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Haematological Parameters and Haemoparasites of West African Dwarf Goats Sold at Trans-Amadi and Rumuokoro Abattoirs, Port Harcourt, Nigeria

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Abstract

Haemoparasitism has been a major problem to livestock production, resulting in high morbidity and mortality especially in small ruminants like goats. This research examined the haematological parameters and haemoparasites of West African Dwarf Goats traded at Trans-Amadi and Rumuokoro abattoirs, Port Harcourt, Nigeria. Blood samples were collected from the jugular vein of fifty goats from each location. The samples were emptied into Ethylene diamine tetra-acetic acid (EDTA) bottles and taken to the Haematological Laboratory, Department of Medical Laboratory Science, Rivers State University, Nigeria, for laboratory analyses using standard procedures. Results showed that red blood and white blood cell counts of goats from Trans-Amadi abattoir ranged from 0.44-30.87 (10^{12}/L) and 0.87-57.88 (10^{9}/L), respectively. The values of these parameters from Rumuokoro were 1.31-7.82 (10^{12}/L) and 65-30.87(10^{9}/L), respectively. The mean red blood cell counts and packed cell volume of the goats from both locations were lower than reference values. A decrease in the packed cell volume (PCV) is an indication of anaemia. The goats were infected with *Plasmodium* spp. at a prevalence of 12.0% and 36.0% in Trans Amadi and Rumuokoro abattoirs, respectively. This observation is attributed to the warm and moist environmental conditions at both abattoirs, which are favorable to mosquitoes. Regular examination of goats for haematological parameters is encouraged as it enables early detection of infections. Better sanitary conditions and fumigation should be observed in abattoirs.

Keywords: Haematology; Haemoparasites; WAD goats; *Plasmodium*; Abattoirs

Introduction

Goats are important domestic animals. They contribute substantially to the production of meat, skin, milk and their socioeconomic values account for about 35% of the capital values of the Nigerian Livestock Industry [1]. In southern Nigeria, goats are in high demand owing to ceremonial uses such as in burial ceremonies, traditional marriage ceremonies and other festivals. This demand has provided a source of income and employment opportunities for animal farmers who own the animals; butchers who prepare the animal for consumption; foragers who source for feed for the goats, and the government [2].

Haematological parameters are measurable characteristics associated with blood and the organs that form blood which indicate the physiological status of an animal [3,4]. Blood acts as a pathological indicator of the status of animals exposed to toxic and other unhealthy conditions [5]. Good blood composition in animals result in good performance and productivity [6]. The examination of blood helps to investigate the presence of numerous metabolites and other body constituents, the physiological, nutrition and pathological status, as well as the presence of infections in blood [7-9]. Laboratory tests on blood are necessary tools that help in detecting any deviation from normal in the body and providing necessary information for the diagnosis and prognosis of disease conditions in the animals [10,11]. The haematological values of farm animals are influenced by environmental conditions, physiologic status, genetics, nutrition, stress, age, sex, breed, management system, season and disease [12,13].

Parasitic diseases have led to the low productivity of goats [14,15]. Haemoparasites are reported to be the most prominent disease-causing agents of goats [16]. One haemoparasite found in goats is the goat malaria parasite *Plasmodium caprae* [17,18]. In the tropics, especially in Nigeria, haemoparasites are responsible for about 60% loss of whole population of animals generally, and account for losses in goats and sheep ranging between 30 to 40% [19]. Other haemoparasite genera infecting goats include *Trypanosoma*, *Babesia*, *Anaplasma*, Ehrlichia and to a less extent *Theileria* [20]. The aim of this research is to determine the haematological parameters of west African dwarf goats slaughtered in Trans-Amadi and Rumuokoro abattoirs, Port-Harcourt, Rivers State, Nigeria, and to investigate the haemoparasites of the goats.

Methodology

Study Location: Study samples were obtained from two abattoirs in Port Harcourt, Rivers State, Nigeria. These were the Trans-Amadi (N04°48 49.086', E007°2 44.01') and the Rumuokoro (N04°51 59.99', E006° 59.99') abattoirs (Figure 1).

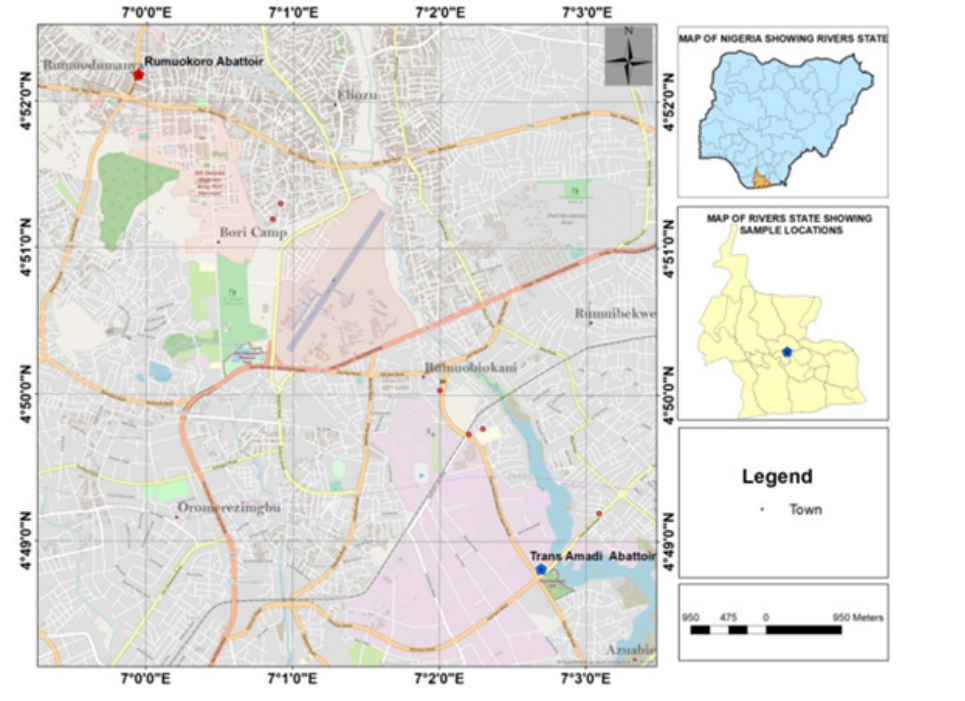

Figure 1: Map showing position of study locations in Port Harcourt, Nigeria.

Sample Collection and Examination

Blood samples were collected from a total of fifty animals from each location between February to April 2019. 5ml of blood sample was collected from the jugular vein and emptied into a bottle containing Ethylene diamine tetra-acetic acid (EDTA). The sex of each animal was identified by morphological examination and noted. Samples were properly labelled and transported to the Haematological Laboratory of the Department of Medical Laboratory Science, Rivers State University, for parasitological and haemalotogical examination.

In the laboratory, thick and thin blood films were made on clean glass slides. 0.02µl of blood was pipetted onto a clean grease free glass slide and spread with a plastic bulb pipette to make a thick smear. The thin film was made with the edge of a glass slide and the slides were air dried. [21].

Stock Giemsa solution was diluted 1 in 10 (10%) in a buffered distilled water of pH 7.2. The thin film was fixed in methanol for a few seconds and allowed to dry by evaporation. The slides were placed on a staining rack and flooded with 10% Giemsa stain using a pipette for 10 minutes. The stain was gently flushed off the slide by adding drops of clean water while avoiding tipping off the stain to avoid leaving deposits of scum over the film. The slides were placed on a slide rack to drain and dry ensuring the film does not touch the rack. This was done following the procedure described by [21]. The thick and thin films were examined microscopically using oil immersion objective (×100). Identification of haemoparasites was performed using morphologic characteristics [22].

Haematological analysis: Haematological parameters including total white blood cell count (WBC count), packed cell volume (PCV), haemoglobin (Hgb), red blood cell count (RBC),

mean corpuscular haemoglobin concentration (MCHC), mean corpuscular volume (MCV) and mean cell haemoglobin (MCH) were measured by an automatic analyser.

Statistical analysis: Descriptive statistics were used to compute the mean and range values for the haematological parameters. Prevalence of infection was computed after Bush et al. (1997) [23]. Student t-tests were used to test for significant differences in the haematological parameters between male and female goats from each location. Analysis of variance (single factor) was used test for the significant differences between the haematological parameters of infected and uninfected goats from both locations. Significance was taken at $P<0.05$. These tests were done using MS Excel.

Results

One hundred blood samples were examined in the course of the research for haematological parameters and haemoparasites. The fifty samples from Trans-Amadi were comprised of forty-one males and nine females. Among those from Rumuokoro, there were forty males and ten females.

Haematological parameters of the goats

The white and red blood cell counts of the goats from both locations were generally higher in male than in female animals (Table 1). Some WBC counts were lower or higher than the reference values (4.0-13 x10^9/L) while the red blood cell counts were either lower or within the reference value of 8-18 (10^{12}/L). The HGB counts and PCV were also either lower or within the reference ranges of 8.0-12g/dL and 22.0-38.0%, respectively. The MCV and MCH values were all higher than the reference values of 16.0-25.0fl and 5.2-8.0pg for MCV and MCH, respectively. The MCHC values were either below or higher than the reference range of 30.0-36.0g/dL. Mean values of these parameters are graphically presented (Figures 2-7).

Table 1: Summary of haematological parameters of Red Sokoto goats, Trans-Amadi and Rumuokoro abattoirs, Port Harcourt, Nigeria.

Parameter	Total		Male Goats		Female Goats	
	Range	Mean	Range	Mean	Range	Mean
Trans-Amadi						
WBC	0.87-57.88	11.87	3.59-57.88	13.47	0.87-13.8	4.61
RBC	0.44-11.8	3.68	1.6-11.8	4.03	0.44-6.86	2.1
HGB	2.8-12.3	8.39	2.8-12.3	8.97	3.0-8.7	5.76
PCV	1.6-36.88	12.63	5.84-36.88	14.22	1.6-11.2	5.39
MCV	31-42	37.78	31-42	38.05	36-38	36.56
MCH	9.1-57.8	31.44	9.1-43.2	27.43	24.9-57.8	49.71
MCHC	29.1-98.8	72.43	29.1-93.1	68.31	62.2-98.8	91.18
Rumuokoro						
WBC	1.65-30.87	9.83	1.65-30.87	10.54	1.87-17.43	6.97
RBC	1.31-7.82	3.57	1.65-7.6	3.61	1.31-7.82	3.41
HGB	3-12.1	8.26	3-12.1	8.44	3.4-10.6	7.56
PCV	2.6-30.06	11.56	2.6-30.06	11.68	3.69-21.56	11.07
MCV	36-42	37.92	36-41	37.9	36-42	38
MCH	14.5-57.9	31.35	14.5-57.8	31.08	20-57.9	32.44
MCHC	37-98.7	75.25	37-97.9	75.62	50-98.7	73.76

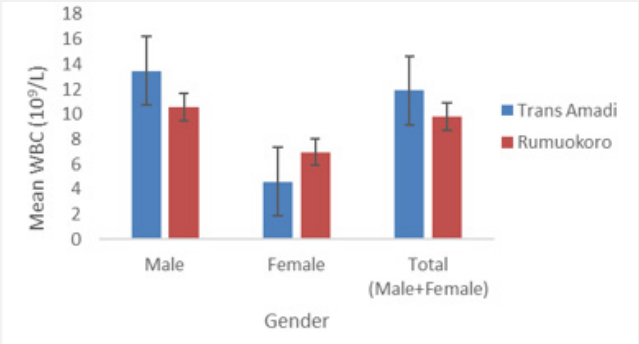

Figure2: Mean WBC (10^9/L) values in Red Sokoto goats of Trans Amadi and Rumuokoro.

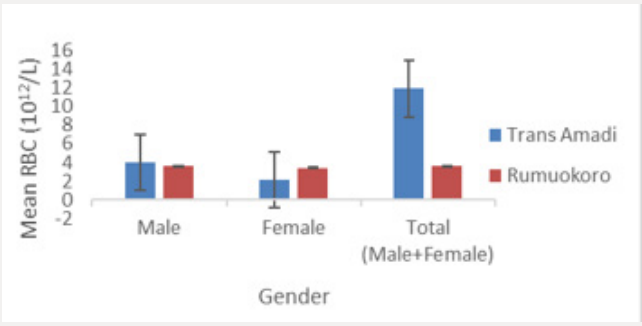

Figure 3: Mean RBC (10^{12}/L) values in Red Sokoto goats of Trans Amadi and Rumuokoro.

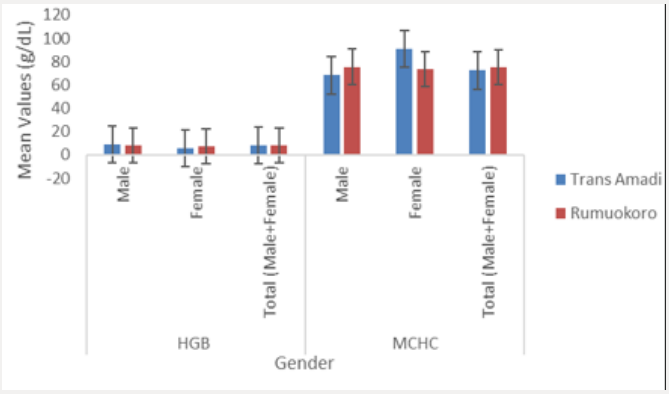

Figure 4: Mean Values of HGB (g/dL) and MCHC (g/dL) in Red Sokoto goats of Trans Amadi and Rumuokoro.

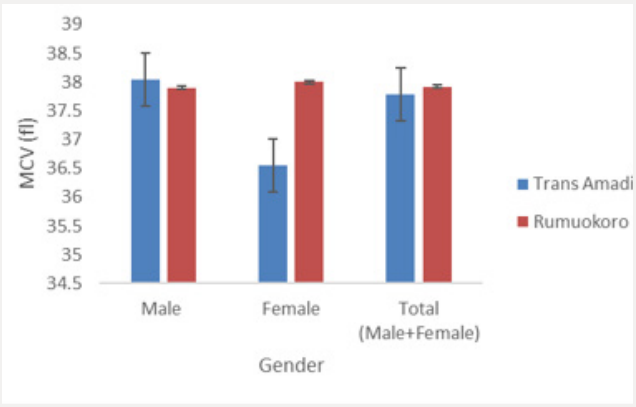

Figure 5: Mean MCV (fl) in Red Sokoto goats of Trans Amadi and Rumuokoro.

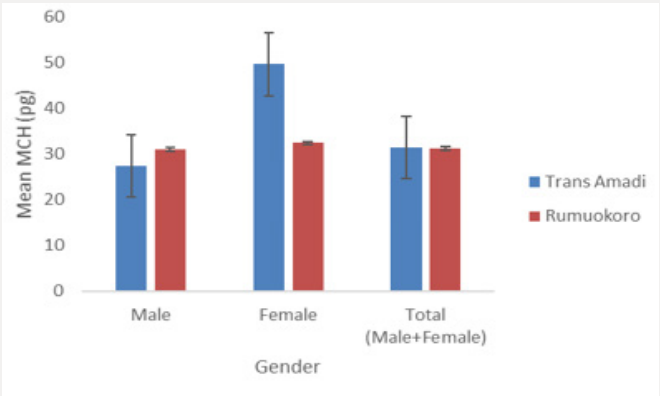

Figure 6: Mean MCH (pg) in Red Sokoto goats of Trans Amadi and Rumuokoro.

The differences observed in the values of the haematological parameters between male and female hosts were tested for significant differences. In samples from Trans Amadi, these parameters were significantly higher in male than in female goats: WBC (t_{48}=2.76, p=0.004), RBC (t_{48}=2.52, p=0.008), HGB (t_{48}=4.24, p=5.05E-05), PCV (t_{48}=4.06, p=8.91E-05) and MCV (t_{48}=2.65, p=0.005). The MCH (t_{48}=7.19, p=1.88E-09) and MCHC (t_{48}=4.07, p=8.58E-05) were significantly higher in female than in male goats. Among the goats from Rumuokoro, there were no significant differences in the haematological parameters (WBC, RBC, HGB, PCV, MCV, MCH and MCHC) in male and female goats (p>0.05). Analysis of variance (single factor) was used to test for significant differences in the haematological parameters of infected and uninfected goats. The results showed there were no significant differences in the parameters in both categories of goats (p>0.05): WBC (F=0.93, p=0.43), RBC (F=0.60, p=0.62), HGB (F=1.36, p=0.26), PCV (F=0.34, p=0.80), MCV (F=0.13, p=0.94), MCH (F=0.02, p=0.10) and MCHC (F=0.37, p=0.78).

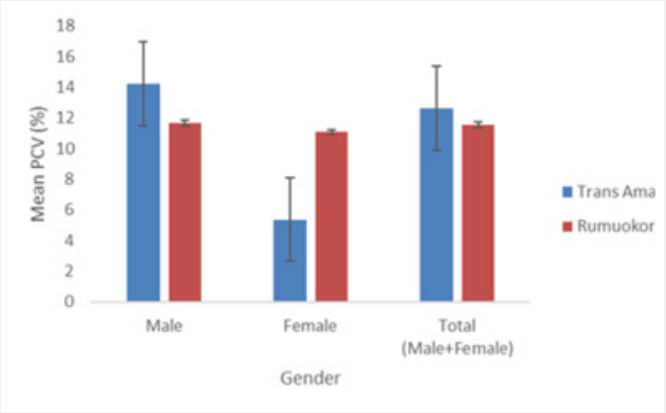

Figure 7: Mean PCV (%) in Red Sokoto goats of Trans Amadi and Rumuokoro.

Results of parasitic investigations

Plasmodium species were identified from the blood of the goat samples. Six hosts from the Trans-Amadi abattoir were infected, while eighteen from Rumuokoro abattoir were infected (Table 2). No other parasite was encountered. The prevalence of infection was 12.0% and 36.0% in Trans Amadi and Rumuokoro abattoirs, respectively. Male animals were more infected than their female counterparts. For instance, of the six infected specimens from Trans-Amadi, five were males and one female. Among the eighteen infected specimens from Rumuokoro, thirteen were males and five were females. Some micrographs from the research are presented in (Plates 1-3).

Table 2: Prevalence of Plasmodium sp. in Red Sokoto goats, Trans-Amadi and Rumuokoro abattoirs, Port Harcourt, Nigeria.

Location	Number examined	Number infected (Prevalence %)
Trans-Amadi	50	6 (12.0%)
Rumuokoro	50	18 (36.0%)
Total	100	24 (24.0%)

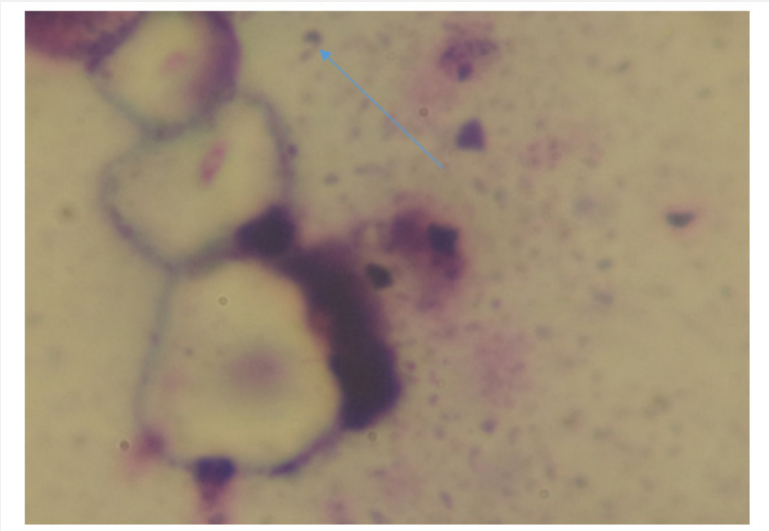

Plate 1: *Plasmodium sp*. in the blood of an infected red Sokoto goat (x100).

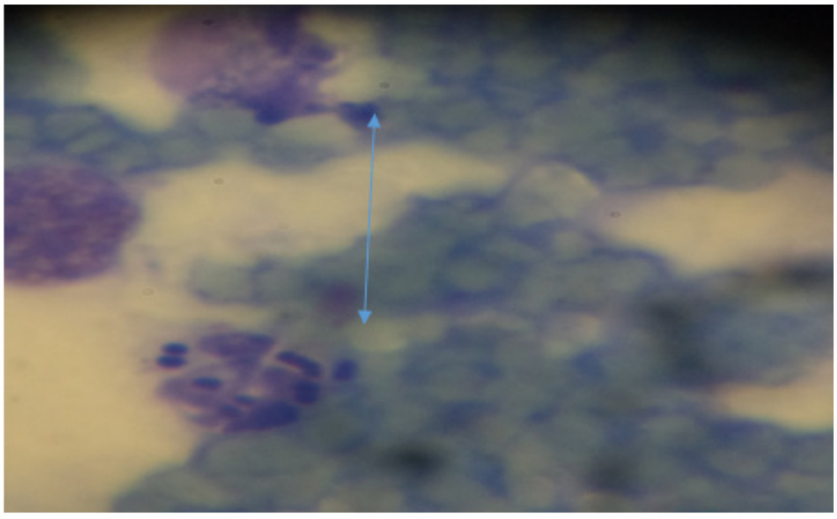

Plate 2: Red blood cells of Red Sokoto goats (x100).

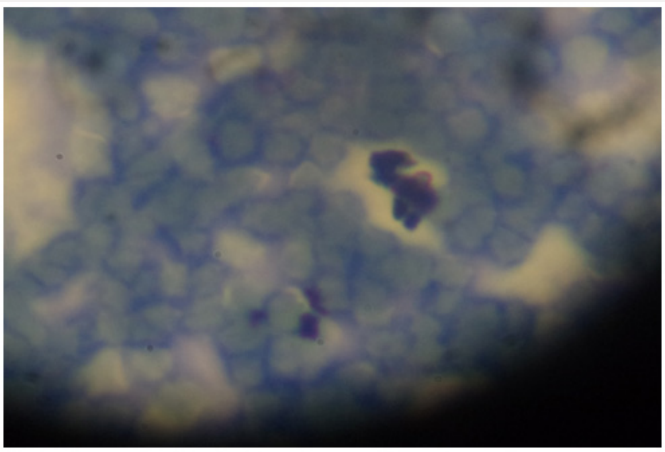

Plate 3: Red blood cells of Red Sokoto goats (x100).

Discussion

The mean values of red blood cell (RBC) counts and PCV levels in many of the goats from Trans-Amadi and Rumokoro abattoirs were relatively lower when compared with the normal ranges for goats [24], but the ranges had values that were below or higher than the reference values. The higher values may have been due to infection or stress. Mean HGB value was also found to be below normal in some of the goats observed. A decrease in packed cell volume (PCV) is an indicator of anaemia [25]. The mean values of MCH, MCV and MCHC were generaly higher than normal. These blood parameters are also indicators of anaemia. Increased levels of MCH and MCHC indicates macrocytic anaemia resulting from increased in size of blood cell [26]. These anaemic symptoms observed in the haematological parameters could be tied to the prevalence of the malaria parasite, *Plasmodium* [17]. Haemoparasitism remains a major impediment to livestock production, resulting in high morbidity and mortality especially in small ruminant animals like goats [27,28]. Most previous literature reported the presence of tick-borne haemoparasites such as *Theilera, Babesia, Anaplasma* [2,29-31] and *Trypanosoma* [2]. However, this study did not observe any of these parasites in the goats examined possibly due to lack of encounter with the arthropod vectors of the parasites. However, Obed and Imafidor [20] reported *Babesia*, *Theilera*, *Anaplasma* and *Trypanosoma* species in cattle slaughtered at both abattoirs. Only *Plasmodium* species was encountered in the present research at a prevalence of 12% and 36% at Trans Amadi and Rumuokoro abattoirs, respectively. Kaewthamasorn et al. [17] had reported on the genetic homogeneity of goat malaria parasites in Asia and Africa. In their research, 200 goat samples from five countries (Thailand, Myanmar, Iran, Kenya/Zambia and Sudan) were studied. It was observed that *Plasmodium* caprae, otherwise called the goat malaria parasite was found in goats from each location. These authors reported the prevalence of goat malaria parasites in the samples was about 11% in Thailand, 40% in Myanmar, 31% in Iran, 11% in Sudan, and 9% in Kenya/Zambia. Similarly, Hakimi et al. [18] also reported the presence of *Plasmodium caprae* in goats sampled at Iran. Previous studies which have detected *Plasmodium* spp. in other animals have suggested that *P. caprae* is only transmitted by mosquitoes, and not by any other arthropod [32,33]. It is most likely that the *Plasmodium* species detected in this research is *P. caprae*, as many research works have shown that *P. caprae* has worldwide distribution.

The high prevalence of mosquito-borne *Plasmodium* parasite in this research could be attributed to the favorable environmental conditions for the survival of mosquitoes which acts as insect vectors responsible for its transmission [1]. Abah and Udoidang [34-36] in their research on the co-infection of malaria and Hepatitis B virus in Port Harcourt, explained that several conditions in Port Harcourt and its environments favors the development and life cycle of mosquitoes, providing good sites for the increased breeding and population of mosquitoes. These conditions include poorly drained gutters, inadequate and improper waste disposal system and climatic conditions. As the breeding success in mosquitoes increases, the transmission of *Plasmodium* also increases. Mordi and Burke [33] in their study also confirmed that climatic and atmospheric conditions such as rainy season can favour the breeding of mosquitoes, thus increasing the prevalence of malaria. This research was carried out in rainy season, thus it contributed to the presence of the mosquito vectors of *Plasmodium caprae* in both study locations.

Conclusion

The result obtained in this study indicates that *Plasmodium* parasites are prevalent in goat populations from the two abattoirs investigated in Port Harcourt, Nigeria. Based on the observations from this study, it can be inferrred that *Plasmodium* is associated with the alterations found in the haemotological parameters of the goats, and consequentially, responsible for anaemic conditions.

Recommendation

It is recommended that haematological parameters be examined frequently for early determination of infection in goats. Conditions that would control the insect vector should be introduced in the abattoirs. These include well drained gutters to prevent stagnant water, proper waste disposal system and fumigation with nontoxic chemicals.

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