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Evaluation of Hematology and Serum Biochemistry of Uda Rams Fed Graded levels of Two Forms of *Kanwa*

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ABSTRACT

The study evaluated the effects of natron (*kanwa*) on hematological and morphometric responses of Uda rams. Twenty Eight (28) Uda rams were allotted to seven Treatments; with Yar Zankowa and Mai Fatsi Fatsi at 0.5, 1.0 and 1.5% of the dites as Treatments 1, 2, 3 and 5, 6, 7 respectively while Treatment 4 with 0.0% as control in a Completely Randomized Design (CRD). The experiment lasted for 84 days (12 weeks). Data are collected for serum biochemical parameters and hematological parameters. The results revealed that there were significant ($P<0.05$) differences hematological indices except for Hb, RBC and MCV. Serum results showed significant ($p<0.05$) variation; treatment 1 had higher urea, creatinine, TP and globulin compared to other Treatments. It was concluded that *kanwa* supplementation did not affect serum and hematological profile of the animals.

Key words: haematology, serum biochemistry, sheep, blood

INTRODUCTION

Background of the Study

The use of feed additives in diet of livestock for nutrient utilization as well as growth and production has immense importance. Feed additives that modify rumen fermentation such as organic acids, yeast, enzymes and ionophores are being used to optimize performance in animal production systems (Gebrehiwot, 2014). From recent scientific reports, it has been discovered that there is an increased use of geological minerals in human and animal feeds. Moreover, Nigeria's government revitalization concern in the exploration of solid mineral could perhaps explain the reason for the use of naturally occurring inorganic substances (salts) for various purposes (Aribido *et al*., 2001). One of such geological mineral is potash popularly called *kanwa* in Northern parts of Nigeria. *Kanwa* is a dry-lake salt and is largely a hydrated sodium carbonate (Davidson *et al.*, 1974; Oyeleke and Morton, 1981). It is a mould, growing out of the soil during rain but scrapped off, dried in the sun and sold without further Treatment. In Nigeria, potash mostly occurs as a common deposit of saline lakes, the deposit is usually covered by shallow water, less than two feet deep (Makanjuola and Beetlestone, 1975). Its occurrence is common in the northern part of the country, especially in Kano and Maiduguri areas, extending to neighboring countries like Chad and Niger. According to Makanjuola and Beetlestone (1975), *kanwa* is the second most commonly used salt in Nigeria. It is next important table salt with very low amounts of potassium as compared to sodium (Ekanem, 1977). There are basically varieties of potash that are well known in Nigeria and their uses have also been noted. It is known locally by different tribes such as *Kaun* by Yoruba in Southwest Nigeria and Igbos in Eastern Nigeria, *Kanwa* or karu by Hausa in Northern Nigeria and O*kanwa* and Ikoro by Igalas and

Egbira ethnic groups, respectively, in the middle belt of Nigeria (Makanjuola and Beetlestone, 1975).

MATERIALS AND METHODS

Experimental Site

This study was carried out at the Department of Animal Science Livestock Teaching and Research Farm, Main Campus, Usmanu Danfodio University, Sokoto. Sokoto is located between latitudes 13^{o} 08'04N and longitudes 5^{o} 13'00E in the Northern part of Nigeria and at an altitude of 283m above the sea level (Google Earth, 2019). The State falls within the Sudan savannah vegetation zone with alternating wet and dry seasons. The annual rainfall is about 700mm, the rainy season starts from June and ends in early October with a peak in August; the hot dry spell extends from March to May and sometimes to June in the extreme northern parts. A short, cool, dry period (harmattan) occurs between October and February (Malami *et al*., 2001). Potential evapotranspiration has been reported to be 162mm, maximum temperature of 41^{o}C occurs in April and minimum of 13.2^{o}C in January (Malami *et al*., 2001). The State is one of the largest livestock producing area in Nigeria.

Experimental Animals and their Management

Twenty eight (28) Uda rams were used for this study. The experimental animals were sourced from Achida Livestock Market. The animals were dewormed with Ivermectin 5% (1ml/50kg body weight) and Albendazole against external and internal parasites, respectively before the commencement of the experiment. Also, Oxytetracycline (a broad-spectrum antibiotic) and multivitamins injections were given at rate of 1ml/10kg body weight for three days against any subclinical infections and to reduce stress. Feed and water were given to the animals *ad libitum*. The animals were housed in pens with adequate ventilation. An experimental diets were offered *ad libitum* as total mixed ration.

Measurements of production parameters

Feed consumption from each Treatment was measured on daily basis by subtracting the quantity of leftover from the quantity served per ram. Adequate measures were taken to safeguard against wastage.

The animals were weighed individually each week using a hanging weighing balance to determine body weight change. Feed conversion ratio was measured by dividing the mean feed intake per animal by mean body weight gain as per description of Girgiri *et al.* (2013)

$$Feed\ Conversion\ Ratio = \frac{Mean\ feed\ intake\ (g)}{Mean\ body\ weight\ gain\ (g)}$$

Treatments and Experimental design

The animals were allotted to 7 Treatments: four (4) animals were randomly allocated to each Treatment in a Completely Randomized Design (CRD). The animals were balanced for weight before commencement of the experiment and weighed on weekly basis throughout the experimental period. The experiment lasted for 84 days (12 weeks).

Composition of Experimental Diets

A single experimental diet was formulated using groundnut pods, maize stover, cottonseed cake, rice offal, cowpea hay and molasses, which were sourced from Kara Market, Sokoto. Graded levels of the two forms of *kanwa; Mai Fatsi Fatsi (MFF)* and *Yar Zankowa (YZK)* were added to the experimental diet at 0.5, 1.0 and 1.5% to form seven Treatments with one as control (T1, T2, T3, T4, T5, T6 and T7).

Table1. Composition of Experimental Diet

	TREATMENT						
	YZK			Control	MFF		
Ingredient	T1(0.5%)	T2(1%)	T3(1.5%)	T4(0%)	T5(0.5%)	T6(1.%)	T7(1.5%)
Groundnut pods	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Maize Stover	15.0	15.0	15.0	15.0	15.0	15.0	15.0
Cotton seed cake	17.1	17.1	17.1	17.1	17.1	17.1	17.1
Rice offal	25.6	25.6	25.6	25.6	25.6	25.6	25.6
Cowpea hay	18.3	18.3	18.3	18.3	18.3	18.3	18.3
Molasses	04.0	04.0	04.0	04.0	04.0	04.0	04.0
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Chemical Composition							
Energy (Kcal/Kg.ME)	2509.0	2509.0	2509.0	2509.0	2509.0	2509.0	2509.0
CP (%)	12.14	12.14	12.14	12.14	12.14	12.14	12.14
CF (%)	23.46	23.46	23.46	23.46	23.46	23.46	23.46

YZK= yar zankowa, MFF= mai fatsi fatsi, CP=crude protein, CF=crude fibre

Blood sample collection

At the end of the experiment, the animals were fasted overnight. The fasting of animals is to avoid the temporary elevation of blood metabolites following feeding (Jain, 1986). Three animals each from the Treatments were randomly selected, each animal was restrained and blood samples were collected from the jugular vein using 10ml sterilized disposable syringe. The blood samples collected was emptied into two separate sample bottles, in which one contains ethylene diamine tetra – acetic acid (EDTA) and the other one blank. The blood samples in EDTA bottles were used for haematological analysis while the samples in plain bottles were used for serum biochemical analyses. The samples for the serum biochemistry were centrifuged for five minutes so as to separate the serum from the whole blood for the evaluation of serum biochemical indices as per the procedure of Kolo *et al*. (2017)

Evaluation of haematological parameters

Packed cell volume (PCV), red blood cells (RBC) count, white blood cells (WBC) counts, Leucocytes differential counts and haemoglobin concentration (HB) were determined in accordance with the methods outlined by Bush (1991a)

Erythrocyte indices which include the mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were computed in accordance with the standard formulae of Schalm *et al.* (1975) as shown below:

$$\text{MCV (fl)} = \frac{\text{PCV}}{} \quad X \quad \frac{10}{}$$

$$\text{RBC Count In } 10^6/\text{Mm}^3 \qquad 1$$

$$\text{MCH (pg)} = \frac{\text{Hb (G/Dl)}}{\text{RBC (In } 10^6/\text{Mm}^3\text{)}} \times \frac{10}{1}$$

$$\text{MCHC (g/dl)} = \frac{\text{Hb (G/Dl)}}{\text{PCV (\%)}} \times \frac{100}{1}$$

Evaluation of serum biochemical analysis

Blood samples prepared for serum biochemical analyses were used for the determination of urea concentration, serum total protein, albumin, Aminotransferase (ALT), alkaline phosphatase (ALP), total bilirubin and electrolyte .The blood urea concentration was estimated by Nessler's reaction (Tanis and Naylor, 1968). Serum total protein was estimated by the Biuret method as described by Kohen and Allen (1995). Albumin was determined by Bromo Cresol Green (BCG) method (Peter *et al*., 1982), while globulin concentration was determined by difference between total protein and albumin. Albunin/globulin ratio was calculated by dividing albumin value by the calculated globulin value. Aspartate aminotransferase (AST), Alanine Aminotransferase (ALT), alkaline phosphatase (ALP) activities was determined using spectrophotometric method, as described by Rej and Hoder (1983). Total bilirubin was being determined using orbital techniques as described by Westwood (1991). Electrolyte determination was being done using flame photometer as described by Chirase *et al.* (1991).

Data Analysis

Data generated from the experiment were subjected to analysis of variance using Statview Statistical Package (SAS, 2002). Least significant difference (LSD) test was used to separate the means at 5% level of significance.

RESULT

Hematological Indices of Uda Rams Fed Graded Levels of Different Forms of *Kanwa*.

The heamatological parameters of Uda rams supplemented with different levels of *kanwa* (natron) are shown in Table 2. There were significant ($P<0.05$) differences among the Treatments in packed cell volume (PCV), white blood cells, platelets, mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) while haemoglobin (Hb), red blood cell (RBC) and mean corpuscular volume (MCV) values were not significantly influenced ($P>0.05$) by Treatments and all the parameters measured were within the normal reference values.

Treatment 2 had highest values of PCV compared to other groups but have similar values with Treatments T3, T4 and T6 (P>0.05). MCV was significantly (P<0.05) higher in T2 and lower in T3 and T6, however, there was no significant (P<0.05) difference between Treatments T1 and T2 with respect to MCV levels, so also between Treatments T3, T4, T6 and T7. There was significant (P<0.05) difference with regards to MCHC, between T3 and Treatments T1, T2 and T4. Treatments T1 and T5 had higher values of white blood cells

compared to others but had similar values with Treatments T2, T4, and T6 (P>0.05). T 3 had higher platelets value compared to other treatment groups.

Table: 2 Hematological indices of Uda rams fed graded levels of different forms of *Kanwa*.

Parameter	T1	T2	T3	T4	T5	T6	T7	P-values	SEM	Reference values**
Packed Cell Volume (%)	30.00^{b}	37.50^{a}	34.5^{ab}	36.5^{ab}	26.5^{c}	34.5^{a}	32.5^{b}	0.035	1.07*	27-45
Haemoglobin g/dl	8.20	8.60	9.30	8.45	8.92	8.62	8.32	0.221	0.51^{NS}	9-15
Red Blood Cell g/dl	8.83	9.21	9.36	9.67	9.82	8.69	8.92	0.072	0.83^{NS}	9-15
MCH (pg)	8.87	8.83	8.85	8.79	8.17	9.21	9.04	0.081	0.88^{NS}	8-12
MCV (fl)	32.21^{ab}	33.60^{a}	29.43^{d}	30.21^{cd}	31.33^{bc}	29.41^{d}	29.88^{cd}	0.023	0.51*	28-40
MCHC (%)	31.33^{b}	31.42^{b}	33.10^{a}	31.30^{b}	31.82^{ab}	32.00^{ab}	31.89^{ab}	0.040	0.49*	31-34
White Blood Cells 10^{9}/L	13.20^{a}	10.60^{ab}	9.90^{b}	10.95^{ab}	12.95^{a}	10.55^{ab}	9.75^{b}	0.033	0.75*	4-12
Platelets	155.00^{d}	105.50^{d}	396.50^{a}	317.50^{b}	109.00^{d}	104.00^{d}	196.00^{c}	0.012	18.6*	-
Neutrophils (%)	55.0^{a}	55.5^{b}	46.0^{bc}	69.5^{a}	42.0^{c}	69.0^{a}	71.0^{a}	0.040	2.80	-
Lymphocytes (%)	44.0^{b}	44.0^{ab}	53.0^{ab}	30.5^{c}	56.5^{a}	31.0^{c}	29.0^{c}	0.032	2.70	2-90
Monocytes (%)	1.0^{ab}	0.5^{bc}	0.5^{bc}	0.0^{c}	1.5^{a}	0.0^{c}	0.0^{c}	0.002	0.150	0-0.8

SEM = Standard error of means, NS = Not significant (P> 0.05); *= significant (P< 0.05); abcd = Means in the same row bearing different superscripts differ significantly (P<0.05); MCV=Mean Corpuscular Volume; MCH=Mean Corpuscular Haemoglobin; MCHC=Mean Corpuscular Haemoglobin Concentration;**source = (Elmhurst *et al*., 2002)

Serum Biochemistry of Uda Rams Fed *Kanwa* Supplement

The results of Uda rams supplemented with diet containing different levels and forms of *kanwa* are presented in Table 3. There were significant ($p < 0.05$) differences in all the parameters observed except for alkaline phosphatase (ALP). Animals in the control group had significantly ($p<0.05$) higher values for Urea and Creatinine than other treatment groups, T1, T2, T5 and T6 had similar values for urea and creatinine ($P>0.05$) which is lower than those found in Treatments T3 and T7. Similarly, the Control had significantly ($p<0.05$) higher TB values compared to T2 but was similar to other Treatments. Treatment 3 was significantly ($p<0.05$) higher in DB compared to Treatments T2, T5, T6 and T7 but similar with Treatments T1 and T4. Control group was significantly ($p<0.05$) higher in TP compared to other Treatments but is similar to T1 and T2. Treatments T2 and T7 had significantly ($p<0.05$) higher values of AST compared to other Treatments but similar to T3. ALT was significantly ($p<0.05$) higher in Treatment T1 compared to other Treatments but similar with those in Treatments T4 and T7.The result shows that T3 had significantly higher values of Na, K, Cl compared to other Treatmens. There was no significant ($p< 0.05$) difference in Treatments T1, T2, T5, and T6 in terms of Na, K and Cl except T6 having significantly ($p< 0.05$) lower values of K. The Control group was significantly ($P< 0.05$) different from all the Treatments in Na, K and Cl contents but had similar ($p>0.05$) values of Na with T3, as shown in Table 4.

Table: 3. Serum Biochemistry of Uda rams fed graded levels of different forms of *Kanwa*.

Parameter	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**SEM**	P-values	Reference values**
Urea(mmol/l)	5.9^{bc}	4.7^{c}	7.55^{ab}	8.65^{a}	5.7^{c}	4.75^{c}	7.65^{ab}	0.60*****	0.015	3-10
Crt (mg/dl)	0.95^{b}	0.9^{bc}	0.7^{d}	1.2^{a}	0.95^{b}	0.88^{bc}	0.8^{cd}	0.04*****	0.035	0.79-1.19
TB (mg/100ml)	1.35^{ab}	1.05^{b}	1.27^{ab}	1.46^{a}	1.22^{ab}	1.43^{a}	1.42^{a}	0.09*****	0.040	1.71-8.55
DB(mg/100ml)	0.11^{a}	0.07^{bc}	0.13^{a}	0.10^{ab}	0.06^{cd}	0.03^{d}	0.04^{cd}	0.01*****	0.039	0 - 4.61

SEM = Standard error of means, NS = Not significant (P> 0.05); *= significant (P< 0.05); abcd = Means in the same row bearing different superscripts differ significantly (P<0.05); TB =Total bilirubin, DB =Direct Crt= creatinine, bilirubin, ******source = (Elmhurst *et al*., 2002), ***=Njidda *et al*. (2014)

Table: 4. Serum Biochemistry and electrolyte of Uda rams fed graded levels of different forms of *Kanwa*.

Parameter	T1	T2	T3	T4	T5	T6	T7	SEM	P-values	Reference values**
TP(g/dl)	7.55^{ab}	7.15^{ab}	6.4^{c}	7.85^{a}	5.55^{d}	6.75^{bc}	5.45^{d}	0.24*	0.033	6 - 7.9
ALB(g/dl)	2.5^{d}	2.85^{bc}	3.40^{a}	2.90^{b}	2.30^{d}	2.55^{cd}	2.45^{d}	0.09*	0.002	2.4-3
GLB(g/dl)	5.05^{a}	4.3^{b}	3.00^{c}	4.95^{a}	3.25^{c}	4.2^{b}	3.00^{c}	0.16*	0.041	3.6-4.9
AST(iu/L)	156.5^{b}	256.0^{a}	177.5^{ab}	142.5^{b}	149.5^{b}	145.5^{b}	245.5^{a}	20.78*	0.004	60-280
ALT(iu/L)	74.0^{a}	37.5^{b}	28.5^{b}	60.0^{ab}	42.5^{b}	36.0^{b}	50.00^{ab}	8.37*	0.020	22-38
ALP(iu/L)	463.5	333.5	515.00	449.00	400.50	319.50	402.00	58.23	0.060	70-390
Na (Mmol/L)	151.5^{b}	145.5^{b}	155.5^{a}	154.50^{a}	140.50^{b}	141.50^{b}	111.0^{c}	4.95*	0.030	140-156***
K (Mmol/L)	4.85^{c}	4.56^{c}	7.2^{a}	5.70^{b}	4.55^{c}	4.15^{c}	3.90^{c}	0.17*	0.041	4.6-12.4***
Cl (Mmol/L)	113.00^{c}	105.00^{c}	145.00^{a}	137.00^{b}	101.00^{c}	106.00^{c}	99.00^{c}	3.7*	0.040	95-109***

SEM = Standard error of means, NS = Not significant (P> 0.05); *= significant (P< 0.05); abcd = Means in the same row bearing different superscripts differ significantly (P<0.05);TP=total protein,ALB= albumin,AST – Aspartate Aminotransferase, ALT – Alanine Aminotransferase, ALP- Alkaline phosphatase, Na=sodium, K=potassium, Cl=chlorine**source = (Elmhurst *et al*., 2002), ***=Njidda *et al*. (2014)

DISCUSSION

Hematological Indices of Uda Rams Fed Graded Levels of Different Forms of *Kanwa*.

The heamatological performance of fattening sheep administered varying levels and forms of *kanwa*. The PCV value of sheep Administered varying levels and forms of *kanwa* ranged from 26.5 to 37.50 %. The PCV values obtained in this study were lower than the finding of Swenson (1990); Egbe- Nwiyi *et al*, (2000) who reported value of 43.8-60% and 38-45%, respectively, Jain (1986) has reported PCV value within the range value of 27 – 45%. It further showed that in all the Treatments, animals did not suffer from anaemia or dehydration. This confirms the report of The Merck Veterinary Manual (1998) that a low PCV value was an indication of anaemia while sharp increased in PCV is most often caused by dehydration.

The haemoglobin values obtained in the present study is decreasing with increasing levels of Yarzankoya supplementation while it is increasing with increasing levels of Mai Fatsi Fasti form of *kanwa*. The haemoglobin values were within the normal range (8 – 16g/d*l*) of haemoglobin for healthy sheep (Greenwood, 1977). Normally, increase in the Hb concentration is connected with better ability to combat disease and infection. Low level is an indication of vulnerability of disease and poor nutrition (Tambuwal *et al*., 2002). The values obtained for Hb in the entire Treatment group indicates nutritional adequacy of all diets since values did not indicate mal-or-under nutrition (Church *et al*., 1984).

The RBC values in this trial were slightly above what was obtained by Njidda *et al*. (2014) for RBC values (6.49– 9.25 g/dl) of adult Uda breed sheep. The values of RBC in this finding were similar to the reports of Frandson (1981); Heath and Olusanya (1988) in

sheep. The main function of the RBC is to carry oxygen from lung to the body tissue and transfer carbon dioxide from tissue to the lungs. The high RBC values may be related with conditions that cause the body to build too numerous red blood cells or impaired pulmonary function, while low RBC counts may be associated with iron deficiency, internal bleeding, some types of anemia or some vitamin deficiency (Njidda *et al*., 2014). The administered varying levels and forms of *kanwa* did not indicate mal-or-under nutrition of the diets.

The white blood cell values ranged from 9.75 to 13.20 x 10^9/L. The white blood cells (WBC) were within the normal range values of sheep 5.2 to 27.70 x 10^9/L and 6.93 – 12.66 x 10^9/L) reported by Fadiyimu *et al.* (2010) and Njidda *et al*., (2014) respectively. This trial showed that the animals were healthy because decrease in number of WBC below the normal range is an indication of allergic conditions, while elevated values (leucocytosis) indicate the existence of a recent infection, usually with bacteria (Ahamefule *et al.,* 2008).

The neutrophils, lymphocytes and monocyte recorded in the study are comparably similar with the normal range observed by Njidda *et al*. (2014) (45 – 76, 19.00 – 48, 0- 3.0, 0 - 4, o %) respectively and Coles (1986) 40-75, 10-50 and 1-5% respectively. The variations in the WBC Differentials values recorded in this study could be compared with the report of Bush (1991b) and could be due to differences in *kanwa*forms and inclusion levels. Therefore, the differential counts values obtained showed that the animals were in good health. This indicates that the used levels of *kanwa* were not toxic to the animals.

The MCV, MCH and MCHC values reported in this study were comparably within the normal range of 33.12 – 54.09fl, 10.46-17.89 pg and 15.40 – 33.90% as reported by Njidda *et al*. (2014) respectively. These parameters were used to measure the size and hemoglobin content of erythrocytes and the values are useful in diagnosing various forms of anemia. The higher MCH and MCV values may be due to age (Egbe-Nwiyi, 2000). The values of MCV and MCH are very important in the diagnosis of anemia and also serve a useful index of the capacity of the bone marrow to produce red blood cells (Awodi *et al*., 2005).

Mean corpuscular Volume MCV values obtained for sheep were slightly lower than (35.3 – 43.7f*l*) reported by Borjesson *et al.* (2000). The values of mean corpuscular haemoglobin obtained in the study were within normal range of 10.46 -17.89 fl for fattening sheep as reported by Njidda *et al*. (2014). The lower MCV values might be due to increased *kanwa* supplement given to the animals. These parameters were used to measure the size and hemoglobin content of erythrocytes and the values are useful in diagnosing various forms of anemia (Kolo *et al.,* 2017).

Serum Biochemistry of Uda Sheep Fed *Kanwa* Supplement

Serum biochemical indices is used to determine the level of heart attack, liver damage and to evaluate protein quality and amino acid requirements in animals as reported by (Harper *et al*. 1999). The urea values obtained in this study were close to the average values (5.28 mg/dl) reported by Baneejee (2007) in matured sheep. The urea values obtained in the present study were; below reference range (8-26 mg/dl) as reported by Babeker and Elmansoury (2013) except for the control (T4), but above the 4.30–5.60 mg/dl range reported by (Antunovic *et al.,* 2011) for urea concentration as in sheep. Kolo *et al*. (2017) reported that the blood urea levels in the study falls within the recommended limits and this suggests that the kidneys and liver of the animals were normal. The higher value obtained in serum urea for animals on T without *kanwa* was a suggestion of poor of efficiency of use of nitrogen and urea recycling and might affect the amino acid balance.

The creatinine levels obtained in the study were lower than normal range reported by Boyd (1984) and Aruwayo *et al.,* (2009) which were 1.21 to 1.44 (mg/dl) except for the control group. The highest values were recorded in the control (Treatment without *kanwa* supplementation). High creatinine is pointer to poor protein and amino acid metabolism that can cause impaired renal function and cardiac infarction (Gray and Howarth, 1980). The urea levels in conjunction with creatinine levels indicate normal liver.

The total and direct bilirubin values in the study were in conformity with the finding of Coles (1986) and Aruwayo *et al*. (2009) who reported the total and conjugated bilirubin of sheep at 0.082 - 0.185 and 0.066 - 1.28 mg/dl respectively. Kolo *et al.,* (2017) reported bilirubin (mg/100ml) was between 0.2750 and 1.7900 in blood of West Africa dwarf goat, which the values fell within normal range of this research. Bilirubin tests measure the amount of the bilirubin in the blood sample and it is considered the true test for the liver function (Frandson, 1981; Singh, 2004).

The values for total protein and albumin obtained in this study were within the normal range reported for normal healthy rams (Njidda *et al.*, 2014) which are 5.5 - 9.4 and 2.3 - 3.3g/l respectively. The total protein values and albumin were similar to the range value (6.0 – 9.3g/*l*) and 30 – 38g/d*l* for sheep as reported by Borjesson *et al.* (2000). Kolo *et al*. (2017) reported that serum total protein and albumin of animals are indirect indices to assess the nutritional protein adequacy in farm animals. Alade *et al.* (2005) reported that total protein and albumin is an important blood clotting factor due to its ability to prevent haemorrhage, therefore the higher the value the better for the animals. This study conforms to the findings of Allison (1955) who reported changes in protein reserve in animal and indicated that serum total protein is associated with alterations in albumin fraction.

The serum aspartate amino transferase (AST) serum alanine amino transferase (ALT) and serum alkaline phosphatase (ALP) activity values observed in this study were within the normal range reported for healthy sheep (Mitruka and Rawnsley, 1977). AST level is helpful for the diagnosis and following of cases of myocardial infarction, hepatocellular disease and skeletal muscle disorders, in trauma or in diseases affecting skeletal muscle, after a renal infarct and in various haemolytic conditions (Alex and Laverne, 1983). ALT is a liver-specific hepatocellular enzyme that is used to assess liver damage (Mahgoub *et al*., 2008). The results obtained for the fattening sheep, all the aminotransferases and phosphatase (AST, ALT and ALP) are normal for sheep which showed the animal are in good condition.

The values of serum electrolyte of sodium, potassium and chloride ranged from 111.0 to 204.5 mmol/L, 3.90 to 7.2 mmol/L and 99.0 to 145.0 mmol/L respectively. The values obtained in this study are above the normal range reported by Baneejee (2007). This could be attributed to the high levels of these electrolytes in *Kanwa*. The electrolytes are known to regulate osmotic pressure, maintain membrane potentials and acid base balance and transmit nerves impulses sodium and potassium deficiency affect the tubes of kidney resulting in inability to concentrate urine (Latimer *et al*., 2004)

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