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Haemato-Biochemical Profile of Yankasa Rams Fed Varying Levels of *Panicum maximum* Concentrate Mix under Intensive Feedlot in Southwestern Nigeria

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Abstract

Background: Paucity of information on the effect of feeding varying proportions of grass and concentrate supplements on the blood constituents of Yankasa rams exist in sub humid zone of Nigeria.

Method: Twenty yearling Yankasa rams of an average body weight of 21.33 ± 0.50 Kg were evaluated for haematological and biochemical constituents. Basal diet of *Panicum maximum* fodder replaced by concentrate mix at 0 (Treatment 1, T1), 0.5 (Treatment 2, T2), 1.0 (Treatment 3, T3), 1.5 (Treatment 4, T4) and 2.0% (Treatment 5, T5) body weight of rams were fed in a randomized complete block design for 84 days. The amount of feed offered was adjusted weekly based on average body weight from the preceding week.

Results: Mean values of packed cell volume (PCV), and red blood cell in T5 (32.08 ± 0.3% and10.17 ± 0.21 × 10^6 µL respectively) were significantly ($p<0.05$) higher than those of other treatments with T1 having the least values. The values for mean corpuscular volume mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration also followed the same trend. The value of white blood cells of T1 was not significantly ($p>0.05$) different from T2 to T5.

Biochemical parameters showed that values of total protein (TP), albumin (alb), globulin (glb), triglycerides (TG) and total cholesterol (TC) in T1 were significantly reduced when compared to other treatments except T3 which showed no difference to control in TG values. Treatment 1 recorded an increase in high density lipoprotein but statistically ($p>0.05$) similar values (45.17 ± 0.66 mg dl^{-1}) were observed when compared with the other treatments.

Conclusion: Health status using haemato-biochemical parameters indicated concentrate mix at 2.0% body weight of rams as the most acceptable supplement level for Yankasa rams.

Keywords: Biochemistry; Haematology; *Panicum maximum*; Yankasa rams; Feedlot

Introduction

Food of animal origin is an important source of nutrients in the human diet and its provision in terms of quality and quantity at all times cannot be over emphasized [1]. Meat, a nutrient dense food that provides high quality protein, essential minerals and vitamins such as iron, zinc, vitamin B_{12} and omega-3 [2], is an excellent food source for human consumption that could be obtained from chickens, fowls, wild and cultivated animals. Among these cultivated animals is sheep which is important because of its short generation interval and the absence of religious taboos associated with its meat [3].

Yankasa breed of sheep is not traditionally managed in the sub humid southern zone of Nigeria, but is a meat breed found in north and north central Nigeria which is believed to have descended from a common ancestor to the indigenous West African Dwarf sheep. This breed can be managed in the sub humid southern environment where it can be used to augment the animal protein supply of this area because of its bigger carcass weight compared with the WAD sheep [4,5].

In Nigeria, sheep is mostly raised under semi intensive and extensive system which affects their productivity and result in economic loss due to seasonality in availability of feed, adverse weather condition and poor management system [6]. For effective production of animal protein, livestock farmers have embarked on intensive management system of rearing animal through confinement, provision of adequate nutrition, shelter and sustainable health management to keep the animals in good shape and to optimize productivity [7]. Intensive sheep production offers a major attraction for feedlot large-scale production of rams especially for sale during festivals when they are sold very high prices [8]. The main benefits of lot feeding are greater control and flexibility in the production and marketing of livestock.

Environmental condition, nutrition and management affect the health status of animals kept for productive purpose and their health status can be investigated by carrying out haematogical analyses of their blood sample [9,10]. Blood is known to be vital to the life of an organism because it is a medium through which nutrients are conveyed to various parts of the body system. A readily available and fast means of assessing clinical and nutritional status of an animal on feeding trial may be the use of blood analysis [11]. Haematological parameter is an important and reliable medium used to monitor and evaluate health and nutritional status of animals [12]. The various functions of the blood are carried out by the individual and collective actions of its constituents-the haemotological and biochemical components [13].

Haematological tests have been widely used for the diagnosis of diseases associated with nutrient intake of animals. The information gained from the blood parameters would substantiate the physical examination and together with medical history provide excellent basis for medical judgment. Also, it would help determine the extent of tissue and organ damage, the response of defense mechanism of the animal and aid in diagnosing the haematological problems associated with the feed consumed. The values obtained from experimental animals provide useful tools to compare with normal values for healthy animals [14,15].

Even though considerable information is available on the normal blood parameters of domestic animals, the values are that of exotic breeds kept under different environment and management conditions [16]. Most researchers conducted on influence of feeding regime on blood metabolites of sheep in the sub humid zone of Nigeria has been on WAD sheep. The aim of this study therefore was to investigate some haemato biochemical constituents of Yankasa rams fed varying proportions of *Panicum maximum*-concentrate mix under intensive feedlot in south western Nigeria

Materials and Methods

Experimental site

The experiment was carried out at the small ruminant section of the Teaching and Research Farm, Ekiti State University, Ado Ekiti South Western Nigeria. Ado Ekiti lies between latitude 07^0 3^1 15^{11} and longitude 05^0 13^1 17^{11} E. average humidity of 72%. It experiences a tropical climate with a temperature range of 20°C-28°C and a bimodal rainfall distribution between April and October with peak in June and September and a break in August. Generally, dry season in the sub humid zone is between November and March. The average precipitation in the area is $1367mm^3$.

Experimental animals and their management

Twenty yearling Yankasa rams with an average weight of 21.33 ± 0.50 Kg were purchased from ruminant market in Ajase-Ipo, Kwara State, North central Nigeria. Prior to implementation of the experimental protocol, the rams were quarantined for 30 days according to NAPRI [17] method. The animals were treated against ectoparasites using ivermectin injection, dewormed with Albendazole bolus to take care of endoparasites and also injected intra-muscularly with Oxytetracyline long acting broad spectrum antibiotic as a precautionary measure against bacterial infections. Peste despetits ruminants (PPR) vaccine was also administered to vaccinate the animals against PPR infection. The animals were later allotted into five treatment groups and fed for a pre-treatment period of two weeks to enable them adapt to the experimental diets and the environment before the commencement of the actual experiment. Water was provided *ad-libitum*.

Experimental Design

The rams were randomly assigned into five treatment groups with four animals per group in a randomized completely block design (RCBD). The experimental diets consist of *Panicum maximum* grass as the basal diet at 3% body weight of the rams. Concentrate diet was formulated as shown in table 1 to serve as the supplement to the basal diet and to replace the basal diet at 0, 0.5, 1.0, 1.5 and 2.0% body weight of the rams respectively in treatment 1, 2, 3, 4 and 5. The amount of feed offered was adjusted weekly based on average body weight from the preceding week. The experiment lasted for 84 days.

Blood Collection and Analysis

An average of 8 ml of blood sample was collected from the individual animal from their right jugular veins between

Table 1: Proximate composition of *Panicum maximum*-concentrate mix fed to Yankasa rams.

Parameters	Level of concentrate (as % body weight)				
	0	0.5	1.0	1.5	2.0
DM	72.28	80.11	82.62	85.71	86.11
CP	9.42	11.64	12.92	14.52	14.97
CF	31.58	29.11	29.01	27.46	26.78
EE	3.30	5.76	5.40	5.86	6.06
ASH	11.36	9.48	8.66	8.01	7.54
NFE	44.34	44.01	44.01	44.24	44.65
GE (Kcalkg$^-$)	2280	2600	2811	2901	3028

Dry matter-DM; Crude protein-CP; Crude fibre-CF; Ether extract-EE; Nitrogen free extract-NFE; gross energy-GE.

7:00 AM and 9:00 AM on the 28th, 56th and 84th day of the experiment. About 5ml of the blood sample collected was emptied into labelled ethylene diamine tetraacetate (EDTA) bottle (heparinized test tube) and reserved for haematological studies while the remainder was decanted into labelled plastic test tubes for serum metabolites determination. Packed cell volume (PCV), White Blood Cell (WBC) and differential counts of WBC (Neutrophils, Eosinophils, and Lymphocytes) were determined according to the methods described by Coles, et al. [18]. Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) were calculated as:

MCV (fl) = Haematocrit (PCV) × 10 RBC mm^{-3}

MCH (pg) = Hb in g/100ml blood × 10 RBC mm^{-3}

MCHC % = Hb in g/100ml blood × 10 Haematocrit (PCV)

Total protein, albumin and other serum metabolites were determined using commercially available diagnostic kits according to the methods described [19-21].

Statistical Analysis

Data generated were subjected to analysis of variance (ANOVA) using the General Linear Model (GLM) procedure of SAS [22]. Means were separated using Duncans Multiple Range Test (DMRT).

Results

Proximate composition of test ingredients

The analyzed proximate composition of the concentrate mix and *Panicum maximum* forage are presented in table 2. The dry matter of the concentrate (92.15 g $100g^{-1}$) was higher than that of the forage (72.28 g $100g^{-1}$). The crude protein (CP) constituents of concentrate mix (16.65 g $100g^{-1}$) was higher compared to the CP of the forage (9.42 g $100g^{-1}$ e , the Gross Energy (GE) value of concentrate (3228 Kcal kg^{-1}) exceeded the GE value of forage (2280 Kcal kg^{-1}). However, the crude fibre (CF) of forage (31.58 g $100g^{-1}$) was greater than the CF of concentrate mix (26.48 g $100g^{-1}$) [23].

Haematological Characteristics

Table 3 shows the haematological response of the experimental animals used for this study. There were significant differences ($p<0.05$) in the means of packed cell volume (PCV) in all the treatment groups. The PCV value for rams fed concentrate diets ranged from 28.3 ± 0.58% in rams fed 2.5% *Panicum maximum* and 0.5% concentrate mix (T2) to 32.08 ± 0.30% rams fed 1.0% *Panicum maximum* and 2.0% concentrate mix (T5) as compared to PCV value of 23.5 ± 0.25% in rams fed 3.0% *Panicum maximum* and 0% concentrate mix (T1). Significant differences ($p<0.05$) in the red blood cell and haemoglobin of the animals under study also existed. Red blood count (RBC) value was highest at T5 (10.17 ± 0.21 $10^6\mu$) and lowest at T1 (7.78 ± 0.16 $10^6\mu$). Haemoglobin (Hb) value for T2 to 5 (11.38 ± 0.62, 11.65 ± 0.44, 11.81 ± 0.52 and 12.93 ± 0.51g dl^{-1} respectively) were significantly ($p<0.05$) higher than the value recorded in the control diet (8.05 ± 0.57g dl^{-1}). The white blood cell (WBC) value ranged from 9.07 ± 1.44 × 10^9L^{-1} in rams fed the control diet to 10.73 ± 0.49 × 10^6L^{-1} in T5 without any significant differences ($p>0.05$). The result of mean haemoglobin corpuscular concentration (MCHC) reduced significantly ($p<0.05$) in rams on T1 (18.9 ± 1.46%) while the value obtained in T5 (41.42 ± 1.58%) increased significantly. The mean values for mean corpuscular value (MCV) and mean corpuscular haemoglobin (MCH) also followed the same pattern withT2, T3 (2% *Panicum maximum* and 1% concentrate mix) and T4 (1.5% *Panicum maximum* and 1.5% concentrate mix) having statistically similar ($p<0.05$) values of 28.18 ± 0.63, 28.28 ± 2.84 and 28.81 ± 4.67 fl for MCV and 11.33 ± 1.47, 11.50 ± 1.56 and 12.01 ± 1.09 pg for MCH respectively.

Table 4 shows the serum biochemical indices of Yankasa rams fed *Panicum maximum* -concentrate mix. Apart from HDL and LDL, all the serum chemistry constituents showed significant ($p<0.05$) differences in the treatments. The TP and Alb were increasing with increased level of concentrate except for a slight decrease of Alb in treatment 4 with 1.5 level of concentrate mix. Almost similar patterns were seen in other parameters. There was a significant difference ($P<0.05$) at various inclusion levels.

Significant differences ($p<0.05$) also existed among the means of albumin and globulin in the rams fed the experimental diets. Albumin values ranged from 3.04 ± 0.03g $100ml^{-1}$ to 3.41 ± 0.04g $100ml^{-1}$ in treatment 1 to 5. The globulin values also varied from 2.18 ± 0.07g $100ml^{-1}$ to 3.16 ± 0.12g $100ml^{-1}$ in treatment 1-5. The total cholesterol recorded varied values of 47.78 ± 0.44 to 69.77 ± 2.32g $100ml^{-1}$ with no significant difference in treatment 2 to 5 but significantly reduced ($p>0.05$) in treatment 1. Triglyceride values were from 15.22 ± 0.11 to 16.77 ± 0.29g $100ml^{-1}$ with significant reduction ($p<0.05$) in treatment 1 and 3.

Table 2: Proximate (%) composition of *Panicum maximum*-concentrate mix fed to Yankasa rams.

Parameters	*Panicum maximum*	Concentrate
DM	72.28	92.15
CP	9.42	16.65
CF	31.58	26.48
EE	3.30	4.23
Ash	11.36	7.6
NFE	44.34	45.04
Gross E^0 (Kcal/kg)	2280	3228

DM-Dry matter, CP-Crude protein, CF-Crude Fibre, EE-Ether extract, NFE-Nitrogen-free extract

Table 3: Haematological characteristics of Yankasa rams fed *Panicum maximum*-concentrate mix in intensive feedlot.

Parameters	Level of Concentrate (%body weight of ram)				
	0	0.5	1.0	1.5	2.0
PCV (%)	23.5 ± 0.25[c]	28.30 ± 0.58[b]	28.58 ± 0.51[b]	28.33 ± 1.31[b]	**32.08 ± 0.30[a]**
RBC (10^6µL)	7.78 ± 0.16[c]	9.96 ± 0.13[b]	9.88 ± 0.26[b]	10.17 ± 0.21[a]	10.02 ± 0.02[a]
Hb (g/dl)	8.05 ± 0.57[b]	11.38 ± 0.62[a]	11.65 ± 0.44[a]	11.81 ± 0.52[a]	12.93 ± 0.51[a]
WBC (10^9/L)	9.07 ± 1.14	10.21 ± 0.39	9.78 ± 1.78	10.03 ± 0.75	10.73 ± 0.49
Neut (%)	57.11 ± 2.12	58.0 ± 3.05	60.33 ± 2.99	59.66 ± 2.26	61.0 ± 2.50
Lymp (%)	32.78 ± 0.59	32.55 ± 1.42	32.89 ± 3.73	29.00 ± 1.89	30.01 ± 0.40
Mono (%)	4.44 ± 0.44	4.44 ± 0.44	6.46 ± 0.79	4.88 ± 0.29	5.99 ± 0.88
Eosin (%)	2.22 ± 0.22	2.44 ± 0.44	2.44 ± 0.44	3.22 ± 0.78	2.44 ± 0.44
MCHC (%)	18.90 ± 1.46[c]	32.21 ± 2.16[b]	33.20 ± 1.42[b]	33.34 ± 1.58[b]	41.42 ± 1.58[a]
MCV (fl)	18.21 ± 1.71[b]	28.18 ± 0.63[a]	28.28 ± 2.84[a]	28.81 ± 4.67[a]	32.14 ± 0.81[a]
MCH (pg)	6.26 ± 0.50[b]	11.33 ± 1.47[a]	11.50 ± 1.56[a]	12.01 ± 1.09[a]	12.90 ± 0.74[a]

Means with different superscripts a, b, c along the same row are significantly different
Packed cell volume-PCV; red blood cells-RBC; haemoglobin, White blood cell-WBC

Table 4: Serum biochemistry of Yankasa rams fed *Panicum maximum*- concentrate mix in intensive feedlot.

Parameters	Level of Concentrate (% body weight)				
	0	0.5	1.0	1.5	2.0
TP g dl^{-1}	5.22 ± 0.15[c]	6.39 ± 0.18[b]	6.41 ± 0.38[b]	6.44 ± 0.19[b]	6.77 ± 0.12[a]
Al g dl^{-1}	3.04 ± 0.03[b]	3.30 ± 0.10[a]	3.35 ± 0.80[a]	3.34 ± 0.06[a]	3.41 ± 0.04[a]
Glg dl^{-1}	2.18 ± 0.07[b]	3.08 ± 0.11[a]	3.06 ± 0.17[a]	3.10 ± 0.03[a]	3.16 ± 0.12[a]
TC mg dl^{-1}	47.78 ± 0.44[b]	64.44 ± 1.83[a]	69.77 ± 0.67[a]	67.22 ± 1.28[a]	69.77 ± 2.32[a]
TG mg dl^{-1}	15.22 ± 0.11[c]	17.33 ± 0.19[a]	15.78 ± 0.68[c]	16.44 ± 1.16[b]	16.77 ± 0.29[b]
HDL mg dl^{-1}	45.17 ± 0.66	44.55 ± 1.36	43.88 ± 0.73	42.33 ± 0.67	43.44 ± 0.62
LDL mg dl^{-1}	10.77 ± 0.59	12.44 ± 0.62	12.89 ± 0.40	13.55 ± 0.11	13.66 ± 0.19

Means with difference superscripts a,b,c along the same row are significantly different.
Total protein-TP; globumin-Alb; globulin-Glb; Total cholesterol-TC; Triglyceride-TG; high density lipoprotein-HDL; low density lipoprotein-LDL

Discussion

The crude protein (CP) constituent of *Panicum maximum* (Pm) used in this study (9.42 g kg^{-1}) was less than 12.17 g kg^{-1} obtained by Fadiyimu, et al. [24] but more than 5.87 g kg^{-1} obtained by Oluboyede, et al. [25]. However, the CP value was above the normal range of 7.7% which the critical level is recommended for small ruminants (ARC 1985). The crude fibre (CF) of *Pm* (31.58 g kg^{-1}) was lower than the CF (37.47 g kg^{-1}) obtained by Fadiyimu, et al. [24]. Also, the nitrogen free extract (NFE) value in this study (44.35 g kg^{-1}) was higher than 34.47 g kg^{-1} obtained by the above two researchers. The reasons for these differences could be due to age and harvest season which may affect proximate analysis.

The crude protein (16.65 g kg^{-1}) content of the concentrate diet was above 12% minimum value recommended for growing small ruminants [26]. The CP content of the concentrate mix used in this study was higher than the CP of most grasses including *Pm* but lower than the CP of 20.11g kg^{-1} used to supplement confined lambs which were kept on Brachariabrizantha grass pastures [27]. The CP values in the experimental treatments 1 to 5 fell within the limit of 9 to 14% recommended for growing sheep [28]. Concentrates usually means high quality low fibre diets of less than 18% CF (Van 2006), but the CF of 26.97g kg^{-1} to 29.11g kg^{-1} with moderate CP and a high NFE of the concentrate mix in this study could make it a high energy supplement with moderate CP [29].

Haematological traits especially PCV and Hb were similar with nutritional status of the animal [30]. In the PCV values obtained in this present study only rams fed the control diet had a value of 23.5% which was below the normal range (27.0%-45.0%) reported for healthy sheep [30]. Other rams fed varied level of the concentrate had a value that fell within this range However; rams fed the highest level of concentrate (Treatment 5) recorded the highest level of PCV. Isaac et al. (2013) underscored the importance of PCV as a parameter indicating oxygen transportation and absorption of nutrients in all animals and man. The higher PCV values in the rams fed concentrate mix in this study is an indication of a better nutritional status of the diets.

Generally, increase in the Hb concentration is associated with greater ability to resist infections and low level is an indication of poor nutrition and high susceptibility to infections [31,19]. Haemoglobin has the physiological function of transporting oxygen to tissues of the animal for oxidation of ingested food so as to release energy for the other body functions as well as transport carbon dioxide out of the body of animals [32]. This implies that increased haemoglobin level with increased concentrate in this study would enhance high perfusion rate in the animal tissues and adequate removal of carbon dioxide with improved animal health and production. This is in agreement with the studies of Fasae, et al. [33] who reported increased Hb level with increased supplementation of maize cob with forage legumes.

The major functions of the white blood cell and its differentials are to fight infections, defend the body by phagocytosis against invasion by foreign organisms, produce or transport and distribute antibodies in immune response. Rams fed control diet which had low WBC value were likely to be exposed to higher risk of diseases, while rams fed concentrate which had high WBC value were capable of generating antibodies in the process of phagocytosis with high degree of resistance to diseases [32]. Also, with the introduction of concentrate mix in the animal diets, there will be enhanced adaptability to local environmental and disease prevalent conditions [34]. The values of WBC obtained in this study (9.07 ± 1.14-$10.73 \pm 0.49 \times 10^9 L^{-1}$) were within the normal values of 4-12 $\times 10^9 L^{-1}$ for sheep [35]. This is also in consonant with the work of Bello and Tsado, et al. [36] who reported values of 7.0- 12.9 $\times 10^9 L^{-1}$ in Yankasa rams fed graded levels of poultry droppings based diet.

However, the RBC values obtained in this present study (9.96-10.17 $\times 10^6$ µL) for animals fed concentrate mix were within the normal range reported by Campbell, et al. [37] who reported a range of 9-11 $\times 10^6$ µL in their study. Normal RBC values have been associated with absence of haemolytic anaemia and depression of erythropoiesis whereas reduced RBC level is a requisite for susceptibility to anaemia-related diseases by animals [38].

Biochemical parameters are responsible for various body functions and its deficiency result in impairment of functions induce structural and physiological abnormalities [39]. Tumbleson, et al. [40] reported that the liver synthesizes all the component of serum total protein except the immunoglobulin which is produced by the spleen. A reduction in the concentration of these is an indication of liver dysfunction. A higher total protein level in the blood sera of the rams fed highest level of concentrate mix as demonstrated in this study signifies a better protein synthesis in the animals since the diet had the highest level of crude protein. This is similar to the findings of Hoffman, et al. [41] who recorded higher serum total protein and albumin when Holstein heifers were fed 15% CP as against 8% Ross JG, et al. [42] confirmed that the most sensitive biochemical index of impending protein deficiency is a drop in serum albumin. In addition, Altman, et al. [43] reported that a reading of total albumin that is less than the normal physiological values usually indicate hypoalbuminemia which may result from deficient intake of protein, deficient synthesis of albumin, excess protein breakdown, chronic liver diseases or starvation and chronic gastro intestinal diseases with their interference with protein digestion and absorption. Mean globulin values in this study is higher than that reported by Carlos, et al. [44] in Morada Nova sheep blood analysis but slightly lower than that reported by Kaneko, et al. [45] for healthy sheep. The differences in the three studies may be attributable to differential diet intake and environment.

This study shows a range of TG between 15.22 and 17.33 mg dl^{-1}. This level is similar to that reported by Sureshkumar and Vasanthankumar, et al. [46] whose values ranged from 13.34 to 18.05 mg dl^{-1} when sheep were fed concentrate diets at different physiological stages. Also, the significantly higher triglyceride levels in the rams fed higher concentrate feed is in agreement with the findings of Sarwar, et al. [47] who reported significantly higher levels in concentrate treated groups than animals fed with fodder only. The increased levels of total cholesterol values in the rams fed concentrate mix is also in consonant with the results of other authors who recorded higher cholesterol in serum biochemistry of sheep fed concentrate diets compared with those on sole fodder diets [46-48]. However, the cholesterol levels were within normal limits which imply that meat from the experimental animals would not cause cholesterol elevation in consumers [49].

Finally, slightly lower but non-significant levels of HDL observed in the blood serum of rams fed with concentrate mix in this study was an indication that the level of HDL which is a protective cholesterol in animals would not be negatively affected by the supplements.

Conclusion

The investigated haematological and biochemical parameters indicated that supplement in grams diet with concentrate mix were better than feeding sole grass diet. Generally, the concentrate mix at 2.0% body weight of rams outperformed other treatment groups in most haematological and biochemical indices.

Conflict of Interest: None

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References

1. Murphy SP, Allen LH (2003) Nutritional importance of animal source foods. J Nutr 133: 3932S-3935S.
2. Babiker SA, El Khider IA, Shafie SA (1990) Chemical composition and quality attributes of goat meat and lamb. Meat Sci 28: 273-277.
3. Ozung PO, Nsa EE, Ebegbulem VN, Ubua JA (2011) The potential of small ruminant's production in Cross River rainforest zone of Nigeria: A review. Continental Journal of Animal and Veterinary Research 3: 33-37.
4. Osaiyuwu OH, Akinyemi MO, Salako A E (2010) Factor Analysis of the Morphostructure of Mature Balami Sheep. Res Jour Anim Sci 4: 63-65.
5. Yunusa AJ, Salako AE, Oladejo OA (2013) Principal component analysis of the morphostructure of Uda and Balami sheep of Nigeria. Int Res J Agric Sci 1: 45-51.
6. Ngere LO, Adu IF, Mani I (1979) Report of small ruminant breeding Subcommittee. NAPRI Bulletin 1, National Animal Production Research Institute.

7. Ademosun AA (1992) Constraints and prospects of small ruminant research and development in Africa. Proceedings of the 2nd Biennial conference on the African Small Ruminant Research Network AICC, Arusha, Tanzania.

8. Sarma PK, Ahmed JU (2011) An economic study of small scale cattle fattening enterprise of Rajbari district. J Bangladesh Agric Univ 9: 141-146.

9. Aderemi FA (2004) Effects of replacement of wheat bran with cassava root sieviate supplemented or unsupplemented with enzyme on the haematology and serum biochemistry of pullet chicks. Tropical Journal of Animal Science 7: 147-153.

10. Ewuola EO, Folayan OA, Gbore FA, Adebunmi AI, Akanji RA, et al. (2004) Physiological response of growing West African dwarf goats fed ground nut shell-based diet as the concentrate supplement. Bowen J Agric 1: 61-69.

11. Olabanji RO, Ojebiyi OO, Tona GO, Ologun O (2009) Haematological and serum biochemical response of growing rabbits fed diets containing processed mango (*Mangiferaindica*). In: Akinlade JA, Olayeni TB, Rafiu TA, Akinwunmi AO, Aderinola OA, et al. (eds) Global Economic Recession and the Challenges to Livestock Production in Nigeria. Proceedings of the 14th annual conference of Animal Science Association of Nigeria held at LadokeAkintola University of Technology, Ogbomoso, Oyo State, Nigeria 170-173.

12. Gupta AR, Patra RC, Saini M, Swarup D (2007) Haematology and serum biochemistry of chital (Axis axis) and barking deer (*Muntiacus muntjak*) reared in semi-captivity. Vet Res Commun 31: 801-808.

13. Akinmutimi AH (2004) Evaluation of Sword Bear (*Canavaliagladiate*) as an alternative feed resources for broiler chickens PhD Thesis Michael Okpara University of Agriculture, Umudike, Nigeria.

14. Schalm OW (1975) Veterinary Haematology. 3rd Edition, Lea and Fibiger Philadelphia, USA, 144-167.

15. Jezek J, Klopcic M, Klinkon M (2006) Influence of age on biochemical parameters in calves. Bull Vet Inst Pulawy 50: 211-214.

16. Tibbo M, Aragaw K, Jibril Y, Woldemeskel M, Dawo F, et al. (2004) Factors Affecting Hematological Profiles in Three Ethiopian Indigenous Goat Breeds. Appl Res Vet Med 2: 297-309.

17. NAPRI (1984) Highlights of Research Achievements on Animal Production. Science and Technology Briefing 3-17.

18. Coles EH (1986) Veterinary Clinical Pathology. 4th Edition, Pa: Saunders, Philadelphia, USA.

19. Cheesbrough M (1998) District laboratory practice in tropical countries. Part 1, Cambridge University press, Cambridge, 355-358.

20. Ogunsanmi OA, Ozegbe PC, Ogunjobi D, Taiwo VO, Adu JO (2002) Haematology, plasma biochemistry and whole blood minerals of the captive adult african grasscutter (*thryonomys swinderianus, temminck*). Trop Vet 20: 27-35.

21. Ahamefule FO, Obua BE, Ukweni IA, Oguike MA, Amaka RA (2008) Haematological and biochemical profile of weaner rabbits fed raw or processed pigeon pea seed meal based diets. Afr J Agric Res 3: 315-319.

22. SAS (2008) Statistical Analysis System User's Guide. SAS Institute Inc, Cary, NC, USA.

23. Sanh MV, Wiktorsson H, Ly LV(2002) Effects of Natural Grass Forage to Concentrate Ratios and Feeding Principles on Milk Production and Performance of Crossbred Lactating Cows. Asian -Australian J Anim Sci 15: 650-657.

24. Fadiyimu AA, Alokan JA., Fajemisin AN, Onibi GE (2016) Feed Intake, Growth Performance and Carcass Characteristics of West African Dwarf Sheep Fed *Moringa oleifera*, Gliricidia sepium or Cassava Fodder as Supplements to *Panicum maximum*. J Exp Agric Int 14: 1-10.

25. Oluboyede TA, Sowande OS, Arigbede OM (2007) Effect of Types of Concentrate Supplement on Feed Intake and Performance of West African Dwarf Sheep Fed *Panicum Maximum* as Basal Diet. Moor J Agric Res 8: 33-39.

26. Gatemby RM (1995) Sheep in the tropical agriculturist 2nd Edition, Macmillan Publishers.

27. Prado TF, Franca AFS, Meirinhos MG, Peron HJMC, Ferreira RN, et al. (2015) Animal performance and carcass characteristics from confined lambs on fed concentrate feed and additives. Ann Brazilian Aca Sci 87: 2255-2263.

28. Aduku OA (2005) Practical Livestock Feeds production in the tropics. In: Sekwolo SA & Co publishers. Zaria, Nigeria.

29. Oyedele OJ, Asaolu VO, Odeyinka SM (2016) Nutrient Digestibility and Growth Performance of West African Dwarf (WAD) Goats Fed Foliage Combinations of *Moringa oleifera* and *Gliricidia sepium* with Equal Proportions of A Low-cost Concentrate. J Nat Sci Res 6: 20-29.

30. Banerjee GC (2007) A text Book of Animal Husbandry. 8th edition, Oxford and IBH publishing Co. Pvt Ltd, New Delhi, 1079.

31. Tambuwal FM, Agale BM, Bamgama A (2002) Hematological and Biochemical Values of Apparently Healthy Red Sokoto Goats. In Proceedings of the 27th Annual Conference of the Nigerian Society of Animal Production, Federal University Technology, Akure, Nigera, 50-53.

32. Soetan KO, Akinrinde AS, Ajibade TO (2013) Preliminary studies on the haematological parameters of cockerels fed raw and processed guinea corn (*Sorghum bicolor*). Proceedings of 38th Annual Conference of Nigerian Society for Animal Production. River State University of Science and Technology 49-52.

33. Fasae OA, Adedoku FT, Badmus TM (2014) Effect of forage legume supplementation of maize cob on the performance of West African Dwarf sheep. Slovak J Anim Sci 47: 157-163.

34. Isaac LJ, Abah G, Akpan B, Ekaette IU (2013) Haematological properties of different breeds and sexes of rabbits. Proceedings of the 18th Annual Conference of Animal Science Association of Nigeria. Abuja, Nigeria, 24-27.

35. Jain NC (1993) Essentials of Veterinary Hematology. Lea and Febiger Publishers Malvern, Pennsylvania.

36. Bello AWA, Tsado DN (2013) Haematological and Biochemical Profile of Growing Yankasa Rams Fed Sorghum Stover Supplemented with Graded Levels of Dried Poultry Droppings Based Diets. Pakistan J Biol Sci 16: 1922-1928.

37. Campbell JR, Kenealy MD, Campbell K L (2009) Animal Sciences: The Biology, Care, and Production of Domestic Animals. Waveland Press Inc, 510.

38. Hameed AAA, Salih AM, Fadel Elseed AM, Amasab EO (2013) Effect of feeding untreated or urea treated groundnut hull supplemented with different protein sources on blood parameters of Sudan desert lambs. Online J Anim Feed Res 3: 40-46.

39. McDowell LR (2003) Minerals in Animal and Human Nutrition. Elsevier, New York, United States.

40. Tumbleson ME, Hutchernson DP, Van Burgeo JT(1976) Serum Protein Concentration and Enzyme activity as a Function of Dye Sex in Miniature Swine Growth. J Anim Sci 40: 53-68.

41. Hoffman PC, Esser NM, Bauman LM, Denzine SL, Engstrom M, et al. (2001) Short communication: Effect of dietary protein on growth and nitrogen balance of Holstein heifers. J Dairy Sci 84: 843-847.

42. Ross JG, Christie G, Halliday WG, Jones RM (1978) Haematological and blood chemistry "comparison values" for clinical pathology in poultry. Vet Rec 102: 29-30.

43. Altman RB (1979) Avian Clinical Pathology, Radiology, Parasitic and Infectious Diseases, Proceedings of Amer Amin Hosp Assoc South Bend, W.

44. Carlos MML, Leite JH, Chaves DF, Vale AM, Facanha DAE, et al. (2015) Blood parameters in the morada nova sheep: Influence of age, sex and body condition score. J Anim Plant Sci 25: 950-955.

45. Kaneko JJ, Harvey JW, Bruss ML (2008) Clinical biochemistry of domestic animals. 6th edition. Academic press, San Diego, USA, 916.

46. Suresh Kumar P, Vasanthakumar P (2016) Serum Biochemical changes due to various levels of concentrate feed supplementation at different physiological stages in sheep. Indian Vet J 93: 47-49.

47. Sarwar M, Mukhtar N, Shahzad MA, Nisa M (2010) Traditional versus high input feeding system: Impact on nutrient intake, blood dynamics, hormonal profile, weight gain and economics in growing lambs. Egyptian J. of sheep& goats sci 5: 127-145.

48. Muralidharan J, Jayachandran S, Selvaraj P, Visha P, Ramesh SV (2012) Effect of concentrate and urea molasses mineral block supplementation on blood biochemical profile of mecheri lambs. Indian J Anim Res 49: 409-412.

49. Oloche J, Ayoade JA, Oluremi OIA (2015) Haematological and Serum Biochemical Characteristics of West African Dwarf Goats Fed Complete Diets Containing Graded Levels of Sweet Orange Peel Meal. Am J Exp Agric 9: 1-5.