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EFFECT OF BREED, SEX AND SOURCE WITHIN BREED ON THE HEAMATOGICAL PARAMETERS OF THE NIGERIAN GOATS

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ABSTRACT: *Effect of breed, sex and source within breed, together with their interactions on the haematological parameters of Nigerian goats were studied using 81 goats (comprising 9 males and 18 females per breed), objective being to characterize and outline the differences and similarities between the breeds in blood parameters. The goats were derived from different geo-ecological zones in the country based on the areas of preponderance of each breed. The breeds studied were: the Sahel goat (SG), Red Sokoto goat (RSG), and West African Dwarf goat (WADG) and hematological values obtained per breed were: 22.52±1.48, 23.04±3.56, and 29.22±4.76 (%PCV); 7.52±0.50, 7.82±1.25 and 9.48±1.60 (g/dl Hb); 2.71±0.23, 3.09±0.64, and 4.10±0.42 (x10^{12}/l RBC); 11.94±1.10, 11.32±2.03 and 9.23±0.63 (x10^{9}cells/l WBC), and 83.22±1.67, 76.72±2.30 and 73.34±3.40 (x10^{6}/mm^{3} MCV), respectively. Significant differences (P<0.05) were observed between the breeds, but the platelets, MCH and leucocytes differential counts were similar (P>0.05) for all the breeds. The WADGs were superior to the RSGs and SGs in PCV, Hb, and RBC counts, but lower in WBC counts and MCV. The SGs were similar in most of the haematological profiles examined, irrespective of geo-ecological distance, indicating homogeneity of the breed. The sahelian goat breed also outscored other breeds in MCV, showing that the breed has greater propensity to transport oxygen and in situation occasioning oxygen starvation, the breed survives better. This explains the reason for the survival of the breed in arid and semi-arid zone. Gender has no effect on the MCV and the values of 83.22±1.67x10^{6}/mm^{3}, 76.72±2.30x10^{6}/mm^{3} and 73.34±3.40x10^{6}/mm^{3} were observed for the SG, RSG, and WADG, respectively.*

ORIGINAL ARTICLE

Keywords: indices, red Sokoto goat, Sahel goat, West African Dwarf goat, haematology

INTRODUCTION

The major problem facing the third world countries is how to increase the biological value of their menu, and how to improve and maintain the productive potentials of their domestic livestock given adverse ecological and physiological constraints in the country. In Nigeria precisely, goat ranked second to poultry in terms of number among the farm livestock species, representing about 48.7 % of total domestic livestock (Oyenuga et al., 1974). So any meaningful progress in goat production entails general increase in meat production and consumption by the Nigerian populace. This suggests the relative importance of goats in livestock farming in Nigeria.

Three distinct groups of goats are found in Nigeria, and each has its unique utility. While the West African Dwarf Goat (WADG) is known for her resistance to trypanosomiasis and tolerance to harsh environmental conditions, the Red Sokoko breed (Maradi) is distinct for her excellent meat and milk yields, high quality skins, twinning ability and other characteristics. The multi-coloured Sahel breed is characterized by her high prolificacy, multiple births (twin, triplet and quadruplets) and good meat quality, but poor meat yield (Pagot, 1993).

Though a good number of researchers have carried out studies on some haematological indices of West African Dwarf goat (Daramola et al., 2003) and Red Sokoto goat (Olotu et al., 1998; Lazzaro, 2001; Tambuwal et al., 2002), little or no information exists on effect of breed, sex and geographical distance on these indices. This study was therefore designed provide further information on the haematological indices, such as RBC, Hb, PCV, WBC, Platelet counts and differential white blood cell counts of the Nigerian goat breeds, and to ascertain the effects of breed, sex and source within each breed on these parameters. In addition, information generated may be used as a guide for diagnosis, and treatment of many diseases associated with blood.

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MATERIALS AND METHODS

The study was conducted at the Goat Research Unit of the Department of Animal Science and Fisheries, Faculty of Agriculture, Delta State University, Asaba Campus, Asaba, Delta State. Delta State falls within the humid tropics of Nigeria, and Asaba precisely lies between longitudes 6 ^{0}E and 8 ^{0}E, and between latitude 4 ^{0}N and 10 ^{0}N. It has a moderate climate with a very high temperature during the dry season and average rainfall during the rainy season.

Design of the Experiment

The experiment was conducted under a 2 x 3 factorial in a completely randomized design (CRD) to test the effects of sex, breed, and their interactions on the haematological parameters of the Nigerian indigenous goats. Sex was tested on two levels with unequal replicates of twenty-seven bucks and fifty-four does; while there were three breeds with twenty-seven goats for each breed. In addition, effect of source of goat within each breed on these parameters was tested using one-way classification.

The statistical model used:

$Y_{ijk} = \mu + B_i + S_j + (BS)_{ij} + €_{ijkl}$

Where:

Y_{ijk} -is the observed haematological index

μ -the population mean;

B_i – the effect of the breed, $_i$= 1, –, 3

S_j – the effect of $_j$th sex of the animal, $_j$=1, 2

$(BS)_{ij}$- is the interaction between breed and sex, and

$€_{ijkl}$ –is the error term associated with the observations.

Assumptions; error term is independently, identically & normally distributed, with zero mean and constant variance, that is, iind (0, δ^2).

Sources of the Experimental Animal

Each breed was randomly obtained from three different towns (at the rate of three males and six females from each town) based on area of its predominant in the country. The Sahelian goats (SGs) were procured from arid region, red Sokoto goats (RSGs) were sourced from semi arid region, while the West African Dwarf goats (WADGs) were obtained from rainforest zone where they are predominant. A total of nine goats (comprising three males and six females) were randomly selected from each location/ source in the region. Typical SG, RSG and WAD goat are shown in Figures 1-3, respectively.

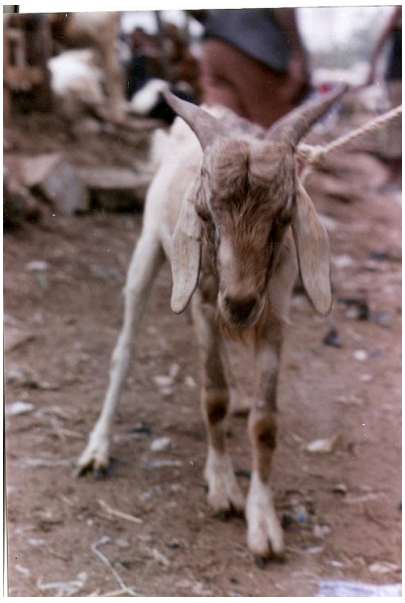

Fig. 1 - Typical Sahelian Buck

Fig. 2 - Typical RS Buck

Fig. 3 - Typical WAD Buck

Analytical Procedure

Sterilized syringe and hypodermic needles were used to collect 8ml of blood from the jugular vein of the animals. One syringe and needle were used per goat to avoid mixing-up or contaminations of blood samples. The samples collected were placed immediately on an anti-coagulant (EDTA) containing tube properly labelled for identification. The samples were shaken manually to prevent clotting. Sahlis's method was used to determine the haemoglobin concentration, while Formula citrate solution was used for RBC counts.

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Turk's solution was used to dilute the blood sample prior to WBC counts, while 10% ammonium oxalate was used for platelet counts. For differential counts, a thin film of the blood sample was made on a grease free slide and allowed to air dry. It was stained with leishman's stain, diluted with buffer solution and washed off with water and allowed to dry. A drop of oil immersion was added and viewed for lymphocytes, neutrophils, eosinophils, basophils and monocytes.

Statistical Analysis

All the data collected were subjected to analysis of variance (ANOVA) appropriate for a 2x3 factorial in a CRD to test the effects of breed, sex and their interactions on the measured parameter. The differences between means were separated using Duncan's New Multiple Range Test (DNMRT). SPSS (2004) Statistical Package was used for data analysis.

RESULTS AND DISCUSSION

The values of PCV observed in this study (Table 1) is close to values recorded by Olotu et al. (1998), Lazzaro (2001) and Daramola et al. (2003), and within the percentage range of 22-38 % reported by Plumb (1999) and Tambuwal et al. (2002) for different breeds of goat. Breed differences ($P<0.05$) were observed in PCV percentages (Table 1). Pronounced breeds x sex interaction (Table 2) effects were observed in PCV only in the RSG breed where the bucks recorded higher ($P<0.05$) percentages than the does. Also, source x breed interaction effects (Table 3) on PCV were observed in the RSG and WADG. While the RSGs from Sokoto were higher in PCV than those from Gusau, the WADGs from Umuahia (South-East) were higher than those from Ughelli (South-South) and Akure (South-West). These discrepancies in PCV values as a result of breed, sex and location have been reported by Azab and Abdel (1999) and Tambuwal et al. (2002) for goats and Kaushish and Arora, (1977) in sheep. Also such variations have been reported by Orji et al. (1987).

Table 1 - Mean values of PCV, Hb, RBC, WBC and platelet counts for SG (B_1), RSG (B_2) and WADG (B_3) and with respect to gender

Parameter	B_1(SG)	B_2 (RSG)	B_3 (WADG)	Bucks	Does
PCV (%)	22.5±1.48^a	23.0±3.56^a	29.22±4.76^b	23.2±1.23^a	22.2±3.08^a
Hb (g/dl)	7.52±0.50^a	7.82±1.25^a	9.48± 1.60^b	8.44±1.03^a	8.19±1.66^a
RBC (10^{12}/l)	2.71±0.23^a	3.09±0.64^a	4.10±0.42^b	3.50±0.52^b	3.18±0.81^a
WBC (10^9/l)	11.9±1.10^b	11.3±2.03^b	9.23±0.63^a	10.2±1.21^a	11.7±1.25^b
Platelet Count x 10^9/l	139±6.49^a	146±17.10^a	146±9.19^a	141±9.72^a	145±14.60^a

*Means bearing different superscript letter on the same row for breeds and sex are significantly different ($P<0.05$)

Table 2 - Mean of PCV, Hb, RBC, WBC and platelet counts in bucks (males) and does (females) of each breed of goats

Breed	Sex	PCV %	Hb g/dl	RBC (x10^{12} /l)	WBC (x10^9/l)	Platelet count (10^9/l)
SG	Bucks	23.2±1.23^a	7.56±0.50^a	2.92±0.17^b	10.83±0.51^a	141±5.81^a
	Does	22.2±3.08^a	7.50±0.50^a	2.61±0.19^a	12.53±0.81^a	138±6.60^a
RSG	Bucks	25.1±1.91^b	8.75±0.97^b	3.62 ±0.27^b	10.86±1.31^a	143±12.20^a
	Does	21.0±3.74^a	7.33±1.11^a	2.82±0.60^a	11.55±2.27^a	147±22.0^a
WADG	Bucks	27.8±2.12^a	9.00±0.94^a	4.08±0.33^a	9.03±0.46^a	138±9.32^a
	Does	29.9±5.34^a	9.72±1.79^a	4.11±0.51^a	9.46±0.65^a	150±5.79^a

*Means bearing the different superscript letter along the same column within the same breed are significantly different ($P<0.05$).

The concentrations of Hb obtained in this study (Table 1) are comparable to the ranges reported by Tambuwal et al. (2002), Plumb (1999), Olotu et al. (1998) and Lazzaro (2001) and lower than the range 12-18 g/dl reported by Singh (2004) for man. The WADG has significantly higher ($P<0.05$) Hb concentration than the other breeds. But the SG and RSG are similar in the Hb concentrations. Sex has no pronounced effect (Table 1) on the Hb concentration, but when measured by breed (Table 2), it was discovered that the bucks of RSGs have higher ($P<0.05$) Hb values than their does. Source also exhibited significant effects on the Hb concentrations in the RSG and WADG. These discrepancies agreed with the documentations by various researchers in different livestock and man (Oduye and Adadevoh, 1976; Oduye and Otesile, 1977; Obi and Anosa, 1980; Singh, 2004). Generally increase in the Hb concentration is associated with greater ability to resist disease infection and low level is an indication of disease infection and poor nutrition (Cheesbrough 2004; Tambuwal et al., 2002).

The red blood cell counts obtained for the Nigerian goats were slightly lower than 5.70±0.10x10^{12}/l and 5.30±0.10x10^{12}/l reported by Tambuwal et al. (2002) for the WADG and RSG, respectively. The RBC count for the WADG falls within the border line of the range of 4.0-9.0 x10^{12}/l obtained by Olotu et al (1998), Plumb (1999), and Lazzaro (2001). The ranges observed for the RSG and SG breeds appear to be lower than the literature values (Olotu

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et al., 1998; Plumb 1999; Lazzaro 2001; Tambuwal et al., 2002). The low counts observed for the SG and RSG breeds could be as a result of physiological and environmental stress since the breeds were sourced from the north where they are predominance. Generally, the males have higher (P<0.05) RBC counts than the females. Except for the WADG, this is true even when the RBC count is determined on the basis of sex by breed (Table 3). Again, the source had a pronounced effect (P<0.05) on the RBC counts of the RSG and WADG. This agreed with the report of Cheesbrough (2004) who maintained that the RBC counts vary with age, gender, geographical location and health status of the animals.

Table 3. Mean values of PCV, Hb, RBC, WBC and platelet counts for source by breed

Breed	Source	WBC ($x10^9$/l)	Hb g/dl	RBC ($x10^{12}$ /l)	PCV %	Platelet count (10^9/l)
SG	Maiduguri	12.2±1.34^a	7.67±0.47^a	2.81±0.21^a	22.8±1.37^a	135±4.91^a
	Potiskum	11.9±0.99^a	7.35±0.47^a	2.77±0.12^a	22.0±1.41^a	139±5.83^a
	Gumel	11.7±0.83^a	7.56±0.50^a	2.56±0.26^a	22.7±1.49^a	143±5.44^b
RSG	Sokoto	9.48±0.67^a	8.00±1.05^a	3.58±0.21^b	24.7±3.09^b	133±5.48^a
	Katsina	12.4±2.17^b	8.11±1.10^a	2.93±0.45^{ab}	22.9±2.69^{ab}	156±19.8^b
	Gusau	12.1±1.44^b	7.33±1.49^b	2.75±1.41^a	21.6±4.06^a	148±21.1^a
WADG	Umuahia	9.43±0.64^a	9.22±1.23^{ab}	4.31±0.51^b	28.4±3.72^b	148±7.51^a
	Ugheli	9.39±0.46^a	8.56±1.71^a	4.07±0.11^{ab}	26.8±5.69^a	148±5.14^a
	Akure	9.13±0.72^a	10.7±0.94^b	3.92±0.18^a	32.4±2.23^c	142±12.2^a

*Means bearing the different superscript letter along the same column within the same breed are significantly the different (P<0.05).

The WBC counts obtained in this study are statistically lower (P<0.05) in the WADG than in the other breeds (Table 1), but similar in the RSG and SG. The value obtained for the WADG is lower (P<0.05) than 13.5±0.8 $x10^9$/l reported by Tambuwal et al (2002); but higher than the value reported by Plumb (1999), and falls within the range of 7.5-15.8 $x10^9$/l documented by diverse researchers (Hunter 1996; Olotu et al 1998; Lazzaro 2001; Daramola et al 2003). Again, the values observed for the RSG (11.32±2.02 $x10^9$/l) and SG (11.94±1.10 $x10^9$/l) are close to 10.60±1.60 $x10^9$/l reported by Tambuwal et al (2002), and within the range given by some researchers (Olotu et al., 1998; Lazzaro 2001; Daramola et al., 2003). Generally, does are significantly higher (P<0.05) than bucks in the WBC counts, and the location of origin affected the WBC counts only in RSG breed. The RSGs from Sokoto are lower in WBC counts than those from Katsina and Gusau. This variation could be responsible for the concentration of the breed in Sokoto and its environs and as the breed disseminates to other parts, its inherent qualities continue to decline.

The platelet counts obtained in this study (Tables 1 and 2) are statistically uniform (P>0.05), irrespective of the breeds, sexes and sex by breed. The values are comparable to the literature values (Olotu et al., 1998; Plumb, 1999; Lazzaro, 2001; Daramola et al., 2003). Also the counts are very close the values reported for sheep (Kaushish and Arora, 1977; Oduye and Adadevoh, 1976) and for man (Graw, 2002; Singh, 2004). Significant locations differences (P<0.05) were observed (Table 3) in platelet counts in the SG and RSG breeds. While the SGs from Gumel are higher than the SGs from Maduguri and Potiskum, the RSGs from Katsina are higher than the RSGs from Sokoto and Gusau in platelet counts. Platelets play a critical role in the prevention of blood loss. At sites of minor blood vessel injury, platelets rapidly adhere to the exposed collagen, and then to one another to form a platelet plug which blocks the wound (Harper et al., 1977; Singh, 2004). According to them, thrombocytopenia (severe decrease in platelet counts) is associated with a bleeding tendency, while thrombocytosis (increase in platelet counts) may follow haemorrhage, Surgery or fracture of bone. But the platelet counts of all these goats fall within the normal range of 130-400 $x10^9$/l.

The percentage of lymphocyte, eosinophil, neutrophil, basophil and monocytes are similar (P>0.05) in the entire goat breeds studied (Table 4). That is, the percentage compositions of these individual cells in the leucocytes (WBC) are the same irrespective of the amount of the WBC in the breed. The values fall within the referral range (Hunter, 1996; Olotu et al., 1998; Plumb, 1999; Lazzaro, 2001; Tambuwal et al., 2002; Daramola et al., 2003). The bucks are higher (P<0.05) than the does in lymphocytes and eosinophil percentages, while the does are higher (P<0.05) in neutrophil counts (Table 4). Except for SGs, the same is true for sex by breed (Table 5); though all fall within the referral range. The higher WBC counts in the females are as a result of lower percentage of lymphocytes or more active response to the prevailing conditions. The SGs are similar (P>0.05) in all the leucocytes counts irrespective of geographical distance (Table 6); consequently, the breed is more homogenous compared to other breeds. The RSGs from Sokoto are higher in neutrophil counts, while those from Katsina are higher in lymphocytes, and those from Gusau are highest in eosinophil counts. These disparities are purely due to the location of origin. The sahelian goat breed recorded highest levels in MCV, so the sizes of their erythrocyte cells are larger than the cells in other breeds. Gender has no effect on the MCV. The values of MCV for the Nigerian goats (Table 4) were higher than 20- 60 $x10^6/mm^3$ reported by Tambuwal et al. (2002) and Plumb (1999) for different breeds of goat The MCH concentration is the same in the Nigerian goat breeds studied, and gender has no effect on the MCH concentration. The MCH values obtained ranged from 23.94-26.69 ug.

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Discrepancies in most haematological indices between breeds observed in this study follow a similar trend in brood protein fraction and x-chromatin incidences among the breeds of Nigerian goats as reported by Okonkwo et al. (2010a) and Okonkwo et al. (2010b), respectively. Also, genetic diversity between Nigerian goat breeds has been unveiled by Adebambo et al. (2011).

Table 4 - Mean values of the MCV, MCH and differential counts of the Nigerian goats according to sex and breeds

Parameter	Bucks	Does	B_1 (SG)	B_2 (RSG)	B_3 (WADG)
Lymphocyte (%)	76.8±0.11[b]	74.4±0.42[a]	76.4±0.08[a]	74.0±0.50[a]	75.2±0.37[a]
Eosinophil (%)	5.81±0.47[b]	5.67±0.25[a]	5.89±0.15[a]	6.04±0.21[a]	5.22±0.23[a]
Neutrophil (%)	15.2±0.06[a]	17.5±0.37[b]	15.5±0.05[a]	17.5±0.44[a]	17.1±0.33[a]
Basophil (%)	0.96±0.20[a]	0.72±0.27[a]	0.67±0.23[a]	0.93±0.11[a]	0.82±0.25[a]
Monocyte (%)	1.44±0.10[a]	1.69±0.19[a]	1.63±0.06[a]	1.37±0.26[a]	1.82±0.14[a]
MCV($x10^6/mm^3$)	73.6±14.21[a]	79.8±15.3[a]	83.2±1.67[b]	76.7±2.30[a]	73.3± 3.40[a]
MCH (µg)	23.9±5.32[a]	26.7±5.26[a]	27.4±3.54[a]	25.9±3.90[a]	24.1±7.46[a]

* Means bearing different superscript letter on the same row for sex and for breeds are significantly different (P<0.05).

Table 5 - Mean percentage values of the differential counts, and MCV and MCH values of bucks and does of the goat breeds

Parameter	B_1(SG)		B_2(RSG)		B_3(WADG)	
	S_1(M)	S_2(F)	S_1(M)	S_2(F)	S_1(M)	S_2(F)
Lymphocyte %	75..2±0.03[a]	77.0±0.09[a]	77.9±0.20[b]	72.1±0.50[a]	77.3±0.04[b]	74.1±0.50[a]
Eosinophil %	6.78±0.01[b]	5.44±0.18[a]	5.00±0.19[a]	6.56±0.18[b]	5.67±0.06 [b]	5.00±0.31[a]
Neutrophil %	16.1±0.32[a]	15.17±0.05[a]	14.8±0.06[a]	18.8±0.54[b]	14.8±0.06[a]	18.3±0.40[b]
Basophil %	0.78±0.17[a]	0.61±0.24[a]	1.22±0.17[a]	0.78±0.36[a]	0.89±0.21[a]	0.78±0.27[a]
Monocyte %	1.56±0.04[a]	1.67±0.07[a]	1.11±0.15[a]	1.50±0.30[a]	1.67±0.04[a]	1.89±0.19[a]
MCV $x10^6/mm^3$	81.4±3.51[a]	84.1±8.45[a]	71.4±6.89[a]	79.4±13.0[a]	68.1±6.71[a]	76.0±20.7[a]
MCH(µg)	24.2±2.16[a]	28.9±2.98[a]	24.6±2.85[a]	26.5±4.17[a]	23.10±8.42[a]	24.6±6.68[a]

*Mean bearing different superscripts in the same row within the same breed are significantly different (P>0.05).

Table 6 - Mean values of MCV, MCH and differential counts for source by breed

Breed	Source	MCV $x(10^6/mm^3)$	MCH (ug)	LYMPH %	EOSINO %	NEUTR %	BASOPH %	MONOPH %
SG	Maduguri	81.8±6.58[a]	27.4±2.54[a]	77.1±0.07[a]	5.67± 0.26 [a]	14.7±0.07[a]	0.56±0.24[a]	2.00±0.60[a]
	Potiskum	79.5±2.35[a]	26.6±2.00 [a]	76.6±0.14[a]	5.67± 0.14[a]	15.6±0.04[a]	0.67±0.22[a]	1.44±0.04[a]
	Gumel	88.4±8.28 [a]	28.0±5.12[a]	75.6±0.02 [a]	6.33±0.02[a]	16.2±0.02[b]	0.78±0.17[a]	1.44±0.04[a]
RSG	Sokoto	69.2 ±7.87[a]	22.4±2.68[a]	70.9±0.73[a]	5.89±0.18[ab]	21.0±0.76[c]	1.00±0.59[a]	1.11±0.07[a]
	Katsina	80.4±13.0[b]	28.0±3.72[b]	78.0±0.06[b]	5.44±0.14[a]	13.8±0.01[a]	0.67±0.31[a]	1.89±0.08[a]
	Gusau	80.6±10.6[b]	27.2±2.53[b]	73.2±0.38[a]	6.78±0.29[b]	17.7±0.13[b]	1.11±0.27[a]	1.11±0.27[a]
WADG	Umuahia	67.3±12.8[a]	21.8±4.20[a]	73.0±0.13[a]	7.33±0.14[b]	17.6±0.15 [b]	0.56±0.32[a]	1.67±0.07[a]
	Ugheli	66.1±15.6[a]	21.0±4.49[a]	72.8±0.13[a]	3.78±0.11[a]	20.6±0.19 [a]	0.89±0.21[a]	2.22±0.26[a]
	Akure	86.6±16.3[b]	29.5±9.21[b]	79.7±0.41[b]	4.56±0.11[a]	13.2±0.15[a]	1.00±0.13[a]	1.56±0.07[a]

*Means bearing different superscript letter along the same column in the same breed are significantly different (P<0.05).

CONCLUSION

WADGs are generally superior to RSG and SG breeds in erythrocyte parameters and have greater inherent ability to resist diseases and tolerate harsh tropical environment with high load of trypanosomiasis. Bucks are inherently superior to does in erythrocyte indices; therefore, can withstand more adverse conditions. The erythrocyte counts of Nigerian goat breeds are higher at the point or location where the individual breed predominates. The percentages of lymphocyte, eosinophil, neutrophil, basophil and monocyte are similar in all the three breeds of Nigerian goats studied. That is, the percentage compositions of these individual cells in the leucocytes (WBC) are the same irrespective of the amount of the WBC in the breed. The SG breed survives better than other breeds in semiarid and arid regions due to larger sizes of their red blood cells.

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