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Comparison of the Haematological Parameters of Indigenous and Exotic Dogs in Maiduguri, Nigeria

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ABSTRACT

Health status of dogs may be assessed with haematological parameters, but adaptation to environmental stress can lead to adjustment of these normal parameters. This study was designed to compare the haematological parameters of indigenous and exotic dogs in Maiduguri during the hot dry season. Forty apparently healthy indigenous (n = 20) and exotic (n = 20) dogs of both sexes and aged from 3-48 months were used. Blood sample (5 ml) was collected from the cephalic vein of each dog in EDTA bottles. Parameters were determined using microhaematocrit method for packed cell volume (PCV), haemocytometery for red blood cell (RBC) count and total white blood cell (TWBC) count, cyanmethemoglobin method for haemoglobin concentration (Hb), and examination of stained blood smear for relative differential white blood cell (WBC) count. Mean corpuscular volume (MCV) and haemoglobin concentration (MCHC), and absolute differential WBC counts were calculated. The TWBC and neutrophil counts were significantly ($p < 0.05$) higher in indigenous than exotic dogs. Exotic females had significantly ($p < 0.05$) lower MCHC and neutrophil count than indigenous females and all males. Age significantly ($p < 0.05$) affected MCV, but the highest value was recorded in young exotic dogs. Adult indigenous dogs had significantly ($p < 0.05$) higher neutrophil count than young indigenous and all exotic dogs. Monocyte count was significantly ($p < 0.05$) higher in young than adult exotic and all indigenous dogs. However, haematological values were within standard reference intervals for dogs.

Keywords: age, breed, exotic dogs, haematology, Nigeria indigenous dogs, sex

INTRODUCTION

Haematological parameters are used as pointers to ascertain the health status of an animal (Etim *et al*., 2013; Pessini *et al*., 2020). Many physiological processes are linked to either qualitative or quantitative changes in haematological values (Claassen *et al*., 2021). The importance of determining haematological parameters of domestic animals has been well documented (Obi and Anosa 1980; Kaneko *et al*., 2008) and changes in these parameters have been studied in different animals (Vidhan and Rai 1987; Tambuwal *et al*., 2002; Olayemi *et al*., 2009; Osman *et al*., 2016). Ariyibi *et al.* (2002) reported a variation in the haematological parameters in Alsatian and local breeds of dogs as it relates to sex, age, and environment. These differences have further underlined the need to establish appropriate physiological baseline values for various breeds of dogs, which could help in evaluation and diagnosis of health conditions.

The population of dogs found in Nigeria consist of mainly the Nigerian Indigenous dogs and some exotic breeds such as Alasatian, Bull Mastiff, German shepherd, Caucasian, Rottweiler, Bulldog, Chowchow, Neapolitan Mastiff and a few others (Ogbu *et al*., 2021). The Nigerian indigenous dog is long headed (dolichocephalic) with long snout, erect ears, and elongated slender body (Awah and Nottidge, 1998). The exotic breeds of dogs found in Nigeria are genetically and phenotypically different from the Nigerian indigenous dogs but have undergone physiological adaptations to survive in the hot tropical climate (Ogbu *et al*., 2021).

Majority of dogs in Nigeria are needed as guards and for breeding and commercial ventures, some are used for hunting and herding while others are kept as pets (Aiyedun and Olugasa, 2012) and these needs have tremendously increased over the years in northeastern Nigeria. Exotic dogs have been acquired by civilians, police, and the military for security purpose in the country due to their increased ability over the indigenous dogs to perform security functions (Adeniran, 2017). The ambient temperature in Maiduguri rises beyond 35°C in the late dry and hot season of the year (Monguno *et al*., 2017) which causes more heat stress to exotic dogs not acclimatized to the environment than the indigenous dogs. Environmental stress could induce the release of adrenocortical hormones that influence the circulatory system and affect

haematological parameters (Garduño *et al*., 2023) indicating a need to keep track of such changes for better health monitoring. The aim of this study was to compare the haematological parameters within and between indigenous and exotic dogs in Maiduguri, Nigeria.

MATERIALS AND METHODS

Animals

Forty apparently healthy dogs (20 indigenous; 20 exotic), that had health records with the Veterinary Teaching Hospital, University of Maiduguri, and owned by clients residing within Maiduguri metropolis were selected for the study by convenience sampling. The dogs were identified to be either indigenous or exotic breed based on their identifiable phenotypic characteristics by the veterinarian. The sex was defined by genital observation and age was provided by the owner based on the date of birth. The male (n =22) and female (n=18) dogs were categorized as young (3-12 months) or adult (> 12-48 months) (Harvey, 2021).

Blood sampling

Blood samples were collected early in the morning, before 9 am, during home visits. Following careful restraint by the owner, 5 millilitres of blood was obtained from each dog via the cephalic venipuncture into EDTA-containing sample bottles.

Determination of haematological parameters

The haematological parameters were determined using standard procedures reported by Strin and Freeman (2022) as follows: Packed cell volume (PCV) and red blood cell count (RBC) were determined using microhaematocrit and haemocytometric methods, respectively; haemoglobin concentration (Hb) was determined using cyanmethemoglobin method; haemocytometry was used to determine total WBC count and differential WBC count was manually done by examination of Giemsa-stained blood smear. Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated from RBC, PCV and Hb values using standard formulas (Strin and Freeman, 2022).

Statistical Analysis

Data obtained from the study were summarized as Means ± Standard deviations (SD). The mean values of each parameter were compared between the indigenous and exotic dogs with students t-test with the aid of a computer software, Graphpad Instat® version 3.1, Dotmatics, Boston (2013) and $p<0.05$ was considered as statistically significant.

Ethical Statement

Consent was obtained from the owners and the dogs used were handled according to the International Guiding Principle for Biomedical Research Involving Animals (CIOMS, 1985).

RESULTS

Comparison of haematological parameters between indigenous and exotic dogs is summarized in Table 1. All the hematological parameters of the indigenous and exotic dogs did not significantly differ from one another except TWBC and neutrophil counts that were significantly higher in indigenous (11.58±3.97x10^3/µL and 7.37±1.69 x10^3/µL) than exotic (8.63±3.17x10^3/µL and 5.89±1.23 x10^3/µL) dogs.

The haematological parameters of male and female dogs are presented in Table 2. There were no significant differences in the parameters between the male and female dogs when they were compared within and between the indigenous and exotic breeds except in MCHC and neutrophil count. The exotic females had significantly lower MCHC (32.24±3.41g/dl) and neutrophil (5.44±0.82 x10^3/µL) count respectively than in the indigenous females and the males (indigenous and exotic).

The haematological parameters of the young and adult dogs are summarized in Table 3. MCV significantly varied among various young and adult groups of the indigenous and exotic dogs. The highest MCV (71.04±3.31fL) was recorded in young exotic dogs. The adult indigenous dogs had significantly higher neutrophil count (7.82±1.12 x10^3/µL) than young indigenous and exotic (young and adult) dogs. Monocytes were significantly higher (1.68±0.22 x10^3/µL) in exotic young dogs when compared with exotic adult and indigenous (young and adult) dogs.

DISCUSSION

In this study, all the haematological parameters for the indigenous and exotic dogs were within the reference intervals of the parameters already reported for dogs and used in laboratory evaluation of clinical situations (Rizzi *et al*., 2010; McCourt and Rizzi, 2022). Both indigenous and exotic breeds of dogs were verified to have haematological values that provided insights into the possible validation of the published reference intervals that could be used in our laboratory. After comparison of the parameters within and between indigenous and exotic dogs, mean values of PCV, Hb, RBC, and MCH of indigenous and exotic dogs did not show any significant variations like the earlier reports in Southwest, Nigeria (Ariyibi *et al*., 2002; Olayemi *et al*., 2009; Olayemi and Ighagbon, 2011; Adebiyi *et al*., 2014). However, significantly higher values were observed in the mean TWBC and neutrophil counts of indigenous than exotic dogs. The circulating white blood cells in the blood are involved in immunological defence of the animals and the differences in counts may reflect varied immune status of the indigenous and exotic dogs (Tigner *et al*., 2022). The welfare of exotic dogs is better off than the indigenous ones in terms of feeding, housing and routine medical checks which contributes to boosting their immune capabilities. An increase in neutrophil count is usually the most common reason for an increased TWBC count (Levine and Andreasen, 2022). Senescence, stress, and inflammation are some of the factors known to cause an increased neutrophil count (Ishikawa *et al*., 2020). Stress leads to rapid mobilization of the immune system by an increase in the neutrophil (Tang *et al*., 2022).

Table 1: Comparison of haematological parameters between indigenous and exotic dogs

Parameter	Reference values*	Indigenous dogs (n= 20)	Exotic dogs (n= 20)
Packed cell volume (%)	37.0-55.0	41.25±9.08	40.1±8.02
Haemoglobin (g/dl)	12.0-18.0	12.52±2.28	12.29±2.53
Red blood cell count (x10^6/µL)	5.5-8.5	5.72±1.05	5.46±1.17
Mean corpuscular volume (fL)	60.0-77.0	66.06±3.86	65.86±2.34
Mean corpuscular haemoglobin (pg)	21.0-26.2	21.35±5.85	24.3±2.22
Mean cell haemoglobin concentration(g/dl)	32.0-36.0	33.18±4.26	35.45±4.65
Total White blood cell count (x10^3/µL)	6.0-17.0	11.58±3.97[a]	8.63±3.17[b]
Neutrophil (x10^3/µL)	3.0-11.5	7.37±1.69[a]	5.89±1.23[b]
Lymphocyte (x10^3/µL)	1.0-4.8	3.67±1.56	2.75±1.15
Monocyte (x10^3/µL)	0.1-1.4	0.90±0.20	0.63±0.12
Eosinophil (x10^3/µL)	0.1-1.3	0.59±0.26	0.47±0.20
Basophil (x10^3/µL)	0-0.1	0.17±0.1	0.16±0.10

[a,b] values with different superscripts along the row are significantly ($p<0.05$) different.*Rizzi *et al*., 2010.

Table 2: Haematological parameters of male and female dogs

Parameter	Males		Females	
	Indigenous (n=10)	Exotic (n=12)	Indigenous (n=10)	Exotic (n=8)
Packed cell volume (%)	43.80±9.26	39.08±8.30	39.1±8.72	39.88±9.23
Haemoglobin (g/dl)	12.46±1.90	12.87±2.30	12.58±2.44	13.93±2.90
Red blood cell count (x10^6/µL)	5.24±1.20	4.58±0.79	4.21±0.55	4.30±1.62
Mean corpuscular volume (fL)	67.67±5.17	66.76±7.67	66.47±0.40	65.51±1.65
Mean corpuscular haemoglobin (pg)	21.13±6.44	22.03±5.79	21.53±4.43	25.54±0.21
Mean cell haemoglobin concentration(g/dl)	34.61±1.04[a]	35.72±0.42[a]	33.77±2.88[a]	32.24±3.41[b]
Total White blood cell count (x10^3/µL)	11.99±3.60[a]	8.70±3.61	9.63±4.97	8.53±2.59
Neutrophil (x10^3/µL)	7.53±1.25[a]	6.65±1.43[a]	6.23±1.00[a]	5.44±0.82[b]
Lymphocyte (x10^3/µL)	3.58±1.06	2.80±1.13	3.71±0.96	2.84±0.82
Monocyte (x10^3/µL)	0.88±0.22	0.80±0.17	0.94±0.19	0.86±0.19
Eosinophil (x10^3/µL)	0.64±0.31	0.44±0.23	0.58±0.22	0.53±0.13
Basophil (x10^3/µL)	0.17±0.14	0.13±0.11	0.18±0.12	0.21±0.08

[a,b] values with different superscripts along the row are significantly ($p<0.05$) different

Table 3: Haematological parameters of the young and adult dogs

Parameter	Young (3-12 months)		Adult (>12 months)	
	Indigenous (n=3)	Exotic (n=5)	Indigenous (n=17)	Exotic (n=15)
Packed cell volume (%)	35.67±7.51	36.6±7.98	42.65±8.98	40.33±8.65
Haemoglobin (g/dl)	11.73±2.61	13.4±2.3	12.84±2.22	11.25±2.71
Red blood cell count (x10^6/µL)	4.25±0.62	4.64±1.04	4.81±1.10	4.40±1.23
Mean corpuscular volume (fL)	66.33±0.52[ac]	71.04±3.31[b]	65.13±0.90[a]	66.61±0.63[c]
Mean corpuscular haemoglobin (pg)	22.90±3.02	23.30±2.69	21.78±4.86	24.61±1.64
Mean cell haemoglobin concentration(g/dl)	33.89±1.01	34.19±8.07	33.41±2.50	35.53±0.59
Total White blood cell count (x10^3/µL)	9.40±0.38	9.09±4.48	10.03±0.12	8.47±2.79
Neutrophil (x10^3/µL)	4.10±2.85[a]	4.61±1.66[a]	7.82±1.12[b]	4.98±1.11[a]
Lymphocyte (x10^3/µL)	3.92±2.65	3.32±0.76	3.22±1.94	2.57±0.87
Monocyte (x10^3/µL)	1.02±0.30[a]	1.68±0.22[b]	0.89±0.18[a]	0.81±0.17[a]
Eosinophil (x10^3/µL)	0.47±0.23	0.39±0.22	0.63±0.27	0.60±0.19
Basophil (x10^3/µL)	0.20±0.06	0.12±0.10	0.17±0.11	0.13±0.10

[a,b,c] values with different superscripts along the row are significantly ($p<0.05$) different.

Gender was shown to influence haemoglobin concentration of the red cells and neutrophil counts. The exotic females had lower MCHC and neutrophil count than indigenous females and all males (indigenous and exotic). The stimulatory effect of androgens could cause an increase in MCHC (Choi *et al*., 2011; Ogbu *et al*., 2021). Lawrence *et al*. (2013) also observed female dogs had fewer neutrophils when compared with males; this could be due to the influence of estradiol on neutrophil biology, maturation, and responses (Gupta *et al*. 2020).

Age affected the size of red cells and neutrophil and monocyte counts. The higher MCV recorded in young exotic than adult indigenous and exotic dogs could be due to the presence of reticulocytes in circulation because of accelerated erythropoiesis reported to occur in puppies (Lee *et al*., 2020; Campbell, 2022). The adult indigenous dogs had significantly higher neutrophil count than young indigenous and exotic (young and adult) dogs. Age related increase in the number of circulating neutrophils has been reported (Collerton *et al*., 2012; Verschoor *et al*., 2015).

The adult indigenous dogs are known scavengers and are exposed to many pathogens causing no clinical signs but may influence the number of neutrophils in circulation. Monocytes were significantly higher in young than adult exotic and all indigenous dogs and could be related to stress response and mobilization for phagocytic functions (Lee *et al*., 2020).

Conclusion

The study has shown that the haematological parameters could be affected by breed (indigenous/exotic), sex and age, but the values reported in this study were within published reference intervals for dogs, indicating that the values of the reference interval could be adopted for local use.

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Conflict of Interest

The authors declare that they have no conflict of interest.

Authors' Contribution

NAI contributed to the designing, analysis of data, drafting and final approval of the work. HAI and KUE contributed to collection of blood samples, analysis of data, drafting and final approval of the work.

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