

## Growth performance and blood profile of grazing Red Sokoto bucks fed *Xylopia aethiopica* seed meal diets

Ukanwoko\*, A. I. and Uhumuavbi O. G.

Department of Animal Science, University of Port Harcourt, Rivers State, Nigeria.

\*Corresponding Author: ndutonia@yahoo.com, Phone number: +2347031126294

Target Audience: Animal Scientists, students and livestock producers

### Abstract

This study was aimed at assessing the growth performance and blood profile of grazing Red Sokoto bucks fed *Xylopia aethiopica* seed meal diet. Nine (9) Red Sokoto bucks were apportioned to three (3) dietary treatments; T<sub>1</sub>, T<sub>2</sub>, and T<sub>3</sub> at 0%, 2.5% and 5% *Xylopia aethiopica* seed meal inclusion level in a completely randomized design. The weights of the animals were taken at the beginning of the experiment and done weekly to determine the live weight changes. Feed intake was calculated as the difference between feed served and refusals. The experiment lasted 8 weeks. At the end of the experiment, blood samples were collected from the jugular vein of the experimental animals and taken to the laboratory for haematological and biochemical analysis. *Xylopia aethiopica* supplementation did not statistically ( $P < 0.05$ ) affect performance. There were significant ( $P < 0.05$ ) differences in the Packed cell volume (PCV), haemoglobin (Hb), red blood cells (RBC), white blood cell (WBC), platelet, neutrophil, lymphocyte, aspartate aminotransferase (AST), chloride, urea and creatinine values of the goats though they all fell within the normal range for goats. *Xylopia aethiopica* seed meal diet had no deleterious effects on performance and health conditions of the Red Sokoto bucks and is recommended for use in goat production at 5.0% inclusion levels.

**Key words:** Creatinine; haemoglobin; negro pepper; packed cell volume and white blood cells.

### Description of problem

Goats being the most numerous ruminant animals with an estimated population of 72.5 million (1) is presently helping to solve the problem of protein malnutrition in Nigeria (2). In the order of importance, Red Sokoto goats ranked 50% followed by the West African Dwarf and Sahel goats and they contribute about 24% of animal protein consumed in Nigeria (3). Livestock including goats are faced with seasonal fluctuations in their weights (4) due to scarcity of good quality feed during the dry season. There is always a search for non- conventional feed ingredients (5) to replace the high cost and high demand conventional feed ingredients (6).

Negro pepper (*Xylopia aethiopica*) is known as uda (by the Igbos), sesedu (Yoruba), kimba (Hausa), Ethiopian pepper, African pepper, Hwenteeaa (Ghanian) (7). It is a spice (8) grown in the rain forest areas (9) and used in several therapeutic preparations (10). It has many medicinal values due to the fact that it possesses anti-microbial, antifungal, analgesic, antihelminthic and immune boosting activities (8). In Eastern Nigeria, nursing mothers consume *Xylopia* after giving birth to enhance milk letdown and reduce post natal pains (11). The mature seed of *Xylopia aethiopica* is usually green in colour when fresh but becomes brownish black when dried. It contains 11.39% crude protein, 48.06%

carbohydrate, 30.30% fat, 3.80% fibre and minerals (12).

This study is therefore aimed at evaluating the growth performance and blood profile of Red Sokoto bucks fed *Xylopia aethiopica* seed meal diets.

**Materials and method**

**Study Location**

This study was carried out in the Livestock unit of the Faculty of Agriculture Teaching and Research farm, University of Port Harcourt, Choba, Rivers State. The farm was located on latitude 4°53'14'' N and longitude 6° 54' 00'' E of the equator (13). This farm is situated within the humid rain forest region of West Africa. It has a long duration of rainfall from March to November and a very short duration of dry season. The temperature of this place ranges from 25°C to 28°C with very high relative humidity of above 80% (13).

**Experimental animal and Design**

Nine (9) Red Sokoto bucks were used for this experiment. The nine (9) bucks were assigned to three (3) treatment diets; T<sub>1</sub>, T<sub>2</sub>,

and T<sub>3</sub>. They were housed individually in separate pens. The animals were taken out for grazing in the morning, fed the experimental diets afterwards and water was given *ad libitum*. The daily feed intake was recorded as the difference between feed served and refusals. The animals were weighed at the beginning of the experiment and weighed weekly throughout the experiment. The research was carried out for 8weeks. A Completely Randomized Design was used for this experiment.

**Experimental Diets**

*Xylopia aethiopica* seeds were used for this experiment. Dried *Xylopia aethiopica* seeds were purchased from the Market, then milled. After milling, they were incorporated into T<sub>2</sub> and T<sub>3</sub> diets at 2.5% and 5.0% inclusion respectively, while T<sub>1</sub> was the control at 0% inclusion. Other feed ingredients such as; wheat offal, palm kernel cake (PKC), brewers' dried grain, soyabean meal, bone meal and common salt were purchased and used for the formulation of the feed as shown in Table 1.

**Table 1            Composition of Experimental diets**

Ingredients (%)	Diets		
	A	B	C
Wheat offal	62.0	59.5	57.0
<i>Xylopia aethiopica</i>	0.0	2.5	5.0
Palm kernel cake	15.0	15.0	15.0
Brewers dried grain	15.0	15.0	15.0
Soya bean meal	5.0	5.0	5.0
Bone meal	2.0	2.0	2.0
Common salt	1.0	1.0	1.0
Total	100	100	100

**Laboratory Procedures and Data Collection**

Blood samples were collected from the jugular vein of the nine experimental animals with the use of a disposable syringe and sterile needles,

then put into two plastic tubes in which one of the tubes contained an anticoagulant known as ethylene diamine tetra-acetic acid (EDTA), while the other plastic tube did not contain an

anticoagulant. The blood samples were carried to the laboratory for haematological analysis to determine the Packed Cell Volume (PCV), Haemoglobin (HB), Red Blood Cell (RBC), White Blood Cell (WBC), Neutrophil (N), Lymphocyte (L), Eosinophil (E), Monocyte (M) according to (14) and serum biochemical indices to determine the Aspartate aminotransferase (AST), Alanine aminotransferase (ALT), Alkaline phosphatase (ALP), Total protein (TP), Albumin (ALB), Total bilirubin (TB), Conjugated bilirubin (CB), Sodium (Na), Potassium (K), Chloride (Cl), Bicarbonate ( $\text{HCO}_3$ ), Urea (UR), Creatinine (CR), Total cholesterol (TC), Triglycerides (TG), High density lipoproteins (HDL) using the method described by (15). The weight of the experimental animals were taken weekly using hanging measuring scale. Body weight gain was calculated at the end of the experiment by subtracting the initial body weight from the final body weight. Feed conversion ratio was determined by dividing the feed intake by the body weight gain. Data was collected on feed intake as the difference between the amount of feed served daily and the amount of feed refused. Also, samples of the feeds from the three (3) treatments were carried to the laboratory for proximate analysis (16).

### Statistical Analysis

Analysis of variance (ANOVA) in Statistical Package for Social Science (SPSS) version 20 set at 95% confidence limit was used for the statistical analysis to determine the level of significance between the various treatments. While Duncan test was used for the mean separation (17)

### Results and Discussion

The proximate composition of the experimental diets, *Xylopi*a *aethi*o*pica* and the grasses/legumes browsed by the goats is shown in Table 2. The crude protein contents of the experimental diets fell within the range of 14.00 – 15.06% which is well above the CP contents of 10.25% and 13.73% reported by (18) and (19) respectively for sheep and goat production. The crude fibre contents of the experimental diets ranged from 30.73 - 39.20% with higher values for the *Xylopi*a based diets. This could be due to the fact that *Xylopi*a *aethi*o*pica* seed meal had high CF contents.

The growth performance of Red Sokoto bucks fed *Xylopi*a *aethi*o*pica* seed meal diets is shown on Table 3. There were no significant differences ( $P>0.05$ ) in all the parameters monitored. Numerically, final body weight was highest in  $T_1$  (16.86kg), followed by the goats on  $T_3$  (16.55kg) and the least for goats on  $T_2$  (16.03kg). Body weight gain was numerically highest in  $T_2$  (3.23kg) and least for goats fed  $T_3$  (2.88kg). The findings tended to be in line with (20) who conducted a trial to investigate the growth response of Red Sokoto bucks supplemented with *Xylopi*a *aethi*o*pica* and reported a weight loss at 7.5% inclusion level of *Xylopi*a *aethi*o*pica*. This also agrees with (6) who reported *Xylopi*a *aethi*o*pica* to be hypoglycemic at higher levels.

The haematological indices of Red Sokoto bucks fed *Xylopi*a *aethi*o*pica* seed meal diets are shown on Table 4. There were significant ( $P<0.05$ ) differences in the PCV, Hb, RBC, WBC, platelet, neutrophil and lymphocyte values of the bucks. The PCV values were higher in bucks fed on  $T_3$  (31.67%) and lowest in bucks fed on  $T_2$  (25.67%).

**Table 2. Proximate Composition of Experimental Diets, *Xylopia aethiopica* and browsed grasses/legumes.**

Parameters (%)	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	<i>Xylopia aethiopica</i>	Browsed grasses/legumes
Dry matter	84.00	85.20	85.90	88.50	30.00
Crude Protein	14.00	15.06	14.58	9.19	21.44
Crude Fibre	30.73	34.03	39.20	44.04	0.50
Nitrogen Free Extract	30.90	32.94	31.75	20.80	72.09
Ether Extract	2.07	9.47	1.17	20.77	4.87
Ash	8.30	14.50	13.30	5.20	1.10
Carbohydrate	14.90	18.14	17.35	9.80	2.06

**Table 3. Growth parameters of Red Sokoto bucks fed *Xylopia aethiopica* seed meal diets.**

Parameters	Treatments				SEM
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>		
Initial body weight (kg)	13.83	12.80	13.67		2.53
Final body weight (kg)	16.86	16.03	16.55		2.65
Body weight gain (kg)	3.03	3.23	2.88		0.22
Total feed intake (kg)	16.90	18.57	16.05		1.03
Feed intake (kg/day)	0.98	1.01	0.97		0.03
Feed conversion ratio	0.09	0.09	0.09		0.01

**Table 4. Haematological values of Red Sokoto Bucks fed *Xylopia aethiopica* seed meal diets.**

Parameters	Normal range	Treatments			SEM
		T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	
PCV (%)	21-35	29.00 <sup>ab</sup>	25.67 <sup>b</sup>	31.67 <sup>a</sup>	1.09
Hb (g/dl)	7-15	9.67 <sup>ab</sup>	8.57 <sup>b</sup>	10.57 <sup>a</sup>	0.37
RBC (×10 <sup>6</sup> /ul)	3.5-13.5	7.27 <sup>ab</sup>	6.77 <sup>b</sup>	7.77 <sup>a</sup>	0.18
WBC (×10 <sup>3</sup> /ul)	6.8-20.1	11.87 <sup>ab</sup>	13.63 <sup>a</sup>	10.07 <sup>b</sup>	0.61
Platelet (×10 <sup>3</sup> /ul)	*	187.67 <sup>b</sup>	235.00 <sup>a</sup>	174.00 <sup>b</sup>	10.93
Neutrophil (%)	17-52	28.67 <sup>b</sup>	30.67 <sup>b</sup>	40.00 <sup>a</sup>	1.99
Lymphocyte (%)	47-82	60.00 <sup>a</sup>	57.33 <sup>a</sup>	48.33 <sup>b</sup>	1.95
Eosinophil (%)	1-7	2.67	4.00	4.00	0.41
Monocyte (%)	0-10	8.67	8.00	7.67	0.31

<sup>abc</sup> means in the same row with different superscripts differ significantly (P<0.05). Source (Normal range): (Tambuwal *et al.* 2002). \*Not available

Where PCV= Packed Cell Volume, Hb= Haemoglobin, RBC= Red Blood Cell, WBC= White Blood Cell, SEM= Standard Error of Mean.

The PCV range of 25.67 – 31.67% reported for Red Sokoto bucks in this study fell within the PCV range of 21 – 35% reported by (21) showing that the protein contained in the experimental diets were adequate for the animals. Low PCV values are pointers to poor crude protein diets. Hb was highest in T<sub>3</sub> (10.57g/dl) and lowest in T<sub>2</sub> (8.57g/dl). Hb fell within the range of 8.57 – 10.57g/dl in this study and this compares favourably with the range of 7 – 15g/dl and 8.08 – 9.50g/dl reported by (21) for Red Sokoto goats and (22) for West African Dwarf goats, respectively. This might also be a pointer to the crude protein contained in the diets. Haemoglobin functions as an oxygen carrier from the lungs to every other parts of the body (23). The RBC value was highest in bucks on T<sub>3</sub> (4.77x10<sup>6</sup>/ul) and lowest in bucks on T<sub>2</sub> (3.77x10<sup>6</sup>/ul). The RBC range of 6.77 – 7.77x10<sup>6</sup>/ul in this study compares favourably with RBC ranges of 6.35 – 11.95x10<sup>6</sup>/ul and 6.62 – 9.74x10<sup>6</sup>/ul reported by (24) and (25), respectively for West African Dwarf goats but higher than that (2.7±10x10<sup>6</sup>/ul) reported by (26) for Red Sokoto goats. The WBC range in this study fell within 10.07 – 13.63x10<sup>3</sup>/ul and this range fell within the normal range reported by (21) but lower than the range of 15.6 – 20.4x10<sup>3</sup>/ul reported by (27). This showed that the experimental diets did not affect the immunity of the bucks negatively. Platelet was highest in T<sub>2</sub> (235x10<sup>3</sup>/ul) and lowest in T<sub>3</sub> (174x10<sup>3</sup>/ul). The range of 174 – 235x10<sup>3</sup>/ul platelet reported in this study fell within the normal range of 150 – 230x10<sup>3</sup>/ul reported by (28) but lower than that (324x10<sup>3</sup>/ul) reported by (29). Platelets have been reported to maintain haemostatis. The range of neutrophil reported

in this study was between 28.67 – 40.00% and this range fell within the normal ranges of 17 – 52% and 23.90 – 49.80% reported by (21) and (27), respectively for Red Sokoto goats. A range of 48.33 – 60.00% reported for lymphocytes in this study fell within the normal range of 47 – 82% reported by (21). There were more lymphocytes than neutrophils in this study. This agrees with (30) who reported that goats have more lymphocytes than neutrophils. Lymphocytes are the main WBC differential responsible for immunity.

The serum biochemical indices of Red Sokoto bucks fed *Xylopi aethiopica* seed meal diets is shown on Table 5. There were significant differences (P<0.05) in the AST, chloride, urea and creatinine values of Red Sokoto bucks that fed *Xylopi aethiopica* seed meal diets. AST value in this study was within the range of 91.67 – 96.67u/l and this range compares favourably with the normal range of 58 – 90u/l reported by (28). AST in goats reflects the functionality of the liver and increased AST signal liver malfunction and protein metabolism disorder (31). The chloride range of 77.67 – 95.00u/l reported in this study fell within the normal range of 50 – 95u/l reported by (28). The urea values in this were within the range of 4.23 – 9.23m/mol and this range fell within the range of 0.80 – 9.70m/mol reported by (21) for Red Sokoto goats. Amino acids in the proper balance give rise to normal urea levels (26). Creatinine values of 118.33 – 147.33m/mol reported in this study fell within the normal range of 60 – 140 m/mol reported by (28). Creatinine is known to have a link with kidney function and at high levels it is associated with kidney disease (32).

**Table 5: Serum biochemical Indices of Red Sokoto bucks fed *Xylopia aethiopica* seed meal diets.**

Parameters	Normal range	Treatments			SEM
		T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	
AST (u/l)	58-90	96.00 <sup>a</sup>	91.67 <sup>b</sup>	96.67 <sup>a</sup>	0.95
ALT (u/l)	10-30	4.43	5.10	4.60	0.43
ALP (u/l)	12-34	9.93	14.73	13.50	1.43
TP (g/l)	30-65	41.00	57.67	51.00	4.34
Albumin (g/l)	20-42	22.00	34.00	26.67	2.87
TB (m/mol)	8-11.5	11.33	10.43	10.87	0.28
CB (m/mol)	1.8-9.4	7.30	6.93	6.77	0.24
Sodium (m/mol)	1.30-6.0	120.33	125.67	126.00	1.62
Potassium(m/mol)	70-120	3.40	4.53	4.57	0.38
Chloride (m/mol)	50-95	95.00 <sup>a</sup>	77.67 <sup>b</sup>	90.00 <sup>ab</sup>	3.44
HCO <sub>3</sub> (m/mol)	20 - 32	26.67	23.33	25.67	0.85
Urea (m/mol)	1-10.5	4.23 <sup>b</sup>	9.23 <sup>a</sup>	6.87 <sup>ab</sup>	0.87
CR (m/mol)	60 - 140	118.33 <sup>b</sup>	147.33 <sup>a</sup>	133.33 <sup>ab</sup>	5.07
TC (m/mol)	1-5	3.70	3.77	3.23	0.22
TG (m/mol)	0.2-0.8	0.35	0.53	0.36	0.04
HDL (m/mol)	1.0-3.2	1.40	1.40	1.08	0.16

<sup>abc</sup> means in the same row with different superscripts differ significantly (P<0.05). Source (Normal range): RAR, 2009. Where AST= Aspartate aminotransferase, ALT= Alanine aminotransferase, ALP= Alkaline phosphatase, TP= Total protein, TB= Total bilirubin, CB= Conjugated bilirubin, HCO<sub>3</sub>= Bicarbonate, CR= Creatinine, TC= Total cholesterol, TG= Triglycerides, HDL= High density lipoproteins, SEM= Standard Error Mean.

### Conclusion and Applications

From this study it is revealed that:

1. The utilization of *Xylopia aethiopica* seed meal diets has no deleterious effects on general performance of Red Sokoto bucks and is recommended for use in goat production systems
2. The haematological and serum biochemical indices of the Red Sokoto bucks on *Xylopia aethiopica* seed meal diets fell within the normal range of haematological and biochemical serum values for Red Sokoto goats.
3. Further studies should be carried out to check the effect of *Xylopia aethiopica* seed meal diets on the milk yield and composition of Red Sokoto goats.

### References

1. National Agricultural Sample Survey (2011). Collaborative Survey on National Agriculture Sample Survey (NASS), 2010/2011. National Bureau of Statistics/ Federal Ministry of Agriculture and Rural Development. Available at: <http://nigeria.countrystat.org/documents/detail/en/c/454834/>. Pp: 143
2. Food and agriculture organization (FAO) (2006). A system of integrated agricultural censuses and surveys, volume 1, world programme for the census of Agriculture. Statistical Development Series No 11.
3. Oni, O.O. (2002). Breeds and genetic improvement of small ruminants. *Small ruminant production training workshop*.

- National Animal Production Research Institute, Ahmadu Bello University, Shika-Zaria, Nigeria. Pp.1–7
- Ajala, M. K., Lamidi, O. S. and Otaru, S. M. (2008). Peri Urban small ruminant production in Northern Guinea Savanna, Nigeria. *Asian Journal of Animal and Veterinary Advances*, 3(3),138–146.
  - Adanlawo, I.G. and Ajibade, V. A. (2006). Nutritive values of two varieties of Hibiscus sabdariffa seeds calyxes soaked in wood ash. *Pakistan Journal of Nutrition*, 5(6), 555– 557.
  - Sodeinde, F. G., Asaolu, V., Oladipo, M.A., Akinlade, J. A., Ige, A. O., Amao, S. R. and Alalade, J. A. (2007). Mineral and anti-nutritional contents of some forage legumes consumed by small ruminants in the derived savanna of Nigeria. *Research Journal of Agronomy*, 1(1):30–32.
  - Ukanwoko, A. I. and Samuel, M. B. (2019). Negro pepper fruit: A potential ethnoveterinary boost for enhanced milk production in ruminants. 8<sup>th</sup> ASAN – NIAS Annual Conference. 8<sup>th</sup> – 12<sup>th</sup> Sept, 2019. Pp 1201 – 1209.
  - Taiwo, I. A., Bola, O. O. and Francis-Garuba, P. N (2009). Haematological properties of aqueous extracts of *Phyllanthus amarus* (Schum and Thonn) and *Xylopiya aethiopica* (Dunal) A. Rich in Albino Rats. *Ethno – Medicine*. 3(2): 99 - 103
  - Aguoru, C.U., Pilla, C. and Olasan, J.O. (2016). Phytochemical Screening of *Xylopiya aethiopica* with emphasis on its medicinally active principles. *Journal of Medicinal Plants Research*; 10 (22): 306-309.
  - Ogunkunle, A. T. S. and Ladejobi, T. A. (2006). Ethnobotanical and phytochemical studies on some species of Senna in Nigeria. *African Journal of Biotechnology*. 5(21): 2020 – 2023.
  - Ijeomah, H.M, Chima, U.D, Aiyeloja, A.A. and Ofodile, E.A.U. (2011). Utilization of monkey fruit-Dactyladenia barteri (prance and white) in indigenous agroforestry practice in Ideato South Local Government Area, Imo State. *Asia Pacific Journal of Rural development*, 21(1):113-120.
  - Osabor, V. N., Basse, F. I. and Ivara, S. E. (2015). Chemical Profiling of African guinea pepper fruit (*Xylopiya aethiopica*). *Journal of Medicinal Plant and Herbal Therapy Research*. 3:10-15.
  - Ijeomah, H. M, Chima, U. D. and Okagbare, O. H. (2013). Ecological Survey of Avifaunal Resources in University of Port Harcourt, Nigeria. *Ethiopian Journal of Environmental studies and Management*. 6(6): 648 – 660.  
<http://dx.doi.org/10.4314/ejesm.v6i6.8>
  - Joshi, P. K., Bose, M. and Harish, D. (2002). Changes in certain haematological parameters in a Siluroid catfish *Clarias batrachus* (Linn.) exposed to cadmium chloride. *Pollution Research*. 21(2): 129 - 131.
  - Ogunsami, A. O., Akpavieso, P. A. and Anosa, V. O. (2002). Serum biochemical changes in WAD sheep experimentally infested with *Trypanosoma brucei*. *Tropical Veterinarian* 47(2): 195 – 199.
  - A.O.A.C 2005. Official Methods of Analysis.18th Ed. Association of Official Analytical Chemists, Washington, D.C.
  - Duncan, D. B. (1955). Multiple Range and Multiple F-Tests. *Biometrics* 11: 1 – 42.
  - Abdu, S.B., M.R. Hassan, G.E. Jokthan, H.Y. Adamu, S.M. Yashim and Yusuf, K. (2012). Effect of varied inclusion levels of Gmelina (*Gmelina arborea*) leaf meal on intake, digestibility and nitrogen in Red Sokoto bucks fed on sorghum glum based complete diets. *Advances in*

- Agriculture, Sciences and Engineering Research*. 2(2): 79-84.
19. Okafor, E. C., Lakpini, C. A. M. and Fayomi, A. (2012). Dried Gmelina (*Gmelina arborea* Roxb) leaves as replacement forage to groundnut haulms in the diets of fattening Red Sokoto bucks. *International Journal of Agriculture and Biosciences*. 1: 5 – 10.
  20. Otaru, S. M., Alawa, J. P., Bale, O. O. J. and Lakpini, C. A. M. (1998). Growth response of Red Sokoto bucks to *Xylopiya aethiopica* supplementation. In: Oduguwa, O. O., Fanimu, A. O. and Osinowo, A. O. (Eds). Proceedings of the Silver Anniversary Conference of the Nigerian Society for Animal Production (NSAP) and the Inaugural Conference of the West African Society for Animal Production (WASAP), held at Gateway Hotel, Abeokuta, 21-26th March, 1998, Pp 650.
  21. Tambuwal, F.M., Agale, B.M. and Bangana, A. (2002). Haematological and Biochemical values of apparently healthy Red Sokoto goats. Proceeding of 27<sup>th</sup> Annual conference Nigeria Society of Animal Production (NSAP), March, 17-21, 2002, FUTA, Akure, Nigeria. Pp. 50-53.
  22. Ogundu, E. C., Eyoh, G. D., Idiong, N. B. and Udo, M. D. (2018). Haematological biochemical profiles of West African Dwarf goats fed diets containing cassava peels, brewers' spent grain and *Panicum maximum*. *International Journal of Scientific Research Publications*. 8(3): 291 – 294.
  23. Daramola, J. O, Adelofe, A. A, Fatiba, I. A. and Soladoye, A. O. (2005). Haematological and biochemical parameters of West African Dwarf goats. *Livestock Research for Rural Development*. 17 (8): 20 – 25.
  24. Ocheja, J. O., Lalabe, B. C., Alex, D. O. and Onoja, S. (2014). Performance, haematological and serum biochemical profiles of weaned West African Dwarf goats fed with diets containing graded levels of cashew nut shell. *International Journal of Research in Agriculture and Forestry*. 1(1):27 – 33.
  25. Saingbe, P. A., Danda, A., Duwa, H. and Akomka, J. A. (2018). Haematology and biochemical parameters of West African Dwarf bucks fed white rot fungus (*Pleurotus tuber regium*) biodegraded groundnut shell included diets. *Nigerian Journal of Animal Science and Technology*. 1(3):92 – 99.
  26. Opara, M. N., Udevi, N. and Okoli, I. C. (2010). Haematological parameters and blood chemistry of apparently healthy West African Dwarf (WAD) goats in Owerri, South Eastern Nigeria. *New York Science Journal*. 3(8): 68 – 72.
  27. Hyelda, A. J., Yahya, M. M., Abakura, J. B. and Wafar, R. J. (2017). Haematological and biochemical parameters of Red Sokoto goats fed Desert Date (*Balanites aegyptiaca*) leaves as supplement to urea treated maize stover. *Journal of Advances in Biology and Biotechnology*. 15(2): 1 – 7.
  28. Research Animal Resource [RAR] (2009). Reference values for laboratory animals: Normal haematological values. RAR Websites, RAR, University of Minnesota. Retrieved from <http://www.ahc.umn.edu/rar/refvalues.html>
  29. Raji, A. Y., Butswat, I. S. R., Njidda, A. and Jolani, I. (2016). Blood components of Red Sokoto goats fed Moringa oleifera (l) leaf meal supplemented diets. *Nigerian Journal of Animal production*. 43(1): 25 - 30
  30. Ibrahim, A. A., Hudu, S., Tamburawa, M. S. and Ashiru, R. M. (2014). Growth



- Performance, Nutrient Digestibility and Haematological Parameters of Red Sokoto Goats fed Sabara (*Guiera senegalensis*) Leaf Meal. *Iranian Journal of Applied Animal Science* 4(1): 53-58.
31. Topchiyeva, S. H. A. (2018). Change in the enzymatic activity of Aspartate Aminotransferase in the blood of goats related to the state of Animal Health. *Journal of Medicinal Research and Biological Studies*. 1(1): 1 – 5.
32. Kaneko, J. J. (2009). Clinical biochemistry of domestic animals. 6<sup>th</sup> Ed. New York Academic press.