Journal of Animal Husbandry and Dairy Science
Volume 3, Issue 1, 2019, PP 14-19.
ISSN 2637-5354

Effect of Age and Sex on Haematological Profiles in Indigenous Helmeted Guinea Fowl (Numida Meleagris) in the Guinea Savannah Zone of Ghana

[1]Ali ZS, [1*]Obese, FY [1]Naazie A, [2]Abdul-Rahman II, and[1]Ayizanga RA

[1]*Department of Animal Science, University of Ghana, P.O.Box LG226, Legon, Ghana*
[2]*University for Development Studies, Tamale, Ghana*

***Corresponding Author:** Dr. Frederick Y. Obese, Department of Animal Science, University of Ghana, Legon, Email: fyobese@yahoo.com*

ABSTRACT

The objective of this study was to evaluate the effect of age and sex on haematological indices in the helmeted Guinea fowl. Blood samples were collected from 10, 26 and 52 weeks old helmeted Guinea fowls classified as early growers, adults and breeders from TibZaa farms in the Northern Region of Ghana and the haematological profiles of the birds determined. Haematological indices determined were haemoglobin, red blood cell (RBC), packed cell volume (PCV), mean corpuscular volume (MCV),mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), total white blood cell (WBC) counts, heterophils, basophils, eosinophils, monocytes and lymphocytes. Haemoglobin concentration was higher ($P<0.05$) for 52- week old Guinea fowls than the 10 and 26 week olds. The overall mean haemoglobin concentration was 12.25 ± 2.15 g/dL. The PCV percentage was higher ($P<0.05$) in the 52-week old Guinea fowls than the 10 and 26 week olds. The overall mean PCV value was 34.11± 9.18%. The 52-week old Guinea fowls had higher ($P<0.05$) MCV and MCH levels than the 10 and 26–week olds. The overall mean MCV and MCH values were 168.31 ± 57.65 fL and 60.43 ± 16.47 pg respectively. The 26–week old Guinea fowls had higher heterophils counts than the 10-week olds (60.37 ± 1.05 versus 56.53 ± 1.07 %). The overall mean heterophils count was 58.53 ± 6.83%. Lymphocyte percentage was significantly ($P<0.05$) higher in the 10–week old Guinea fowls than the 26–week olds. The overall mean lymphocyte value was 32.71 ± 8.13%. Apart from haemoglobin concentration which was significantly ($P< 0.05$) higher in male than female Guinea fowls (13.16 ± 0.30 versus 11.91 ± 0.30 g/dL), the effect of sex was not significant ($P>0.05$)on the other haematological indices measured. The levels of some haematological indices increased with age in the Guinea fowl.

Keywords: *age, sex, haematology, guinea fowl*

INTRODUCTION

The helmeted Guinea fowl is an important poultry species, commonly kept by most households in the three northern regions in Ghana (Teye et al., 2000). It is a hardy bird which produces tastier-gamey meat which is very tender, lean and rich in protein and essential fatty acids. Its hard-shelled eggs have longer shelf and storage life and are less susceptible to breakage during handling (Teye and Adam, 2000). In some societies in Ghana, the production of Guinea fowl serves as a source of ready cash for investment in crops production and purchase of grains to bridge the gap in food shortages (Konlan and Avornyo, 2013). In addition, they play key roles in certain ceremonial and festive rites (Teye and Adam, 2000). According to Adeyemo et al. (2006), there is enormous potential in the Guinea fowl to contribute to the much-needed animal protein requirements in diets of people in developing countries.

Haematological indices play important roles in the productivity and adaptability of birds in their production environments. Coupled with other diagnostic procedures these indices enables the evaluation of health and nutritional status of animals (Newman et al., 1997; Okoroet al., 2011). Furthermore, information on blood profiles can be used in the development of new genetically superior strains (Abdi-Hachesoo et al., 2013). Haematological indices of importance to ornithological studies include Haemoglobin, Red Blood Cells, Packed Cell

Volume, White Blood Cells, Mean Corpuscular Volume, Mean Corpuscular Haemoglobin and Mean Corpuscular Haemoglobin Concentration (Reece and Swenson, 2004; Etim et al., 2014).

Changes in the levels of haematological constituents can influence production performance of livestock including poultry (Onasanya et al., 2015). In poultry, these parameters are markedly influenced by nutritional status, diseases, physiological states, sex differences, age, season, systems of production, and breed and genotype (Okoroet al., 2011; Etim et al., 2014).Currently there is dearth of knowledge on the haematological profiles in the helmeted Guinea fowl raised under the various production systems in Ghana. Information on the normal haematological values in the helmeted Guinea fowl under our local conditions is therefore key as this will enhance proper nutrition and management, breeding, disease prevention and treatment. The main objective of this experiment is to determine the effect of age and sex on haematological profiles in the indigenous helmeted Guinea fowl (Numida meleagris) reared intensively in the Northern Region of Ghana.

Materials And Methods

Experimental Location and Duration of Study

This study consisted of two experiments undertaken at two different locations. The first experiment (Experiment 1) was carried out at TibZaa farm located in the Tamale Metropolis of the Northern Region of Ghana. The Metropolis is located within the Savannah woodland zone of Ghana. The area is 180 m above sea level and the land is generally rolling with few isolated hills. This area lies between latitude 9º16' and 9º 34' N and longitudes 0º 36' and 0º 57' W (GSS, 2014). The area has a unimodal rainfall pattern which occurs from May to November. The mean annual rainfall is between 900-1300 mm. The dry season is characterized by dry harmattan winds from November-February and high sunshine from March-May (GSS, 2014).

Management, Feeding and Watering of Birds

The study consisted of 98 helmeted Guinea fowls (49 birds per sex) that were indigenous to the Northern Region of Ghana and were maintained at TibZaa farm in the Tamale Metropolis. Birds of ages10, 26 and 52 weeks were used in this study. The Guinea fowls were housed in structures that consisted of rectangular concrete side walls about 1 m high and covered with wire netting in all four corners. This house had iron roofing. The floors were covered with wood shavings. Keets (0-8 weeks) were fed ration containing 23.64% crude protein (CP) while growing birds (9 weeks onwards) were given a ration containing 16.19% CP on the farm. Feed and water were provided ad lib. The birds used in this experiment were selected at random and sexed using the size and length of phalli as described by Abdul-Rahman et al. (2015). Male Guinea fowls had prominently thicker and longer phalli compared to female Guinea fowls. Appropriate prophylactic treatments and vaccinations were administered throughout the experimental period.

Blood Sampling

Blood was collected aseptically with a sterile syringe and needle between 07:00 and 10:00 h from the wing vein of each bird. 1 mL of blood sample was collected from each bird and then dispensed into a 7 mL glass vacutainer tube (Agary Pharmaceutical Ltd, Nigeria) containing ethylene diamine tetra acetic acid anticoagulant for haematological analyses. The blood samples were placed on ice and transported immediately to the Animal Research Institute's Parasitology Laboratory for haematological evaluations.

Hematological Analysis

The blood parameters measured were Hb, PCV, total RBC count and its indices mean corpuscular volume (MCV) mean corpuscular haemoglobin (MCH), and mean corpuscular haemoglobin concentration (MCHC), and total WBC count and its differentials (heterophils, lymphocytes, monocytes, eosinophils and basophils).

The haemoglobin concentration was determined by the cyanmethaemoglobin method (Gillet et al. 2009) while PCV was estimated by the micro haematocrit method (Samour, 2006). The RBC and WBC counts were determined using the haemocyto meter. The RBC indices were computed using the formulas provided by Reece and Swenson (2004) as follows,

- $\text{MCV (fl)} = \frac{\text{PCV}}{\text{RBC}} \times 10$
- $\text{MCH (pg)} = \frac{\text{Hb}}{\text{RBC}} \times 10$
- $\text{MCHC (\%)} = \frac{\text{Hb}}{\text{PCV}} \times 100$

Thin blood smears stained with Giemsa stain were used for the differential WBC counts.

Statistical Analyses

The analyses were first run on a full model including all interactions. Subsequently, interactions found to be non-significant in the respective models were eliminated. The data were then subjected to least squares analysis using the Generalised Linear Model (GLM) type III procedure of Statistical Analysis System (SAS, 1999) on the following fixed model:

Yij = μ + Ai+ Sj + eij

Yij = The parameter of interest (PCV, Hb, RBC, MCV, MCH, MCHC, WBC etc)

μ = Overall mean for the parameter of interest

Ai = Fixed effect of ith age (i= 3)

Sj = Fixed effect of jth sex (j= 2)

eij = Random error associated with each record

Where the analysis of variance showed significant differences between groups, the PDIFF procedure of SAS (1999) was used to separate such means.

Results and Discussion

The haematological parameters of helmeted Guinea fowls from the TibZaa farm in the Northern Region of Ghana are given in Table 1. The RBC pigment Hb is responsible for transport of oxygen and carbon dioxide to and from cells and tissues during respiration (Klinken, 2002). The Hb concentrations recorded in this study increased with age with concentrations being higher for breeder birds (52 weeks) than those of early growers(10 weeks) and adults (26 weeks). This may be attributed to increased demand for oxygen from greater metabolic and physiological activities as the birds matured from 10 weeks to 52 weeks (Keçeci and Çöl, 2011). The overall mean Hb concentration 12.25 ± 2.15 g/dL obtained in the present study was similar to the values of 12.64 ± 2.29 g/dL and 12.17 ± 0.67 g/dL reported by Oyewale and Ogwuegbu (1986) and Okoro et al. (2011) respectively for Guinea fowls in Nigeria. The PCV level followed a similar pattern and was higher ($P<0.05$) for birds at 52 weeks than those at 10 and 26 weeks of age. The increase in PCV values with age might be attributed increased erythropoiesis due to increased growth rate, metabolic activities, and high production of gonadotrophins and metabolic hormones which resulted in the release of large amounts of RBC into circulation (Fair et al., 2007; Aina and Ajibade, 2014; Sujata et al., 2014). The overall mean PCV value of 34.11 ± 9.8% obtained in this study was comparable to the values 36.0 ± 3.80 and 33.16 ± 0.83 % reported for the Guinea fowl by Strakova et al.(2010) and Pandian et al. (2012) in Czech Republic and India respectively. The PCV value was however, lower than the 45.50 ± 9.02 % reported by Olayemi (2009) for Guinea fowls in Nigeria. Factors such as differences in age, management of the birds and location of studies could have accounted for these differences.

RBC counts determined in this study did not vary with age. The overall mean total RBC counts 2.11 ± 0.45 $x10^{12}$/L obtained was in agreement with the reported values of 2.03 ± 0.41, 2.20 ± 0.78 and 2.15 ± 0.45 $x10^{12}$/L for the Guinea fowl by Oyewale and Ogwuegbu (1986), Olayemi (2009), and Strakova *et al*. (2010).The mean corpuscular volume (MCV) provides information on the size of erythrocytes. It varies directly with PCV and is inversely related to RBC counts (Reece and Swenson, 2004). From this study, the RBC counts obtained did not vary significantly with age and the increasing trend in MCV was similar to PCV. Therefore, the higher MCV at 52 weeks could be related to the stimulatory effect of erythropoietin on erythropoiesis which resulted in the release of large number of RBCs in the blood (Aina and Ajibade, 2014). The overall mean MCV value 168.31 ± 57.65 fL recorded in the present study was comparable to the value 158.78±14.66 fL reported by Awotwi and Booehene (1992) in Ghana but lower than those reported elsewhere (Oyewale and Ogwuegbu, 1986; Olayemi, 2009; Okoro et al., 2011). These differences might be due to location, management, nutrition or season. The MCH levels showed similar pattern of increase with age as did Hb concentration. The haemoglobin content of RBC is reflected by the MCH and MCHC (Sujata et al.,2014). The higher MCH at 52 weeks is due to the higher Hb contents of blood at the 52 weeks, since MCH is directly proportional to Hb (Reece and Swenson, 2004; Dalai et al.,2015). The overall mean MCH value of 60.43 ± 16.47 pg obtained in this study was within the reported physiological range 44.2 - 71.6 pg for Guinea fowls (Olayemi, 2009; Strakova et al., 2010; Pandian et al., 2012; Adedibu et al., 2014).MCHC was observed to be unaffected by age. A similar result has been reported in chickens (Islam et al., 2004). The overall mean MCHC value 33.38 ± 8.65% in this study was within the normal ranges of 28.4- 35.4 % reported in various studies involving the use of Guinea fowls (Awotwi and Boohene, 1992; Olayemi, 2009; Strakova et al., 2010; Pandian et al., 2012). The WBC counts were similar in the 10 week, 26 week and 52 week old Guinea fowls examined. The overall mean value 2.90 ± 0.62 x10^9/L was lower than the range of 13.6 – 14.4 x10^9/L reported by some workers for the Guinea fowl (Oyewale and Ogwuegbu, 1986; Awotwi and Boohene, 1992; Strakova et al., 2010; Adedibu et al., 2014). It was however, comparable with the 1.43 ± 0.08 x10^9/L obtained by Okoro et al. (2011). The differences in the above observations may be due to different ages of birds used and management practices as well as the health condition of the birds used as these factors tend to affect WBC counts in birds.

Table1. *Haematological indices three age groups of helmeted Guinea fowl at TibZaa*

Parameter	Age (weeks)			Overall Mean	P- value
	10 (39)	26 (41)	P- value		
Hb (g/dL)	11.46± 0.31^b	12.31^b± 0.30	13.83^a ± 0.46	12.25±2.15	0.001
RBC (x10^{12}/L)	2.15± 0.07	2.12± 0.07	1.98± 0.11	2.11±0.45	0.405
PCV (%)	32.68± 1.39^b	32.61± 1.36^a	40.50± 2.05^a	34.11±9.18	0.001
MCV (fL)	155.31±8.69^b	160.29±8.48^b	214.04±12.79^a	168.31±57.65	0.001
MCH (pg)	54.50±2.44^b	60.38± 2.38^b	73.39± 3.59^a	60.43 ± 16.47	0.001
MCHC (%)	32.03± 1.38	34.30± 1.35	34.32± 2.03	33.38 ± 8.65	0.446
WBC (x10^9/L)	2.78± 0.10	3.02± 0.10	2.88± 0.14	2.90 ± 0.62	0.237
Heterophils (%)	56.53± 1.07^b	60.37± 1.05^a	58.06± 1.58^{ab}	58.40 ± 6.83	0.041
Basophils (%)	1.74± 0.25	2.46± 0.24	2.44± 0.37	2.17 ± 1.57	0.088
Eosinophils (%)	3.85± 0.64	3.73± 0.62	3.00± 0.94	3.63 ± 3.97	0.744
Monocytes (%)	2.51± 0.45	3.58± 0.44	3.17± 0.66	3.08 ± 2.79	0.237
Lymphocytes(%)	35.37± 1.25^a	29.86± 1.22^b	33.33 ± 1.84^{ab}	32.71 ± 8.13	0.009

Farms(LSM ± SE) Means in the same row with different superscripts (a, b) are significantly different (P<0.05)Number of birds per age group is represented in parenthesis

Birds at 26 weeks had higher heterophils than the 10-week olds. Since heterophils are the first line of defence against bacterial invasion (Mócsai, 2013), the increased levels at 26 weeks may be attributed to increase in response to some pathological conditions such as bacterial infection (Reece and Swanson, 2004;Frandson et al., 2009). However, all the birds remained physically healthy during the study. Heterophils were the predominant leucocytes in this study, similar to what was reported by Okoro et al. (2011).Basophils, eosinophils and monocytes values were similar in the three age groups. The values obtained for these WBC differentials were comparable to the values 0.82 ± 0.18 %, 3.25 ± 1.55 % and 5.50 ± 0.54 % reported by Okoro et al. (2011) for the helmeted Guinea fowl in Nigeria. However, a study by Awotwi and Boohene (1992) in Ghana with 32-week old helmeted Guinea fowls reported higher WBC, Basophils, eosinophils and monocytes values than the present study. Probably, the birds used in the study by Awotwi and Boohene (1992) may have had some underlying sub-clinical parasitic infections. Also, different management practices imposed on the birds may have accounted for this Lymphocyte percentage was higher in Guinea fowls at 10 weeks of age than those at 26 weeks of age. The higher value in the 26-week old birds may be due to physiological causes associated with intense growth (Kerr, 2002). The overall mean value 32.71 ± 8.13% obtained was comparable to the value of 31.33 ± 1.51% reported by Okoro et al. (2011).

Table2. *Haematological indices in male and female helmeted Guinea fowl at TibZaa*

Parameter	Sex		P-Value
	Male (49)	Female (49)	
Hb (g/dL)	13.16± 0.30^a	11.91± 0.30^b	0.003
RBC (x10^{12}/L)	2.16± 0.07	2.01± 0.07	0.136
PCV (%)	36.10± 1.33	34.42± 1.33	0.378
MCV (fL)	172.86± 8.32	180.24± 8.31	0.532

MCH (pg)	63.68± 2.33	61.84± 2.33	0.577
MCHC (%)	32.24± 1.32	34.85± 1.32	0.167
WBC ($x10^9$/L)	2.95± 0.09	2.83± 0.09	0.376
Heterophils (%)	57.86± 1.03	58.78± 1.03	0.524
Basophils (%)	2.40± 0.24	2.03± 0.24	0.267
Eosinophils (%)	4.04± 0.61	3.01± 0.61	0.234
Monocytes (%)	3.21± 0.43	2.96± 0.43	0.678
Lymphocytes (%)	32.48± 1.20	33.22± 1.20	0.666

Farms (LSM ± SE) Means in the same row with different superscripts (a, b) are significant different (P <0.05)Number of birds per sex is represented in parenthesis

Effect of sex on haematological indices of helmeted Guinea fowls at Tibzaa farms indicated that Male Guinea fowls had higher Hb concentrations than females (Table 2) corroborating the observations in other research involving Guinea fowls (Awotwi and Boohene, 1992; Nalubamba et al., 2010; Okoro et al., 2011).

This is not surprising since the male hormone testosterone, is known to stimulate erythropoiesis in male animals, thus accounting for the above observations (Balash et al., 1973; Sturkie, 1986; Vander et al., 1990) whilst oestrogen (the female hormone) inhibits erythropoiesis in females (Campbell, 2012). The sex of Guinea fowl did not influence the other haematological indices measured. Okoro et al. (2011) also did not observe any significant effect of sex on WBC counts and its differentials in the helmeted Guinea fowl.

Conclusions

Some of the haematological indices such as Hb, PCV, MCV, MCH, MCH generally increased with age in the helmeted Guinea fowl suggesting an increase in metabolic and physiological activities as birds mature. Stimulatory effect of androgen on erythropoiesis increased the Hb concentrations in male Guinea fowls

References

[1] Abdi-Hachesoo B, Talebi A, Asri-Rezaei S, Basaki M. Sex related differences in biochemical and haematological parameters of adult indigenous chickens in Northwest of Iran. Journal of Animal Science Advances.2013: 3 (10): 512-516.

[2] Abdul-Rahman I.I, Awumbila B, Jeffcoates IA, Rboinson JE, Obese FY. Sexing in Guinea fowls (*Numida meleagris*). Poultry Science. 2015: 94 (2): 311 – 318.

[3] Adedibu II, Ayorinde KL, Musa AA. Identification of haematological markers suitable for improving productivity of helmeted Guinea fowl (*Numida meleagris*). American Journal of Experimental Agriculture.2014: 4 (10): 1186-1196.

[4] Adeyemo AI, Oyejola O. Afolayan TA. Performance of Guinea fowl (*NumidaMeleagris*) fed varying protein levels. Journal of Animal and Veterinary Advances. 2006:5 (6): 519-521.

[5] Aina OO, Ajibade T. Age- related changes in haematologic parameters of cage-raised Japanese quails (*Cortunix japonica*). Journal of Veterinary Medicine and Animal Health.2014: 6 (4): 104-108.

[6] Awotwi EK, Boohene YG. Hematological studies on some poultry species in Ghana. Bulletin of Animal Health and Production in Africa. 1992: 40: 65-71.

[7] Balash J, Palacious LL, Musquera S, Ralomeque J, Menez MJ , Alemany M. Comparative haematological values of several Galliformes. Poultry Science.1973: 52: 1531-1534.

[8] Campbell TW. Haematology of birds. In: Thrall MA, Weiser G, Allison RW,

[9] Campbell, TW (eds.) Veterinary Haematology and Clinical Chemistry. 2nd ed.. John Wiley &Sons Inc. USA. 2012.p238-276.

[10] Dalai M, Puspamitra S, Bhattacherjee A, Acharya D, Mohanty PK. Comparative Haematology of *Anas platyrhynchos* (Anseriformes) and *Coturnix coturnix japonica*(Galliformes). Journal of Entomology and Zoology Studies.2015: 3 (5): 50-53.

[11] Etim NN, Willaims ME, Akpabio U, Offiong EEA. Haematological parameters and factors affecting their values. Agricultural Science. 2014: 2 (1): 37-47.

[12] Fair J,Whitaker S, Pearson B. Sources of variation in haematocrit in birds. Ibis, 2007:149: 535–552.

[13] Frandson RD, Wilke WL, Fails AD. Anatomy and physiology of farm animals, 7th eds. USA: Wiley-blackwell; 2009

[14] Ghana Statistical Service- GSS. 2010 Population & Housing Census. District Analytical Report. Tamale Metropolis. Statistical Service, Ghana. 2014

[15] Islam MS, Lucky NS, Islam MR, Ahad A, Das BR, Rahman MM, Siddiu MSI.Haematological parameters of Fayoumi, Assil and Local chickens reared in Sylhet Region in Bangladesh. International Journal of Poultry Science. 2004: 3 (2): 144-147.

[16] Keçeci T, Çöl R. Haematological and biochemical values of the blood of pheasants (*Phasianus colchicus*) of different ages. Turkish Journal of Veterinary and Animal Sciences2011: 35(3):149–156.

[17] Kerr MG. Veterinary laboratory medicine: Clinical biochemistry and haematology. 2^{nd} eds. UK: Blackwell Science Ltd; 2002

[18] KlinkenSP.Red blood cells. The International journal of Biochemistry and cell Biology. 2002: 34: 1513 – 1518.

[19] Konlan SP, Avornyo FK. The effect of wetland on Guinea fowl (*Numida meleagris*)egg productivity and fertility during the dry season in the Guinea Savannah Ecological Zone of Ghana. Sky Journal of Agricultural Research. 2013: 2 (9): 126 – 131

[20] Mócsai A. Diverse Novel Functions of Neutrophils in Immunity, Inflammation, and Beyond (Review). Journal of Experimental Medicine. 2013: 210 (7): 1283-1299.

[21] Nalubamba KS, Mudenda NB, Masuku M. Indices of health: clinical haematology and body weights of free-range Guinea fowl (*Numida meleagris*) from the Southern Province of Zambia. International Journal of Poultry Science. 2010: 9 (12): 1083-1086.

[22] Newman SH, Piatt JF, White J. Haematological and plasma biochemical reference range of Alaskan seabirds: Their ecological significance and clinical importance. Colonial Water birds.1997: 20 (3): 492-504.

[23] Olayemi FO.Haematological changes in Guinea fowls (*Numida meleagris galeata*, Pallas) following haemorrhage. International Journal of Poultry Science. 2009: 8 (11): 1093-1095.

[24] Okoro VMO, Ogundu UE, Ogbuewu IP, Obikaonu H, Emenyonu C.Effect of sex and systems of production on the haematological and serum biochemical characters of helmeted Guinea fowls in South-Eastern Nigeria. International Journal of Biosciences. 2011: 1 (3): 51-56.

[25] Onasanya GO, Oke FO, Sanni TM, Muhammad AI. Parameters influencing haematological, serum and bio-chemical references in livestock animals under different management systems. Open Journal of Veterinary Medicine. 2015: 5: 181-189.

[26] Oyewale JO, Ogwuegbu SO. Hematological studies on the Guinea fowl (*Numida meleagris* Pallas). Bulletin on Animal Health and Production in Africa 1986: 34): 61-65.

[27] Pandian C, Pandiyan MT, Sundaresan A, Omprakash AV. Haematological profile and erythrocyte indices in different breeds of poultry. International Journal of Livestock Research. 2012: 2 (3).

[28] Reece WO, Swenson MJ. The composition and functions of blood. In: Reece WO (ed). Duke's Physiology of Domestic Animals. 12^{th} ed. Comstock Publishing Associates, Cornell University Press. Ithaca and London, 2004. p 26-51.

[29] Samour J. Diagnostic value of hematology. In: Harrison GJ, Lightfoot TL Clinical Avian Medicine. Vol. II. Spix publishing, Inc., Palm Beach, Florida. 2006. p 587-630.

[30] SAS. Statistical Analysis Systems. Version 8, for windows. SAS Institute Inc., Cary, North Carolina, U.S.A. 1999.

[31] Strakova E, Suchy P, Kabelova R, Vitula F, Hezig I.Values of selected haematological indicators in six species of feathered game. *Acta Veterinaria*Brunensis.2010: 79: S3 – S8.

[32] Sturkie PD. Avian Pathology. New York: Springer – Verlag; 1986.

[33] Sujata P, Mohanty PK, Mallik BK.Haematological analyses of Japanese Quail (*Coturnix Coturnix Japonica*) at different stages of growth.International Research Journal of Biological Sciences. 2014: 3 (11):51-53.

[34] Teye G A, Gyawu P, Agbolosu A, Dei HK, Adjekum YA. Simple technique for sexing young Guinea fowl. World Poultry Elsevier2000: 16 (7).

[35] Teye GA, Adam M. Constraints to Guinea fowl production in northern Ghana: A case study of the Damongo area. Ghana Journal of Agriculture Science 2000: 33: 153-157.

[36] Vander, A.J., Sherman, J.H. and Luciano, D.S. Human physiology: The mechanisms of body function. 4^{th}ed. New York: McGraw-Hill Publishing Company; 1990

Citation: *Ali ZS, Obese, FY,Naazie A, Abdul-Rahman II, and Ayizanga RA."Effect of Age and Sex on haematological Profiles in Indigenous Helmeted Guinea Fowl (Numida Meleagris) in the Guinea Savannah Zone of Ghana" Journal of Animal Husbandry and Dairy Science, 3(1), pp 14-19.*