Nigerian J. Anim. Sci. 2020 Vol 22 (3): 315-324 (ISSN:1119-4308)

Lameness and its associated hematological features among Nigerian breeds of goats in Ibadan, Nigeria

Olaogun S.C.[1]*, and Oyetoyinbo T.E.[1],

[1]*Department of Veterinary Medicine, Faculty of Veterinary Medicine, University of Ibadan, Oyo state, Nigeria.*

Corresponding Author: *charle.sunday@yahoo.com* ***Phone number:*** *+2347056556098*

Target audience: *Animal scientist, Animal technologist, Veterinarian and Livestock farmers.*

Abstract

Clinical lameness manifesting in various form is one of the commonest condition often encountered in Nigeria with its adverse socio-economic consequences. A total of 96 lame goats were sampled at the livestock markets, Ibadan, Nigeria. Blood samples were aseptically collected into well labeled heparinized bottles from lame goats with signalment such as breed, age, sex and level of severity classified and recorded appropriately. Blood samples were analyzed by adopting standard hematological procedure (manual counts). Lameness was highest in Red Sokoto goats 79.2% and lowest 8.3% in Crossed bred goats. Majority 66.6% were males and 33.3% were females. Lameness was more in young than adult goats, 2-2½year 41.66% and >4year 20.83%. Significant difference (P≤0.05) observed in the values of lymphocytes between breeds with higher values in crossed breed compared to others. There were significant differences (P<0.05) in the values of RBC and platelet counts between age groups, with lower values of (7.13±0.39 and 3.82±0.2) respectively in adult goats. We therefore conclude that lame cross bred goats appeared more resilient with improved hematological features, significant reduction in RBC and platelet counts should be taken into consideration during management of lameness in adult goats in particular.

Key words*: Breed; Goats; Haematology; Lameness; Nigeria*

Description of Problem

In Nigeria, sheep and goats play a significant socio-economic role in the lives of the people: they are slaughtered during ceremonies and festivals, and serve as a source of ready cash to small farmers. Goats are multipurpose animals. It produces milk, meat, skin and fiber (1). In most advanced countries of the world, there have been growing concerns about animal welfare, particularly ones that induce pain and suffering on animals (2). One of these commonest condition associated with pain is lameness in animals. Lameness often encountered frequently in Nigeria with its adverse socio-economic and welfare consequences; the general welfare and wellbeing of animals is directly depends on the health status of the animal's hoof.

Lameness is a condition associated with animals' feet, painful and it affects the normal walking gait (3). Lameness represents one of the major health problems for ruminants worldwide and had raised significant question about economic aspect and welfare issues in agriculture (4). Though causes of lameness can be multifactorial, but can generally be classified as infectious and non-infectious. Roles of factors such as environment, genetics, nutrition, management and ages on occurrence of lameness in animals have been reported by many authors. (5) reported high prevalence of lameness in rapidly growing animals and in animals with high yielding potential. High incidence of lameness has been linked to wet season vis a vis high level of moisture in the environment in which animals live (6).

Rapidity of transmission within the flock has also been linked to environmental moisture content, muddiness of the soil or bedding, stocking density, management factors, as well as the frequency of foot bathing, and virulence of the infectious bacteria present (7).

Despite serious economic losses associated with lameness in various aspects such as reduction in meat and milk production, poor performance (feed to meat conversion ratio) fertility problems, increasing culling rates, loss of weight and growth retardation, premature culling, increased in cost of Veterinary care and treatment. There have been less reported cases of lameness in goats compared to cattle and sheep generally in the whole world and in Nigeria (8). There has been greater availability of data on hematology of goats as a result of its economic potential (10; 11). Also, influences of breed, age, sex and season on the haematological profile of goats have been previously described (12; 13; 14). In addition, importance of hematological indices in evaluating small ruminants' health, disease diagnoses and treatment efficacy monitoring has been previously described (9).

(6) investigated effects of lameness on reproductive performance in small ruminants in Nsukka Area of Enugu state, Nigeria. But there have not been any studies on lameness in Nigerian goats and its associated hematological profile in relation to breed, sex, age and severity to the best of our knowledge. Considering economic importance of lameness and its associated animal welfare issue in goats, we therefore aimed to highlight lameness and values of hematological parameters in relation to breed, age, sex and level of severity in goats in Ibadan, Nigeria. This investigation therefore, provides baseline hematological parameters for lameness among Nigerian breeds of goats. These findings will be essential in designing appropriate measures for proper prevention and management of lameness in goats and other ruminants in general. Data from this study will also serve as reference hematological data for lameness among Nigeria goats.

Materials and methods

Study location

This investigation took place at the Small ruminant section of Akinyele Livestock market areas, Ibadan Oyo State, Nigeria. The livestock market is located along Oyo-Ibadan express way and within longitude 30 45 (E), and 40 0 (E) and latitude 30 15 (N) and 70 30 (N) of the equator (15).

Table 1: Breed distribution of lameness amongst some breeds of goats in Ibadan, Nigeria.

Breed	Number	Percentage%
Red Sokoto	76.00	79.20
West African dwarf	12.00	12.50
Crossed breed	8.00	8.30
Total	96	100

Table 2: Sex distribution of lameness amongst indigenous goats in Ibadan, Nigeria

Sex	Number	Percentage%
Male	64	66.70
Female	32	33.30
Total	96	100

Table 3: Distribution of lameness among indigenous goats under different age groups in Ibadan, Nigeria

Age (in years)	Number	Percentage%
2-2½	40	41.66
3-3½	36	37.50
Adult	20	20.83
Total	96	100

Animals sampled

The breeds of goats that were studied and sampled included: Red Sokoto, West African Dwarf, and Crossed-bred Goats. Each of these breeds was morphologically examined, identified and classified according to body coat coloration, body conformation, height and other distinguishable characteristics. Sex was established based on their reproductive organs. Degree of severity classified based on extent of lesion and gait of the animal (16). Rostral dentition was used to establish ages based on the procedure described by (17).

Sampling procedure

Samplings were carried out from January to June, 2018. Goats manifesting clinical signs of lameness were classified as lame goats based on appearance of foot lesions and impaired locomotion observations visually recognized. Each of the lame goats were appropriately identified, classified and recorded based on breed, sex, age and level of severity of lameness and blood samples were aseptically collected via the jugular into well labeled heparinized bottles simultaneously. The samples were immediately stored inside thermo flask containing ice pack and quickly transported to the Hematology Unit, Department of Veterinary Physiology and Biochemistry laboratory, University of Ibadan for immediate analysis of the samples.

Hematological analysis

The haematological indices were analyzed using standard methods, Haemoglobin (Hb) concentration was determined using the cynomethaemoglobin method, total erythrocyte and leucocytes(RBC and WBC) counts were done using an improved Neumbuer haemocytometre. The packed cell volume (PCV) was determined using the microhaematocrit centrifuge technique; Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin Concentration (MCHC) and Mean Corpuscular Haemoglobin (MCH) were calculated from PCV, Hb and RBC values. These were carried out according to the procedure described by (18)

Statistical analysis

Field and Laboratory data were entered to the database management spreadsheet Microsoft Excel and analyzed using SPSS software. The significant differences of Mean ±SD of haematological parameters for sex and level of severity were tested and established using independent t-test while the significant difference of haematological analytes among breeds and age groups were analyzed using Analysis of variance (ANOVA). Differences were considered significant at a level of $P<0.05$.

Results and Discussion

Table 1 provides information on breed distribution of lameness among goats in Ibadan, Nigeria. This revealed as follows; lameness was highest 76 (79.2%) in Red Sokoto breed, followed by 12 (12.5%) in West African Dwarf breed, and lowest 8 (8.3%) in Crossed bred goats in Nigeria. Lameness was more frequently encountered among Red

Sokoto breed of goats than in West African dwarf and crossed bred goats as seen in this present study. This may be as a result of larger population of Red Sokoto goats than other breeds of goats in the study location due to relatively high price and demand for Red Sokoto than other breeds by consumer. It may also be due to strong genetic trait of West African dwarf and crossed bred goats. This is in agreement with the earlier report of (19) who reported higher incidence of lameness in Balami breed than in other breeds of sheep in Maiduguri, Northeast Nigeria.

Table 2 indicates the sex distribution of lameness among goats in Ibadan, Nigeria. Findings showed that highest occurrence of lameness was observed in Male goats (Buck) with 64 (66.6%), while Female (Doe) had lowest occurrence of lameness with 32 (33.3%). Relatively higher occurrence of lameness in male (buck) than female (doe), as reflect in this study, may be due to hormonal changes associated with heat period results in restlessness that may cause lameness as a result of dislocation, fracture or any traumatic injury to the limb. This is not in conformity with the earlier report by (19) who reported that the condition was common in female sheep (ewe) than male sheep (ram) in Maduguri, Northeast Nigeria. This might be due to the difference in the temperament of sheep and goats; it may also be due to difference in the study location, as more male goats are generally being brought to the market to sell than females. This conforms to the report of (20), who reported more lameness in bull than cow in Nasarawa state, Nigeria. This also is in agreement with (21) who reported higher occurrence of lameness in male goats than in female goats in Dedo and Serbo districts livestock markets in Jimma zone, Oromia regional state, south western Ethiopia.

Table 3 enumerates distribution of lameness among indigenous goats under different age groups in Ibadan, Nigeria. This result reflected as follows; 2-2½ year were 40 (41.66%), 3-3½ year were 36 (37.5%), and 20 (20.83%) were adult or above 4 year old. The highest cases of lameness in young animals compared to older animals as seen in this present study may be associated with fragile nature of bones of young animals compared to older animals and may also be due to movement inexperience in a particular area. This is similar with the observation of (22) who reported increased prevalence of lameness in young sheep compared to adult in northeast Nigeria. The high incidence of lameness in young animals may also be due to the fact that adult animals might have been previously exposed to most infectious conditions that can results in lameness and would have developed some level of resistance. This also agrees with the findings of (23) who reported higher prevalence of lameness in young camel than in adult camel in the Abu Dhabi Emirate.

Table 4 reveals hematological parameters of different breeds of lame goats in Ibadan, Nigeria. Findings showed as follows; Crossed breed of goat had better hematological analytes as follows; PCV of 48.5±0.71; RBC 9.87±0.16; WBC 8.5±0.71; PLT8.5±0.71; HB 16.45±0.78; MCH 16.62±0.58; MCHC 33.91±1.11 and Lymphocyte3401±849.94 and Red Sokoto breed had their values as follows; PCV of 39.95±6.38; RBC 8.45±1.17; WBC 7.42±1.16;HB 13.37±1.89;MCV 47.19±2.29; MCH 15.83±0.67;and Lymphocyte 2584.89±446.61.There was a statistical significant variation ($P<0.05$) in the values of lymphocytes among all breeds of lame goats with highest lymphocytes count of (3401±849.94) in crossed bred lame goats.

Table 4: Hematological parameters of different breeds of lame goats in Ibadan, Nigeria

Hematological parameters (Mean ± S.D)	Crossed breed goats	Red Sokoto goats	West African Dwarf goats
Packed cell volume (%)	48.5±0.71	39.95±6.38	43.67±2.08
Red blood cell(10^6/µL)	9.87±0.16	8.45±1.17	8.85±0.32
White blood cell (10^3/µL)	8.5±0.71	7.42±1.16	7.67±0.58
Platelets (10^3/µL)	6.5±0.71	4.93±1.23	4.33±1.53
Haemoglobin (g/dl)	16.45±0.78	13.37±1.89	14.3±0.7
Mean corpuscular volume (fl)	49.14±0.06	47.19±2.29	49.17±1.06
Mean corpuscular haemoglobin (pg)	16.62±0.58	15.83±0.67	16.16±0.22
Mean corpuscular haemoglobin concentration (g/dl)	33.91±1.11	33.57±1.35	32.75±1.04
Neutrophils, (10^3/µL)	4909±298.4	4810.37±981.54	4427.33±684.91
Lymphocytes, (10^3/µL)	3401±849.94*	2584.89±446.61	3177.33±740.89
Monocytes, (10^3/µL)	0±0	21±43.47	78.67±82.2
Eosinophils, (10^3/µL)	40±56.57	7.42±22.24	0±0
Basophil(10^3/µL)	0±0	0±0	0±0

ANOVA-Test * shows values with significant different of (P=<0.05)

Table 5: Hematological parameters of male and female lame goats in Ibadan, Nigeria.

Hematological parameters (Mean ± S.D)	Male	Female
Packed cell volume (%)	42.88±5.83	37.63±5.85
Red blood cell (10^6/µL)	8.92±1.04	8.01±1.07
White blood cell (10^3/µL	7.87±0.93	6.89±1.16
Platelets (10^3/µL)	5.31±1.37	4.34±0.85
Haemoglobin (g/dl)	14.25±1.91	12.74±1.57
Mean corpuscular volume (fl)	47.95±2.24	46.9±2.11
Mean corpuscular haemoglobin (pg)	15.93±0.65	15.93±0.71
Mean corpuscular haemoglobin concentration (g/dl)	33.24±1.05	34.01±1.63
Neutrophils, (10^3/µL)	4861.06±872.38	4590±998.79
Lymphocytes, (10^3/µL)	2952.13±529.89	2276.63±308.42
Monocytes, (10^3/µL)	34.19±56.69	11±30.71*
Eosinophils, (10^3/µL)	9.56±26.16	8.5±24.04
Basophil(10^3/µL)	0±.000a	0±.000a

Student T-Test * shows values with significant different of (P=<0.05)

The crossed bred goats appeared to have the best hematological parameters when compared to WAD and RSG breed of goats. Though there was no significant difference in the value of PCV of all the breeds, but the crossed bred goats had significantly high PCV counts. The relatively high PCV values observed in our study is similar to the findings of (24) who reported a similar increased in PCV values in apparently healthy Nigerian goats. It is also in

agreement with (25) who reported a similar increased in PCV values in local breed drought horses affected with acute laminitis in Basrah-Iraq. The relatively high PCV value observed in all breeds of lame goats could be due to relatively high environmental temperature associated with months of January to June in Nigeria when the study was conducted. This is also in agreement with the findings of (14) who reported a similar high PCV values among tropical goats during the hot dry season compared to cold dry season and rain season.

The white blood cells values as observed in this study were within the normal range, but the crossed bred goats' showed apparently increased value for lymphocyte, compared to other breeds. This agrees with (26), who reported that goats unlike other ruminant animals have higher lymphocyte than neutrophils in circulation. Lymphocytosis has observed in this study, revealed better response to ongoing inflammatory process. The increased in the value of complete WBC observed in crossed breed of goats compared to other breeds sampled is in agreement with the report of (18), who reported leukocytosis and neutrophilia in goats compared to other animals. All these increases are likely due to body defense mechanism in reaction to an inflammatory response induced by lameness. The increased in WBC count observed in our study is also in agreement with the findings of (27), who reported a similar increased in WBC due to stimulation of immune system and stem cells in the bone marrow resulting from endotoxemia. Though, the causes of lameness were not taken into consideration in the course of this study as either infectious, non-infectious, physical, metabolical or whichever.

Table 5 shows hematological parameters of male and female lame goats in Ibadan, Nigeria. The findings revealed hematological indices as follows; Packed cell volume 42.88±5.83; Red blood cell 8.92±1.04; White blood cells 7.87±0.93; Platelets 5.31±1.37; Haemoglobin 14.25±1.91; Mean corpuscular volume 47.95±2.24; Neutrophils 4861.06 ± 872.38; Lymphocytes 2952.13±529.89 Monocytes 34.19±56.69; and Eosinophils 9.56±26.16, when compared to female goats having most of their parameters been lower as follows; Packed cell volume, 37.63±5.85; Red blood cell 8.01±1.07; White blood cells 6.89±1.16; Platelets 4.34±0.85; Haemoglobin 12.74±1.57; Mean corpuscular volume 46.9±2.11; Neutrophils 4590±998.79; Lymphocytes 2276.63±308.42; Monocytes 8.5±24.04 and Eosinophils 8.5±24.04. There was a statistical significant variation ($P<0.05$) in the values of monocytes among male and female lame goats with significant lower value of monocytes count of (11±30.71) in female lame goats.

The improved hematological values seen in male goats when compared to female goats as observed in this study may be associated with high ruggedness of male goats compared to female goats naturally. This observation is not in agreement with the findings of (28) who reported that the hematological values are better in females compared to males in their work on hematology and biochemistry of apparently healthy West African dwarf goats in Owerri Southeast, Nigeria. The improved hematological parameters observed in males compared to females may also be related to hormonal influences in both male and female goats. It may also be as a result of physiological status of female animals such as pregnancy, lactation, estrus cycle which might reduce the values of some hematological parameters.

The relatively high lymphocyte and Neutrophils counts observed in male animals' when compared to the female animals is similar to the earlier observation of (26). They also reported lymphocytosis and neutrophilia in male goats compared to female goats in their report on hematological and biochemical parameters of apparently healthy Red Sokoto

goats in Northern Nigeria.

The significant decreased in monocytes count in female goats compared to male goats observed in this present study also agrees with the findings of (29) who reported higher monocyte and eosinophil counts in male goats compared to female goats as well. Lack of significant variation in the basophil values observed in both sexes in this present study also concurs with the reports of (28).

Table 6: Hematological parameters of lame goats of different ages in Ibadan, Nigeria

Hematological parameters (Mean ± S.D)	2 - 2½ years	3 - 3½ years	above 4years
Packed cell volume (%)	42.4±6.06	43.78±5.04	33.8±1.92
Red blood cell (10^6/µL)	8.83±0.96	9.22±0.79	7.13±0.39*
White blood cell (10^3/µL	7.82±0.74	8.03±1.02	6.12±0.56
Platelets (10^3/µL)	5.14±1.46	5.47±1.1	3.82±0.2*
Haemoglobin (g/dl)	13.99±1.84	14.68±1.62	11.58±0.49
Mean corpuscular volume (fl)	47.88±2.69	47.39±1.92	47.41±2
Mean corpuscular haemoglobin (pg)	15.81±0.57	15.89±0.74	16.25±0.67
Mean corpuscular haemoglobin concentration (g/dl)	33.03±1.14	33.57±1.25	34.3±1.45
Neutrophils, (10^3/µL)	5005.2±580.31	5031.89±998.26	3831.6±744.02
Lymphocytes, (10^3/µL)	2795±404.81	2904.22±656.08	2271.8±506.92
Monocytes, (10^3/µL)	47.6±66	17.56±35.06	0.2±0.45
Eosinophils, (10^3/µL)	7.3±23.08	8.89±26.67	13.6±30.41
Basophil(10^3/µL)	0±0	0±0	0±0

ANOVA-Test * shows values with significant different of (P=<0.05)

Table 7: Hematological parameters of lame goats in mild and severe infection

Hematological parameters (Mean ± S.D)	Mild	Severe
Packed cell volume (%)	42.37±6.25	36.4±3.65
Red blood cell (10^6/µL)	8.88±1.07	7.64±0.74*
White blood cell (10^3/µL	7.68±1.12	7.01±0.92
Platelets (10^3/µL)	5.26±1.31	3.94±0.26
Haemoglobin (g/dl)	14.16±1.89	12.18±1.07*
Mean corpuscular volume (fl)	47.58±2.34	47.66±1.83
Mean corpuscular haemoglobin (pg)	15.93±0.68	15.96±0.59
Mean corpuscular haemoglobin concentration (g/dl)	33.5±1.39	33.5±0.91
Neutrophils, (10^3/µL)	4837.42±1003.89	4517.2±247.3
Lymphocytes, (10^3/µL)	2782.11±533.59	2517.4±690.81
Monocytes, (10^3/µL)	29.58±54.09	14.6±32.09
Eosinophils, (10^3/µL)	11.63±27.67	0±0
Basophil(10^3/µL)	0±.000a	0±.000a

Student T-Test * shows value with significant different of (P=<0.05)

Table 6 reveals hematological parameters of lame goats under different age groups in Ibadan, Nigeria. The details is as follows; the analytes of goats under 3-3½year old category indicated that packed cell volume, 43.78±5.04;Red blood cell,9.22±0.79; White blood cells, 8.03±1.02; Platelets,5.47±1.1; Haemoglobin,14.68±1.62; Neutrophils, 5031.89±998.26; Lymphocytes, 2904.22±656.08; whereas goats that were adult or above 4year old category seems to possessed the least for most of the hematological indices as follows; Packed cell volume 33.8±1.92;Red blood cell 7.13±0.39; White blood cells 6.12±0.56; Platelets 3.82±0.2; Haemoglobin 11.58±0.49; Neutrophils 3831.6±744.02; Lymphocytes 2271.8±506.92. There were statistical significant variations ($P<0.05$) in the values of RBC and platelet counts between the age groups of lame goats, with significantly lower values of RBC and Platelet counts of (7.13±0.39 and 3.82±0.2) respectively in adult age category of lame goats.

The significant reduction in the values of red blood cells and platelets in adult lame goats compared to young goats as observed in this present study may be as a result of efficient hematopoietic system of young animals compared to adult animals in general. This correlates with the findings of (30), who also reported that, there is decrease in RBC value with increase in age of animals. This might also be associated with dysfunction of the bone marrow or bone marrow inefficiency commonly seen in older animal as a result of old age. The results obtained from this study also showed that leukocyte count was gradually decreasing as the animals' grow older. This finding also corroborates the reports of (31) who reported a similar reduction in leukocyte count with increase in age.

Table 7 shows hematological parameters of lame goats in mild and severe infection**.** The values for most of the analytes in mild condition were as follows; packed cell volume 42.37±6.25Red blood cell 8.88±1.07; White blood cell 7.68±1.12 ; Platelets 5.26±1.31; Haemoglobin 14.16±1.89; Neutrophils 4837.42±1003.89; Lymphocytes 2782.11±533.59; Monocytes 29.58±54.09; whereas, the parameters were as follows in severely infected lame goats ; Packed cell volume 36.4±3.65; Red blood cell 7.64±0.74; White blood cell 7.01±0.92; Platelets 3.94±0.26; Hemoglobin 12.18±1.07; Neutrophils 4517.2±247.389; Lymphocytes 2517.4±690.81; Monocytes 14.6±32.09. There were statistical significant variations ($P<0.05$) in the values of RBC and Hb counts between mild and severe lame goats, with significantly lower values for RBC and Hb counts of (7.64±0.74and 12.18±1.07) respectively observed in severely affected lame goats. The hematological parameters in mildly affected lame goats appeared better when compared with the hematological parameters of severely affected lame goats. This seems logical as it was expected for the hematological parameters to correlate with the severity of infection which indicate the milder the severity, the better the hematological parameters.

Conclusion and Applications

1. The study concluded that occurrence of lameness is highest in Red Sokoto breed, male goats and in young goats
2. Hematological parameters appeared to be better in crossed breed goats, male goats and young goats compared to other breeds, female goats and adult goats respectively.
3. This study can be applied in formulating appropriate prevention and management strategy for lameness in general. Especially in the management of lameness in adult goats.

Conflicts of Interest

The authors declare no conflicts of interest.

References

1. Abdelatif, A.M., Ibrahim, M.Y and Hassan, Y.Y (2009). Seasonal variation in erythrocytic and leukocytic indices and serum proteins of female Nubian goats. *Middle-East Journal of Sciencitific Research*, 4(3): 168-174.
2. Godyń, D., Herbut, E and Walczak, J (2013). Infrared thermography as a method for evaluating the welfare of animals subjected to invasive procedures–a Review/Termografia jako metoda oceny dobrostanu zwierząt poddanych inwazyjnym zabiegom–artykuł przeglądowy. *Annals of Animal Science*, 13(3): 423-434
3. Radostits, O.M., Gay, C., Hinchcliff, K.W and Constable, P.D (2007). A textbook of the diseases of cattle, sheep, goats, pigs and horses. *Veterinary Medicine 10th edition Bailliere*, Tindall, London, UK, 1576-1580.
4. Hernandez, J., Shearer, J.K and Webb, D.W (2001). Effect of lameness on the calving-to-conception interval in dairy cows. *Journal of the American Veterinary Medical Association*, 218(10): 1611-1614.
5. Green, L.E., Hedges, V.J., Schukken, Y.H., Blowey, R.W and Packington, A.J (2002). The impact of clinical lameness on the milk yield of dairy cows. *Journal of dairy science*, 85(9):2250-2256.
6. Eze, C.A. (2002). Lameness and reproductive performance in small ruminants in Nsukka Area of Enugu State, Nigeria. *Small Ruminant Research*, 44(3): 263-267.
7. Wassink, G. J., Grogono-Thomas, R., Moore.L. J and Green, L. E (2003) Risk factors associated with the prevalence of foot rot in sheep from 1999 to 2000. *Veterinary Record*, 152, 351-358.
8. Smith, M.C and Sherman, D.M (1994). Caprine arthritis encephalitis. Goat Medicine. *Lea and Febiger*, Philadelphia, 73-79.
9. Fazio, F., Giangrosso, G., Marafioti, S., Zanghì, E., Arfuso, F and Piccione, G (2016). Blood haemogram in Ovis aries and Capra hyrcus: effect of storage time. *Canadian Journal of Animal Science*, 96(1):32-36.
10. Tibbo, M., Jibril, Y., Woldemeskel, M., Dawo, F., Aragaw, K and Rege, J.E.O (2004). Factors affecting hematological profiles in three Ethiopian indigenous goat breeds.
11. Piccione, G., Monteverde, V., Rizzo, M., Vazzana, I., Assenza, A., Zumbo, A and Niutta, P.P (2014). Reference intervals of some electrophoretic and haematological parameters in Italian goats: comparison between Girgentana and Aspromontana breeds. *Journal of Applied Animal Research*, 42(4): 434-439.
12. Egbe-Nwiyi, T.N., Nwaosu, S.C and Salami, H.A (2000).Haematological values of appararently healthy sheep and goats as influenced by age and sex in arid zone of Nigeria. *African Journal of Biomedical Research*, 3(2): 109-115.
13. Zumbo, A., Sciano, S., Messina, V., Casella, S., di Rosa, A.R and Piccione, G (2011). Haematological profile of messinese goat kids and their dams during the first month post-partum. , 29(3). *Animal Science Papers and Reports*
14. Habibu, B., Kawu, M.U., Aluwong, T and Makun, H.J (2017). Influence of seasonal changes on physiological variables, haematology and serum thyroid hormones profile in male Red Sokoto and Sahel goats. , 45(1): 508-516.
15. Filani, M.O., Akintola, F and Ikporukpo, C.O (1994). Ibadan region. R. Charles *Journal of Applied Animal Research* Publication in association with Connel Publications. (Eds.)
16. O'callaghan, K. A., Cripps, P. J., Downham, D. Y and Murray, R. D. (2003). Subjective and objective assessment of pain and

discomfort due to lameness in dairy cattle. *Animal Welfare*, 12(4):605-610.

17. Lasisi, O.T., Ojo, N.A and Otesile, E.B (2002). Estimation of age of cattle in Nigeria using rostral dentition. *Tropical Veterinarian*, 20(4): 204-208.
18. Fernandez, F. R., Grindem, C. B., Feldman, B. F., Zinkl, J. G and Jain, N. C (2000). Schalm's Veterinary Hematology. Philadelphia: Lippincott Willians & Wilkins, cap, 19: 110-116.
19. Aliyu, M.M., Bukar, M.M and Zira, A.B (2005). Occurrence of small ruminant lameness in Maiduguri and its environs. *Sokoto Journal of Veterinary Sciences*, 6**.**
20. Hambali, I.U.M., Zakariah, D., Jidda, N.B., Adamu, A.O., Tijjani ,A.M., Saidu, J.R., Lawal, A.M., Wakil, S.M., Jajere, F.B., Mustapha, A and Mohammed (2015). Prevalence of Lameness among Cattle found In Karu and Keffi Local Government Areas of Nasarawa State. *International Journal of Life Sciences Research*, 3:63-67.
21. Henok, Genetu., Gebretsadik, Yohannes., Jemal, Jabir and Nuraddis, Ibrahim (2018). Prevalence of Lameness and Associated Risk Factors in Ruminants in Jimma Zone of Oromia Region, South-western Ethiopia. *Academic Journal of Animal Diseases*, 7(1): 07-11.
22. Bokko, B.P and Chaudhari, S.U.R (2001). Prevalence of lameness in sheep in the north east region of Nigeria. *İnternational Journal of Agriculture of Biology*, 519-521.
23. Al-Juboori, A (2013).Prevalence and etiology of lameness in racing camels (Camelus dromedarius) in Abu Dhabi Emirate. *Journal of Camelid Science*, 6:116-121.
24. Isidahomen, E.C., Ikhimioya, I., Njidda, A.A and Okoruwa, M.I (2010). Haematological parameters and Blood chemistry of different species of Ruminant animals in Humid Tropical environment. *Nigeria Agricultural Journal*, 3: 85-90.
25. Al-Derawie, H.A (2012). Clinical, hematological with some biochemical study of acute laminitis in drought horses in basrah. *Basrah Journal of Veterinary Research*, 11(1):66-73.
26. Tambuwal, F.M., Agale, B.M and Bangana, A (2002). Hematological and biochemical values of apparently healthy Red Sokoto goats. *In Proceeding of 27th Annual Conference Nigerian Society of Animal Production* (NSAP) (pp. 50-53).
27. Abrahamsen, E.J (2007). Effective pain management in the acute stage of laminitis. In Proceedings of the 2007 BEVA Congress. Harrogate, England: *Equine Veterinary Journal*, Ltd (pp. 211-2).
28. 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.
29. Babeker, E.A and Elmansoury, Y.H.A. (2013). Observations concerning haematological profile and certain biochemical in Sudanese desert goat. *Journal of Animal and Feed Research***,** 3(1): 80-86.
30. Addass, P.A., Midau, A and Babale, D.M (2010. Haemato-biochemical findings of indigenous goats in Mubi Adamawa State, Nigeria. *Journal of Agriculture and Social Sciences*, 6(1): 14-16.
31. Egbe-Nwiyi, T.N., Igwenagu, E and Samson, M (2015). The influence of sex on the haematological values of apparently healthy adult Nigerian Sahel goats. *Sokoto Journal of Veterinary Sciences*, 13(2): 54-58.