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Original Research Article

Haematological parameters in relation to age, sex and body weight of free range village chickens (*Gallus gallus domesticus*) in Maiduguri, Nigeria

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ABSTRACT

The haematology of animals including chickens is an important indicator of their health status. It is therefore considered a useful tool in clinical diagnosis. The aim of this study was to investigate the haematological parameters of apparently healthy free range domesticated chickens as influenced by their sex, age and body weights. Blood samples taken from the jugular veins were analysed using standard haematological protocols. PCV, haemoglobin concentration, TRBC, TWBC, differential leukocyte counts, erythrocytes indices (MCV, MCHC and MCH) were measured. The study showed that there were no significant (P>0.05) age-dependent variation in all the measured haematological parameters. However, sex had effect on PCV, TRBC and heterophil count. Male chickens had higher PCV value of (34.4%) and TRBC value of (2.4×10^{12}/L) as compared to female chickens with PCV value of (30.5%) and TRBC value of (2.1×10^{12}/L). On the other hand, female chickens had higher mean heterophil value of (22.0×10^{9}/L) and MCHC value of (29.5g/dl) as compared to male chickens with mean heterophil and MCHC values of (16.8×10^{9}/L) and (25.7g/dl) respectively. There was significant (P<0.05) increase in PCV with increasing body weights in males but not in females. The MCHC decreased significantly (P<0.05) as the body weight increased also in males but not in females. The results of the study indicate that sex and body weights influenced normal haematological parameters of apparently healthy free range domestic chickens in the study environment.

Keywords: Age, body weight, haematology, sex, village chicken.

INTRODUCTION

The local chicken (*Gallus gallus domesticus*) also regarded as rural or family chicken (Spradbrow, 1999) belongs to the family *galliformes* and is a subspecies of the red jungle fowl (Buffalo, 2003). They are natives to southern Asia, particularly the jungles of India and are believed to have originated from a continental population of *Gallus gallus gallus* (Fumihito *et al.*, 1996) and spread all over the world when people domesticated them (Philips, 2010).

These chickens (*Gallus gallus domesticus*) are omnivores. In the wild, they often scratch the soil to search for seeds, insects and even larger animals such as lizards and young mice (Gerard, 2008). They are recognised by their morphologic features. These features are so varied that several combinations of them produce a plethora of chickens referred to as the indigenous or local chickens. Some are long-legged while others are short-legged. Majorities are full feathered while a few are frizzled-feathered. In all cases, a truly indigenous chicken is small sized and commonly weighing less than 1.2 kg at point of lay (Adene, 2004). Though, highly variable in plumage colour and pattern, the predominant plumage colour is perhaps the simple proof of the mongrel genetic status of the indigenous chicken (Adene, 2004).

Local chicken production is based mainly on the scavenging free-range system of management. The chickens constitute the predominant species in the rural poultry sector in Africa (Aichi, 1995). About 85% of the rural households keep chickens or other types of poultry as supplementary to the main livelihood activities in sub-Saharan Africa (Kryger *et al.,* 2010). These local chickens remain predominant in African villages despite the introduction of exotic and crossbred strains, because farmers have not been able to afford the high input requirement of the hybrids (Kaiser,

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1990; Safalaoh, 1997). In the free range scavenging system, local chickens commonly inhabit treetops or chicken houses made of inexpensive local materials (Alders, 2001).

The local chicken flock usually comprises about 5-20 birds kept by one family and it is estimated that the village chicken makes up more than 80% of the total domestic fowl population in Africa (Gueye, 1998). Therefore, they provide household food security and a source of high value animal protein (Aichi, 1995), which invariably reduces the incidence of malnutrition in resource-poor households.

Haematological values and body weight are widely used as indices of health in large animal practice, but are not yet used widely in poultry medicine. Although, in developed countries, it is considered an integral part of clinical laboratory diagnostics in avian medicine (Sarmour, 2006). However, the use of haematological parameters in avian clinical diagnosis cannot be achieved without establishing normal reference values specific to particular species in a particular region (Brar *et al.,* 2011). Therefore, this study aims to establish the haematological values of apparently healthy local chickens in Maiduguri as influenced by age, sex and body weight. It is hoped that the study will provide reference haematological values that would be valuable in the assessment of the health status of the local chicken in the study area.

MATERIALS AND METHODS

SAMPLE POPULATION

A total of 100 local chickens comprising young and adults were randomly procured from various households within Maiduguri Metropolis and Jere local government area. The birds were kept and provided with feeds and water *ad libitum* in cages for two days prior to sampling. The sexes were separated to prevent fighting and stress, which may interfere with the haematological parameters.

SEXING

The chickens were sexed using standard methods as described by Maguelonne *et al.* (2009). Vent sexing was performed for confirmation in young chickens when sexing based on plumage colouration was doubtful (Sargatal *et al.,* 2013).

AGING

Age differences were estimated by plumage colouration, feather (wing and tail) development and its level of wear as described by Saether *et al.* (1994). Level of development of the comb, wattles and the spur may also be used to estimate age of birds (Magwisha, *et al.,* 2002; Maina, 2005). In this study, the chickens were placed into the two age groups (young and adult) based on the above methods and information obtained from the farmers (Table I).

WEIGHING

Individual body weights of birds were taken using manual weighing scale calibrated in grams. All measurements were taken by the same person to avoid variation between individuals. Birds were divided into four groups based on the body weight as follows: W1 (600-700grams), W2 (710-800grams), W3 (810-900 grams) and W4 (910-1000grams).

Table I: Features of the age groups of local free range chickens.

AGE GROUP	FEATURES
Young	Presence of fuzzy natal down and juvenile plumage that replaces natal down. It is dull and loosely textured.
Adult	Presence of adult basic plumage which has glossy appearance. Roosters have well developed comb and wattles. Barbs of the feathers have high ability to reconnect after being disrupted. Rudimentary or prominent spurs.

Source: (Sargatal, *et al.,* 2013).

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SAMPLE COLLECTION

Five millilitres of blood was aseptically collected using 5ml sterile syringe from the right jugular vein (Samour, 2006). The needle was removed and the blood carefully dispensed into sample bottles containing EDTA as anticoagulant. All samples were collected early in the morning and taken to the laboratory within 30 minutes of sampling for analysis.

HAEMATOLOGY

Packed cell volume (PCV) was determined using the standard micro haematocrit method as described by Brar *et. al.* (2011). Haemoglobin concentration was determined using the cyanmethaemoglobin method as described by Brar *et al.* (2011). Total red blood cell (TRBC) and total white counts blood cell (TWBC) were carried out using the standard Natt and Herrick's method as described by Campbell (1995). The differential leukocyte count was carried out as described by Sarmour (2006).

STATISTICAL ANALYSIS

The results were summarized as Means ± Standard deviations. Means were compared using student's t-test for differences in age and sex while a one-way analysis of variance with Turkey post-hoc test was used to compare difference in body weights using computer software [GraphPad Instat, 1993].

RESULTS

THE EFFECT OF SEX ON HAEMATOLOGICAL PARAMETERS OF APPARENTLY HEALTHY LOCAL CHICKENS IN MAIDUGURI.

The mean values of haematological parameters of male and female chickens are presented in Table II. Significant ($p < 0.05$) variations were observed in the mean PCV (34.4% in males and 30.5% in females), total erythrocyte count (TRBC) (2.4×10^{12}/L in males and 2.1×10^{12}/L in females), MCHC (25.7g/dl in males and 29.5g/dl in females) and heterophil counts (16.8×10^{9}/L in males and 22.0×10^{9}/L in females) between male and female village chickens. The mean PCV and total erythrocyte count were significantly ($P<0.05$) higher in males; while MCHC and heterophil counts were significantly ($P<0.05$) higher in females. There were no variations in the other haematological parameters between males and female chickens

THE EFFECT OF AGE ON HAEMATOLOGICAL PARAMETERS OF APPARENTLY HEALTHY LOCAL CHICKENS IN MAIDUGURI

The haemogram of the apparently healthy village chickens based on different age groups is presented in Table III. Age had no significant ($P>0.05$) effect on haematological parameters of local chickens in the study area. .

THE EFFECT OF BODY WEIGHT ON HAEMATOLOGICAL PARAMETERS OF APPARENTLY HEALTHY LOCAL CHICKENS IN MAIDUGURI

The mean values of the haematological parameters of apparently healthy village chickens based on body weights are presented in Table IV. The PCV was significantly higher ($P<0.05$) in groups W3 (34.2%) and W4 (34.6%) as compared to W1 (30.4%) and W2 (31.1%). MCHC values were significantly ($P<0.05$) higher in W1 (29.5g/dl), W2 (29.9g/dl) and W3 (25.6g/dl) as compared to W4 (23.7g/dl). Body weight had no significant ($P<0.05$) effect on the remaining haematological parameters.

Full blood count of 100 apparently healthy scavenger chickens presented in Table V showed the mean values of all the haematological parameters and reference ranges for each parameter.

Table II: Haemogram (Mean ± SD) of apparently healthy male and female village chickens *(Gallus gallus domesticus)* in Maiduguri

Haematological parameters	Male (n=39)	Female (n=61)
PCV (%)	34.4 ± 3.5^{a}	30.5 ± 4.2^{b}
Hb (g/dl)	8.8 ± 2.2^{a}	8.9 ± 2.3^{a}
TRBC $\times10^{12}$/L	2.4 ± 0.5^{a}	2.1 ± 0.3^{b}
TWBC $\times10^{9}$/L	45.6 ± 18.7^{a}	41.2 ± 17.4^{a}
MCHC (g/dl)	25.7 ± 6.4^{a}	29.5 ± 7.1^{b}
MCV (fl)	149.3 ± 28.9^{a}	146.8 ± 29.6^{a}
MCH (pg)	38.8 ± 14.4^{a}	43.2 ± 13.5^{a}
Heterophils ($\times10^{9}$/L)	16.8 ± 9.1^{a}	22.0 ± 13.6^{b}
Lymphocytes ($\times10^{9}$/L)	13.1 ± 7.4^{a}	14.2 ± 5.6^{a}
Monocytes (10^{9}/L)	3.4 ± 2.7^{a}	2.5 ± 2.2^{a}
Eosinophil ($\times10^{9}$/L)	2.4 ± 2.3^{a}	1.9 ± 1.9^{a}
Basophil ($\times10^{9}$/L)	0.2 ± 0.6^{a}	0.1 ± 0.4^{a}
Thrombocytes ($\times10^{9}$/L)	5.3 ± 4.1^{a}	5.0 ± 3.7^{a}

[ab]Mean ± SD along rows with different superscripts are significant at $P<0.05$

Table III: Haemogram (Mean ± SD) of Different Age Groups of Apparently Healthy Village Chickens *(Gallus Gallus domesticus)* In Maiduguri

Haematological parameters	**Young (n=77)**	**Adult (n=23)**
PCV (%)	32.5 ± 2.9^{a}	30.4 ± 6.1^{a}
Hb (g/dl)	9.0 ± 2.6^{a}	8.0 ± 1.8^{a}
TRBC $\times10^{12}$/L	2.3 ± 0.4^{a}	2.2 ± 0.4^{a}
TWBC $\times10^{9}$/L	44.6 ± 17.0^{a}	41.8 ± 15.0^{a}
MCHC (g/dl)	27.5 ± 6.9^{a}	27.1 ± 7.2^{a}
MCV (fl)	142.5 ± 28.5^{a}	141.2 ± 32.2^{a}
MCH (pg)	39.5 ± 12.0^{a}	38.1 ± 13.9^{a}
Heterophils ($\times10^{9}$/L)	20.8 ± 9.7^{a}	17.4 ± 7.1^{a}
Lymphocytes ($\times10^{9}$/L)	13.3 ± 6.3^{a}	14.3 ± 8.6^{a}
Monocytes ($\times10^{9}$/L)	3.4 ± 2.1^{a}	3.0 ± 2.6^{a}
Eosinophil ($\times10^{9}$/L)	2.0 ± 1.9^{a}	2.2 ± 1.8^{a}
Basophil ($\times10^{9}$/L)	0.2 ± 0.4^{a}	0.3 ± 0.7^{a}
Thrombocytes $\times10^{9}$/L)	5.0 ± 2.8^{a}	4.6 ± 3.4^{a}

[ab]Mean ± SD along rows with different superscripts are significant at $P<0.05$

DISCUSSION

Haematological parameters in birds have been shown to be influenced by several factors among which are sex, age, nutrition season of the year, breeds (strains), body weight (Sturkie, 1965; Oyewale, 1990) and diurnal fluctuation and changes in physical and metabolic activities (Sanni *et al.*, 2000; Piccione *et al*., 2001, 2005). In this study, the PCV and the total erythrocyte count were significantly higher in male chickens which were comparable to findings from indigenous chickens in Sudan (Elagib & Ahamed, 2011), golden local quails (Muhammad, 2013) and free range guinea fowl (King *et al.*, 2010). Generally, PCV percentage in males is greater than female fowls (Bowes *et al.*, 1989; Simaraks *et al*., 2004; Pampori & Igbal, 2007; Addass *et al.*, 2012; Abdi-Hachesoo *et al.*, 2013). This may be due to the increased erythropoiesis and metabolic activities influenced by androgens in males (Coles, 1986; Sembulingam, 2010) as androgens and thyroxin are reported to stimulate erythropoiesis, whereas estrogen depresses erythropoiesis (Herbert et al., 1989) which accounts for the lower PCV in females. In contrast, Nowaczewski and Kontecka (2012) reported lower values in male broiler chickens. Among the erythrocyte indices, only MCHC showed significantly higher values in females than in males as opposed to findings reported by Elagib and Ahamed (2011).

In general, this study showed higher total leukocyte values ($42.9 \pm 17.9 \times 10^9$/L) than those reported in intensively managed broiler chickens ($32.6 \pm 1.7 \times 10^9$/L)

Table IV: Haemogram (Mean±SD) of apparently healthy village chickens *(Gallus gallus domesticus)* in Maiduguri based on their individual weights.

Haematological Parameters	Weight in Grams			
	W1 (600-700) n=25	W2 (710-800) n=40	W3 (810-900)n=22	W4 (910-1000)n=13
PCV (%)	30.4 ± 3.9 [a]	31.1 ± 4.9 [a]	34.2 ± 3.1 [b]	34.6 ± 3.4 [b]
Hb (g/dl)	8.9 ± 1.9 [a]	9.2 ± 2.4 [a]	8.8 ± 2.1 [a]	8.0 ± 2.3 [a]
TRBC $\times10^{12}$/L	2.2 ± 0.4 [a]	2.2 ± 0.5 [a]	2.4 ± 0.4 [a]	2.3 ± 0.3 [a]
TWBC $\times10^9$/L	39.6 ± 15.9 [a]	42.9 ± 19.2 [a]	45.5 ± 16.5 [a]	45.6 ± 20.9 [a]
MCHC (g/dl)	29.5 ± 6.4 [a]	29.9 ± 7.3 [a]	25.6 ± 5.8 [a]	23.7 ± 6.7 [b]
MCV (fl)	144.1 ± 29.3 [a]	148.9 ± 34.7 [a]	147.8 ± 21.4 [a]	151.2 ± 23.7 [a]
MCH (pg)	42.5 ± 12.7 [a]	44.4 ± 15.4 [a]	37.8 ± 10.3 [a]	36.8 ± 15.7 [a]
Heterophils ($\times10^9$/L)	17.8 ± 11.4 [a]	17.5 ± 10.2 [a]	21.2 ± 13.1 [a]	21.1 ± 11.4 [a]
Lymphocytes ($\times10^9$/L)	13.7 ± 7.3 [a]	13.5 ± 7.5 [a]	13.8 ± 4.9 [a]	13.0 ± 6.8 [a]
Monocytes ($\times10^9$/L)	2.6 ± 1.8 [a]	3.5 ± 3.0 [a]	2.4 ± 1.8 [a]	3.7 ± 3.1 [a]
Eosinophil ($\times10^9$/L)	2.0 ± 2.1 [a]	2.5 ± 2.4 [a]	1.7 ± 1.2 [a]	2.7 ± 2.8 [a]
Basophil ($\times10^9$/L)	0.2 ± 0.6 [a]	0.3 ± 0.6 [a]	0.2 ± 0.3 [a]	0.1 ± 0.1 [a]
Thrombocytes ($\times10^9$/L)	3.2 ± 2.4 [a]	5.8 ± 4.5 [b]	6.3 ± 4.0 [c]	5.2 ± 3.2 [a]

[ab]Mean ± SD along rows with different superscripts are significant at P<0.05

Table V: Full blood count of apparently healthy local scavenger chickens *(Gallus gallus domesticus)* in Maiduguri

Parameters	No. of chickens	Minimum value	Maximum value	Mean ± SD	Range
PCV (%)	100	19.00	44.00	32.0 ± 4.4	19-44
Hb (g/dl)	100	4.50	15.80	8.9 ± 2.2	5-15
TRBC $\times10^{12}$/L	100	1.41	4.04	2.2 ± 0.4	1.4-4
TWBC $\times10^9$/L	100	14.50	98.50	42.9 ± 17.9	15-98
MCHC (g/dl)	100	14.52	49.38	28.0 ± 7.0	15-49
MCV (fl)	100	91.74	228.76	147.8 ± 29.2	91-229
MCH (pg)	100	21.37	80.39	41.5 ± 13.9	21-80
Heterophils $\times10^9$/L	100	5.25	66.98	18.8 ± 11.3	5-66
Lymphocytes $\times10^9$/L	100	3.19	37.99	13.5 ± 6.7	3-38
Eosinophils $\times10^9$/L	100	0.00	11.28	2.2 ± 2.2	0-11
Monocytes $\times10^9$/L	100	0.00	12.35	3.0 ± 2.5	0-12
Basophils $\times10^9$/L	100	0.00	2.58	0.2 ± 0.5	0-3
Thrombocytes $\times10^9$/L	100	0.00	18.33	5.2 ± 3.9	0-18

(Nowaczewski, 2012). This may explain why extensively managed scavenger chickens are relatively resistant to some diseases (Talabi *et al.,* 2005). In a study by Bayona *et al.* (2017) in chickens, leucocytes (predominantly heterophils) were seen to be rapidly mobilized to site of acute inflammation as early as 4 hours and reached a peak at 12 hours post challenge; with heterophils and monocyte/macrophages being the main contributors of reactive oxygen species (ROS) production. However, only heterophil count showed significant ($P<0.05$) variation with higher values in females which may reflect the physiological stress due to laying in adult females (Talabi *et al.,* 2005; Muhammad, 2013). Some workers (Maxwell & Robertson, 1998; Puvadolpirod & Thaxton, 2000; Davis *et al.,* 2008) have reported the use of the heterophil/lymphocyte ratio as an indicator of physiological stress in the avian specie. This is because heterophils increase during mild or moderately stressful conditions. The higher heterophil values in females in this study are similar to reports by Muhammed (2013) in golden quails and Talabi *et al.* (2005) in broiler hybrids. In contrast, results of lower values were reported by Abdi-Hachesoo *et al*. (2013). Heterophils were observed to be the most abundant leukocyte in this study. This may be because of the scavenging nature of the birds which makes them prone to stressful conditions and heterophils have been reported to increase in mild or moderately stressful conditions (Puvadolpirod & Thaxton, 2000; Davis *et al.,* 2008). Similar findings were made by Aroch *et al.* (2013) whereas in some avian species, lymphocytes were reported to be the predominant cell type (Latimer *et al.,* 1988; Fudge, 2000; Schmidt *et al.,* 2009).

Age had no significant influence on all the haematological parameters in this study. This is in contrast to findings in broiler hybrids by Talabi *et al.* (2005) who reported that, with increasing age, the erythrocytic parameters (except MCV, MCH and MCHC) and leukocytic parameters (except heterophils and heterophil/lymphocyte ratio) were significantly increased. Similar observation was made by Muhammad (2013) where the haematological parameters increased in direct proportion to age in golden quails. This also agrees with an age related haematological findings in Kori Bustard (*Aedeotiskori*) chicks (Sarmour, 2006) where there was steady increase in their haematological parameters between 1-4 months of age although, this was followed by about 5 months of plateau, where no rise in haematological values were observed. Increase in haematological parameters of avian specie has mostly been reported in adult birds probably because of the effect of sexual hormones such as androgens on blood parameters. This may explain why no significant variations were observed between the various age groups because most of the birds sampled in this study were within the age range of 4-10 months.

Packed cell volume (PCV) values in this study showed a significant increase with increasing body weight. This may be attributed to the increasing energy demand by the body, increasing growth rate and high production of metabolic hormones with resultant release of large numbers of erythrocytes into circulation (Fair *et al.,* 2007; Aina & Ajibade, 2014; Sujata *et al.,* 2014). In contrast, the MCHC decreased significantly with increasing body weight and this may be explained by the increases in PCV values.

CONCLUSION

Haematological parameters of village chickens in the study area were influenced by sex and to a lesser extent by their individual body weights, with no influence due to different age of the chickens.

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CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

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