





Table 1. Composition of Experimental Diet

Ingredient	TREATMENT						
	YZK			Control	MFF		
	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
<b>Calculated Chemical Composition</b>							
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:

$$MCV (fl) = \frac{PCV}{RBC} \times 10$$

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

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

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

**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. Albumin/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.

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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 <sup>b</sup>	37.50 <sup>a</sup>	34.5 <sup>ab</sup>	36.5 <sup>ab</sup>	26.5 <sup>c</sup>	34.5 <sup>a</sup>	32.5 <sup>b</sup>	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 <sup>NS</sup>	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 <sup>NS</sup>	9-15
MCH (pg)	8.87	8.83	8.85	8.79	8.17	9.21	9.04	0.081	0.88 <sup>NS</sup>	8-12
MCV (fl)	32.21 <sup>ab</sup>	33.60 <sup>a</sup>	29.43 <sup>d</sup>	30.21 <sup>cd</sup>	31.33 <sup>bc</sup>	29.41 <sup>d</sup>	29.88 <sup>cd</sup>	0.023	0.51*	28-40
MCHC (%)	31.33 <sup>b</sup>	31.42 <sup>b</sup>	33.10 <sup>a</sup>	31.30 <sup>b</sup>	31.82 <sup>ab</sup>	32.00 <sup>ab</sup>	31.89 <sup>ab</sup>	0.040	0.49*	31-34
White Blood Cells 10 <sup>9</sup> /L	13.20 <sup>a</sup>	10.60 <sup>ab</sup>	9.90 <sup>b</sup>	10.95 <sup>ab</sup>	12.95 <sup>a</sup>	10.55 <sup>ab</sup>	9.75 <sup>b</sup>	0.033	0.75*	4-12
Platelets	155.00 <sup>d</sup>	105.50 <sup>d</sup>	396.50 <sup>a</sup>	317.50 <sup>b</sup>	109.00 <sup>d</sup>	104.00 <sup>d</sup>	196.00 <sup>c</sup>	0.012	18.6*	-
Neutrophils (%)	55.0 <sup>a</sup>	55.5 <sup>b</sup>	46.0 <sup>bc</sup>	69.5 <sup>a</sup>	42.0 <sup>c</sup>	69.0 <sup>a</sup>	71.0 <sup>a</sup>	0.040	2.80	-
Lymphocytes (%)	44.0 <sup>b</sup>	44.0 <sup>ab</sup>	53.0 <sup>ab</sup>	30.5 <sup>c</sup>	56.5 <sup>a</sup>	31.0 <sup>c</sup>	29.0 <sup>c</sup>	0.032	2.70	2-90
Monocytes (%)	1.0 <sup>ab</sup>	0.5 <sup>bc</sup>	0.5 <sup>bc</sup>	0.0 <sup>c</sup>	1.5 <sup>a</sup>	0.0 <sup>c</sup>	0.0 <sup>c</sup>	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 Treatments. 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	Referen ce values* *
Urea(mmol/l)	5.9 <sup>bc</sup>	4.7 <sup>c</sup>	7.55 <sup>ab</sup>	8.65 <sup>a</sup>	5.7 <sup>c</sup>	4.75 <sup>c</sup>	7.65 <sup>ab</sup>	0.60*	0.015	3-10
Crt (mg/dl)	0.95 <sup>b</sup>	0.9 <sup>bc</sup>	0.7 <sup>d</sup>	1.2 <sup>a</sup>	0.95 <sup>b</sup>	0.88 <sup>bc</sup>	0.8 <sup>cd</sup>	0.04*	0.035	0.79- 1.19
TB (mg/100ml)	1.35 <sup>ab</sup>	1.05 <sup>b</sup>	1.27 <sup>ab</sup>	1.46 <sup>a</sup>	1.22 <sup>ab</sup>	1.43 <sup>a</sup>	1.42 <sup>a</sup>	0.09*	0.040	1.71- 8.55
DB(mg/100ml)	0.11 <sup>a</sup>	0.07 <sup>bc</sup>	0.13 <sup>a</sup>	0.10 <sup>ab</sup>	0.06 <sup>cd</sup>	0.03 <sup>d</sup>	0.04 <sup>cd</sup>	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 <sup>ab</sup>	7.15 <sup>ab</sup>	6.4 <sup>c</sup>	7.85 <sup>a</sup>	5.55 <sup>d</sup>	6.75 <sup>bc</sup>	5.45 <sup>d</sup>	0.24*	0.033	6 - 7.9
ALB(g/dl)	2.5 <sup>d</sup>	2.85 <sup>bc</sup>	3.40 <sup>a</sup>	2.90 <sup>b</sup>	2.30 <sup>d</sup>	2.55 <sup>cd</sup>	2.45 <sup>d</sup>	0.09*	0.002	2.4-3
GLB(g/dl)	5.05 <sup>a</sup>	4.3 <sup>b</sup>	3.00 <sup>c</sup>	4.95 <sup>a</sup>	3.25 <sup>c</sup>	4.2 <sup>b</sup>	3.00 <sup>c</sup>	0.16*	0.041	3.6-4.9
AST(iu/L)	156.5 <sup>b</sup>	256.0 <sup>a</sup>	177.5 <sup>a</sup>	142.5 <sup>b</sup>	149.5 <sup>b</sup>	145.5 <sup>b</sup>	245.5 <sup>a</sup>	20.78*	0.004	60-280
ALT(iu/L)	74.0 <sup>a</sup>	37.5 <sup>b</sup>	28.5 <sup>b</sup>	60.0 <sup>ab</sup>	42.5 <sup>b</sup>	36.0 <sup>b</sup>	50.00 <sup>ab</sup>	8.37*	0.020	22-38
ALP(iu/L)	463.5	333.5	515.0	449.0	400.5	319.50	402.00	58.23	0.060	70-390
Na (Mmol/L)	151.5 <sup>b</sup>	145.5 <sup>b</sup>	155.5 <sup>a</sup>	154.5 <sup>a</sup>	140.5 <sup>b</sup>	141.50 <sup>b</sup>	111.0 <sup>c</sup>	4.95*	0.030	140-156***
K (Mmol/L)	4.85 <sup>c</sup>	4.56 <sup>c</sup>	7.2 <sup>a</sup>	5.70 <sup>b</sup>	4.55 <sup>c</sup>	4.15 <sup>c</sup>	3.90 <sup>c</sup>	0.17*	0.041	4.6-12.4***
Cl (Mmol/L)	113.0 <sup>c</sup>	105.0 <sup>c</sup>	145.0 <sup>a</sup>	137.0 <sup>b</sup>	101.0 <sup>c</sup>	106.00 <sup>c</sup>	99.00 <sup>c</sup>	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 hematological 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/dl) 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<sup>9</sup>/L. The white blood cells (WBC) were within the normal range values of sheep 5.2 to 27.70 x 10<sup>9</sup>/L and 6.93 – 12.66 x 10<sup>9</sup>/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, 0 %) 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 – 43.7fl) 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 (Frandsen, 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/dl 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 Banejee (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)

## REFERENCES

- Ahamefule, F.O., Obua, B.E., Ukwani, I. A., Oguike, M.A. and Amaka, R.A. (2008). Haematological and biochemical profile of weaner rabbits fed raw or processed pigeon pea seed meal based diets. *African Journal of Agric Research*, 3: 315-319.
- Alade, A. A., Bambose, A. M. Ogotona, E.B. and Fanimo, A.O. (2005). Heamatological parameters, serum metabolites carcass characteristic of weaner Rabbits fed yam

- feel meal diets. *Proceedings of 10th annual conference of Animal science Association of Nigeria* Dairo, F.A.S. So. K Fajemilehin and G.E Onobi (Eds) held on 12-15 September at university of Ado-Ekiti, Nigeria.pp: 280-282
- Alex, K. and Laverne, L.S. (1983). *Clinical Chemistry; Interpretation and Techniques 2nd Edition* Seattle, Washington pp: 156-339.
- Allison, J.B. (1955). Biological evaluation of proteins. *Physiological Reviews*, 35: 664-669.
- Anassori, E., Dalir-Naghadeh, B., Valizadeh-Keshmeshtappeh, M. and Jafari, S. (2017). A comparative study on the efficacy of Garlicon and monensin supplementation on blood metabolites and performance of fattening lambs, *Livestock Science*, Volume 199, Pages 74-78, ISSN 1871-1413, <https://doi.org/10.1016/j.livsci.2017.03.014>.  
(<http://www.sciencedirect.com/science/article/pii/S1871141317300938>)
- Antunovic, Z., Novoselec J., Sauerwein H., Speranda M., Vegara M. and Pavic V. (2011). Blood metabolic profile and some of hormones concentration in ewes during different physiological status. *Bulgarian Journal of Agricultural Science*, 17 (5), 687-695
- Aribido, S.O., Ogunmodede, B.K. and Lakpini, C.A.M. (2001). Nutritional assessment of “Gwanwarasa”. Type of natural potash (*kanwa*). *Nigerian Journal of Chemical Research*. 6 (3): 27-30.
- Aruwayo, A., Maigandi, S. A., Malami, B.S. and Deneji, A.I. (2009). Haematological and biochemical indices of growing lambs fed fore-stomach digesta and poultry litter waste. *Nigerian Journal of Basic and Applied Sciences* 17(2): 223-228..
- Awodi, S., Ayo, J. O.; Atodo, A. D. and Dzende, T. (2005): Some haematological parameters and the erythrocyte osmotic fragility in the laughing dove (*Streptopella senegalensis*) and the village weaner bird (*Ploceus cucullatus*). *Proceedings of the 10th Annual Conference of Animal Science Association of Nigeria*, 384-387.
- Babeker, E.A. and Elmansoury, Y.H.A. (2013) Observations concerning haematological profile and certain biochemical in Sudanese desert Goat. *Online Journal of Animal Feed Resource* 3(1): 80-86.
- Baneejee, G. C. (2007). *A Textbook of Animal Husbandry ( 8th Edn.)*, Raju Primlani for Oxford and IJB publishing Co. PVT Ltd, New Delhi Pp 1079.
- Borjesson, D.L., Christopher, M.M. and Boyce, W.M. (2000). Biochemical and Haematological reference intervals for free ranging Desert Bighorn sheep. *Journal of Wildlife Diseases*, 36(2): 294-300.
- Boyd, J.W. (1984). The interpretation of Serum Biochemistry test results in Domestic Animals in Veterinary Clinical Pathology, *An International Journal of Laboratory Medicine*, 13 (2), 7-14.
- Bush, B.M. (1991a). *Essentials of Veterinary Hematology*. Blackwell Scientific Publication.778pp
- Bush, B.M., (1991b). *Interpretation of Laboratory Results of Small Animal Clinics*. Blackwell scientific publication, London, 515pp.
- Chirase, N. K. Hutcheson, D. P. and Thompson, G. B. (1991). Feed intake, rectal temperature, and serum mineral Concentrations of feedlot cattle fed zinc oxide or zinc methionine and challenged with Infectious bovine rhinotracheitis virus. *Journal of Animal Science*. 69:4137-4145

- Church, J. P., Judd, J. T., Yong, C. W., Kebay, T. L. and Kim, W. W. (1984). Relationship among dietary constituents and specific serum clinical component of subjects eating self- selected diets. *American Journal of Clinical Nutrition* 40: 1338 – 1344.
- Coles, E.H. (1986). *Veterinary Clinical Pathology*, (4th Edition). WB Saunders Company, Philadelphia.
- Davidson, M., Trevitt, L. and Parry, E.H.O. (1974). Peripartum Cardiac Failure. In A.G. Shaper, *et al.*, *Cardiovascular disease in tropics*. London, British Medical Association, 156-158
- Egbe-Nwiyi, T.N.; Nwaosu, S.C. and Salami, H.A. (2000): Haematological values of apparently healthy sheep and goats as influenced by age and sex in arid zone of Nigeria. *African Journal of Biomedical Research* 3; 109-115
- Ekanem, E.J. (1977). A preliminary analysis of samples of *Kanwa* for sodium, potassium and other minerals. *Journal of Biochemical Analysis*. 2(1): Pp. 25 - 43.
- Elmhurst, S., Hons, B. A., and Pearson, M. (2002). *Clinical Examination of Farm Animals* (1<sup>st</sup>Ed.). Osney Mead, Oxford OX2 0EL, UK: BlackWell Scientific Publication. p. 456
- Fadiyimu, A.A.; Alokun, J.A. and Fajemisin, A.N (2010): Digestibility, Nitrogen balance and haematological profile of West African Dwarf sheep fed dietary levels of *Moringa oleifera* as supplement to *Panicum maximum*. *Journal of American Science*. 6 (10).
- Fajemisin, A.N., Fadiyamu, A.A. and Alokun, J.A. (2010). Nitrogen retention and haematological indices of West African Dwarf Rams fed sun dried and fermented rumen digesta and cage hen droppings diets. In: O.J. Babayemi, O.A. Abu and E. O. E Ewuola (eds.) *Fast – Tracking Animal Agriculture in a Challenged Economy*. Proceedings of the 35<sup>th</sup> Annual Conference of the Nigerian Society of Animal Production (NASP) 14<sup>th</sup> – 17<sup>th</sup> March, held at University of Ibandan, Nigeria. Pp 604 – 607.
- Frandsen, R.D. (1981). *Anatomy and the Physiology of Farm Animals* (3rd Edn.) Baillere Tindell, London, p 716.
- Gebrehiwot, T. (2014). Rumen Manipulation for Enhanced Feed Utilization and Improved Productivity Performance of Ruminants: A review. *Momona Ethiopian Journal of Science*, 6 (2) 3-17
- Girgiri, A.Y., Abubakar, S.M., Medugu, C.I., Saleh, B. and Gure, M.M. (2013). Haemato-Biochemical indices of Yankasa rams fed varying levels of Doum palm (*Hyphaenethebaica* L.) meal. In: Akpa, G.N. Dairo, F.A.S., Bawa, G.S., Solomon, I.P., Amaefuele, K.U., Odunsi, A.A. and Ladokon, A.O. (eds.) *Industry Standards And Regulations: A Tool For Improved Productivity In Animal Husbandry*. Proceedings of the 18<sup>th</sup> annual conference of the animal science association of Nigeria (ASAN), 8<sup>th</sup> – 12<sup>th</sup> September held at National Centre for Women Development, Tafawa Balewa Street, Central Business District, Garki Abuja, Nigeria. Pp 379 – 382.
- Greenwood, B. (1977). Haematology of sheep and goat. In: R.K. Archer and L.B. Jeffcoat (eds). *Comparative Clinical Haematology*. Blackwell, Oxford. pp. 305-344.
- Harper, A.E., Rodwell, B. and Mayes P.A. (1999). *Review of Physiological Chemistry*. Lang Medical, Los Altos. California 944. Pp 60 – 81, 188 – 216.

- Heath, E. and Olusanya, S. (1988) (Eds). *Anatomy and Physiology of Tropical Livestock*. (ELBS Edition). Longman Limited, Singapore.1-132.
- Jain, N.C (1986). Schalm Veterinary Haematology. (4<sup>th</sup> Ed.) *Lea and Febiger Philadelphia, USA*.
- Kohen, R. A. and Allen, M. S. (1995). Enrichment of proteolytic activity relative to nitrogen in preparation from the rumen for *in vitro* studies. *Animal Feed Science and Technology*. 52:1-14
- Kolo, U. M., Adeloye, A. A., Yousuf M. B. (2017). Effect of Urea-Fortified All Concentrate Corn cob Diets on Serum Biochemical and Hematological Indices of West African Dwarf Goats. *Agricultural Science and Technology*, 9 (2) Pp. 114-118.
- Latimer, K. S., Mahaffey, E.A. and Prasse, K.W. (2004). *Clinical pathology: veterinary laboratory medicine (4th Ed.)*, Iowa state university press Ames, Iowa USA. 415p
- Mahgoub, O., Kadim, I.T., Tageldin, M.H., Al-marzooql, W.S., Khalaf, S.Q. and Ali, A. A. (2008). Clinical profile of sheep fed non-conventional feeds containing phenols and condensed tannins. *Small Ruminant Research*.78: 115–122.
- Makanjoula, A.A. and Beetlestone, J.G. (1975). Some Chemical and Mineralogical notes on *Kaun*. *Journal of Mineral Geology*. 10: Pp. 1- 2.
- Malami, B.S., Rambo, U.G. and Nasiru, M. (2001). A note on the indigenous knowledge on treating camel (*Camelus dromedary*) disease among farmers in Sokoto State, Nigeria. *Journal of Agriculture and Environment* 2(1): 159-163.
- Mitruka, B. M. and Rawnsley, H. M. (1977). *Clinical Biochemical and Hematological Reference Values in Normal Experimental Animals*, Massion Publishing USA Pp 42-47.
- Njidda, A. A., Shuai'bu, A. A. and Isidahomen, C.E. (2014): Haematological and Serum Biochemical Indices of Sheep in Semi-Arid Environment of Northern Nigeria. *Global Journal of Science Frontier Research: D Agriculture and Veterinary Volume 14 (2)*
- Oyeleke, O.A. and Morton I.A. (1981). Impairment of lysine availability from cowpeas cooked with *kanwa*. *Nigerian Journal of Nutrition and Science*. 1(2): 123–131.
- Peter, T., Biamonte, G. T. and Doumas, B. T. (1982). Protein (total protein) in serum urine and cerebrospinal fluids; Albumin in serum. In: Paulker, W. R and Meote, (eds) *Selected Method of Clinical Chemistry* 9:1-7 American Association for clinical Chemistry, Was hington, D.C
- Rej, R. and Hoder, M. (1983). Aspartase transaminase In: Berfmeyer, H. U. Bergmeyer, J and grassi, M. (eds) *Methods of Enzymatic Analysis*. (3<sup>rd</sup> edition) pp.134-154
- Schalm, O.W, Jain, N. C and Carrol, E. J. (1975). *Veterinary Haematology* (3rd edition) Lea Febiger Philadelphia USA. 445p.
- Singh, S.P., (2004). *Practical Manual in Biochemistry*. (5<sup>th</sup> Edn.) Satish Kuma Jain, India, 315p.
- Statistical Analysis System (SAS) Institute (2002). *SAS/STAT User's Guide*. Version 8, (6th Edition), SAS Institute, Cary, 112
- Swenson, M.J. (1990). Physiological properties, cellular and chemical constituents of blood In: *Duke's Physiology of Domestic Animals*. (10th Ed.). Cornell University Press, USA. Pp 124-132

- Tambuwal, F. M. Agale, B. M and Bangana, A. (2002). Haematological and Biochemical values of Apparently Healthy Red Sokoto Goats. In: *Proceeding of 27th Annual Conference Nigerian Society of Animal Production (NSAP)*, March, 17-21, 2012, FUTA Akure, Nigeria.
- Tanis, R. J. and Naylor, A. W. (1968). Physical and chemical studies of a low molecular weight form of cheese. *Biochemical Journal*, 108:771
- The Merck's (1998). *The Merck Veterinary Manual* (8<sup>th</sup> Edition), Susan, E.A. (ed.) Published by Merck and CO., Inc. Whitehouse Station, N.J., USA. 2305pp.

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