



Research Article

## Abnormalities in Haemogram of Local Scavenger Chickens Infected with Blood Parasites in Maiduguri, Nigeria

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**ABSTRACT**

A survey of haemoparasitism and associated changes in haemogram of local scavenger chickens (LSC) (*Gallus gallus domesticus*) was carried out at Maiduguri live bird market. A total of one hundred and twenty-two (122) blood samples were collected during slaughter at the slaughter slab, screened for haemoparasites and examined for changes in haematological parameters using standard procedures. Among the 122 blood samples taken, *Haemoproteus spp.* had higher prevalence than *Plasmodium spp.* The female chickens had higher prevalence of haemoparasites than males. Although there were some slight variations in the haemogram (PCV, Hb and RBC) between apparently healthy and haemoparasite infected LSC, the differences were not statistically significant. The result showed significant ( $p < 0.05$ ) variations in the TWBC counts between apparently healthy male and female; apparently healthy and haemoparasite infected males; apparently healthy male and haemoparasite infected female. Also, there was significant ( $p < 0.05$ ) variation in the heterophil counts between apparently healthy male and female; apparently healthy and haemoparasite infected male; apparently healthy female and haemoparasite infected male; apparently healthy male and haemoparasite infected female. Similarly, there was significant ( $p < 0.05$ ) variation in lymphocytes counts between apparently healthy male and female; apparently healthy female and haemoparasite infected male; apparently healthy female and haemoparasite infected female. In conclusion, the overall prevalence of 45.9% observed for haemoparasite in the study area suggests endemicity of these parasites in local scavenger chickens. The absence of significant differences in haematological profile with the exception of TWBC, heterophils and lymphocytes for apparently healthy and haemoparasite-infected chickens indicate that birds may be harbouring the parasites without causing and/or showing any changes in the haematological profile.

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## INTRODUCTION

Poultry production specifically includes chickens, ducks, guinea fowl, turkey and ostrich (Opara *et al.*, 2012, Lawal *et al.*, 2019). Chicken is one of the most intensively reared of the domesticated poultry species and the most developed and profitable animal production enterprise. Poultry production in Africa and parts of Asia is still distinctively divided into commercialized and village enterprise subsector, each with its peculiarities (Muchadeyi *et al.*, 2005). The domestic chickens (*Gallus domesticus*) likely had its ancestry in the red jungle fowl *Gallus gallus* that originated from Asia (Lawal *et al.*, 2016). Village chickens are always associated with free-range management systems in rural areas or as backyard flocks in urban and peri-urban areas of most developing countries including Nigeria (Opara *et al.*, 2016). The types of feed used for this group of chickens and their feeding systems are also very typical to their group and different from those used for commercial breeds in intensive commercial farms (Sehgal 2015; Mohammed *et al.*, 2019). The village chickens are however very important component in the life of villagers or those living in the rural areas (Bebora *et al.*, 2005). Village chickens contribute immensely to rural employment of youths, serves as sources of protein to family nutrition and also serve as source of petty income (sale of eggs and birds) (Kiptarus, 2005; FAO, 2012). They also form part of cultural life of the rural dwellers used for sacrifices during cultural festivals and ceremonies as well as gifts to visitors and relatives (Ogbaje *et al.*, 2019). Unfortunately, the *Gallus domesticus* can easily be infested with several types of bacterial, viral, fungal and parasitic pathogen (Lawal *et al.*, 2016). Parasitism ranks high among factors that threaten chicken production (Mapiye *et al.*, 2008). Among the various parasitic diseases, haemoparasites infections are the most prevalent (Lawal *et al.*, 2016). The haemoparasites are common blood parasites of reptiles, birds, and mammals with

some stages of development in both tissues and circulating blood cells of infected hosts (Ogbaje, 2019). The most commonly recorded parasites in smears of peripheral blood are unicellular eukaryotic parasites of the genera, *Haemoproteus*, *Leucocytozoon* and *Plasmodium* (Benedikt *et al.*, 2009). These pathogens are widespread and commonly include species from the genera *Plasmodium*, *Haemoproteus*, *Leucocytozoon*, *Fallisia* and *Trypanosoma* (Valkiūnas, 2005; Braga *et al.*, 2011).

Avian haemoparasites are known to be pathogenic to their hosts causing high mortalities (Merino *et al.*, 2000; Cardona *et al.*, 2002), these blood parasites can exert important selection pressure on their hosts through effects on survival (Sol *et al.*, 2003; Møller and Nielsen, 2007), on reproductive success (Merino *et al.*, 2000; Sanz *et al.*, 2001; Marzal *et al.*, 2005; Knowles *et al.*, 2011), on plumage colouration with important ecological and evolutionary consequences, such as changes in community structure (Sol *et al.*, 2003; Marzal *et al.*, 2005; Dunn *et al.*, 2011). They also cause anaemia by invading the host's erythrocytes which are consequently destroyed by the bird's autoimmune system, leading to death (Permin and Hansen, 2018). Information on the prevalence of haemoparasites of local scavenger chickens and their effect on blood parameters in Maiduguri, Northeastern Nigeria is scanty.

Therefore, this important study is carried out to investigate the prevalence of haemoparasites of local scavenger chickens and their effect on blood parameters Maiduguri, Northeast, Nigeria to validate the scanty studies carried out in this part of the country.

## MATERIALS AND METHODS

### Description of the study area

Maiduguri is the capital of Borno state. It is located in the Sahel Savanna region of north-eastern Nigeria at latitude 11°05' North and longitude 13°05' East and at about 350m above sea level. Maiduguri has mean annual rainfall and temperature of about 630mm and 32°C

respectively, but temperature can go as high as 45 to 48°C in the month of March to May. It is the largest city in Northeastern Nigeria. Modern Maiduguri was founded in 1907 near the old town of Maiduguri founded in 1672. The population of Maiduguri is estimated to have crossed one million by 2009. There are many ethnic groups living in the town including Kanuri, Shuwa Arab, Babur/Bura and others. The city is a rail, road, and air transportation center serving north-eastern Nigeria and parts of Niger (Lawal *et al.*, 2016).

#### **Collection of Blood Sample**

A total of one hundred and twenty-two (122) samples were collected by convenience sampling. Three (3mls) millilitres of blood were collected from each bird at the point of slaughter in sterile EDTA-coated bottles and labelled according to the sex. The samples were transported to the haematology laboratory, Department of Veterinary Pathology, Faculty of Veterinary Medicine, University of Maiduguri for haematological evaluation.

#### **Determination of Haematological Parameters**

Packed cell volume (PCV) was determined by the microhaematocrit method (Thrall and Weiser 2002). Microhaematocrit capillary tubes were filled with blood by capillary action to about 75% of their lengths, and outside of the tubes were carefully dried with cotton wool after filling each of the tubes with blood. The opposite ends were then sealed with a flame from Bunsen burner. The sealed tubes were then packed in a haematocrit centrifuge machine (to touch the rim). Blood samples were centrifuged in capillary tubes for 5 minutes at 4383 xg using the Saitexiangyi TG12MX<sup>®</sup> Micro-haematocrit centrifuge machine. Then the proportion of cells in total volume of blood was measured and recorded as a percentage using the Hawksley<sup>®</sup> Microhaematocrit Reader.

Blood haemoglobin concentration (Hb) was assayed colorimetrically using cyanmethaemoglobin method as described by Higgins *et al.* (2008). Five millilitres of

haemiglobincyanide (HICN) (Drabkin) solution were measured using a 5 ml syringe into plastic test tubes. Twenty microliter (20 µl) of blood was measured using a micropipette and added to the Drabkin solution in the test tube and properly mixed by gently shaking the test tube. It was centrifuged at 1509 x g for 15 minutes to separate the empty RBC from interfering with the reading. The supernatant was separated into a sample bottle. The mixture was absorbed into the haemoglobin meter (XF-C, China). After the wiggling pump stops working, the value displayed on the screen was recorded in g/dl as the haemoglobin concentration.

Red blood cells (RBC) count was determined with the Nat-Herrick solution (1:200 dilutions) and the Improved Neubauer haemocytometer (Thrall and Weiser 2002). The heparinised blood samples were slightly agitated and the RBC diluting pipette was used to pipette the blood to the 0.5 mark. The tip of the pipette was cleaned properly using a tissue paper without touching the distal opening of the pipette tip with tissue, as this will cause capillary shift of blood into the tissue. The diluting solution (Natt-Herrick) was also pipette to the 101 marks (1:200) without entirely immersing the pipette tip into the diluting fluid. The mixture was well shaken to obtain sufficient dilution. Cover slip was applied. The first 5 drops were discarded before filling the counting chambers of the improved Neubauer haemocytometer and the cells were allowed to settle.

The light microscope (Olympus-XSZ-107BN), at low power magnification (X40) was used to view the cells and counting was done using the tally counter.

For RBC count, the cells contained in the four corner and central squares in the mid-section of the haemocytometer were counted. Following the “L” rule: cells that touch the centre triple lines of the ruling on the left and the bottom sides were counted but cells that touch the centre triple lines of the ruling on the right and the top sides were

not counted. The RBC count was calculated using the formula below:

$$\text{RBC count} = N/5 \times 25 \times \text{DF} \times 10 = N \times 5 \times 200 \times 10 = N \times 10000/\mu\text{L}$$

Where N = Total number of RBC counted in the 5 squares in the mid-section of the haemocytometer (or in 160 squares).

The white blood cell (WBC) in the four outer large squares of the haemocytometer were counted and calculated using the formula below:

$$N \times 500 = \text{WBC} \times 10^3 /\mu\text{l or } \text{WBC} \times 10^3 \times 10^6/\text{L}$$

Where N = Number of WBC counted in the four outer large squares (or in 64 small squares)

Note that both charged sides of the haemocytometer were counted for both the RBC and TWBC and the average calculated.

$$\frac{\text{Percentage of WBC counted} \times \text{TWBC}}{100} = \text{Absolute Number} \times 10^9/\text{l}$$

The erythrocytes indices were calculated using the following mathematical expressions derived from the PCV, haemoglobin and total erythrocyte values according to the standard formulae for *Coles (1980)*:

#### Mean Corpuscular Volume

$$\text{MCV (fl)} = \frac{\text{PCV (\%)}}{\text{RBC (millions}/\mu\text{l)}} \times 10$$

#### Mean Corpuscular Haemoglobin Concentration

$$\text{MCHC (g/dl)} = \frac{\text{Haemoglobin (g/dl)}}{\text{PCV (\%)}} \times 100$$

#### Mean Corpuscular Haemoglobin

$$\text{MCH (pg/cell)} = \frac{\text{Haemoglobin (g/dl)}}{\text{RBC (millions}/\mu\text{l)}} \times 10$$

#### Thin Blood Smear Preparation and Microscopic Examination

Thin blood smear was prepared on grease-free glass slides and stained according to standard procedure (Tostes *et al.*, 2015) for haemoparasite. Thin blood and buffy coats smear of each blood sample were made on two separate slides and left to air dry for a few minutes, then labelled appropriately. The slides were fixed with methanol for five (5) minutes and allowed to air dry, packaged and then stained with diluted 10% Giemsa stain as defined by Tostes *et al.* (2015).

#### Determination of Differential White Blood Cell Counts

The differential leukocyte count was carried out by thoroughly examining the shoulder (which is the edge of the oval-shaped smear) of the stained blood smear under high magnification (1000x) with oil immersion. This is the area where the blood cells are in monolayer and are slightly segregated, thus facilitating cell differentiation (*Thrall and Weiser, 2002*). The total of 100 white blood cells was counted and classified according to their morphologic and staining characteristics using a manual tally counter. The differentiated leukocytes were expressed as a percentage of the total leukocytes. The percentage of each cell group was then converted into absolute numbers using the following formula:

The percentage of each cell was then converted into absolute numbers by reference to the total WBC using the formula below:

The slides were later examined using a microscope at low magnification (x40) and at high magnification (x100) under oil immersion for 10-15 min for the presence of intracellular blood parasites as previously described by Lawal *et al.* (2021). Parasite identification was based on the morphology, height and pigmentation of the endoerythrocytic parasites and photographs compared to the species already described by Taylor *et al.* (2007)

### Data Analyses

Data analysis was performed using GraphPad Prism software (GraphPad Inc., San Diego, CA). Prevalence rates were calculated as percentages of proportion, Chi-squared test was used to compare categorical variables (health status and sex). Differences were considered significant for p-values equal to or less than 0.05.

### RESULTS

#### PREVALENCE OF HAEMOPARASITES IN LOCAL SCAVENGER CHICKENS IN MAIDUGURI

The prevalence of haemoparasitism in local scavenger chickens (LSC) in Maiduguri is presented in Table 1. Out of the 122 blood samples collected, 39(31.9%) had *Haemoproteus spp* while 17(14.0%) had *Plasmodium spp*

**Table 1:** Prevalence of Haemoparasites in Local Scavenger Chickens in Maiduguri

Haemoparasite	Number of samples	Prevalence (%)
<i>Haemoproteus spp.</i>	39	31.9
<i>Plasmodium spp.</i>	17	14.0
Apparently Healthy	66	54.1
<b>Total</b>	<b>122</b>	<b>100</b>

#### Sex-Specific Prevalence of Haemoparasitism in Local Scavenger Chickens in Maiduguri

The sex-specific prevalence of haemoparasitism in LSC in Maiduguri is presented in Table 2. The female (27.9%) had higher prevalence rate of haemoparasite than male (18.0%) LSC in Maiduguri. From the 27.9% (34) prevalence in

female LSC, the *Haemoproteus spp* constitute 23(18.9%) while the *Plasmodium spp* had 11(9.0%). Similarly, out of the 18.0% (22) prevalence rate of haemoparasite observed in male LSC, the *Haemoproteus spp* and *Plasmodium spp.* constitute 13.1% (16) and 4.9% (6) prevalence rate, respectively.

**Table 2:** Sex-Specific Prevalence of Haemoparasitism in Local Scavenger Chickens in Maiduguri

Sex	Haemoparasite	Number of Samples	Prevalence (%)
Male	<i>Haemoproteus spp</i>	16	13.1
	<i>Plasmodium spp</i>	6	4.9
	Apparently Healthy	26	21.3
Female	<i>Haemoproteus spp</i>	23	18.9
	<i>Plasmodium spp</i>	11	9.0
	Apparently Healthy	40	32.8

#### Effect of Haemoparasitism on the Haemogram of Local Scavenger Chickens in Maiduguri

The mean values of the haematological parameters of apparently healthy and haemoparasite-infected local scavenger chickens

(LSC) in Maiduguri is presented in Table 3. There was no significant ( $p>0.05$ ) variation in all the haematological parameters between the apparently healthy and haemoparasite-infected local scavenger chickens.

**Table 3:** Haemogram of Apparently Healthy and Haemoparasites-Infected Local scavenging chickens

Haematological Parameters	Apparently Healthy (n= 66)	Haemoparasite-Infected (n=56)
PCV (%)	31.2±3.8 <sup>a</sup>	31.1±4.9 <sup>a</sup>
Haemoglobin (g/dL)	11.8±3.8 <sup>a</sup>	12.5±3.1 <sup>a</sup>
RBC (10 <sup>6</sup> μL)	2.4±0.5 <sup>a</sup>	2.4±0.5 <sup>a</sup>
WBC (10 <sup>3</sup> μL)	12.3±1.7 <sup>a</sup>	12.1±2.3 <sup>a</sup>
MCV (fl)	131.0±27.2 <sup>a</sup>	131.6±25.6 <sup>a</sup>
MCH (pg)	49.8±18.2 <sup>a</sup>	52.4±13.9 <sup>a</sup>
MCHC (g/dL)	37.7±13.4 <sup>a</sup>	41.0±10.0 <sup>a</sup>
Heterophils (%)	32.9±4.1 <sup>a</sup>	32.7±3.5 <sup>a</sup>
Lymphocytes (%)	57.9±6.0 <sup>a</sup>	57.3±4.9 <sup>a</sup>
Monocytes (%)	6.9±2.7 <sup>a</sup>	7±2.4 <sup>a</sup>
Eosinophils (%)	2.6±1.6 <sup>a</sup>	2.9±1.5 <sup>a</sup>
Basophils (%)	0.0±0.0 <sup>a</sup>	0.0±0.0 <sup>a</sup>

<sup>abc</sup> Mean±SD with different superscripts are significant along rows

#### Mean Haematological Values of Apparently Healthy and Haemoparasite-infected LSC based on Sex in Maiduguri

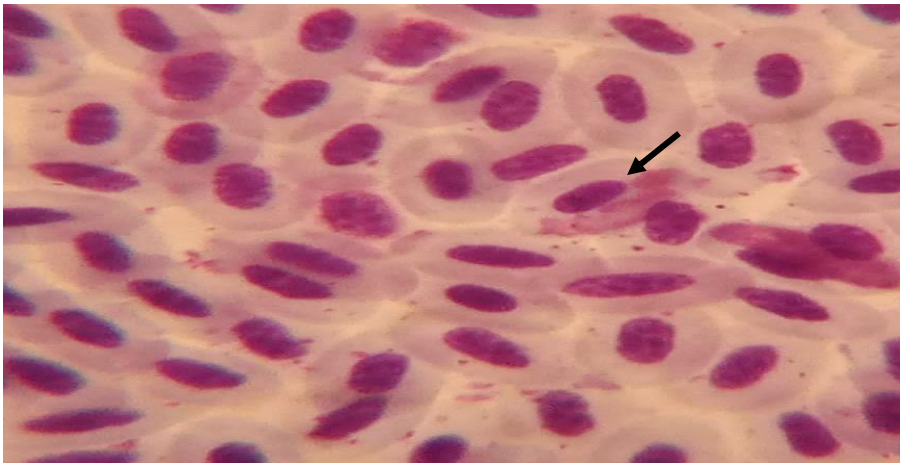
The mean values of the haematological parameters of apparently healthy and haemoparasite-infected LSC based on sex is presented in Table 4. The result showed significant ( $p<0.05$ ) variations in the TWBC counts between apparently healthy male and female ( $12.6 \pm 1.6$  and  $12.1 \pm 1.7$ , respectively); apparently healthy and haemoparasite infected males ( $12.6 \pm 1.6$  and  $12.2 \pm 2.4$ , respectively); apparently healthy male and haemoparasite infected female ( $12.6 \pm 1.6$  and  $12.1 \pm 2.3$ , respectively). Also, there was significant ( $p<0.05$ ) variation in the heterophil counts between

apparently healthy male and female ( $34.5 \pm 4.3$  and  $31.9 \pm 3.7$ , respectively); apparently healthy and haemoparasite infected male ( $34.5 \pm 4.3$  and  $30.0 \pm 3.2$ , respectively); apparently healthy female and haemoparasite infected male ( $31.9 \pm 3.7$  and  $30.1 \pm 3.2$ , respectively); apparently healthy male and haemoparasite infected female ( $34.5 \pm 4.3$  and  $33.1 \pm 3.7$ , respectively). Similarly, there was significant ( $p<0.05$ ) variation in lymphocytes counts between apparently healthy male and female ( $55.2 \pm 5.1$  and  $59.7 \pm 5.9$ , respectively); apparently health female and haemoparasite infected male ( $59.7 \pm 5.9$  and  $57.8 \pm 5.4$ , respectively); apparently healthy female and haemoparasite infected female ( $59.7 \pm 5.9$  and  $57.0 \pm 4.7$ , respectively)

**Table 4:** Mean Haematological Values of Apparently Healthy and Haemoparasite-infected Male and Female Local Scavenger Chickens in Maiduguri

Haematological parameters	Apparently Healthy		Haemoparasite- infected	
	Male (n=26)	Female (n=40)	Male (n=22 )	Female (n=34 )
PCV (%)	32.1 ± 4.0 <sup>a</sup>	30.5 ± 3.6 <sup>a</sup>	31.6 ± 5.8 <sup>a</sup>	30.7 ± 4.4 <sup>a</sup>
Haemoglobin (g/dL)	11.5 ± 3.6 <sup>a</sup>	12.0 ± 4.0 <sup>a</sup>	12.5 ± 2.2 <sup>a</sup>	12.5 ± 3.6 <sup>a</sup>
RBC ( 10 <sup>6</sup> μL)	2.4 ± 0.5 <sup>a</sup>	2.4 ± 0.4 <sup>a</sup>	2.3 ± 0.5 <sup>a</sup>	2.5 ± 0.5 <sup>a</sup>
WBC ( 10 <sup>3</sup> μL)	12.6 ± 1.6 <sup>b</sup>	12.1 ± 1.7 <sup>a</sup>	12.2 ± 2.4 <sup>a</sup>	12.1 ± 2.3 <sup>a</sup>
MCV (fl)	172.2± 204.3 <sup>a</sup>	126.7± 15.5 <sup>a</sup>	142.5± 33.1 <sup>a</sup>	124.6± 16.4 <sup>a</sup>
MCH (pg)	48.8± 17.1 <sup>a</sup>	50.4± 9.1 <sup>a</sup>	56.6± 2.7 <sup>a</sup>	50.5 ± 14.0 <sup>a</sup>
MCHC (g/dL)	34.4± 12.0 <sup>a</sup>	39.8± 4.0 <sup>a</sup>	40.1 ± 6.5 <sup>a</sup>	41.5 ± 11.7 <sup>a</sup>
Heterophils (%)	34.5 ± 4.3 <sup>b</sup>	31.9 ± 3.7 <sup>a</sup>	30.0 ± 3.2 <sup>c</sup>	33.1 ± 3.7 <sup>a</sup>
Lymphocytes (%)	55.2 ± 5.1 <sup>a</sup>	59.7 ± 5.9 <sup>b</sup>	57.8 ± 5.4 <sup>a</sup>	57.0 ± 4.7 <sup>a</sup>
Monocytes (%)	7.2 ± 2.5 <sup>a</sup>	6.7 ± 2.7 <sup>a</sup>	7.0 ± 2.6 <sup>a</sup>	7.0 ± 2.3 <sup>a</sup>
Eosinophils (%)	3.5 ± 1.8 <sup>a</sup>	2.3 ± 1.6 <sup>a</sup>	2.8 ± 1.2 <sup>a</sup>	2.9 ± 1.7 <sup>a</sup>
Basophils (%)	0.0 ± 0.0 <sup>a</sup>	0.0 ± 0.0 <sup>a</sup>	0.0 ± 0.0 <sup>a</sup>	0.0 ± 0.0 <sup>a</sup>

<sup>abc</sup> Mean±SD with different superscripts are significant along rows



**Plate 1:** Photomicrograph of a thin blood smear of LSC showing *Haemoproteus spp* (arrow). Giemsa stain x100



**Plate 2:** Photomicrograph of a thin blood smear of LSC showing *Plasmodium spp* (arrow). Giemsa stain x100

## DISCUSSION

The overall prevalence of 45.9% observed for haemoparasite infection in local scavenger chickens in Maiduguri in the present study was higher than 19.56% previously reported by Karamba *et al.* (2012) in Kano, 37.7% by Hassan *et al.* (2017) in Nassarawa and 11.4% by Lawal *et al.* (2021) in Borno. However, the result of present study appeared slightly lower than the 46.7% prevalence rate earlier reported by Opara *et al.* (2016) in Imo state. The Variations in the reported prevalence rates might be attributed to differences in sample sizes, season of sample

collection and abundance of appropriate arthropod vectors. The result of present study recorded only two *spp.* (*Haemoproteus spp.*, *Plasmodium spp.*) of avian haemoparasite in LSC, while previous studies (Sadiq *et al.*, 2003; Usmana *et al.*, 2012; Buhari *et al.*, 2022) recorded more than two *spp.* (*Haemoproteus* species, *Plasmodium spp*, *Leucozytozoon spp.* and *Trypanosoma spp*). These variations could be as a result of differences in habitat, climate, behaviour and diet of chickens (Siong *et al.*, 2010). Other factors such as methods used for diagnosis, vector/arthropod breeding season, sampling effort

and location and poultry species could be some of the possible reasons (Gimba *et al.*, 2014; Bell *et al.*, 2015).

The higher prevalence rate of haemoparasites observed in female as compared to male in the present study is in consonant with the findings of Hasson (2015) and Naqvi *et al.* (2017) in LSC. However, our result contradict those of Opara *et al.* (2016), Etisa *et al.* (2017), Hassan *et al.* (2018), Ogbaje *et al.* (2019) and Buhari *et al.* (2022) who observed higher prevalence of haemoparasites infections in cocks when compared to hens of village chickens. Similarly, other studies (Al-barwari and Saed, 2012; Lawal *et al.*, 2016; Opara *et al.*, 2016) reported that sex is not a risk factor of acquiring the infections. The exact cause of higher blood parasite infection in females cannot be explained but, in general higher level of prolactin and progesterone hormone suppress the immune status of the individual chicken, thereby making the female chicken more susceptible than males to any parasite infection (Ogbaje *et al.*, 2019). Haason *et al.* (2015) also attributed the higher prevalence of haemoparasite in the female LSC to the fact that, they are kept longer than the male for the purpose of egg production.

The result of statistical significant differences ( $P > 0.05$ ) between apparently healthy and haemoparasite infected chickens in the TWBC and heterophils counts buttresses the reports of Pampori and Iqbal, (2007), Kumar and Kumbhakar, (2015), Ikhlas and Marwa, (2017), Emebet, (2017) and Panigraphy *et al.* (2017). However, there was a slight deviation from Motta *et al.* (2013) who observed higher monocytes in chickens infected with haemoparasites than the

non-infected ones. The stage and severity of the infections also determine the types and population of blood cells in the peripheral circulation and the level of anaemia (Cannell *et al.*, 2013). It could also be that the LSC may be harbouring the parasites without causing any changes to their haematological parameters but in the long run it may have effect on their productivity. Similarly, the significant increase in white blood counts between the apparently healthy female compared to male LSC could be as a result of the weight difference amongst the two sex used for this study. Adeyemo *et al.* (2018) recounted that weight, age, sex, diet type, strain and climate are factors which cause variation in the haematological parameters of chicken. However, this present study disagrees with the finding of Adewole *et al.* (2021) who observed that the FUNAAB Alpha males had higher white blood count over their female counterpart. Also, the higher heterophils counts observe in the present study in the apparently healthy female LSC when compared to the male counterpart is in disagreement with Adewole *et al.* (2023) who observed the opposite. However, the result was similar to the report by Simaraks *et al.* (2004) where the percentages of lymphocytes in females were higher than in male chickens. Therefore, from the result of percentage prevalence of haemoparasites recorded in the present study, it may be concluded that haemoparasites are endemic in LSC population within Maiduguri. However, there occurrence was not significantly associated with sex and haematological parameters except for total white blood cell counts, heterophils and lymphocytes.

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