Nigerian J. Anim. Sci. 2019, 21 (1): 126-134

Blood profile and nitrogen losses in goats fed urea-treated sugarcane waste and kolanut husk as supplements to poor quality forage.

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***Target Audience:** livestock farmers, Animal scientists, goat nutritionists*

Abstract

The effect of urea treated sugarcane waste and kolanut husk supplementation on blood profile and nitrogen losses in West African dwarf goats fed poor quality forage were assessed during a feeding trial of 84 days. Twenty four West African dwarf female goats with an average body weight of 5.00 ± 0.58kg were randomly assigned to four dietary treatments with two replicates of three goats per treatment in a completely randomised design. The compared treatment diets were: T_1 (100% guinea grass), T_2 (50% guinea grass and 50% urea treated sugar cane waste), T_3 (50% guinea grass and 50% urea treated kolanut husk) and T_4 (50% guinea grass with urea treated 25% sugarcane waste and 25% kolanut husk). A metabolism trial was carried out at the end of the feeding trial to assess diets on nitrogen losses after the blood collection. Results obtained in the study indicated that faecal nitrogen output (3.61g/day) and total nitrogen excreted (4.46g/day) was significantly ($P > 0.05$) higher in T_1 than other treatment diets. Goats on T_3 had higher significant ($P > 0.05$) values in Creatinine (2.01mg/dl), urea (11.23mg/dl), nitrogen intake (18.78g/dl) and urinary nitrogen output (1.01g/day). Packed cell volume (30.00%), haemoglobin (10.19g/dl), red blood cell (9.89×10^6/ML), white blood cell (11.93×10^3/ML), total protein (7.78g/dl), albumin (3.92g/dl), globulin (3.86g/dl) and glucose (70.17g/dl) were significantly ($P > 0.05$) better in goats on T_4 than other treatment diets. Significant difference ($P < 0.05$) did not occur in mean corpuscular volume, mean corpuscular haemoglobin, and mean corpuscular haemoglobin concentration, faecal nitrogen output as percentage of nitrogen intake and total nitrogen output with urinary nitrogen output as percentage of nitrogen intake and total nitrogen output among treatment diets. It could be concluded that goats fed 50% guinea grass with combination of urea treated 25% sugarcane waste and 25% kolanut husk had the potential to enhance blood profile and reduced nitrogen losses.

***Keywords**:* urea, sugarcane waste, kolanut husk, goats

Description of Problem

Goats are prolific ruminant livestock that play significant roles in livelihoods of the rural populace in most of the developing countries like Nigeria. Apart from serving as a vital animal protein source to humans, they also provide income for meeting household needs. However, goats are facing the problem of forage scarcity with high cost of feeds precipitated by inadequate supply of feed ingredients in the tropics. Dry season nutritional stress is the major cause of this unstable feeds supply that threats the sustainable production of goats in Nigeria. The scenario has affected small ruminant industry negatively and created wide gap between the demand and supply of animal protein in the country (1). To salvage this situation of poor goat nutrition, the exploration of locally available and cheaper alternative feed resources as supplement to maintain goats in periods when green forages are grossly inadequate are important.

Sugarcane waste and kolanut husk are some of these alternative agro- industrial by-products derived after processing sugarcane and kolanut. These by-products that are alternative means of feeding bulky materials to goats are underutilized, ignored and cause nuisance to the surroundings which can result to environmental pollution (2, 3). Sugarcane waste and kolanut husk are readily accepted by goats in fresh, dried or ensiled, but due to their fiber and anti-nutritional factors, poor nutrients and low intake with digestibility of nutrient, they are being used partially as feed supplements (3, 4). Hence, the need to upgrade their nutrient content especially protein for better utilization by goats is vital, since rumen micro-organisms depend on dietary protein for proper growth and optimum activity. Judicious treatment of sugarcane waste and kolanut husk with nitrogen rich locally available resources such as urea can improve their nutritive value with subsequent improvement in goat performance.

Urea has been reported by (5) as commonly use feed additive to improve crude protein content, digestibility and nitrogen retention in ruminants. Thus, these by-products can be described as promising potential feed ingredients with considerable attempts made at rendering them suitable as feeds that can help in bridging the gap between supply and demand of the feedstuffs during the periods of scarcity. Therefore, this study was aimed at investigating the effects of urea treated sugarcane waste and kolanut husk on blood profile and nitrogen losses in goats fed poor quality forage.

Materials and Methods

Location of experimental site:

This study was conducted at the Small Ruminant Unit of the Teaching and Research Farm, Ambrose Alli University, Ekpoma, Nigeria. Ekpoma is located at latitude 6.42^0N and longitude 6.09^0E within the south-south geographical zone of Nigeria. The location is characterised by an average annual rainfall and temperature of about 1556mm and 31^0C respectively (1).

Collection and preparation of experimental diets:

Matured poor quality guinea grass was obtained in November last year around the Teaching and Research Farm for the study. They were allowed to wilt over-night before manually chopped to lengths of about 4 – 5cm. Kolanut husk and sugarcane waste that comprised peels and bagasse (dry pulpy residue left after the extraction of juice from sugarcane) were collected from their processing areas within Ekpoma. They were fermented using urea solution. Two kilograms of urea were dissolved in 50 litres of water and carefully sprinkled on 50kg dry matter of kolanut husk and sugarcane waste before they were thoroughly mixed separately. The treated kolanut husk and sugarcane waste were filled into different large drums, compacted, sealed tightly with polyethylene sheets and covered with a heavy object placed on the cover. The ammoniated ensiled kolanut husk and sugarcane waste were opened after one week and sundried for three days to eliminate volatile ammonia gas that could cause ammonia toxicity, and thereafter crushed into meal separately.

The percentage ratios of the poor quality guinea grass to the test urea treated sugarcane waste and kolanut husk or their mixture in the dietary treatments were 50:50 and 50:25:25 each. The sole intake of poor quality guinea grass served as the control group. Hence, the four treatment diets comprised T_1 (100% guinea grass), T_2 (50% guinea grass and 50% urea treated sugarcane waste), T_3 (50% guinea grass and 50% urea treated kolanut husk) and T_4 (50% guinea grass and urea treated 25% sugarcane waste with 25% kolanut husk).

Management of experimental animals and design:

Twenty four West African dwarf female goats used for the study were sourced within Ekpoma livestock market. They were about 5 – 6 months old with an average body weight of 5.00 ± 0.58kg. The goats were acclimatized for three weeks by feeding them with the experimental diets to allow them adapted to the treatment feeds and environmental conditions prior to the commencement of the experiment. During this period they were also de-wormed with albendazol bolus and sprayed using Diazinol 60% against internal and external parasites respectively, following the manufacturers recommendation. They were also vaccinated against common bacterial and viral diseases.

At the end of the adaption period, goats were randomly selected and assigned to each of the four treatment diets based on their initial body weight. Each treatment was replicated twice with three goats per replicate in a completely randomised design. They were housed in individual pens and each pen was bedded with wood shavings that changed twice weekly. Treatment diets were given to the goats at 5% dry matter body weight twice daily at about 8:00am and 5:00pm. The treatment diets were inform of complete mixing and ensuring voluntary consumption. Goats also had free access to drinking water in their various pens. The experiment lasted for 84days excluding the three weeks for adaption period.

Blood collection for haematology and biochemical study:

At the end of the feeding trial, two sets of blood samples were taken from individual goats (all the 24 goats) using 10ML hypothermic syringe with needle before feeding in the morning via the jugular vein. The 5ML of the blood samples were introduced into well labelled sterile bottles containing ethylene diamine tetra acetic acid (EDTA) as anticoagulant for haematological parameters. The other 5ML blood samples for serum biochemical analysis were introduced into bottles that were anticoagulant free. They were centrifuged at 4000rpm for 20minutes, thereafter the blood sera were separated and preserved in clean and sterile bottles at -18^0C for subsequent biochemical analysis.

Metabolic Study:

Metabolic trial was conducted two weeks to the end of the experiment to assess nitrogen losses. Three goats were randomly assigned to each of the same diet as in feeding trial and housed separately in metabolic cage designed for separate collection of faeces and urine. After allowing an adjustment period of 7days to the metabolic cages, daily total faeces and urine excretion per goat was collected for 7days. Weighed treatment diet was fed to the goats in their respective cages daily. Faecal and urinary output with leftover feeds of each goat were collected, weighed and recorded in the morning before feeding and offering of water. The daily collection of faeces and urine were separately bulked for each goat and about 10% of sub – samples were pooled together as representative samples in plastic containers and stored in the freezer (-20^0C) until they were required for analysis. Note that nitrogen loss from urine by volatilization was prevented by introducing 10ML of 10% H_2SO_4 into the urine sample to trap the ammonia (6).

Nitrogen losses in goats were therefore estimated by removing urinary and faecal nitrogen output from nitrogen intake. Total nitrogen output was calculated by addition of total nitrogen excreted in faeces and urine from nitrogen intake (7).

Chemical Analysis

After the pooled faecal samples were dried in forced draft oven at 105^0C for 48hours for the determination of dry matter, the oven dried test feeds, experimental diets and faecal samples were analysed for proximate composition (8). Nitrogen concentration in the urine was also analysed using the same methods as reported by (8). Packed Cell Volume (PCV) and Haemoglobin (Hb) concentration were done using the method of (9). Red Blood Cell (RBC) and White Blood Cell (WBC) were determined using the Neubauer haemocytometer after appropriate dilution. Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) were calculated from PCV, Hb and RBC as described by (10). Serum total protein, glucose and albumin determination followed the procedures of (11), while serum urea and creatinine were obtained by the method of (12). Serum globulin was calculated by subtracting the albumin value from corresponding serum total protein value.

Statistical analysis

Data collected from blood profile and nitrogen losses were subjected to one way Analysis of Variance while significant differences among means were compared using Duncan's multiple range test (13).

Results and Discussion

The proximate composition of urea treated sugarcane waste, kolanut husk and experimental diets are shown in Table 1. The dry matter of the urea treated sugarcane waste and kolanut husk with experimental diets ranged from 87.43 to 97.02% with experimental diet T_1 having the highest and kolanut husk the lowest. The experimental crude protein content of T_3 (15.24%) was highest followed by T_4 (13.63%) and T_2 (13.02%) before T_1 (7.98%). However, the crude protein values of the test diets (T_2, T_3 and T_4) were higher than 8% crude protein requirement for small ruminants as noted by (14). The crude fibre content was highest in control diet (40.23%) than the test diets that ranged between 26.96% and 36.12%. The observed differences could be attributed to the higher lignin content of the poor quality guinea grass in control diet than test diets. Ash content that ranged between 6.61 and 7.96% was similar in values of the diets. Ether extract was lowest in control diet compared with the test diets, explaining the poor contribution of the guinea grass to fat content of the treatment diets. Nitrogen free extract values that ranged between T_2 (35.27%) and T_4 (41.97%) explained the level of energy supplied to the test diets compared with the control diet that consisted of poor quality forage. The forage was classified as poor quality due to the fact that, it was over matured and harvested during the dry season which increased lignin content of the grass and reduced the nutrient value. The crude protein and ash values of the urea treated sugarcane waste and kolanut husk in this study were higher than the values reported by (2) and (15) respectively. The ammoniating of the feeds could have be the reason for such disparity.

Table 1. Proximate composition (%DM) of urea-treated sugarcane waste, kolanut husk and experimental diets

			Experimental Diets			
Parameters	SW	KH	T_1	T_2	T_3	T_4
Dry matter	92.82	87.43	97.02	93.42	90.73	92.08
Crude protein	10.06	12.49	7.89	13.02	15.24	13.63
Crude fibre	31.99	13.68	40.23	36.12	26.96	31.54
Ash	8.03	6.34	6.88	7.96	6.61	7.79
Ether extract	1.18	1.63	0.89	1.04	1.26	1.15
Nitrogen free extract	41.56	53.29	40.02	35.37	41.66	41.97

SW = Sugarcane Waste, KH = Kolanut Husk

Blood profile of West African dwarf goats fed experimental diets is presented in Table 2. Haematological components have been reported by (16) to be valuable in monitoring feed toxicity especially with feed constituents that affect the blood as well as the health status of animals. Packed Cell Volume (PCV) for goats on diets T_2 (29.62%) and T_4 (30.00%) were significantly ($P > 0.05$) higher in values than those on T_1 (25.89%) and T_3 (27.99%). The better PCV values obtained in T_2 and T_4 tend to indicate that the diets were nutritionally adequate and better utilized for growing goats. However, the reduction in PCV concentration in goats on T_1 and T_3 might suggest poor contribution of blood cell which has adverse effect on blood formation. The Haemoglobin (Hb) concentration and Red Blood Cell (RBC) counts that ranged from 7.01 to 10.19 (g/dl) and 6.99 to 9.89 (x10^6/ML) respectively were numerically significant ($P > 0.05$) in test diets (T_2, T_3 and T_4) than the control diet (T_1). The marked reduction in Hb and RBC in goats on diet T_1 implies a reduction in the levels of feed nutrient and oxygen that would be carried to the lungs of the goats. The Hb and RBC have been revealed by (17) to have physiological functions of transporting oxygen to the tissue of animals for oxidation of ingested feed, so as to release energy for the other body functions as well as transporting carbondioxide out of the body of the animals. The Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) recorded values that varied from 29.96 to 32.78 (fl), 9.94 to 10.39 (Pg) and 29.97 to 30.68 (g/dl) respectively and were not significantly ($P < 0.05$) influenced by treatment diets. This is an indication of better nutritional adequacy and safety of the test ingredients. However, the values of MCV, MCH and MCHC obtained in this study were within the reference mean values documented by (1) for healthy goats. Some authors (1, 15) also noted that PCV, Hb and MCH are significant in the diagnosis of anaemia and ability of bone marrow capacity to produce red blood cells in mammals; hence they are major indices for evaluating circulatory erythrocyte. White blood cell values that ranged between 8.93 and 11.93 (x10^3/ML) were recorded for treatment diets T_1, T_2, T_3 and T_4 respectively. Goats that were placed on control diet (T_1) were significantly ($P > 0.05$) lower compared with those on test diets. This variation could be associated to the challenges from the antigens in the circulatory system of the goats. This is in conformity with the report of (1) that white blood cells fight infections and defend the body by phagocyte against invasion by foreign organism.

Total protein that is an indication of the protein retained in the animal's body was significantly higher in diets T_2 (7.02g/dl), T_3 (7.22g/dl) and T_4 (7.78g/dl) compared with diet T_1 (5.69g/dl). This implies that goats on the test diets utilized and synthesized the dietary protein from test ingredients adequately than the control group. The numerical values of albumin and globulin that varied from 2.98 to 3.92mg/dl and 2.71 to 3.86mg/dl respectively followed the same trend as total protein. Serum albumin synthesis has been reported to be released to the amount of available protein and will increase when protein intake exceeds the amount required for maintenance and growth (18). The same author also noted that the presence of higher serum globulin indicate better ability of animals to combat body infections. However, the significant ($P > 0.05$) lower albumin and globulin values recorded in diet T_1 could be a sign of poor protein utilisation which was a strong predictor of bad outcome that would have resulted from poor quality forage, hence it reflected in the health status of the goats. Blood glucose had been noted by (4) to monitor the nutrient status and performances of animals. The serum glucose values obtained in this study were significantly ($P > 0.05$) lower in goats on control diet T_1 (50.82mg/dl) than the test diets T_2 (69.97mg/dl), T_3 (62.89mg/dl) and T_4 (70.17mg/dl). This variation could be attributed to the increase in the forage poor quality that was affected by either the age of the plant or the nutritional quality of the forage. Creatinine that is associated with muscle wastage did not follow a trend that could be traced to the control diet. Goats on T_3 (2.01mg/dl) had values that were significantly ($P > 0.05$) higher than those on T_1 (1.05mg/dl), T_2 (1.03mg/dl) and T_4 (1.01mg/dl). Excess Creatinine in the blood is from muscle when wastage occurs and Creatinine phosphate is catabolised, which indicates that the goats were surviving at the expense of body reserves that might result to a loss of weight. Serum urea concentration is closely associated with the breakdown and deamination of protein in the rumen and the rate of ammonia utilization for bacteria protein synthesis. According to (4) an increase in the serum urea level may reflect an accelerated catabolism rather than a decrease in urinary excretion. The significant ($P > 0.05$) higher concentration of serum urea nitrogen in the test diets T_2 (10.01mg/dl), T_3 (11.23mg/dl) and T_4 (10.13mg/dl) except the control diet T_1 (7.99mg/dl) was in line with the findings of (18) who reported that supplementation of a basal diet of buffaloes with non-protein nitrogen compounds resulted in higher serum urea concentration. The values of serum urea recorded in this study fell within the normal range of 4.00 to 20.00mg/dl reported by (1). This implies that the application of non-protein nitrogen in the test diets led to positive effect on blood urea concentration.

Table 2. Blood profile of West African dwarf goats fed experimental diets

Parameters	Treatment Diets				SEM±
	T_1	T_2	T_3	T_4	
Packed cell volume (%)	25.89^b	29.62^a	27.99^b	30.00^a	0.14
Haemoglobin (gdl)	7.01^b	9.73^a	9.07^a	10.19^a	0.06
Red blood cell (x 10^6/ML)	6.99^b	9.24^a	8.94^a	9.891^a	0.09
MCV (fl)	29.96	31.07	30.03	32.78	0.21
MCH (Pg)	9.94	10.19	10.08	10.39	0.16
MCHC (g/dl)	29.97	30.25	30.06	30.68	0.34
White blood cell (x 103/ML)	8.93^b	11.01^a	10.98^a	11.93^a	0.08
Serum Biochemical Traits					
Total protein (g/dl)	5.69^b	7.02^a	7.22^a	7.78^a	0.03
Albumin (g/dl)	2.98^b	3.62^a	3.71^a	3.92^a	0.02
Globulin (g/dl)	2.71^b	3.40^a	3.51^a	3.86^a	0.01
Glucose (mg/dl)	56.82^c	69.97^a	62.89^b	70.17^a	0.38
Creatinine (mg/dl)	1.05^b	1.03^b	2.01^a	1.01^b	0.03
Urea (mg/dl)	7.99^b	10.01^a	11.23^a	10.13^a	0.17

MCV = Mean Corpuscular Volume, MCH = Mean Corpuscular Haemoglobin, MCHC = Mean Corpuscular Haemoglobin Concentration

^{a,b,c} Means on the same row with different superscripts differ significantly ($P < 0.05$), SEM±= Standard Error of Mean.

Table 3 shows the effect of urea-treated sugarcane waste and kolanut husk supplementation on nitrogen losses in goats fed poor quality forage. Nitrogen loss is explained by (19) as the proportion of nitrogen that is not utilised by farm animals from the total nitrogen intake for body process. Nitrogen intakes in goats were significantly ($P > 0.05$) highest in T_3 (18.78g/day) followed by T_4 (16.93g/day) and T_2 (14.89g/day) before T_1 (9.02 g/day). This difference could be a reflection of ammoniated different test ingredients in the diets and the low protein content of the poor quality forage. Faecal nitrogen (N) output that varied between 2.89 and 3.61g/day was significantly ($P > 0.05$) higher in T_1 compared with the test diets T_2, T_3 and T_4. This could be as a result of high fibre content of the aged guinea grass that was undigested. It was reported by (20) that fibre nature of poor quality forage impaired nitrogen digestibility, making the animal to pass out undigested nitrogen as faeces, hence the higher faecal nitrogen output in goats on T_1 had close relationship with the diet. Faecal N output as percentage of total N intake and output that ranged from 0.38 to 0.56g/day and 0.11 to 0.16 g/day respectively were similar in numerical values with no significant ($P < 0.05$) difference among the treatment diets.

Urinary nitrogen (N) output values of 0.85, 0.92, 1.01 and 0.86 g/day were recorded on T_1, T_2 T_3 and T_4 respectively. Excess urinary N output recorded in goats on T_3 could be as a result of excretion of incompletely oxidized nitrogenous products, both from the blood and body cells. It was noted by (20) that excess or incompletely oxidized dietary nitrogen is converted to urea, which is a soluble compound that will diffuse into various body fluids such as blood, milk and urine. Urinary N output as percentage of total N intake and output that were varied from 0.08 to 0.09 g/day and 0.03 to 0.04 g/day respectively were not significantly ($P < 0.05$) difference among treatment diets. Total nitrogen (N) excreted were numerically similar in goats on T_1 (4.46g/day) and T_3 (4.00g/day) but higher in significant (P > 0.05) values than those on T_2 (3.86g/day) and T_4 (3.75g/day). This elevation in the level of nitrogen losses in T_1 and T_3 might perhaps be ascribed to the influence of fibre content and urea treatment which could probably interfered with the bioactive compounds in the diets (19). Hence, presence of low total N losses in goats on T_2 and T_4 in this study shows that they might be higher in positive nitrogen balance than those on T_1 and T_3

Table 3. Effects of urea – treated sugarcane waste and kolanut husk supplementation on nitrogen losses in goats fed poor quality forage.

	Treatment Diets				
Parameters	T_1	T_2	T_3	T_4	SEM±
Nitrogen intake (g/day)	9.02^c	14.89^b	18.78^a	16.93^b	0.63
Faecal nitrogen (N) output (g/day)	3.61^a	2.94^b	2.99^b	2.89^b	0.22
As % of N intake (g/day)	0.33	0. 44	0.56	0.49	0.05
As % of total N output (g/day)	0.16	0.11	0.12	0.11	0.02
Urinary nitrogen (N) output (g/day)	0.85^b	0.92^b	1.01^a	0.86^b	0.01
As % of N intake (g/day)	0.08	0.14	0.19	0.15	0.03
As % of total N output (g/day)	0.04	0.04	0.04	0.03	0.01
Total N excreted (g/day)	4.46^a	3.86^b	4.00^a	3.75^b	0.24

^{a,b,c} Means on the same row with different superscripts differ significantly (P < 0.05), SEM±= Standard Error of Mean.

Conclusions and Applications

It could be concluded that:

1. Urea treated sugarcane waste and kolanut husk supplemented to poor quality forage proved better efficiency in terms of blood profile and nitrogen losses reduction in goats than those fed solely poor quality forage.
2. The combination of 50% poor quality guinea grass with urea – treated 25% sugarcane waste and 25% kolanut husk (T_4) had positive pronounced effect on blood constituents and nitrogen losses reduction in goats.

References

1. Okoruwa, M. I. (2017). Effects of locust bean pulp with melon husk supplementation on nitrogen utilization and blood chemistry of West African dwarf goats. *Nigerian Journal of Animal Science*, 19(2): 199 – 208.
2. Ashiru, R. M., Umar, Y. D. and Zango, M. H. (2018). Nutrient intake by yankasa rams fed sugarcane waste silage. *Proceedings* of 43rd Annual Conference of the Nigerian Society for Animal Production, held March 18th – 22nd at Federal University of Technology Owerri. Pg. 724 – 727.
3. Fabunmi, T. B. and Arotupin, D. J. (2015). Proximate, mineral and anti-nutritional composition of fermented slimy kolanut (*Cola verticillata*) husk and white shell. *British Journal of Applied Science and Technology,* 6(5): 550 – 556.
4. Akinbode, R. M., Isah, O. A., Oni, A. O., Adebayo, K. O., Aderinboye, R. Y., Adelusi, O. O. and Ojo, V. O. A. (2018). Nutrient digestibility and blood parameters of West African dwarf sheep fed sugarcane top silage. *Nigerian Journal of Animal Production*, 45(2): 304 – 315.

5. Fang, J. M., Matsuzaki, H., Suzuki, Y. Cai, K. and Horiguchi, T. (2012). Effects of lactic acid bacteria and urea treatment on fermentation quality, digestibility and ruminal fermentation of roll bale rice straw silage in wethers. *Grassland Science*, 58: 73 – 78.
6. Chen, X. B. and Cromex, M. J. (1992). Estimation of microbial protein supply to sheep and cattle based on urinary excretion of purine derivation: an overview of the technical details. *International Feed Research*, Unit Ronett Research Institute Occassional Public. Aberdeen. Pp. 2 – 20.
7. Agie, M., Hristov, A. N., Zaman, S., Schneider, C., Ndegwa, P. M. and Vaddellat, V. K. (2010). Effect of dietary concentrate on rumen fermentation, digestibility and nitrogen losses in dairy cows. *Journal of Dairy Sciences*, 93: 4211 – 4222.
8. AOAC, (1990). Association of Official Analytical Chemist. *Official method of Analysis*. Washington D.C. U.S.A Pp 141.
9. Dacie, J. V. and Lewis, S. M. (2001). Practical haematology, 9th ed. Churchill Livingstone. London. Pp. 633.
10. Jain, N. C. (1993). Essentials of veterinary haematology. Lea and Ferbeiger, Pennsylvania, USA. Pp 7.
11. Wermer,W. H., Rey, H. G and Weielinger, H. (1970). Method of plasma glucose determination. *Journal of Analytical Chemistry*, 252: 224 – 228
12. Valley, H., Gowelock, A. H and Bell, B. A. (1991). Methods for dietary fibre and non-starch polysaccharides in relations to animal nutrition. *Journal of Dairy Science*. 74: 3583 – 3597.
13. SAS, (2000). Statistical Analysis System Institute Inc. User's Guide. Statistical version 6th ed. Cary North Carolina, USA.
14. Norton, B. W. (2003). Tree legumes and dietary supplements. In: forage tree legumes in tropical agriculture. Gutteridge. R. C and H. H. Shelton (Ed) CAB International Walling-ford, Oxon. Pp. 192 – 201.
15. Babatunde, B. B. and Hamzat, R. A. (2005). Effects of feeding graded levels of kolanut husk meal on the performance of cockerels. *Nigerian Journal of Animal Production.* 32(1): 61 – 66.
16 Bolarin, O., Oni, A. O., Olanite, J. A. and Onwuka, C. F. I. (2017). Performance, blood indices and carcass yield of grower rabbits fed diet containing *Moringa oleifera, Aspilia Africana* and *Azadirachta indica* leaf meals. *Nigerian Journal of Animal Production*, 44(4): 139 – 149.
17. Ogunbade, A. A., Oladapo, O. S. Adeniyi, O. A. and Oyetola, A. M. (2017). Blood profile of growing rabbits fed roasted solvent extracted castor seed meal. *Nigerian Journal of Animal Production*, 44(4): 160 – 166.
18. Oloche, J., Anum, J. T. And Adanebi, J. (2018). Effects of high levels of water soaked sweet orange peel meal on the performance response and blood profile of West African dwarf goats. *Nigerian Journal of Animal Production*, 45(2): 289 – 303.
19. Okoruwa, M. I., Edobor, A. E. Ogeide, F. O. and Ikhimioya, I. (2018). Predicting nutrient retention for body weight gain in ewe-lambs fed diets containing gliricidia (*Gliricidia sepium*) and neem (*Azadirachta indica*) leaves supplement. *Nigerian Journal of Animal Science*, 20(1): 106 – 114
20. Agie, M., Hristov, A. N., Zaman, S., Scneider, C., Ndegwa, P. M. and Vaddellat, V. K. (2010). Effect of dietary concentrate on rumen fermentation, digestibility and nitrogen losses in dairy cows. *Jounral of Dairy Science*, 93: 4211 – 4222.