Bangladesh Journal of Veterinary and Animal Sciences, Vol. 4, No. 1 & 2, July 2016

ISSN 2227-6416

Bangladesh Journal of Veterinary and Animal Sciences

Journal home page: www.cvasu.ac.bd/journal/userlist

Research article

Haematological, biochemical and histopathological studies of goats fed *Daniella oliveri* foliage mixed with cowpea husk

Njidda, A. A.[1]*, Chibuogwu, I. C[2]., Salifu, B[2]. and E. Waraqah[2]

[1]Department of Animal Science, Federal University, Kashere, P.M.B. 0182, Gombe State, Nigeria. [2]Department of Animal Science, University of Abuja, P.M.B. 117, Abuja, Nigeria.

ARTICLE INFO

Article history :
Received: 14/07/2016
Accepted: 22/08/2016

Keywords :
Haematology, blood chemistry, breeds, goat, histopathology

** Corresponding Author :*
Email: ahmednjidda7@gmail.com
Cell : +2348032329112

ABSTRACT

An experiment was conducted to determine the haematological, biochemical and histopathological studies of goats fed *Daniella oliveri* mixed with cowpea husk. The dietary treatments compared were T_1 (100% cowpea husk), T_2 (25% *Daniella oliveri* foliage = 75 cowpea husk), T_3 (50% *Daniella oliveri* foliage = 50% cowpea husk), T_4 (75% *Daniella oliveri* foliage = 25% cowpea husk), T_5 (100% *Daniella oliveri* foliage). The results reveal that T_5 had significantly (p>0.05) higher values for ash (958.90 g kg 1 DM), crude protein (166.20 g kg^{-1} DM), crude fibre (188.50 g kg^{-1} DM), acid detergent fibre (376.90 g kg^{-1} DM), neutral detergent fibre (475.90 g kg^{-1} DM), cellulose (284.70 g kg^{-1} DM), and hemicelluloses (99.60 g kg^{-1} DM). T_1 significantly had higher ether extract (32.90 g kg^{-1} DM) and T_3 had significantly (p>0.05) higher acid detergent lignin. Packed cell volume (PCV) was significantly higher (P<0.05) for T_3 and T_4. Haemoglobin (Hb) and Red blood cell count (RBC) were significantly higher (P<0.05) for T_4. The mean corpuscular haemoglobin concentration (MCHC) was significantly different among treatments (P<0.05). White blood cell differentials (Neutrophils, lymphocytes, monocytes, eosinophils and Basophils) showed significant difference (P<0.05) among treatments. All the parameters studied for serum biochemical indices were significantly (P<0.05) different among treatments. Histopathology revealed that T_1 and T_2 had more nephrons with increased glomeruli-bowman's space, distended tubules and detached tubular epithelial cells relative to T_3, T_4 and T_5 kidneys. The liver from T_1, T_2, T_4 and T_5 had focal areas of sinusoidal dilatation when compared to T_3. Serum biochemistry results of markers for kidney (creatinine and serum urea) and liver function (ALT, AST and ALP) showed that the level of histopathology changes were not sufficient to alter their ultimate function when administered for eight weeks, since all values were within normal ranges.Based on these findings, it can be concluded thatfeeding *D. oliveri* substituting cowpea husk does not pose any health hazard but will require some fortification with minerals and vitamins at lower levels of inclusion.

To cite this paper : *Njidda, A. A., Chibuogwu, I. C., Salifu, B. and E. Waraqah. 2016. Haematological, biochemical and histopathological studies of goats fed Daniella oliveri foliage mixed with cowpea husk. Bangladesh Journal of Veterinary and Animal Sciences, 4 : 09-21*

1. INTRODUCTION

Goats have been estimated as 53.8 million in Nigeria (FAO, 2008). Goats contributes about 24% of Nigerian meat supply (Oni, 2002) and one of the cheapest sources of animal protein because of its high fertility rate and quick maturity traits (Jansen and Burg, 2004). Goat meat is characterized by low subcutaneous fat content with greater muscle component at comparable age and slaughter live body weight (Babiker et al., 1990).

Goats in Nigeria suffer several nutritional stresses in the dry season as a result of seasonal variability and nutritive quality of pastures which in turn marked decreases in nutrient intake and utilization. The global climatic changes are increasing the feed shortage to prevalent in the arid and semi-arid lands for most parts of the year. These periods are characterized by poor quality feeds that lead to low feed intake and reduced performance.

A number of browse plant worldwide serve as alternative feed stuff for livestock (Ammar et al., 2004: Rinehart 2008) the leaves of the evergreen tree and shrub are used as emergency feed by ruminants in semi-arid (Njidda, 2011) and guinea savannah region of northern Nigeria (Olafadehan 2011). In Nigeria, there are numerous tree leaves used as browse fodder and one of such of tree is *Daniella oliveri* leave which is widely distributed and available. The trees produces protein rich leaves used as feedstuffs for ruminants (Annugu et al., 2004). *Daniella oliveri* is relatively high in protein about (11.16) dry matter (86.87) ash (4.26) ether extract (6.21) and lignin (4.98). However, the disadvantage of *Daniella oliveri* is that it contains anti-nutritive factors such as tannins, saponin and oxalate (Otori and Mann. 2014).

Cowpea husk are among the most important crop residues obtained from cowpea plant and are used as fodder. Some farmers grow the crops for only this purpose. Large quantity of cowpea husks are produced in the country. Adebowale (1981) reported that about 82,000 metric tonnes of cowpea husks and straws are produced in Nigeria annually.

Haematological tests have been widely used for the diagnosis of various diseases and nutritional status of animal. The information gained from the blood parameters would substantiate the physical examination and together with medical history provide excellent basis for medical judgment (Schalm et al., 1975). In addition, it would help determine the extent of tissue and organ damage, the response of defence mechanism of the patient and aid in the diagnosing the type of possible anaemia (Schalm et al., 1975). A quantifiable variation was reported in blood parameters due to altitude, management, feeding level, age, sex, breed, health status, method of blood collection, haematological techniques used, diurnal and seasonal variation, ambient temperature and physiological status (excrement, muscular exercise, pregnancy, oestrus, parturition, time of sampling, water balance and transportation. (Schalm et al., 1975; Ewuola et al., 2004; Garunwaldt et al. 2005).

Histology is the study of the microscopic anatomy of cells and tissues of plants and animals. It is commonly performed by examining cells and tissues under a light microscope or electron microscope, which have been sectioned, stained and mounted on a microscope slide. Histopathology is the microscopic examination of tissues to observe the appearance of diseased cells in detail. Histopathology, the microscopic study of diseased tissue, is an important tool in determining the effect of diets on tissue diets. The objective of the research is to investigate the nutritional attributes of *Daniella oliveri* species on red Sokoto goats with reference to haematological, biochemical and Histopathology in the semi-arid region of Nigeria.

2. MATERIALS AND METHODS

2.1. Experimental Animals and Diet

The experimental site has been described by Njidda et al. (2016). Twenty (20) growing Red Sokoto goats (males) age between 7 to 8 months of age with an initial body weight (BW) of (13 ± 0.5kg) were used for this study. The animals were from an open livestock market in Mandala. The pens and the surroundings were cleaned and disinfected with a strong antiseptic (Morigad) two weeks before the arrival of the animals. On arrival, the animals were given prophylactic treatment consisting of a long acting antibiotic (Oxytetracycline/ml/10kg) Intramuscularly, Ivomec (ml/50kg) to control endo and ectoparasites (subcutaneous). The animals were house in their cages and were allowed to adapt to the environment for 14 days before the commencement of the experiment. The leaves of *Daniella oliveri* used for the study were at a mature stage and harvested from several stands in the University environment and was allowed to dry in the sun.

2.2. Experimental Design and Treatment

The experimental animals were randomly allocated to five dietary treatments in a completely randomized design with four animals per treatment. Treatments compared included:

T_1 = Cowpea husk 100% + *Daniellia oliveri* leave 0%
T_2 = Cowpea husk 75% + *Daniellia oliveri* leave 25%
T_3 = Cowpea husk 50% + *Daniellia oliveri* leave 50%
T_4 = Cowpea husk 25% + *Daniellia oliveri* leave 75%
T_5 = Cowpea husk 0% + *Daniellia oliveri* leave 100%

2.3. Feeding and Management

The goats were given prophylactic treatment which consists of intramuscular application of oxytetracycline LA and a vitamin B complex at the dosage of 1m/10kg body weight of the goat. The goats were also dewormed with ivomectrin at the dosage of 0.5ml/10kg body weight of the goat subcutaneously. They were also vaccinated against PPR (Pestil de Petit Ruminant) which consist of subcutaneous application of PPR (Pestil de Petit Ruminant) vaccine. The animals were housed in individual pen with free access to water and mineral licks. The study comprises of 14 days of feed adaptation period and 8 weeks of measurement period. Feed was weighed and fed daily at 8 am and immediately after consumption, the basal diet was fed ad libitum. Water was also provided adlibitum. The quantity of feed provided and the residue of previous days were weighed to determine the feed intake of each animal. The goats were weighted at the beginning of the experiment and at weekly intervals in the morning before feeding. The experiment lasted for eight (8) weeks with 14 days adaptation period.

2.4. Haematological and Biochemical Studies

The goats were bled through jugular vein and 10 ml of blood collected. 3 ml of the blood samples was collected into plastic tube containing EDTA for haematological studies. The remaining 7 ml of blood samples was deposited in anticoagulant free plastic tube and allowed to clot at room temperature within 3 hours of collection. The serum samples were stored at -20 ^{0}C for biochemical studies. Total erythrocytic count and total leukocytic counts were determined with the aid of Haemocytometer (Neubaur counting chamber) and Hb concentration was determined by Sahl's (acid haematin) method (Bengamin 1978). Mean corpuscular Haemoglobin Concentration (MCHC), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Volume (MCV) values were calculated (Jain, 1986) Serum Aspartate Aminotransferase, serum Alanine Aminotransferase and Alkaline Phospatase were analyzed spectrophotometric linked reaction method (Henry et al., 1960). Total protein by the Biuret method according to the procedure of Oser (1976), Albumin by Bromocresol green (BCG) method, serum glucose, creatinine by Peters et al. (1982), Sodium ion and potassium ions by flame photometric method. Other biochemical analysis were done using the method describe by (Ogunsami et al., 2002). At the end of the feeding and growth trials, each of the experimental goat from each treatment was randomly selected for collection of tissue samples (Liver, Kidney and Spleen). The animals were humanely slaughtered and properly drained. The tissue samples from each of the experimental animal per treatment were carefully collected fixed in 10% formalinand sent to a histopathology laboratory for analysis. Routine procedures as described by Baker and Silverton (1985) were used and paraffin sections were stained with Hematoxylin and Eosin.

2.5. Chemical analysis

The feed samples were analyzed for crude protein, ether extract, crude fibre and ash while Neutral detergent fibre (NDF). Acid detergent Fibre (ADF) and acid detergent lignin (ADL) were determined by the procedure of Van Soest et al. (1991). Hemicellulose was calculated as the difference between (NDF) and (ADF. Cellulose was calculated as the difference between (ADF) and (ADL).

2.6. Statistical analysis

The data generated were subjected to analysis of variance (ANOVA) in a Randomized Complete Design (RCD) using SAS (2004) where significant difference between the means exist, Least Significant difference (LSD) was use to separate the means (Obi, 1990).

3 . RESULTS

3.1. Chemical composition of experimental diets

The results of the chemical composition are presented in Table 1. The results showed significant difference (p>0.05) for all the parameters studied. The values for ash, CP, CF, NDF, ADF and hemicelluloses tend to increase with increase in the level of *Daniella olliveri* foliage. The ADL and cellulose levels in the diets ranges from moderate to high levels (81.10 to 121.90 g kg-^{1} DM) and (146.80 to 284.70 g kg-^{1} DM) respectively.

Table 1. ***Chemical Composition of the Experimental diets (g kg-^{1} DM)***

Parameters	T_1	T_2	T_3	T_4	T_5	SEM
Dry Matter	896.30^{ab}	901.60^{a}	889.40^{a}	897.80^{a}	920.80^{a}	3.16
Ash	32.30^{e}	46.90^{d}	52.98^{c}	55.60^{b}	58.90^{a}	2.41
Crude Protein	131.00^{e}	134.90^{d}	142.4^{c}	154.30^{b}	166.20^{a}	1.66
Ether Extract	32.90^{a}	25.10^{b}	21.11^{c}	12.30^{d}	11.20^{e}	0.61
Crude Fibre	112.60^{e}	125.60^{d}	134.90^{c}	140.20^{b}	188.50^{a}	1.84
Neutral Detergent Fibre	325.10^{e}	346.10^{d}	369.30^{c}	385.10^{b}	475.90^{a}	2.14
Acid Detergent Fibre	231.60^{e}	251.80^{d}	273.13^{c}	286.30^{b}	376.30^{a}	3.13
Acid Detergent lignin	81.10^{e}	105.00^{c}	121.90^{a}	112.30^{b}	91.60^{d}	2.16
Cellulose	150.50^{c}	146.8^{e}	149.40^{d}	174.0^{b}	284.70^{a}	3.16
Hemicellulose	93.50^{bc}	94.30^{b}	98.00^{a}	98.90^{a}	99.60^{a}	2.16

a, b, c, d, e mean in the same row with different superscripts are significantly (p < 0.05) different. SEM = Standard error of mean.

3.2 Haematological studies

The results of the haematological indices are presented in Table 2. The PCV ranged from 18.00 to 25.00%. The PCV, haemoglobin, and RBC were significantly (P<0.05) higher for treatment T_4 than the other treatment groups. There was significant difference (P<0.05) among treatment for WBC and MCHC. However, MCV and MCH were not significantly different (P>0.05) among treatments. The WBC differentials (neutrophils, lymphocytes, eosinophils, monocytes and basophils) were significantly different among treatments.

3.3 Serum biochemical indices

The results of serum biochemical indices are presented in Table 3. The results showed significant differences (P<0.05) among treatment for all the parameters observed for serum biochemical indices except phosphate and cholesterol where non-significant effects (P>0.05) were observed. The values for all the enzymes (AST, ALP, and ALP) were observed to increase with increase in the level of Daniella oliveri foliage.

Table 2. Haematological parameters of red Sokoto goats fed Daniella oliveri mixed with cowpea husk

	Treatments					
Parameters	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
PCV (%)	22.00^{ab}	18.00^{c}	25.00^{a}	25.00^{a}	23.00^{b}	2.32
HB (g/dl)	7.20^{b}	6.10^{c}	8.10^{a}	8.20^{a}	7.30^{b}	0.02
RBC (x10^6/µl)	3.54	2.89	4.00	4.10	3.70	0.98
WBC (x10^6)	6.50^{b}	8.40^{a}	5.60^{b}	6.20^{b}	6.80^{b}	1.02
MCV (fl)	6.20	6.20	6.30	6.00	6.20	0.65
MCH (pg)	2.00	2.10	2.00	2.00	1.90	0.98
MCHC (g/dl)	32.70	33.80	32.40	32.80	31.70	1.38
Neutrophils (%)	66.00^{ab}	80.00^{a}	23.10^{c}	22.40^{c}	67.00^{b}	2.36
Lymphocytes (%)	17.50^{b}	14.20^{b}	68.40^{a}	66.80^{a}	66.50^{a}	1.54
Monocytes (%)	10.00^{a}	4.10^{c}	5.00^{c}	7.20b^{b}	11.00^{a}	0.62
Eosinophils (%)	6.20^{a}	1.50^{c}	3.00^{b}	2.80^{c}	5.10^{a}	0.84
Basophils (%)	0.30^{c}	0.20^{c}	0.50^{b}	0.80^{a}	0.40^{c}	0.02

a, b, c means in the same row with different superscript differ significantly (P<0.05); PCV=Packed Cell Volume; Hb=Haemoglobin; RBC=Red Blood Cell; WBC= White Blood cells; MCV=Mean corpuscular volume; MCH=Mean corpuscular haemoglobin; MCHC=Mean corpuscular haemoglobin Concentration; Means within the same row with different superscripts are significantly different (P<0.05); NS=Not significant (p>0.05).

Table 3. Serum biochemical parameters of Red Sokoto goats fed Daniella oliveri mixed with cowpea husk

	Treatments					
Parameters	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
Na^+ (mmol/l)	144.00	142.00	148.00	149.00	147.00	3.26
K^+ (mmol/l)	8.60	9.20	7.80	9.10	7.40	2.04
Cl^- (mmol/l)	102.00^{b}	104.00^{b}	109.00^{a}	110.00^{a}	99.00^{c}	1.03
HCO_3^- (mmol/l)	30.00^{b}	32.00^{a}	33.00^{a}	33.00^{a}	31.00^{ab}	0.92
Ca^+ (mmol/l)	3.20^{a}	2.50^{b}	3.10^{a}	3.20^{a}	2.80^{b}	0.04
Mg (mmol/l)	1.97	2.08	2.65	2.60	1.89	0.92
PO_4 (mmol/l)	3.60	3.58	3.60	3.62	4.20	1.32
Blood Urea (mmol/l)	8.60^{b}	9.40^{ab}	11.10^{a}	11.40^{a}	7.90^{b}	1.32
Creatinine (mmol/l)	46.00^{bc}	62.00^{a}	52.00^{b}	51.00^{b}	34.00^{bc}	2.32
AST (µ/l)	98.00^{c}	114.00^{c}	122.00^{b}	130.00^{a}	122.00^{b}	2.46
ALT (µ/l)	24.00^{bc}	18.00^{c}	26.00^{b}	29.00^{b}	34.00^{a}	1.36
ALKP (µ/l)	310.00^{b}	179.00^{c}	268.00^{bc}	281.00^{bc}	420.00^{a}	3.26
Protein (mmol/l)	66.40	64.70	60.20	66.40	60.80	2.01
Albumin (mmol/l)	32.70	32.20	30.10	30.60	32.40	1.32
Globulin (mmol/l)	33.20^{a}	32.50^{a}	29.60^{b}	29.70^{b}	29.10^{b}	0.63
Cholesterol (mmol/l)	1.20	1.34	1.28	1.34	1.29	0.82

a, b, c means in the same row with different superscript differ significantly (P<0.05); AST=Aspartate Aminotransferase; ALT= Alanine Aminotransferase; ALP= Alkaline Phosphatase; Means within the same row with different superscripts are significantly different (P<0.05).

3.4 Histopathological studies

The results of the Histopathological studies are presented in figures 1 to 10.

Micrographs of an upper cortical section of kidneys from goats fed 100% cowpea husk had more increased glomeruli-bowman space ratio to complete loss of glomeruli when compared to kidneys from other treatments (Plate 1, Fig. 1- 5). The lower cortical section also revealed that kidneys from T_1 and T_2 had more renal tubular epithelial cells that detached from their basement membrane and sloughed into the tubular lumen than kidneys from T_3, T_4 and T_5 (Plate 2, Figure 1-5).

Micrographs of the liver showed different levels of dilatation of sinusoids between liver cord cells. The liver from groups fed the 100% cowpea husk (T_1) diet had more sinusoidal dilatation when compared to other groups while liver from the T_3 group showed a more normal picture (Plates 3 and 4).

4. DISCUSSION

The high crude protein content of the feeds makes it suitable supplements for goats. The CP content was observed to increase with increasing level of *Daniella oliveri* foliage, this findings is in line with the reports of Okagbare et al. (2004) and Njidda (2011) that browse forage species have CP content which remains all year round. The crude protein level in this study also compares favourably with that of some foliage crops that have been evaluated and integrated into ruminant feeding, which include *Magnifera indica* 15.13% and *Newbouldia* leaves 15.57% respectively (Ikhimioya, 2005). The level of 166.2g Kg^{-1} DM crude protein in the study is far above 7% CP recommended for rumen microbes of tropical livestock by Minson (1990) below which there will be a deficiency in performance. Ether extract is the lipid component and the energy derived from it is utilized by the animal. The low EE in this study is in agreement with the report of Isah et al. (2013); Ogunbosoye and Otukoya (2014) who worked on *Daniella oliveri* mixtures with other feed stuffs. The NDF and ADF are moderate to high from T_1 (100% cowpea husk) to T_5 (100% *Daniella oliveri* foliage). This is similar to the findings of Njidda (2011) who reported higher values ranging from 412.10 to 595.90 g kg^{-1} DM for NDF and 200.50 to 282.00 g kg^{-1} DM for ADF (n=37) for semi-arid browse forages. Meissner et al. (1991) observed that NDF level of forage above 65% can limit feed intake it is interesting to note that the browse species of the present study is below the threshold level. The lignin content of the browse is moderate and it's within the range reported by Njidda (2011). It is also known that lignin is a component of the cell wall and deposited as part of the cell wall thickening (Boudet et al., 1998).

The result of the haematological parameter of the experimental animals (Table 2) showed that Packed cell volume (PCV) values was low in T_2 (18%) compared to other treatment groups and also falls below the recommended values for healthy goats. This might be due to the physiology of the animals in the treatment groups. Since all other animals in other treatments falls within the normal range.

Haemoglobin values in treatment two (T_2) showed low level value of 6.1 g/dl which may indicate the presence of disease, stress, effect of climatic factors and also genetic variation of the experimental animal. According to Radostits et al. (1994) low haemoglobin could lead to low transport of oxygen (O_2) around the system, animal can also become anaemic and goats are very susceptible to anaemia which is the lack of red blood cell in the body. The RBC values compare favourably with the values (3.03 $x10^6/\mu l$) reported by Njidda et al. (2014) who fed RSG on natural pasture and Raji et al. (2016) who fed *Moringa oliefera* leaf (2.20 to $2.91x10^6/\mu l$) to RSG. The RBC values obtained in the present study were lower compared to the $10.9\times10^6/\mu l$ reported by Tambuwal et al. (2002) and $13.0\times10^6/\mu l$ by Banerjee (2007) for Red Sokoto goats. Low level of RBC values can be attributed to lack of production of RBCs by the bone marrow and also the breakdown of RBCs in circulation (haemolysis). Hyperactivity of the bone marrow (Tung et al., 1975), leading to the production of red blood cells with impaired integrity which were easily destroyed in circulation by reticulo-endothelial system. Shakoori et al. (1990) suggested that decrease in RBC counts is either an indication of excessive damage to erythrocytes or inhibition of erythrocytes formation. The low counts observed for RS Goats in the present study could be as a result of physiological and environmental stress. This also agreed with the report of Cheesbrough (2004) who maintained that the RBC counts vary with age, gender, geographical location and health status of the animals.

Leucocyte count (WBC) is an indicator of immune response to infectious or toxic substances in the organism and a high count is an indication of pathogenic infection or presence of antigens in the organism (Olorunnisomo et al., 2010). The values obtained were lower than that reported by Raji et al. (2016) for healthy Red Sokoto goats (18.25 to $26.34\times10^3/\mu l$) though the values were close to the minimum values reported by other researchers (7.5-15.8 $x10^9/l$) (Hunter 1996; Olotu et al., 1998; Lazzaro, 2001; Daramola et al., 2003). Okwonkwo et al. (2011) reported that The RSGs from Sokotohave lower WBC counts than those from Katsina and Gusau. The values are much lower compare to Red Sokoto Goats purchased at Abuja. He attributed the variation to be responsible for the concentration of the breed in Sokoto and its environs and as the breed disseminates to other parts, its inherent qualities continue to decline. This may have also affected the value for the current research being that the animals were purchased in Kano.

The non-significant (P<0.05) effects of the experimental diets on MCV and MCH of the experimental animals may be attributed to similar haemoglobin content (Raji et al. 2016) and also referred to as RBC indices (Njidda et al., 2013). The results were very low compare to the values reported by Raji et al. (2016) for Red Sokoto goats. The MCHC, MCV and MCH are very significant in the diagnosis of anaemia and also serve as a useful index of the capacity of the bone marrow to produce red blood cells (Awodi et al., 2005; Njidda et al. 2013). The authors also confirmed that if the MCV is greater than 100 fl it may indicate macrocytosis (enlargement of the red blood cells).

The Neutrophil values obtained from the study were lower in T_3 and T_4, but high in T_1, T_2 and T_5 which could eventually be as a result of inflammatory reaction and high neutrophils could be as a result of factors such as anxiety, exercise and sudden infection from bacteria (Valli, 2007). Also, the decrease which reflected in T_3 and T_4 could be linked up with damage in the bone marrow which could also be caused by infection (Valli, 2007).

There are generally more lymphocytes than neutrophils in the circulation in healthy goats (Daramola et al., 2005) Lymphocyte in T_3, T_4 and T_5 were within the range of 50- 70% for healthy goats as reported by Sirois (1995), and were relatively more than neutrophils. While T_1 and T_2 where lower than their values which could either be as a result of dietary effect of the feed given to each treatment which is evident in T_1 and T_2 having higher amount of cowpea husk in the diet or infections due to bacterial action.

Monocytes are responsible for the removal of dead cells, micro-organism and insoluble particles from the blood. The values obtained from the experiment were all within the range as reported by Sirois (1995). Meanwhile, an increase could be a part of the syndrome of iron deficiency. The value for eosinophils in this study was observed to be higher in T_2 (4%) than the other treatments, this favoured the findings of Banerjee (2007) that reported the range of eosinophils fall between (1 to 8%). Like neutrophiles, they release protein cytokines and chemokines that produce inflammation but are capable of killing invading organism. However, the selectins and integrins have some selectivity in the way in which they respond and on the killing molecules they secrete. They are especially tract in the mucosa of respiratory and urinary tracts (Ganong 2005).

Basophil values obtained from the experiment is above the normal range of healthy goats as reported by Sirois (1995). The high values observed in this study could have been due to exposure to cold which occurred during the experiment.

The result of the biochemical indices of the experimental animals reveals the physiological state (Olafadehan et al., 2012) and health status of the animal (Isidahomen et al., 2011). Serum biochemistry is a global medium in assessing the health status of an animal. The values obtained for the minerals ions of the Red Sokoto goats fed D.olivera mixed Cowpea huskshowed some variations though does not pose any threat. Serum metabolites 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. (1979). Sodium (Na) contributes to many processes in the body of an animal, which include maintenance of body temperature, nerve action and chemical transportation. The sodium (Na) 142-149 mmol/L obtained from the experiment fell within the normal range for a healthy goat as reported by Sirosis (1995).

The chlorine (Cl) level is slightly higher than the values reported by Sirosis (1995), higher Cl^- concentration in the plasma is probably caused by dehydration or metabolic acidosis (NRC 2007). Most Cl^- is found in the intestinal fluid and animal excrete about 90% of the chloride in the urine. Chlorine contributes by activating the catabolic enzyme amylase and forming (HCl^-) hydrochloric acid which is one of the substances in the gastric juice (NRC, 1996).

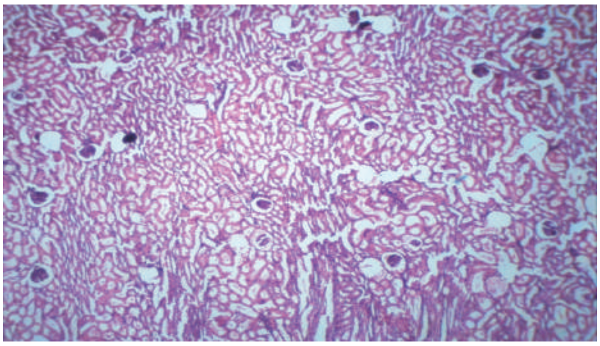
The urea values ranged from 7.9 - 11.4 mmol/L obtained from the experiment which is higher than the standard value for goats ranging from 1.9 to 2.6 mmol/l as reported by Daramola et al (2005) which has been attributed to excessive tissue protein catabolism associated with protein deficiency Oduye and Adadevoh (1986).

Serum proteins are important in immunity and transporting of several substances in the body; the protein values obtained showed the same trend and where not significant (P>0.05). Protein which is measured in mmol/l and ranged from 60.2 to 66.4 in this study is in agreement with values of 47 - 84 g/l reported by Njidda et al. (2013) for normal healthy goat.

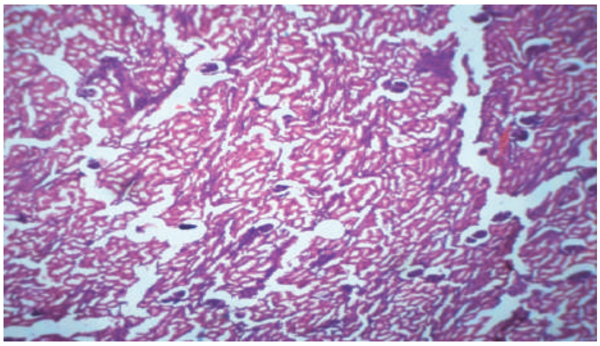
Serum cholesterol obtained followed almost a similar pattern which did not significantly (P<0.05) differ amongst the five treatments.

The values for Aspartate transaminase (AST), alanine transaminase (ALT) and alkaline phosphate (ALP) in the present study are within the normal range reported by Sirosis (1995)and Daramola et al. (2005) for West African dwarf Goatsbut comparatively higher than values reported by Njidda et al. (2013) and Raji et al. (2016) for AST, ALT and ALP for RSG; and higher than the values reported by Opara et al, (2010) for West African Diary Goats of South Eastern Nigeria and Bhat et al. (2001) for Kashimini goats respectively.

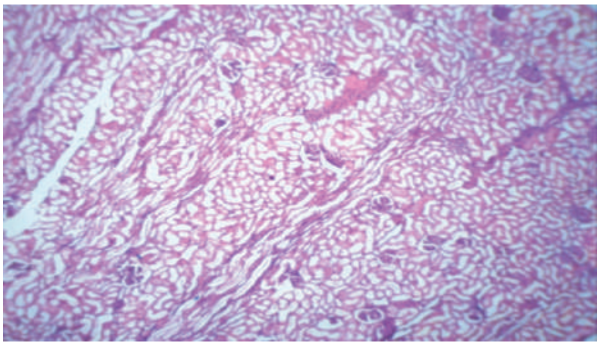
Serum Aspartate Aminotransferase is found in practically every tissue of the body, inducing red blood cell and highly concentrated in cardiac muscle and liver, intermediate in skeletal muscle and kidney in much lower concentrations in other tissues. The measurement of the AST levels helpful for the



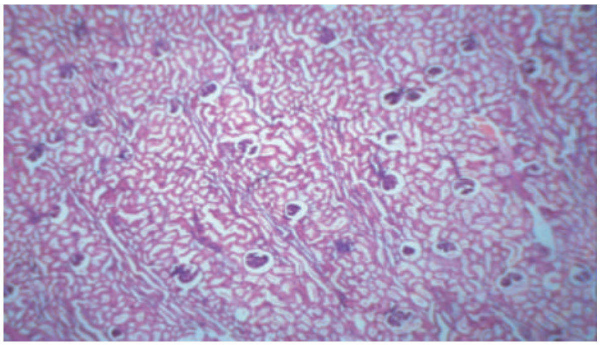
T_1



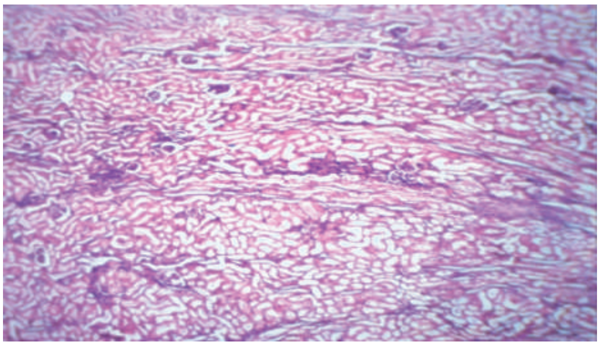
T_2



T_3

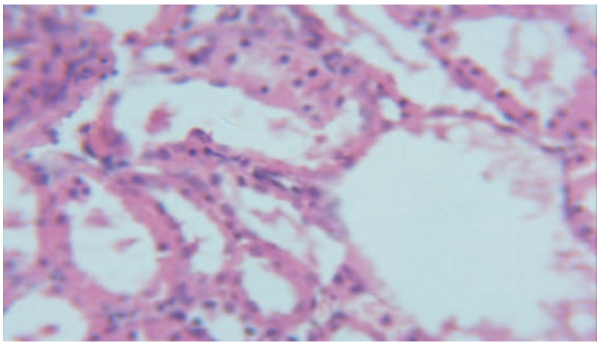


T_4

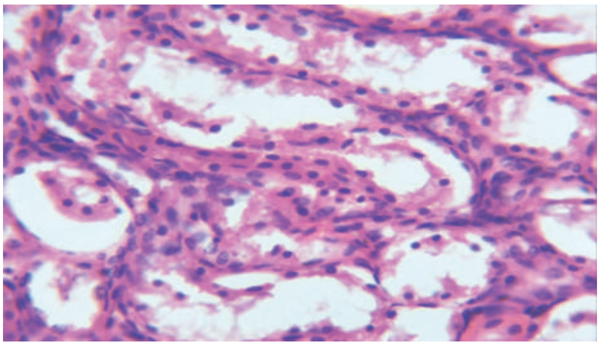


T_5

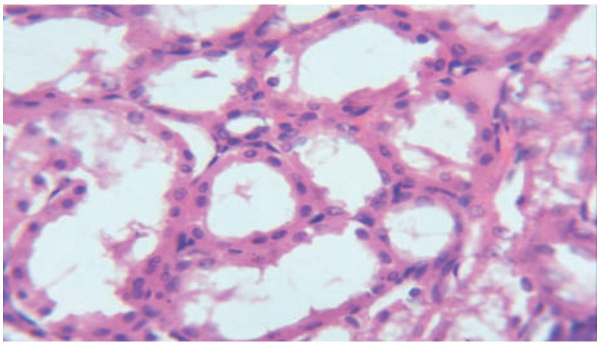
Plate 1: Kidney histomicrograph of Red Sokoto Goats fed *Daniella oliveri* and different levels of replacement with cowpea husk, T_1= 100% cowpea husk; T_2= 75% cowpea/25% *D. oliveri*; T_3= 50% cowpea husk/50% *D. oliveri*; T_4= 25% cowpea husk/75 *D. oliveri*; and T_5= 100% *D. oliveri* (X100 magnification, H&E): Note numerous hypoperfused glomeruli with increased glomeruli-capsular space (a) and several empty spaces of complete glomeruli loss (b) and normal glomeruli (c)



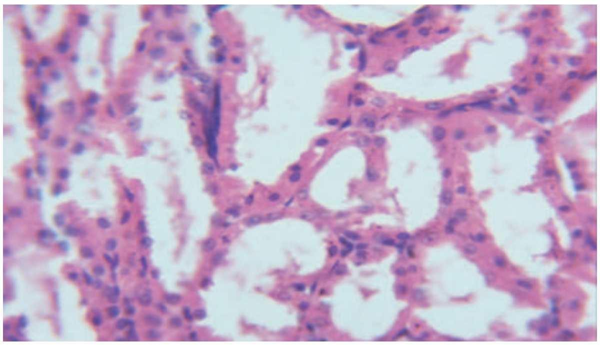
T1



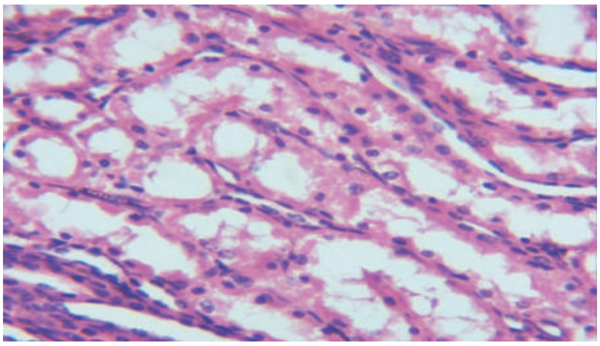
T2



T3

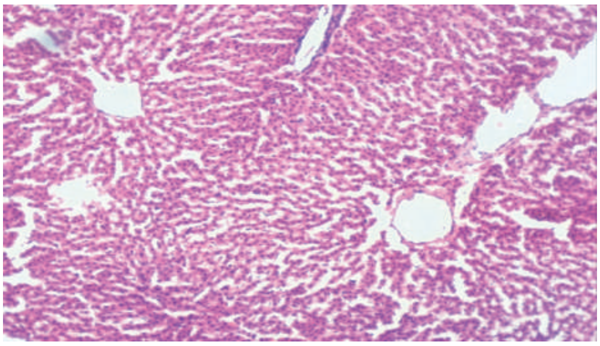


T4

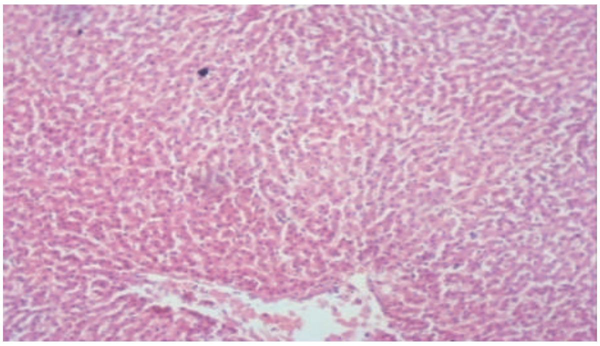


T5

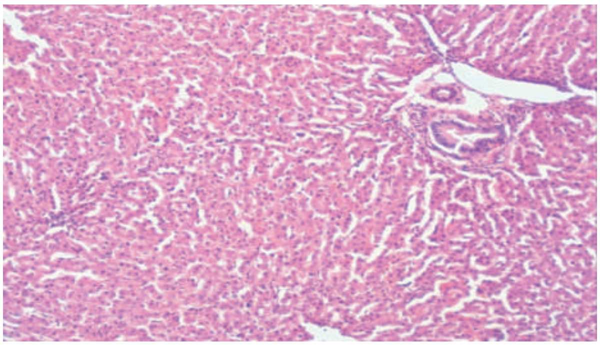
Plate 2: Kidney histomicrograph of Red Sokoto Goats fed *Daniella oliveri* and different levels of replacement with cowpea husk, T_1= 100% cowpea husk; T_2= 75% cowpea/25% *D. oliveri*; T_3= 50% cowpea husk/50% *D. oliveri*; T_4= 25% cowpea husk/75 *D. oliveri*; and T_5= 100% *D. oliveri* (X400 magnification, H&E) Note detachment of renal tubular epithelial cells from the basement membrane in T_1 and T_2 (a), sloughing of cells into the tubular lumen (b), and the formation of tubular casts derived from sloughed cells, tubular debris, and protein (c).



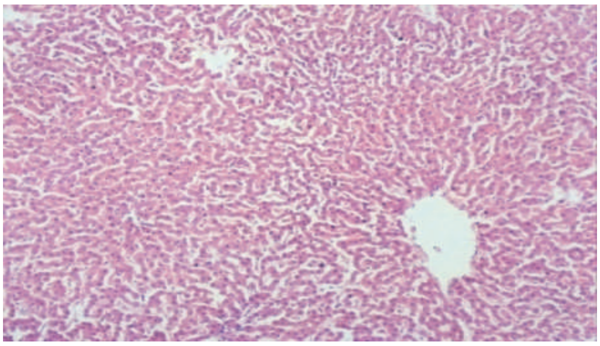
T_1



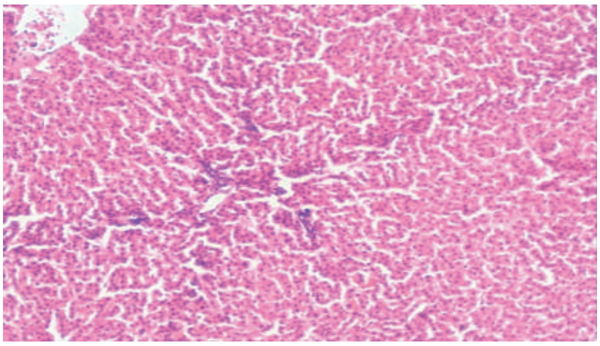
T_2



T_3

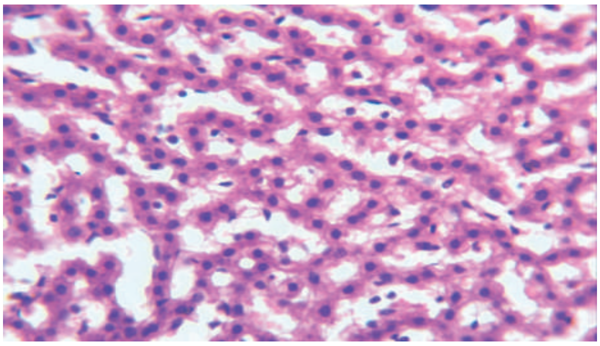


T_4

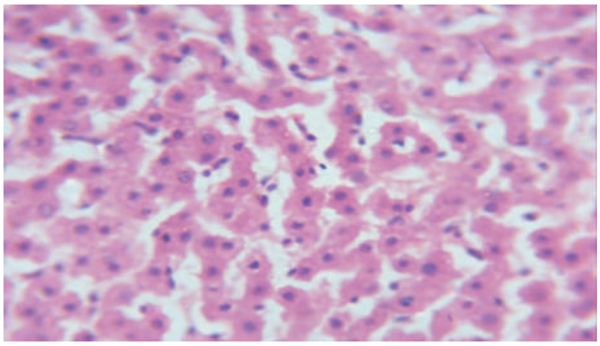


T_5

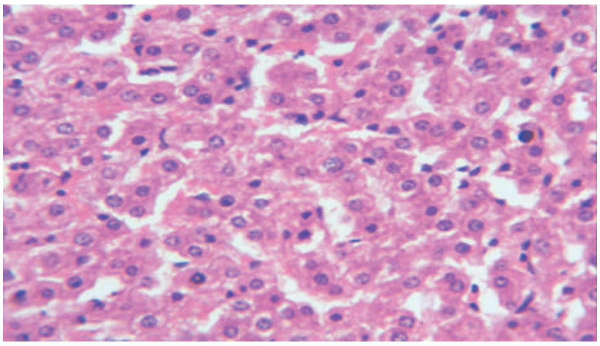
Plate 3: Liver histomicrograph of Red Sokoto Goats fed *Daniella oliveri* and different levels of replacement with cowpea husk, T_1= 100% cowpea husk; T_2= 75% cowpea/25% *D. oliveri*; T_3= 50% cowpea husk/50% *D. oliveri*; T_4= 25% cowpea husk/75% *D. oliveri*; and T_5= 100% *D. oliveri* (X100 magnification, H&E)



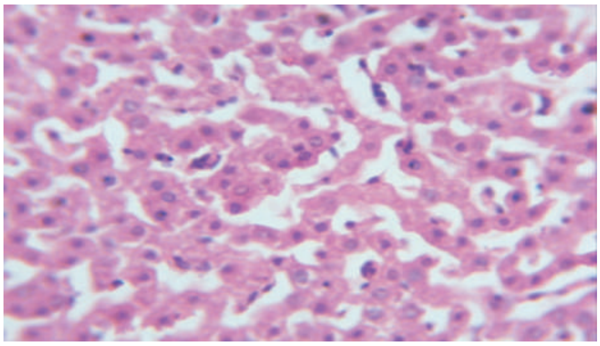
T_1



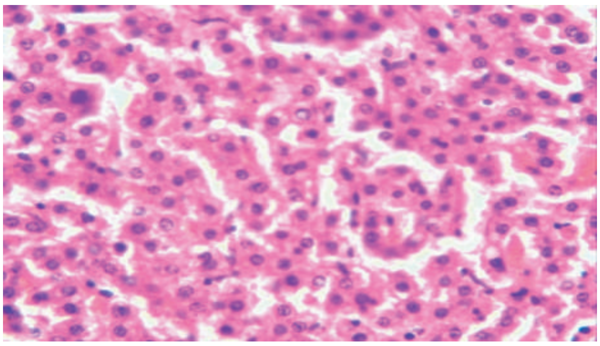
T_2



T_3



T_4



T_5

Plate 4: Liver histomicrograph of Red Sokoto Goats fed *Daniella oliveri* and different levels of replacement with cowpea husk, T_1= 100% cowpea husk; T_2= 75% cowpea/25% *D. oliveri*; T_3= 50% cowpea husk/50% *D. oliveri*; T_4= 25% cowpea husk/75% *D. oliveri*; and T_5= 100% *D. oliveri* (X400 magnification, H&E)

diagnosis and following case 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). The concentration of serum Alanine Aminotransferase in tissues is not nearly as great as for serum Aspartate Aminotransferase. If the serum Aspartate Aminotransferase is elevated while the serum Alamin Aminotransferase remains within normal limits in case of suspected myocardial infarction, the results are compatible with myocardial infarction (Alex and Laverne, 1983).

Increased Glomeruli-Bowman's space ratio implies a small Glomerular tuft in a relatively large Bowman's space. It is an indication of collapsed capillaries of the glomerulus. This could be due to hypoperfusion of blood from renal arteries or arterioles: Renal hypoperfusion reduces glomerular capillary pressure (Harty, 2014). It could also be due to obliteration of the difference in pressure between the glomerulus and the renal tubules. Obliteration of pressure gradient may occur when the integrity of the tubular epithelial cells are compromised either due to an acute ischemic or toxic event and reabsorption of glomerular filtrate is hampered. This causes glomerular filtrate to accumulate and renal tubules may distend when there are obstructions within the tubules. Subsequently, glomerular filtrate back-leaks, accumulates, and exerts pressure on the glomerulus to collapse it (Basile et al., 2012). The presence of detached renal tubular epithelial cells, sloughed cells in the tubular lumen; and the formation of tubular casts in the micrograph may be a sequel to an acute ischemic event since the hematology indicated a possible anaemic condition especially for goats on diets T_1 and T_2 having lower red blood cell parameters when compared to other treatment groups and were below the reference values cited in this study. Furthermore, severe histopathology were observed in the kidney micrographs from T_1 and T_2.

Sinusoidal dilatation in liver histology micrographs could be due to congestion or atrophy of hepatocytes. In this case atrophy is most likely since none of the hepatic vessels were seen to be congested. Furthermore, the hepatocytes of group given the T_3 diet which had a more normal sinusoidal space had larger hepatocytes when compared to other groups. Sinusoidal dialationalone is not sufficient to diagnose liver dysfunction. Simultaneous measurement of serum biochemistry picture is often required. The values for Aspartate transaminase (AST), alanine transaminase (ALT) and alkaline phosphate (ALP) in the present study were higher than the normal values reported by Njidda et al. (2013) and Raji et al. (2016) for AST, ALT and ALP of RSG; and higher than the values reported by Opara et al, (2010) for West African Diary Goats of South Eastern Nigeria and Bhat et al. (2001) for Kashimini goats respectively. ALT is considered a more specific and sensitive indicator of hepatocellular injury than AST The ratio ALT: ALP plays an important role in deciding the type of liver damage by hepatotoxins. The ratio is greater than or equal to five during hepatocellular damage while the ratio is less than or equal to two during cholestatic liver damage. During mixed type of liver damage, the ratio ranges between two and five. ALT and AST or in combination with total bilirubin are primarily recommended for theassessment of hepatocellular injury in rodents and non-rodents in non-clinical studies. The enzyme detects hepatocellular necrosis (Singh et al., 2011). Alkaline phosphatase it is particularly present in the cells which line the biliary ducts of the liver. Hepatotoxicity may leads to elevation of the normal values due to the body's inability to excrete it through bile due to the congestion or obstruction of the biliary tract, It is also found in other organs including bone, placenta, kidney and intestine. Increase in alkaline phosphatase and/or bilirubin with little or no increase in ALTis primarily a biomarker of hepatobiliary effects and cholestasis. In this study, AST, Total Protein, Albumin, globulin and cholesterol were all within the normal range for Red Sokoto goats.

5. CONCLUSION

In conclusion, feeding of *D. oliveri* foliage substituting cowpea husk to goats does not seems to pose any problem on haematology, biochemical and histopathological parametrs of red sokoto goats, fortification with minerals and vitamins at lower levels of inclusion is required as evedent by the performance of T_3, T_4 and T_5 (50, 75 and 100% *D. oliveri* inclusion).

ACKNOWLEGDEMENT

The authors wish to thank University of Abuja, Nigeria for funding the research.

REFERENCES

Adebowale, E.A. 1981. The feeding value of cowpea husk (*Vigna unguichilatawalp*) in ration for goats. Turrialba, 31:141-145.

Alex, K. and Laverne L.S. 1983. Clinical chemistry; interpretation and techniques 2nd edition seatle, Washington, pp: 156-339.

Aikhuomobhogbe, P. U. and Orheruata, A. M. 2006. Haematological and blood biochemical indices of West African dwarf goats vaccinated against *Pestes des petit ruminants* (PPR). African Journal of Biotechnology 5 (9): 743-748. Available online at http://www.academicjournals.org/AJB

Ammar, M.H.M. 2004. Mulecular Mapping of salt tolerance in rice. Ph.D Thesis, Indian Agriculture Research Institute, New Delhi, India.

Annongu, A. A., Joseph J. K. and Liebert, F. 2004. Effect of Anaerobic Fermentation and Lyle Treated prosopis Africana Seed Meal on the Nutritional and Heamatological Responses of Harco chicks. Journal of Raw Material Research, 1: 33 - 41.

Awodi, S., Ayo, J. O., Atodo, A. D. and Dzende, T. 2005. Haematological parameters in Rabbit breeds and Crosses in humid tropics. Pakistani Journal of Biological Sciences, 9: 2102-2106.

Babiker, S. A, E. I. Khider, I. A., Shafie, S. A. 1990 Chemical composition and quality attributes of goat meat and lamb. Meat Science, 28: 273- 277.

Baker, F. J. and Silverton, R.E. 1985. *Introduction to Medical Laboratory Technology*. Sixth Edition, Butterworths and Co. Ltd., Pp: 191-199.

Banerjee, G. C. 2007. A Textbook of animal husbandry. 8th ed. Published by Raju Prinlani for Oxford and IBH publishing Co. Pvt. Ltd. New Delhi, India. Pp: 933-934.

Basile, D. P., Anderson, M. D., and Sutton, T. A. 2012. Pathophysiology of Acute Kidney Injury. Compr Physiol.; 2(2): 1303-1353. doi:10.1002/cphy.c110041.

Boudet, A.M, 1998. A New View of Lignification. Trends Plant Science, 3: 67 - 71

Cheesbrough, M. 2004. District Laboratory Practice in Tropical Countries. Part 2, University Press Cambridge United Kingdom, 266-342.

Daramola, J.O., Adeloye, A.A., Fatoba, T.A and Soladoye, A. O. 2005. Haematological and biochemical parameters for West African dwarf goats. Livestock Research for Rural Development 17. Retrieved from: http://www.cipav.org.co/lrrd 17/8/dara 17095.htm.

Ewuola, E.O., Falayan, O.A, Cibore, F.A., Adebunmi, A.I Akanji, R.A., Ogunlade, J.T. and Adeneye, J.A. 2004. Physiological response of growing West African Dwarf goats fed groundnut shell-based diets as concentrate supplements. BOWEN Journal of Agriculture 1: 61-69.

F. A. O. 2008. Food and agriculture organization of the United Nations. FAO STAT. http://faostat. Fao. Org/ site/ 573/ default. Aspx.

Ganong, W.F. 2005. Review of Medical physiology. 22nd Edition McGraw-Hill Medical Publication Asia spp 459: 516-532.

Grunwaldt, E. G., Guevara, J. C., Estevez, O. R., Vicente, A., Rousselle, H., Alcunten, N., Aguerregaray, D. and Stasis, C. R. 2005. Biochemical and Hematological measurements in beef cattle in Mendoza plain rangeland (Argentina). Tropical Animal Health and Production, 37: *527- 540.*

Harper, H. A., Rodwell, V. W. and Mayer, P. A. 1977. Review of physiological chemistry. 6th ed. California Lange medical publishers. Pp: 559-598. http//en.wikipedia.org/wiki/cholesterol.

Harty, J. 2014. Prevention and Management of Acute Kidney Injury. Ulster Medical Journal, 83: 149-157.

Henry, R.J., Chiamori, N., Golub, O.J. and Berkman S. 1960. Revise Spectrophotometric method for Determination of Glutamic Oxalatic Transaminase and Glutamic Pyruvale Transaminase and lactic and dehydrogenase American Journal of Clinical Pathology, 34: 381.

Hunter, A. 1996. Animal Health Volume II, Macmillan Education Limited, London and Basinstoke.

Ikhimioya, I. 2005. Chemical composition of some Dry Season Shrub and Tree Foliage in Edo, State Nigeria. Tropical Journal of Animal Science, 23: 62 - 63.

Isah, O. A., Oguntuyo, S. A., Dawodu, R. O., Diya, O. O. and Afolabi, M. O. and Omoniyi, L. A. 2013. Feed Utilization, Rumen Parameters (Rumen Microbial Profile of Goats Fed Different Browse Plants with P. Purpurehhum as Basal Diet. Pacific Journal of Science of Science and Technology, 14: 397-405.

Isidahomen, E. C. Ikhimioya, I. Njidda, A. A and Okoruwa, M. I. 2011. Haematological parameters and Blood Chemistry of Different Species of Ruminant Animals in Humid Tropical Environment. The Nigerian Journal of Agriculture and Forestry, 3: 85-90.

Jain, N.C. 1986. Schalms Veterinary Haematology, 4th edition Lea and Febizer, Philadephia.

Jansen, C. and K. V. D Burg 2004. Goat keeping in the tropics. 4thedn.,Agromisa foundation, wageningen, Netherlands, Pp: 1-6.

Kosgey, I. S., Rawlands G. J., Van Arendonk, J. A. M., and Baker, R. L. 2008. Small ruminant production in small holder and pastoral/extensive farming systems in Kenya. Small Ruminant Research, 77: 11 - 24.

Lazzaro, J. 2001. Normal Blood Chemical Values for Adult Goats. www.saanendoah.com/blood values.

Meissner, H. H., Viij, M. D., Van Neierkeki, W. A. 1991. Intake and Digestibility by Sheep of Anthephora, Panicum Rhode and Smuts Finger Grass Pastures: proceedings of the 4th International Rangeland Congress, September, Montipellier, France. 1991, 648 - 649.

Minson, D. J, 1990. Forage in Ruminant Nutrition, Academic Pres, San Diego, U S A, 483 - 484.

Njidda, A. A. 2011. Evaluation of the potential nutritive value of browse forages of semi-arid region of Nigeria. Ph D. Thesis, Ambrose Alli University, Nigeria. 219 pp.

Njidda, A. A. Hassan., I. T. and. Olatunji. E. A. 2013. Hematological and Biochemical Parameters of Goats of Semi-Arid Environment Fed On Natural Grazing Rangeland of Northern Nigeria. IOSR Journal of Agriculture and Veterinary Science, 3: 1-8.

Njidda, A. A. Shuai'bu, A. A. and Isidahomen, C. E. 2014. Haematological and biochemical indices of apparently healthy sheep raised in semi-arid environment of northern Nigeria. Global Journal of Science Frontier Research (D): 14 (2) version 1.0: 49-56.

N.R.C. 2007. *Nutrient requirement of Small Ruminants: sheep, goats, cervids and new world camelids*. National Research Council. National Academic Press, Washington DC.

N.R.C. 1996. *Nutrient requirement of Beef cattle*. National Research Council. National Academic Press, Washington DC.

Obi, T. U. and Anosa, V. O. 1980. Haematological studies of domestick animal iv: climichaematological features of bovine trypanosomiasis, theilerosis, anaplasmois, epetherozoonosis and helminthiasis, zenntralblatt fur veterina *Medizin Relhe* 27: 789-797.

Oduye, O. O. and Adadevoh, B. K. 1976. Biochemical values apparently normal Nigerian sheep, Nigeria Veterinary Journal, 5: 43- 50.

Oduye, O. O. and Otesile, E. B. 1977. Studies on the Canine anemia in Ibadan. Journal of Small Animal Practice, 18: 429-443.

Ogunbosoye, D. O, and Otukoya, F. K. 2014. Evaluation of Preference and Intake of browse Species by West African Dwarf goats International Journal of Innovative Research and Development, 3: 168 - 175.

Ogunsanmi, O. A, Ozegbe, P. C, Ogunjobi, D., Taiwo, V .O and Adu, J.O. 2002. Haematology plasma Biochemistry and whole blood minerals of the captive Adult African Grasscutter (Thryonomysswinderiamus,Temnick) Tropical Veterinarian, 20: 27-35.

Okagbare, G. O., Akpodiete, O. J., Esiekpe, O. and Onagbesan, O. M. 2004. Evaluation of Gmelinaarborea leaves supplemented with grasses (*Pennisetum-purpurem*) as feed for West African dwarf goats. Tropical Animal Health and Production, 36: 593-598.

Okonkwo, J. C., Okonkwo, I. F. and Ebuh, G. U. 2011. Effect of breed, sex and source within breed on the haematological parameters of the Nigerian goats. Online Journal of Animal Feed Research, 1: 08-13.

Olafadehan, O.A. 2011. Change in haematological and biochemical diagnosis parameters of Red Sokoto goats fed tannin-rich *Pterocar puserinaceus* forage diets. Veterinary Arhives, 4: 471 - 483.

Olafadehan, O. A., Adewumi, M. K. and Okunade, S. A. 2014. Effects of Feeding tanning-containing forage in varying proportion with concentrate on the voluntary intake, haematological and biochemical indices of goats. Trakia Journal of Sciences,1:73- 81.

Olorunnisomo, O. A. 2010. Nutritive value of conserved maize, amaranth or maize-amaranth mixture as dry season fodder for growing West African Dwarf sheep. Livestock Research for Rural Development. 22, 191. Retrieved from http://www.lrrd.org/lrrd22/10/olor22191.htm.

Olotu, J. T.,Ologun, A. G. and Osho, I. B. 1998. Haematological Values and Health Status of Red Sokoto Goats within 5 Months of Introduction to South-West Nigeria, Proceedings Silver Annual Conference of Nigerian Society of Animal Production and Inaugural Conference of West African Society of Animal Production, Abeokuta, Nigeria, 1998, Pp: 375-376.

Oser, B. L. 1979. Hawks physiological chemistry. Mc Grew Hill publishing company. New Delhi, India.

Opara, M. N., Udevi, N. and Okoli I. C. 2010. Heamatological parameters and Blood chemistry of Apparently Healthy West African Dwarf (WAD) Goats in Owerri, South Eastern Nigeria. New York Science Journal, 3: 68-72.

Otori, A. A., and Mann, A. 2014. Determination of Chemical Composition, Minerals and Anti Nutritional Factors of Two Wild Seeds from Nupeland, North Central Nigeria. American Journal of Chemistry and Application, 1: 20 -26.

Peter, T., Biamonte, G. T. and Doumas, B. T. 1982. Protein (Total protein) in serum. In: selected method of clinical chemist. Faulkner\, G.W.R and S. Mates (eds). Am. Assoc. clin. Chem. Pp: 100-115.

Radostits, O. M. Blood, D. C. and Gay, C. C 1994. Veterinary Medicine. 8th ed. Bailliere Tindall, London, Pp 86-180.

Raji, A. Y., Butswat, I. S. R, Njidda, A. A. and Jelani, I. 2016. Blood components of redsokoto goats fed *Moringa oleifera* (l) leaf meal supplemented diets. Nigerian Journal for Animal Production, 43: 210 - 222.

SAS (2009). Institute Inc. SAS SAS Institute Incorporation; Cary, NC, USA.

Schalm, O. W., Jain, N. C and carol, E. I. 1975. Veterinary Haematology. 3rd Edn. Lea and Febiger. Philadelphia, PA, USA. Pp: 807.

Shakoori, A. R., Aslam, F. and Sabir, M. 1992. Effect of prolonged administration of insecticide (Cyhalothrin/karate) on the blood and liver of rabbits. Folia Biology, 40: 91-99.

Singh, A., Bhat, T. K., Sharma, O. P. 2011. Clinical Biochemistry of Hepatotoxicity. J. Clinic.

Sirosis, M. 1995. Veterinary Clinical Laboratory Procedure. Mosby Year Book, Inc. St Louis Missouri, USA.

Tambuwal, F. M., Agale, B. M and Bangana. 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.

Tung, H. T., Cook, R. D., Wyatt and Hamilton, P. B. 1975. The anaemia caused by aflatoxin. Poultry Science, 54: 1962-1969.

Van Soest, P.J., Robertson, J.B., Lewi, B.A. 1991. Methods for dietary fibre, neutral detergent fibre and non-starch polysaccharides in relation to animal nutrition. Journal of Dairy Science, 123: