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Effect of Sex and Genotype on Hematological Parameters of Four Commercial Broiler Chickens

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ABSTRACT

Background: The study was conducted to know the effect of sex and genotype on hematological parameters of Arbor acre, Ross, Marshall, and Cobb chickens.
Methods: A total of 200 day-old commercial broiler chicks were used for this study. The birds were randomized and allotted to pens in a brooder house. During the period of 8 weeks, records were kept everyday on Body weight (BDW), this was measured using digital electronic weighing balance of 3,000g capacity. The chicks were fed ad libitum with a broiler starter feed containing 23.75% Crude Protein (CP) and 3,038.64 MEKcal/kg up to 4 weeks of age; thereafter the birds were given broiler finisher diet containing 19.95% CP and 3,102.00 MEKcal/kg till 8 weeks.
Results: The result obtained showed a reduced level of concentration of RBC in all Strains, lower than the normal physiological range or value of 4.21–4.84x 106 /ml. and this could be an indication of poor nutrition especially dietary deficiencies of iron, copper, vitamins, and amino acids. Also, a reduced Hb count was noted in all broiler strains irrespective of sex similarly with normal range of 11.60 to 13.68 g/dl. Arbor acre and Cobb strains showed a better resistance against infectious diseases than the rest of the strain due to high lymphocytes and white blood cell counts.
Conclusion: From this study, it can be concluded that sex and genotype of broilers had a significant ($p<0.05$) effect on different hematological parameters like WBC, lymphocytes, PCV, MCH and MCHC. There were no cases of abnormal rise in the count of WBC and this could suggest a greater ability of male arbor acre and cobb in fighting infections.
Recommendation: The result of the study is helpful for accurate interpretation of hematological parameters of commercial broiler chickens. It is therefore recommended that for profitable broiler production in the tropics, Cobb and Arbor Acre males be considered due to their ability to fight infections.

INTRODUCTION

Broiler production represents nearly 33% of global meat production and is a source of protein that plays an important role in human nutrition (FAO, 2010). Modern intensive poultry production produces market ready broiler chickens within six weeks of their age, this achievement arises from improved productivity via genetic selection, improved feeding and health management practices involving usage of antibiotics as therapeutic agents to treat bacterial diseases and as feed additives for growth promotion (Apata, 2009). One of the major challenges faced by the poultry industry in the developing world is improving efficiency of production. There are various ways to meet up with this challenge and maintain the efficiency of feed utilization, these include incorporation of genetics selection, antimicrobials and other natural products, such as antibiotics as therapeutic agents to treat bacterial diseases and as feed additives for growth promotion, probiotics, vitamin supplements and antibodies to animal feeds and pelleting of feed, all decrease the time that an animal requires to reach market weight, reducing feed and overall cost (Kanwal *et al.,* 2017).

Hematological and blood biochemical diagnosis of disease in human and veterinary medicine within individuals or a population is well established. The ability to compare individual data to a known healthy population mean can be used to identify outliers and diagnose specific disorders (Lindholm and Altimiras, 2016). However, hematological studies are very important in diagnosing the structural and functional status of the animal's body (Elagib *et al.,* 2011). Hematological changes are routinely used to determine various influences of environmental, nutritional and or pathological factors (Graczyk *et al*., 2003). A meta-analysis of haematological parameters allowed comparison of domesticated chickens (commercial or indigenous) with the ancestral red jungle fowl, with wild birds in the order Galliformes and with wild birds. Major differences were observed with haematocrit (HCT)/packed cell volume (PCV). The HCT/PCV was very similar between the ancestral species from which chickens were domesticated, the red jungle fowl (Gallus gallus) and wild birds in the order Galliformes (Scanes and Christensen, 2014). Such information apart from being useful for diagnostic and management purposes could equally be incorporated into breeding programmes for genetic improvement of indigenous chickens (Kral and Sachy, 2000). For proper management of broiler chicken, it is desirable to know the normal physiological values under normal situation. For example, high PCV (%) and high Hb (g/dl) are indicators of high feed conversion efficiency (Nyaulingo, 2013). The haematological parameters of healthy birds are influenced by many factors which include feed restriction and nutrient conditions (Etim *et al*., 2014), environmental factors (Vecerek *et al*., 2002; Graczyk *et al*., 2003), fasting (Lamosova *et al*., 2004), nutritional contents (Bashar *et al*., 2010), water and feed restriction (Iheukwumere and Herbert, 2003; Boostani *et al*., 2010), age (Talebi *et al*., 2005), continuous supplementations of vitamin E (Tras *et al*., 2000), administration of drugs (Squires and Julian, 2001; Suresh *et al*., 2012), breed (Mushi *et al*., 1999) and aflatoxin (Oguz *et al*., 2000). Various studies have been done on the effect of food supplements, different diets (nutrition), management system, sex and breed on hematological parameters of broiler chickens and wild birds in the order Galliformes. The objective of this study is to know the effect of sex and genotype on Hematological parameters of four commercial broiler chickens.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Poultry Unit of Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso Oyo State, Nigeria. Ogbomoso is situated in the derived savannah zone of Nigeria on longitude 4^{o} 15' east and latitude 8^{o} 15' north east of the Greenwich Meridian. The attitude between 300 and 600m above sea level. The mean annual rainfall and temperature are 1247mm and 27^{o}C respectively (Ewetola, 2015).

Experimental Birds and Management

A total of 200 day-old commercial broiler chicks were used for this study. The birds were randomized and allotted to pens in a brooder house. They were brooded with the aid of kerosene stoves and charcoal as heat source and reared on deep litter from day-old to 8 weeks of age. All the chicks were fed ad libitum with a broiler starter feed containing 23.75% Crude Protein (CP) and 3,038.64 MEKcal/kg upto 4 weeks of age; thereafter the birds were given broiler finisher diet containing 19.95% CP and 3,102.00 MEKcal/kg upto 8 weeks in accordance with NRC (1994) nutrient standard for broiler birds. Fresh, cool drinking water was also given ad libitum. Vaccination and other routine medication were carried out as at and when due. The birds were weighed at the beginning of the experiment and thereafter at weekly intervals. Weight of birds were measured individually by using a sensitive digital electronic balance scale in gram, other linear body measurements were measured using tape rule in centimeter.

Data collection

During the period of 8 weeks, records were kept everyday on Body weight (BDW), this was measured using digital electronic weighing balance of 3,000g capacity. The neck was gently straightened out and the length was measured with a tape rule as Neck Length (NEL). Back Length (BKL) was measured from the base

of the neck to the uropygial gland at the base of the tail, including the cape and saddle parts. Thigh Length (THL) was taken from the hock joint to the hinge joint. The tarso-metatarsus (Shank Length) (SHL) was obtained by measuring from the hock joint to the base of the three toes. Breast Width (BRW) was measured across the keel bones from the left armpit to the right armpit. Body Length (BDL) was measured as the distance between the base of the neck to the cloaca. Wing Length (WNL) was measured from the shoulder joint to the extremity of terminal phalanx. To ensure accuracy, each measurement was taken twice. All the measurements were taken on weekly basis by the same person using tape rule calibrated in centimeters (cm) up to 8 weeks of age.

Statistical Analysis

All data collected were subjected to Analysis of Variance (ANOVA) using the genera linear model of SAS (2003) and the same package procedure were used to separate the mean difference. The model generated was fitted for the effects of sex and genotype and their interaction.

Model ;

$\gamma ijk = \mu + G_i + S_{ij} + E_{ijk}$
γijk=Individual Observation
U = Overall Mean
G_i = Effect of Genotype
S_j = Effect of Sex
E_{ijk} = The error.

RESULTS AND DISCUSSION

Tables

Table 1: least square means of hematological indices of male broilers as affected by genotype

Parameters	Arbor Acre	COBB	Marshall	Ross
WBC (10^9/l)	210.40 ±5.84^{b}	207.79 ± 4.99^{b}	219.30 ± 3.88^{ab}	229.65 ± 0.40^{a}
RBC (10^{12}/l)	1.75 ± 0.08^{b}	1.72 ± 0.08^{b}	1.72 ± 0.08^{b}	2.20 ± 0.00^{a}
PCV (%)	22.11 ± 0.97^{c}	22.49 ± 1.25^{c}	25.50 ± 0.55^{b}	29.55 ± 0.07^{a}
MCV (Fl)	126.65 ± 2.02^{b}	126.53 ± 1.02^{b}	137.33 ± 1.43^{a}	134.35 ± 0.62^{a}
MCH (Pg)	53.77 ± 2.30^{ab}	56.03 ± 1.64^{a}	49.66 ± 1.34^{b}	40.90 ± 0.02^{c}
MCHC (%)	42.42 ± 1.77^{a}	43.41 ± 1.35^{a}	35.86 ± 0.51^{b}	30.50 ± 0.15^{c}
NEU (%)	14.75 ± 2.08^{a}	11.25 ± 0.43^{b}	15.00 ± 0.79^{a}	14.00 ± 1.31^{ab}
LYM (%)	91.50 ± 2.47^{b}	109.82 ± 5.38^{a}	88.56 ± 1.61^{b}	86.00 ± 1.30^{b}
PLAT (10^9/l)	342.50 ± 18.10^{b}	176.93 ± 4.17^{b}	151.66 ± 1.39^{c}	190.00 ± 6.54^{b}
EOS (%)	3.25 ± 0.21^{b}	3.16 ± 0.25^{b}	1.57 ± 0.13^{c}	4.36 ± 0.21^{a}
HB (g/dl)	9.20 ± 0.10^{a}	8.85 ± 0.25^{a}	9.23 ± 0.10^{a}	9.00 ± 0.02^{a}

^{abc} Means along the same row with different superscript are significantly (P<0.05) different. **(Ojedapo and Ifanegan 2021)**
WBC= White Blood Cell, RBC=Red Blood Cell, PCV= Packed Cell Volume, MCV= Mean Cell Volume, MCH= Mean Cell Haemoglobin, MCHC= Mean Cell Haemoglobin Concentration, NEU= Neutrophils, LYM= Lymphocytes, Plat= Platelet EOS=Eosinophils HB= Haemoglobin.

Table 1, The blood profiles of male of arbor acre, cobb, marshall and ross revealed a significant (P<0.05) difference between across all parameters. A significantly similar WBC values were recorded in arbor acre (210.40 ±5.84^{b}) and cobb (207.79 ± 4.99^{b}) respectively, while Ross (2.20 ± 0.00^{a}) had a higher value in RBC than the rest of the strains.

Table 2: Least Square Means of hematological indices of Female Broiler Chicken as affected by Genotype

Parameters	Arbor Acre	Cobb	Marshall	Ross
WBC (10^9/l)	232.40 ± 0.02^a	228.15± 0.93^b	224.75± 0.24^c	222.95± 0.30^c
RBC (10^{12}/l)	0.00 ± 0.44^b	1.96 ± 0.04^a	2.17 ± 0.02^a	1.95 ± 0.07^a
PCV (%)	27. 65 ± 0.28^a	24.95 ± 0.41^a	25.92 ± 0.26^b	25.50 ± 0.26^b
MCV (Fl)	130.15 ± 1.38^a	131.42 ± 0.71^a	124.75 ± 0.12^b	123.94 ± 1.05^b
MCH (Pg)	44.90 ± 0.08^a	43.26 ± 1.82^a	38.80 ± 0.04^b	38.20 ± 0.07^b
MCHC (%)	34.40 ± 0.27^a	30.36 ± 1.19^b	30.85 ± 0.11^b	31.05 ± 0.21^b
NEU (%)	11.50 ± 0.73^b	10.72 ± 0.09^b	14.00 ± 0.54^b	9.00 ± 0.22^c
LYM (%)	88.50 ± 0.72^a	89.28 ± 0.09^a	84.50 ± 0.52^c	86.00 ± 0^b
PLAT (10^9/l)	260.00 ± 17.69^a	276.40 ± 11.13^a	165.00 ± 2.56^b	149.00 ± 30.05^b
EOS (%)	2.50 ± 0.10^b	2.64 ± 0.09^b	1.65 ± 0.11^c	4.40 ± 0.23^a
HB (g/dl)	9.50 ± 0.02^a	7.64 ± 0.19^c	8.35 ± 0.06^b	8.06 ± 0.16^{bc}

^{abc} Means along the same row with different superscripts are significant. **(Ojedapo and Ifanegan 2021)**
WBC= White Blood Cell, RBC=Red Blood Cell, PCV= Packed Cell Volume, MCV= Mean Cell Volume, MCH= Mean Cell Haemoglobin, MCHC= Mean Cell Hemoglobin Concentration, NEU= Neutrophils, LYM= Lymphocytes, Plat= Platelet EOS=Eosinophils HB= Hemoglobin.

Table 2, Table 1, The blood profiles of male of arbor acre, cobb, marshall and ross revealed a significant ($P<0.05$) difference between across all parameters. A lower RBC count was recorded in Arbor acre compare to other strains (0.00 ± 0.44^b), arbor acre (88.50 ± 0.72^a) and cobb (89.28 ± 0.09^a) are significantly similar in LYM.

White Blood Cell

The results showed that male arbor acre and cobb had the highest WBC counts 5.84 and 4.99 respectively and are within the normal range of 3.0-6.0, a similar observation by (Mitruka and Rawnsley 1997, Lokhande *et al.,*2009). There were no cases of abnormal rise in the count of WBC and This could suggest a greater ability of male arbor acre and cobb in fighting infections.

Red Blood Cell

In this study, there was a reduced level of concentration of RBC in all Strains, lower than the normal physiological range or value of 4.21–4.84µl observed by (Nyaulingo, 2013) which can be attributed to an indication of poor nutrition especially dietary deficiencies of iron, copper, vitamins, and amino acids.

Packed cell volume

PCV% was found to be significantly ($P<0.05$) higher in male Ross (29.55 %), than female arbor acre (27.65%). The results in all strains were lower than the normal range of 35.90-41.00% by Wikivet (2013) and this could be an indication of anemia in broiler chickens.

Mean corpuscular volume

Mean corpuscular volume is the expression of the average volume of individual red blood cell. Increased MCV values recorded in this study was in agreement with Talebi *et al*.,(2005). The values obtained were far greater in all strains than the normal physiological ranges of Jain (1986) and Wikivet (2012). This may be as a result of reduced values of Red Blood Cells.

Mean Corpuscular Hemoglobin

Mean corpuscular haemoglobin is the mean mass of haemoglobin per red blood cell in a given sample of blood, so it is dependent on haemoglobin. MCH values in this study are closely related in arbor acre and cobb. The MCH values obtained in this study is far greater than the normal physiological ranges of Jain (1986), that is 56.03 ± 1.64^{a} and 44.90 ± 0.08^{a} in male and female of arbor acre and cobb. Though the result of Hb concentration obtained is lower than the normal physiological values.

Mean Corpuscular Hemoglobin Concentration

The mean corpuscular haemoglobin concentration measures the concentration of haemoglobin in a given volume of packed red blood cells. In this study, the result of female Ross and Arbor acre 34.40 ± 0.27^{a} and 30.50 ± 0.15^{c} respectively shows a close correlation with the observation reported by Wikivet (2013) who observed 32.41– 33.37% (MCHC) as the normal hematological value for bird.

Lymphocytes

The result of this study shows that Cobb has the highest lymphocytes counts in both male and female broilers (109.82 ± 5.38^{a} and 89.28 ± 0.09^{a}) respectively and as such lymphocytes are important in forming barriers against local disease conditions and may be involved in antibody formation in cobb broiler.

Hemoglobin

There was a reduced Hb count in all broiler strains irrespective of sex to the normal range of 11.60 to 13.68 g/dl reported by Wikivet (2013). And According to Nse *et al*., (2014) observation, a decrease in the quantity of RBC and Hb are indications of poor nutrition especially dietary deficiencies of iron, copper, vitamins and amino acids.

CONCLUSION

From this study, it can be concluded that sex and genotype of broilers had a significant ($p<0.05$) effect on different hematological parameters like WBC, lymphocytes, PCV, MCH and MCHC. There were no cases of abnormal rise in the count of WBC and this could suggest a greater ability of male arbor acre and cobb in fighting infections.

Recommendation

The result of the study is helpful for accurate interpretation of hematological parameters of commercial broiler chickens. It is therefore recommended that for profitable broiler production in the tropics, Cobb and Arbor Acre males be considered due to their ability to fight infections.

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