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EFFECT OF FEEDING UNTREATED OR UREA TREATED GROUNDNUT HULL SUPPLEMENTED WITH DIFFERENT PROTEIN SOURCES ON BLOOD PARAMETERS OF SUDAN DESERT LAMBS

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ABSTRACT: *Hematology and serum biochemistry from thirty Sudan desert lambs (of an average body weight and age 18.0 ± 0.5 kg and 4-5 months respectively) fed diets contained untreated (UGH) or urea treated groundnut hull (TGH) with different protein supplementations (groundnut cake (GNC), cotton seeds cake (CSC) and fish byproducts (FBP) were investigated. The lambs given six dietary treatments; diets A, B and C were contained TGH supplemented with GNC, CSC and FBP respectively, while diets D, E and F were contained UGH supplemented with GNC, CSC and FBP respectively. Jugular blood samples were taken at 0, 45 and 90 days. There were significant differences between experimental diets in hemoglobin concentration (Hb), red blood cells (RBC), mean corpuscular hemoglobin (MCH) and mean corpuscular volume (MCV) concentrations, while other parameters were similar. Increasing feeding periods resulted in higher increase in Hb, WBC, MCHC and MCH concentrations, while PCV and MCV concentrations decreased. The same trend was observed in total serum protein, urea and triglycerides concentrations with higher values recorded for lambs fed A, B or C diets, while, no differences were found on serum albumin and globulin concentrations. Serum P, K and Na recorded higher values for lambs fed in A and B diets than other experimental diets. as experimental period increased (from 0 to 45 and 90days) serum K and Na concentrations were decreased significantly, while no significant variations in the values of serum Ca and inorganic P. Ration × period interaction had no significant effects on concentration of serum K and Na from A, B and C diets, while there were significant variations on concentration of serum Ca and P. The study revealed that inclusion of TGH supplemented with GNC, CSC or FBP in the diets of growing Sudan desert sheep had positive effects on the haematological and serum biochemical parameters.*

Key words: *Urea, Crop Residues, Protein Sources, Blood Hematology, Blood Biochemical Profile, Sheep.*

ORIGINAL ARTICLE

INTRODUCTION

Ruminants in the majority of developing countries are reared on fibrous crop residues based diets. The main constraints in utilization of such feedstuffs in animal feeding system are their high cell wall and low nitrogen and mineral content coupled by low intake potential. Out of the several physical, biological and chemical methods tried in Sudan and abroad to enhance the nutritive value of crop-residues, urea-treatment has been found to be the most promising, practicable and users friendly and the extra N it supplies increases the crude protein (CP) concentration of crop residues (McDonald et al., 2003). But urea treatment is not sufficient which may require additional N supplementation (Fadel Elseed et al, 2004). Nitrogen supplementation corrects nitrogen deficiency in the rumen and improves the fermentation and microbial activity, hence enhancing the utilization of fibrous crop residues. Nevertheless, results depend upon the nature of nitrogen in the concentrate as there are many protein sources available to supplement the crop-residues basal diets. Therefore different mechanisms involved in the microbial and animal response to supplementation (Seoane et al., 1993). While it is apparent that a lot of work have been done and reported on the feeding values of urea treated crop residues, little or no work have been reported on the haematological and biochemical parameters of Sudan desert sheep fed untreated or urea treated crop residues supplemented with different protein sources. Since evaluation of the blood profile of animals may give some insight as to the potentials of a dietary treatment to meet the metabolic needs of the animal. According to Church et al. (1991), dietary components have measurable effects on blood constituents such that significant changes in their

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values can be used to draw inference on the nutritive value of feeds offered to the animals. Therefore, The present study is designed to determine the effects of fed untreated or urea treated groundnut hull supplemented with different protein sources in the diets of growing Sudan desert sheep on their haematological and serum biochemical parameters.

MATERIAL AND METHODS

Ammoniation of groundnut hull

Groundnut hull was treated with 4% fertilizer grade urea at 50% moisture level and covered with polythene sheet and was kept air tight at room temperature for six weeks, as described by Dass et al. (1984).

Experimental animals, housing and feeding

Thirty growing male Sudan desert lambs (4-5 months of age, 18.5±2.1 kg average body weight) were randomly divided into six groups on the basis of their body weight. During the experiment, the animals were kept in well ventilated shed with individual feeding and watering arrangements. The animals were offered concentrate mixtures (A, B, C, D, E and F) (Tables 1 and 2 AOAC, (1995). Urea treated groundnut hull (TGH) supplemented with groundnut cake (GNC), cotton seed cake (CSC) and fish by-products (FBP) fed to groups A, B and C respectively, untreated groundnut hull (UGH) with GNC, CSC and FBP fed to groups D, E and F respectively for a period of 90 days. Clean and fresh drinking water was provided *ad libitum* to all the experimental animals.

Table 1 - Percentage composition (by weight) of the experiential diets

	Diets					
Ingredients	**A**	**B**	**C**	**D**	**E**	**F**
TGH	25	25	25	-	-	-
UGH	-	-	-	25	25	25
Groundnut cake	12	-	-	10	-	-
Cotton seeds cake	-	15	-	-	15	-
Fish by-products	-	-	8	-	-	7
Sorghum	16	15	19	16	16	18
Molasses	25	23	26	28	25	27
Wheat bran	20	20	20	17	16	20
Urea	-	-	-	2	1	1
Limestone	1	1	1	1	1	1
Common salt	1	1	1	1	1	1
Total	100	100	100	100	100	100

TGH = urea treated groundnut hull , UGH = Untreated groundnut hull

Table 2 - Chemical composition (DM %) of the experimental diets

	Diets					
Ingredients	**A**	**B**	**C**	**D**	**E**	**F**
Dry matter	89.08	90.68	88.23	87.54	90.07	90.80
Organic matter	77.44	78.62	77.09	74.57	77.52	77.33
Crude protein	15.18	15.09	15.13	15.05	15.23	15.49
Ether extract	1.99	2.39	3.43	2.41	2.74	3.2
Crude fiber	15.02	15.46	15.79	17.19	17.31	17.89
Ash	11.64	12.06	11.14	12.97	12.55	13.47
Nitrogen-free extract	56.17	55	54.51	52.38	52.17	49.95
ME (Mj/kg)	11.05	11.23	11.52	10.74	10.85	10.4

ME of the complete diet was calculated according to the equation: ME (M j/kg DM) = 0.012CP + 0.031EE + 0.005CF + 0.014NFE (MAFF, 1975).

Data collection

Blood samples were taken in (three replicates) from the jugular vein of each animal at 0, 45 and 90 day of the experiment. The blood samples were collected in two sets, one set was collected into plastic tubes containing the anti-coagulant ethylene diamine tetra acetic acid (EDTA) for the determination of hematological parameters, the other set was collected into anti-coagulant free plastic tubes, allowed to coagulate at room temperature and centrifuged for 10 minutes at 3000 rmp. The obtained serum samples were stored in a deep-freezer for subsequent biochemical analysis.

Analytical procedures

Haematological parameters were estimated for packed cell volume (PCV), haemoglobin (Hb) concentration, red blood cells (RBCs) count and total white blood cell (WBCs) count according to the outlined procedures by Schalm et al. (1975). Mean corpuscular haemoglobin (MCHC), mean corpuscular haemoglobin (MCH) and mean

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corpuscular volume (MCV) were calculated from RBCs count, Hb concentration and PCV values as described by Jain (1986). Serum calcium (Ca), inorganic phosphorus (P) and urea concentrations were determined using chemical methods (Thomas, 1998). Serum (Na) sodium and potassium (K) concentrations were determined using flame photometry (Endres and Rude 1999), Serum total protein and albumin concentrations were determined using chemical methods (Tietz, 1994). Serum globulin concentration was calculated by subtracting serum albumin concentration from that of total protein. Serum triglyceride concentration was determined using chemical methods (Rifai et al., 1999).

Statistical analyses

Results obtained were analyzed statistically using statistix9 software package. The obtained results were compared on the basis of the source of protein supplementation and with untreated or urea treated groundnut hull in the concentrate diets, using 2×2 factorial analysis of variance (ANOVA). The differences between means were separated using the Least Significant Difference test (LSD).

RESULTS

There were significant differences in hematological indices and measured biochemical parameters between lambs group fed GH diets and those fed– UGH diets. Although, supplementation with different protein sources resulted in significant affects through experimental period.

Table 3 - Haematological values of lambs fed experimental diets

Parameters	WBC ($10^3/mm^3$)	PCV (%)	Hb (g/dl)	RBC ($10^6/mm^3$)	MCHC (g/dl)	MCH (pg)	MCV (fl)
Diet							
A	7.15	31.38	10.96^{a}	7.65^{ab}	29.21	10.41^{a}	47.77^{a}
B	7.79	29.50	11.5^{a}	7.62^{a}	29.39	10.50^{a}	44.83^{ab}
C	8.88	30.63	10.68^{a}	6.87b	31.04	9.75^{b}	44.83^{ab}
D	7.28	30.94	8.23^{b}	6.35^{b}	30.56	9.04^{b}	43.80^{ab}
E	7.41	30.94	8.45^{b}	6.75^{b}	30.56	9.04^{b}	43.80^{ab}
F	8.33	29.50	8.33^{b}	6.40^{b}	29.39	8.70^{b}	41.68b
S.E.M	0.42	0.91	0.29	0.27	0.88	0.63	1.94
Period							
0 day	7.51^{b}	29.44b	8.09^{b}	7.08	23.22^{c}	11.88^{bc}	51.96^{a}
45 day	8.28^{b}	35.63^{a}	7.01^{c}	7.03	23.81^{c}	10.27^{c}	43.63^{b}
90 day	9.95^{a}	30.75^{b}	10.19^{a}	7.16	39.69^{a}	17.37^{a}	43.76^{b}
S.E.M	0.42	0.91	0.29	0.27	0.88	0.63	1.94
Die t X Period							
A X 0	5.79^{c}	37.75^{a}	7.78^{cd}	6.08^{c}	20.59^{hi}	10.10	63.28^{a}
A X 45	9.05^{ab}	31.00^{bc}	7.50^{cd}	9.28^{a}	24.07^{fgh}	11.09	33.51^{fg}
A X 90	7.39^{bc}	31.00^{bc}	12.30^{a}	6.15^{c}	39.72^{a}	12.33	51.03^{bc}
B X 0	8.10^{abc}	27.74^{b}	6.75^{d}	7.15^{bc}	18.10^{i}	9.73	53.76^{ab}
B X 45	10.20^{a}	37.75^{a}	6.90^{d}	5.93^{c}	24.91^{fgh}	11.65	46.89^{bcd}
B X 90	7.09^{bc}	30.75^{bcd}	11.85^{a}	7.08^{bc}	38.58^{ab}	11.97	43.98^{bcdef}
C X 0	6.03^{c}	34.50^{ab}	8.85^{bc}	7.93^{ab}	26.35	12.17	44.76^{bcde}
C X 45	10.32^{a}	29.25^{cd}	6.75^{d}	6.05^{c}	22.83^{d}	11.11	48.86^{bcd}
C X 90	6.33^{c}	29.00^{cd}	11.85^{a}	7.15^{bc}	40.85^{a}	10.70	40.90^{cdefg}
D X 0	6.13^{c}	32.50^{bc}	9.00^{bc}	7.15^{bc}	27.86^{d}	12.53	46.06^{bcd}
D X 45	6.88^{bc}	29.75^{bcd}	6.90^{d}	6.86^{bc}	23.45^{f}	10.22	45.27^{bcde}
D X 90	7.00^{bc}	32.25^{bc}	12.75^{a}	8.25^{ab}	39.63^{a}	10.48	39.13^{defg}
E X 0	6.67bc	27.54^{b}	6.55^{d}	7.05^{bc}	17.10^{i}	9.73	52.12^{ab}
E X 45	6.55c	30.75^{bcd}	7.78^{cd}	5.08^{c}	17.59^{i}	12.10	63.28^{a}
E X 90	6.33^{c}	25.5d	6.46^{d}	5.43^{c}	23.30f	11.93	44.65 ^{bcd}
F X 0	5.77^{c}	22.34e	6.34^{d}	6.65bc	32.22^{b}	10.87	45.98 ^{bcd}
F X 45	6.54^{c}	21.5e	7.73^{cd}	6.38^{c}	33.29^{b}	11.22	51.34 ^{bc}
F X 90	7.32^{bc}	25.5d	7.30^{cd}	6.35^{c}	33.28^{b}	9.25	54.62 ^{ab}
S.E.M	0.83	1.81	0.58	0.54	1.75	1.25	3.88

A, B and C diet contained TGH. D, E and F contained UGH.(A and D), (B and E), (C and F) were contained GNC, CSC and FBP as source of protein respectively. Above values are means of five animals. SEM: Standard error of mean; a-b means with different superscripts in the same column were significantly different (P <0.05)

Erythrocytic indices

Results of the haematological values obtained from thirty Sudan desert lambs are present in Table (3). There were no significant differences between experimental diets in PCV, WBC, MCHC and MCV concentrations, with higher values of WBC in lambs fed FBP as protein supplementation. While significant (P<0.05) differences were found between experimental diets in Hb, RBC, MCH and MCV concentration, with higher values of Hb and RBC were recorded in diet A, B and C compared to other experimental diets. Although, feeding periods had significant effects

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in heamatlogical parameters except RBC concentration which remain unaffected. Therefore, increasing feeding periods resulted in significant increase in Hb, WBC, MCHC and MCH concentrations. On contrast, PCV and MCV concentrations showed significant decrease while feeding period increases. The values obtained in diet × period interaction were significantly ($P<0.05$) different between the six experimental diets in all the blood parameters measured except for MHC concentration. The higher Hb values were detected in lambs fed diet A, B, C and D in 90th day, while higher values for WBC were obtained with A, B and C diets in 45th day.

Blood minerals profile

The concentration of serum potassium (K), sodium (Na), calcium (Ca) and inorganic phosphorus (P) were significantly affected during the experimental period Table (4). Serum P, K and Na recorded significantly ($p<0.05$) higher values for rations A and B than other groups. as experimental period increased (from 0 to 45 and 90days) serum K and Na values were decreased significantly ($P<0.05$), While no significant ($P<0.05$) variations in the values of serum Ca and inorganic P. Ration × period interaction had no significant ($P<0.05$) effects on concentration of serum K and Na from A, B and C diets, while there were significant variations on concentration of serum Ca and P.

Table 4 - Blood minerals profile of experimental diets

Parameters	K(mmol/l)	Na(mmol/l)	Ca(mg/dl)	P(mg/dl)
Diet				
A	4.43^{a}	167.83^{a}	9.52^{c}	6.67^{a}
B	4.30^{abc}	165.50^{ab}	12.10^{a}	6.47^{ab}
C	4.33^{ab}	162.83^{b}	12.67^{a}	5.95^{bc}
D	3.72^{d}	155.17^{d}	7.83^{d}	5.80^{bc}
E	3.87^{cd}	159.83^{c}	10.78^{b}	5.48^{c}
F	3.93^{bcd}	160.00^{c}	9.63^{c}	6.35^{ab}
S.E.M	0.21	1.78	0.32	0.32
Period				
0 day	4.28^{a}	165.42^{a}	10.04	5.95
45 day	4.13^{ab}	163.58^{a}	10.21	6.03
90 day	3.88^{b}	156.58^{b}	10.02	6.38
S.E.M	0.15	1.26	0.23	0.23
Diet X Period				
A X 0 day	4.50^{a}	167.00^{abcd}	9.25^{gh}	6.45ab^{c}
A X 45 day	4.35^{a}	166.50^{abcd}	8.10^{hi}	6.50^{ab}
A X 90 day	4.45^{a}	170.00^{a}	11.20^{de}	7.05^{a}
B X 0 day	4.20^{abc}	166.50^{abcd}	10.00^{fg}	6.00^{abcd}
B X 45 day	4.45^{a}	168.00^{ab}	13.70^{ab}	6.45^{abc}
B X 90 day	4.25^{ab}	162.00^{bcd}	12.60^{bc}	6.95^{a}
C X 0 day	4.40^{a}	163.00^{bcd}	9.70^{g}	5.50^{bcd}
C X 45 day	4.20^{abc}	164.50^{abcd}	13.50^{b}	6.15^{abcd}
C X 90 day	4.40^{a}	161.00^{d}	14.80^{a}	6.20^{abcd}
D X 0 day	4.20^{abc}	161.50^{cd}	7.00^{ij}	6.25^{abcd}
D X 45 day	3.50^{bcd}	153.00^{e}	10.30^{efg}	5.20^{d}
D X 90 day	3.45^{cd}	151.00^{e}	6.20^{j}	5.95^{abcd}
EX0 day	4.15^{abc}	167.00^{abcd}	11.05^{def}	5.30^{cd}
EX45 day	4.00^{abcd}	164.50^{abcd}	9.35^{g}	5.45^{bcd}
EX90 day	3.45^{cd}	148.00^{e}	11.95^{cd}	5.70^{bcd}
FX0 day	4.25^{ab}	167.50^{abc}	13.25^{b}	6.200^{abcd}
FX45 day	4.25^{ab}	165.00^{abcd}	6.30^{j}	6.40^{abc}
FX90 day	3.30^{d}	147.50^{e}	9.35^{g}	6.45^{abc}
S.E.M	0.37	3.0867	0.56	0.56

A, B and C diet contained TGH. D, E and F contained UGH.(A and D), (B and E), (C and F) were contained GNC, CSC and FBP as source of protein respectively. Above values are means of five animals. SEM: Standard error of mean; a-b means with different superscripts in the same column were significantly different ($P<0.05$)

Blood metabolic profile

The serum concentrations of total protein, albumin, globulin, triglycerides and urea were shown in table (5). The concentrations of total serum protein, albumin, globulin, urea and triglycerides ranged from 5.15 to 6.70 g/dl, 3.10 to 3.75 g/dl, 1.65 to 3.30 g/dl, 42.00 to 66.50 mg/dl and 44.00 to 65.50 mg/dl respectively in all groups during experimental periods. Total serum protein, urea and triglycerides were significantly ($P<0.05$) higher for lambs fed A, B or C diets than those fed D, E or F diets. While, no significant ($P<0.05$) difference were found on serum albumin and globulin concentrations. The effect of the feeding period was obvious on the above parameters; in general, 0 day had the lower values. While, higher values were recorded for 45 and 90 days except for albumin which remain unaffected. There were significant ($P<0.05$) differences in total protein, globulin, urea and triglycerides concentrations among lambs on different diet × period interaction, but lambs on diets A, B and C on 45 and 90 days had recorded higher values compared than those on diet D, E and F for the same periods of

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feeding. Whereas, Serum albumin showed no significant (P<0.05) difference in response to different diet × period interaction. Serum urea concentrations were significantly (P<0.05) increased with increases in feeding period for lambs fed A, B and C diets compared to other tested diets. Differences in urea concentrations between Diets B, D and C were non-significant (P<0.05).

Table 5 - Blood metabolic profile of lambs fed experimental diets

Parameters	T. protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	Urea (mg/dl)	Triglycerides (mg/dl)
Diets					
A	6.20^{a}	3.43	2.77^{a}	55.83a	54.67ab
B	6.13^{a}	3.42	2.72^{a}	53.67a	58.50a
C	6.05^{a}	3.57	2.48^{ab}	53.50a	55.67ab
D	5.47^{b}	3.40	2.07^{ab}	44.17b	52.00bc
E	5.43^{b}	3.50	1.93^{b}	44.50b	48.33c
F	5.43^{b}	3.10	2.33^{ab}	44.00b	49.17c
SEM	0.19	0.23	0.34	1.60	1.97
Periods					
0 day	5.41^{b}	3.37	2.04^{b}	43.67^{c}	48.75^{b}
45 day	5.95^{a}	3.43	2.52^{ab}	49.25^{b}	55.08^{a}
90 day	6.00^{a}	3.41	2.59^{a}	54.92^{a}	55.33^{a}
S.E.M	0.13	0.16	0.24	1.13	1.39
Diets X Period					
A X 0 day	5.55^{c}	3.45	2.10^{abcde}	46.50^{d}	46.50^{fgh}
A X 45 day	6.65^{a}	3.55	3.00^{abc}	54.50^{b}	53.00^{def}
A X 90 day	6.40^{ab}	3.20	3.20^{ab}	66.50^{a}	64.50^{a}
B X 0 day	5.15^{c}	3.50	1.65^{e}	43.00d	46.50^{fgh}
B X 45 day	6.55^{a}	3.25	3.30^{a}	52.50^{bc}	65.50^{a}
B X 90 day	6.70^{a}	3.50	3.20^{ab}	65.50^{a}	63.50^{ab}
C X 0 day	5.30^{c}	3.55	1.65^{e}	43.50^{d}	50.00^{defg}
C X 45 day	6.50^{a}	3.55	2.95^{abcd}	52.50^{bc}	60.50^{abc}
C X 90 day	6.35^{ab}	3.50	2.85^{abcde}	64.50^{a}	62.50^{a}
D X 0 day	5.45^{c}	3.50	1.95^{cde}	42.50^{d}	52.00^{def}
D X 45 day	5.15^{c}	3.35	1.80^{cde}	47.00^{cd}	56.00^{cd}
D X 90 day	5.80^{bc}	3.35	2.45^{abcde}	43.00^{d}	48.00^{efgh}
E X 0 day	5.55^{c}	3.35	2.20^{abcde}	44.50^{d}	53.50^{cdef}
E X 45 day	5.50^{c}	3.75	1.75^{de}	45.00^{d}	54.00^{cde}
E X 90 day	5.25^{c}	3.40	1.85^{cde}	45.00^{d}	50.00^{defg}
F X 0 day	5.45^{c}	3.45	2.70^{abcde}	42.00^{d}	44.00^{gh}
F X 45 day	5.35^{c}	3.05	2.30^{abcde}	45.00^{d}	54.00^{cde}
F X 90 day	5.50^{c}	3.20	2.00^{bcde}	45.00^{d}	49.50^{defg}
S.E.M	0.33	0.40	0.59	2.78	3.41

A, B and C diet contained TGH. D, E and F contained UGH.(A and D), (B and E), (C and F) were contained GNC, CSC and FBP as source of protein respectively. Above values are means of five animals. SEM: Standard error of mean; a-b means with different superscripts in the same column were significantly different (P <0.05)

DISCUSSION

Mean PCV values obtained in this study were within the physiological range of 27.0 – 45.0 % given by Jain (1993), slightly higher than the range of 25–30% reported by Opara et al. (2010). In contrast to this, Taiwo and Ogunsanmi (2003) reported higher values of 36.9% and 35.5% for clinically healthy West African dwarf sheep. The Hb range in this study fell within the range of 9–15 g/dl reported by (Kaneko, 1997; Patra et al., 2003), but higher than the values of 5 to 6 g/dl obtained by Belewu and Ogunsola (2010) for goats fed treated Jatropha curcas kernel cake rations. No effects of different protein sources in WBC, PCV, Hb, MCHC and MCV in this study has indicated that different protein sources at same CP levels have no effect on the blood profile. The results of the present study are supported by Nelson and Watkins (1967), who reported that blood profile, remained unaffected by protein sources indicating that homeostatic mechanism might not be influenced by different protein sources. The RBC counts reported in this study were fell below the range of 9.2–13.5 g/dl reported by Tambuwal et al. (2002), 9.9–18.7 g/dl by Taiwo and Ogunsanmi (2003), and 10.25–12.85 × 10^{12}g/dl) obtained by Ajala et al. (2000). The reduced RBC counts recorded for lambs in the D, E and F diets present a likely susceptibility to anaemia-related disease conditions by these lambs. The WBC counts were similar among the treatment groups and fell within the normal range (5 to 11g/dl) reported by Scott et al. (2006) for sheep. The similar WBC counts obtained imply that, the ability of the lambs was compromised to respond to and eliminate infection. The serum protein concentration indicates the balance between anabolism and catabolism of protein in the body. The serum protein concentration at any given time in turn is a function of hormonal balance, nutritional status, water balance and other factors affecting health. the serum concentrations of total protein in healthy animals normally varies between 6.0 and 7.9 g/dl % and is altered during any liver and kidney diseases Kaneko, (1980).The concentrations of total serum

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protein in this study within the normal range implied that the test diets were able to supply adequate amount of protein needed to maintain normal serum protein levels. However, the serum protein concentrations in this study tended to increase significantly with increasing feeding period; similar trend was reported by Maigandi (2001). The serum urea concentration is closely associated with the break down and deamination of the protein in the rumen and the rate of utilization of NH3 for bacterial protein synthesis. An increase in the serum urea level may reflect an accelerated rate of protein catabolism rather than a decrease in urinary excretion (Kaneko 1980). Higher values in serum urea concentrations detected in lambs fed UTG diets in this study were agree with findings by (Dass et al., 1996) which reported that, supplementation of the basal diet of buffaloes with NPN compounds was resulted in higher serum urea concentrations. Increase of serum urea concentration in this study for lambs fed UTG diets versus GH diets may have resulted from the fact that, the content of rumen degradable protein in UTG is greater than in GH diets, given that a positive correlation exists between levels of N intake and concentration of serum urea (Karnezos et al., 1994). Moreover, this UGH fed animals could access enough dietary protein to maintain an optimal total serum protein concentration compared to lower values in other groups that were deficient in CP intake (Sharma et al.2006). The statistically similar, serum urea concentration in lambs fed A, B and C diets in this study was supported by Carro et al. (2006) and Davies et al. (2007). Serum albumin and globulin in this study ranged from 3.05-3.75 and 1.65-3.3mg/dl respectively, which agrees with Coles (1986). The serum Sodium and Potassium levels in this study were within the range of 147.5-167.83mmol/l for Sodium and 3.3-4.5mmol/l for potassium, which compares with the report of Borjesson (2000) who reported values of 153mmol/l and 4.7mmol/l for Sodium and Potassium, respectively. Serum inorganic phosphate values obtained in this study were within the normal physiological range of 5.0 – 7.3mg/dl given by Kaneko (1989). The higher serum inorganic Phosphate, Sodium and Potassium concentrations in lambs fed A and B diets were more likely related to the source of protein supplementations. These observations were in accordance with the findings by (Oboh and Olumese, 2008). They stated that, serum sodium (Na), chloride (Cl) and potassium (K) concentrations differed in response to different protein supplementation in sheep. In contrast, Davies et al., (2007) and Hatfield et al. (1998) reported that, serum minerals (Ca, P, K, Na, Mg and Cl) levels remained unaffected in lambs fed different protein source diets.

CONCLUSION

Despite the significant differences in the tested hematological and biochemical parameters of lambs fed on urea treated GH diets, their levels remained within the physiological ranges which could indicate that urea treated GH did not have any adverse effect on lambs' health.

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