22.53^{b}	23.19^{b}	26.06^{a}	0.78	***
	AF	32.19^{a}	25.85^{c}	21.45^{d}	28.07^{b}	0.46	***
Butyric acid (mm/100ml)	BF	6.66^{a}	4.85^{b}	5.06^{b}	4.99^{b}	0.29	***
	AF	7.13^{a}	5.21^{b}	4.17^{c}	5.47^{b}	0.34	***
Propionic acid (mm/100ml)	BF	14.89^{a}	8.63^{c}	7.73^{c}	12.74^{b}	0.47	***
	AF	14.49^{a}	10.34^{c}	10.81^{c}	12.95^{b}	0.37	***
NH_3- N (mg/100ml)	BF	12.14^{b}	10.11^{b}	9.13^{b}	13.40^{a}	0.51	*
	AF	13.20^{a}	11.09^{b}	10.00^{b}	14.33^{a}	0.59	**
Rumen Ph	BF	5.40^{b}	6.30^{a}	5.50^{b}	6.65^{a}	0.28	**
	AF	6.31^{ab}	5.81^{b}	6.45^{a}	6.60^{a}	0.25	*

^{a,b,c} Means within row with different superscripts are significantly different * =P<0.05, **=P<0.01 *** =P<0.001), BF=before feeding, AF=after feeding LS= level of significant, SEM= standard error of the mean, CSC=cotton seed cake, WO =wheat offal, GNC= groundnut cake, MB=Maize bran.

Table 3: Haematology of Rainy Season Grazing of RSB Supplemented with Protein and Energy Sources

Supplements

Parameters		CSC/WO I	GNC/MB II	GNC/WO III	CSC/MB IV	SEM	LOS
Packed cell volume (%)	BF	23.37^{b}	28.17^{a}	21.69^{c}	22.60b^{c}	0.61	***
	AF	22.25^{c}	29.44^{a}	23.73^{b}	21.02^{c}	0.70	***

White blood cell (µ/l)	BF	11.50[a]	11.94[a]	8.28[c]	10.01[b]	0.69	***
	AF	11.99[a]	11.49[a]	11.14[a]	11.49[a]	0.37	NS
Red blood cell (µ/l)	BF	12.79[a]	12.57[a]	12.21[a]	12.58[a]	0.22	NS
	AF	12.92[a]	11.72[b]	12.68[a]	11.50[b]	0.36	**
Glucose (mmol/l)	BF	2.42[c]	2.83[b]	2.23[c]	3.46[a]	0.18	***
	AF	3.45	3.53	3.32	3.51	0.21	NS
Total protein (g/l)	BF	4.92	5.18	5.39	5.44	0.24	NS
	AF	3.61[c]	5.56[a]	5.01[a]	4.24[b]	0.28	***
Haemoglobin (mg/100ml)	BF	11.44	11.12	11.51	11.21	0.31	NS
	AF	10.41[a]	10.99[a]	10.46[a]	10.25[a]	0.33	NS
Blood urea nitrogen (mmol/l)	BF	5.74[a]	5.59[a]	5.75[a]	5.99[a]	0.31	NS
	AF	6.25[a]	6.04[ab]	6.29[a]	5.47[b]	0.28	*

[a,b,c]Means within row bearing different superscript (s) are significantly different (*=P<0.05, **P<0.01, ***P<0.001) BF= before feeding, AF = After feeding, LOS=Level of significance, NS= Not significant, SEM = standard error of the means, CSC= cotton seed cake, WO = wheat offal, GNC= groundnut cake, MB=Maize bran.

Table 4: Serum Biochemical Indices of Rainy Season Grazing of RSB Supplemented with Protein and Energy Sources

		Supplements					
Parameters		CSC/WO I	GNC/MB II	GNC/WO III	CSC/MB IV	SEM	LOS
Iron (mg/100ml)	BF	33.34[a]	32.94[a]	30.12[c]	31.52[b]	0.55	***
	AF	32.05[b]	34.43[a]	28.24[d]	29.60[c]	0.42	***
Calcium (mg/100ml)	BF	10.07[b]	10.42[b]	11.52[a]	10.21[b]	0.28	***

	AF	10.25[a]	10.14[a]	10.18[a]	9.95[a]	0.48	NS
Phosphorus (mg/100ml)	BF	3.21[c]	4.93[a]	4.76[a]	4.15[b]	0.28	***
	AF	3.72	4.17	4.04	3.83	6.31	NS
Magnesium (mg/100ml)	BF	54.03[a]	52.79[b]	54.20[a]	50.89[c]	0.59	***
	AF	65.81[a]	62.33[b]	59.57[bc]	59.09[c]	1.43	***
Cholesterol (mg/dl)	BF	2.13[a]	1.83[a]	1.88[a]	1.92[a]	0.17	NS
	AF	1.90[a]	1.77[a]	2.14[a]	1.79[a]	0.25	NS

[a,b,c]Means within row bearing different superscript (s) are significantly different (*=P<0.05, **P<0.01, ***P<0.001) BF= before
feeding, AF = After feeding, LOS=Level of significance, NS= Not significant, SEM = standard error of the means, CSC=
cotton seed cake, WO = wheat offal, GNC= groundnut cake, MB=Maize bran.

CONCLUSION

It can be concluded from this study that based on the rumen metabolites, haematology and serum biochemical indices. Bucks fed GNC/MB gave higher values compare to other diets. The values were within the normal range of caprine (goat), this implies that the proportion of energy and protein in this diet was sufficient for efficient rumen function and maintenance of good health status, especially when supplementing rainy season grazing.

RECOMMENDATIONS

Based on these observations, the following recommendations were made: Rainy season grazing of Red Sokoto bucks can be significantly improved by feeding GNC/MB, without a concomitant effects on rumen metabolites, haematology and serum biochemical indices of RSB.

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