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Original Research Article

Comparative effect of genotype and season on the haematological profile of two laying chicken strains in southwest Nigeria

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Abstract

Haematological studies help in understanding the relationship of blood characteristics to the environment. One of the major environmental factors influencing haematological indicators is season. This study was aimed at the variation in haematological profiles of two strains of laying birds at different seasons. We therefore evaluated the effects of genotype and season on the haematological profile in two strains of laying birds – Dominant brown (D-192) and Hyline brown in the tropics. A total of 50 birds per strain at 30 weeks of age were randomly selected for this study. Packed cell volume (PCV) and platelets were obtained using microhaematocrit whereas red blood cells (RBC) and white blood cells (WBC) were counted using a haemocytometer. The result obtained showed that there was a significant difference ($P < 0.05$) in the haematological profile of the birds in the two seasons compared (rainy and dry seasons). The haematological indices obtained during the rainy season had significantly higher mean values in packed cell volume (29.65 ± 0.32%), red blood cells ($2.65 \pm 0.03 \times 10^{12}$/L), haemoglobin (100.1 ± 0.11 g/L) and eosinophil (2.5 ± 0.16%) while those obtained during the dry season had a higher significant effect on the white blood cells ($19.16 \pm 0.36 \times 10^{9}$/L). The results further revealed that between the strains, there was no significant difference ($P > 0.05$) in most of the indicators analysed but Hyline brown had significantly higher values ($P < 0.05$) of eosinophils and platelets. We concluded that the observed differences could be a result of genetic differences between the two strains of birds which gives room for selection and that the rainy season is more favourable for laying birds production under tropical condition.

Keywords: adaptability; blood; genotype; haematology; Dominant brown (D-192); Hyline brown; layers; season; Nigeria; tropics

INTRODUCTION

Nigeria has two major seasons which are the wet and dry seasons; each of these seasons is identified principally by change in ambient temperature, relative humidity and amount of rainfall (Oguntunji et al., 2008). The season has been categorized as one of the most important factors adversely affecting poultry production in the tropics. It affects those reared extensively and those reared intensively without artificial regulation of micro-climatic conditions (Mahmoud et al., 1996; Ayo et al., 2007; Obidi et al., 2008). Studies have also shown that different species of birds vary in haematological profiles; this variation can be attributed to differences in their immune systems (Ladokun et al., 2008; Melesse, 2011). Season has been reported to be one of the major factors influencing haematological indicators among other factors like age, stress and sex (Olayemi and Arowolo, 2009). Both species and seasons along with poor nutrition and difference in immune system as causes of variation in the haematological profiles between strains were listed by Oladele et al. (2001).

Haematological studies are important because the blood is the major transport system of the body and evaluations of the haematological profile usually furnishes vital information on the body's response to injury of all forms, including poisonous injury (Schalm et al., 1975; Coles, 1986; Ihedioha et al., 2004). Haematological studies, ecologically and physiologically gives a better understanding of the relationship between the characteristics of blood and the environment (Ovuru and Ekweozor, 2004). This could aid in the selection of animals that are genetically resistant to certain diseases and environmental conditions. Differentiating animals for genetic improvement has been reported to be achieved through biochemical polymorphism (Egena and Aloa, 2012). Haematological values can therefore be useful in breeding programmes in getting valuable individuals of economic importance (Ladokun et al., 2008).

Haematological variations have been recorded in chickens of the same age and sex reared under the same condition with data collected at different times of the day (Azeez et al., 2009). These observed variations may be as a result of changes in everyday physical and metabolic activities (Islam et al., 2004), ecotypes (Elagib and Ahmed, 2011) and changing the feed of the birds (Ugwu et al., 2008; Adeyemo et al., 2010; Oloyede et al., 2010; Saied et al., 2011).

There is not much available information on the haematological profile of laying birds in the tropics. It is therefore of importance to understand the adaptability of different strains of laying birds at different seasons.

The need to supplement the production of brown laying birds in Nigeria is rising and cannot be overlooked as its production is currently low. Hyline brown is not a common strain in Nigeria and it was therefore introduced to increase the production of brown layers. Brown feathered laying chickens, also known as brown layers, are becoming increasingly popular and sort after by local farmers in poultry production as an aternative to the more common black feathered laying birds. This therefore is increasing the economic importance of brown layers. The hypothesis tested was that the recently imported Hyline brown would not be able to adapt to the climatic conditions of the tropics compared to the Dominant brown which has long been in use in the tropics. The research measured the adaptability of Hyline brown to the seasons in the tropics through biochemical analysis (haematology) in comparison to Dominant brown (D-192). The study was therefore conducted to evaluate the effect of genotype and season on haematological profile of Dominant brown (D-192) and Hyline brown strains of laying chickens. This would help to understand the biochemical variation between the two genotypes used in this study; Dominant brown (D-192) and Hyline brown layers and also the measure of their adaptability to the different seasons of the tropics.

MATERIALS AND METHODS

Experimental site

The study was carried out in a breeder farm located in Igboora (7°26′10″ N and 3°17′34″ E), Oyo State, South-Western, Nigeria.

Experimental birds, management and blood sampling

A total of fifty (50) birds per strain (Dominant brown (D-192) and Hyline brown) were randomly selected for this study. The birds were housed separately per strain in a deep litter system with a living space of five (5) birds per square meter of floor area. The average weight of the Hyline brown birds at 30 weeks of age was 1.91 kg while the Dominant brown (D-192) birds had an average weight of 1.87 kg at 30 weeks of age.

The birds were given layers mash compounded at the farm's feed mill as shown in Table 1, and were fed in the early hours of the day to reduce the effect of heat stress. Water was supplied *ad libitum*.

Blood samples were collected from the birds via the *vena basilica* of the wing into tubes with EDTA (Ethylene diamine tetra-acetic acid) using syringe needle.

Blood sample collection started at 32 weeks of age of the birds. This was carried out in two different seasons of the study, the rainy season (at 32 weeks) and the dry season (at 49 weeks).

Haematological examinations

Packed cell volume (PCV) and platelets were analysed using microhaematocrit method (Lamb, 1991) whereas the total leukocyte (WBC) and red blood cells (RBC) counts were done using haemocytometer method as described by Schalm et al. (1975). Haemoglobin concentration and differential leukocyte count were obtained using the method as described in Schalm et al. (1975).

Statistical analysis

Haematological indicators obtained from the birds were statistically analysed using SAS 9.0 (2009) statistical software. The mean and standard errors were also computed for each parameter. After the removal of non-significant interactions, the following model was used;

$$Y_{ij} = \mu + S_i + T_j + \varepsilon_{ij}$$

Where:

Y_{ij} = an observed value of trait (PCV, WBC, RBC etc.)

μ = Overall mean,

S_i = Effect of Strain (Dominant brown (D-192), Hyline brown)

T_j = Effect of Season (Rainy, Dry)

ε_{ij} = Residual error

Table 1. Layer mash composition

Ingredient	kg
Premix	2.5
Toxin binder	1
Methionine	1.8
Lysine	0.6
Enzyme	0.3
Vitamin C	0.2
Sodium bicarbonate	2
Tylosine	0.2
Oxytetracycline	0.3
Maize	597
Soya bean meal	240
Wheat offal	Balance
Limestone	76
Bone meal	23
Salt	3

Table 2. Effect of season on the haematological indicators of both Dominant brown (D-192) and Hyline brown strains of layer chickens

Indicators	N	Rainy Season	Dry Season
Packed cell volume (%)	100	29.65 ± 0.32^{a}	27.11 ± 0.311^{b}
Haemoglobin (g/L)	100	100.1 ± 0.11^{a}	90.9 ± 0.11^{b}
White Blood Cells ($\times 10^9$/L)	100	11.40 ± 0.28^{b}	19.16 ± 0.36^{a}
Red Blood Cells ($\times 10^{12}$/L)	100	2.65 ± 0.03^{a}	2.27 ± 0.03^{b}
Neutrophils (%)	100	22.05 ± 0.96	24.14 ± 1.27
Lymphocytes (%)	100	73.77 ± 0.95	73.31 ± 1.32
Basophils (%)	100	0.43 ± 0.07	0.46 ± 0.09
Eosinophils (%)	100	2.5 ± 0.16^{a}	1.25 ± 0.14^{b}
Monocytes (%)	100	1.25 ± 0.15	0.96 ± 0.15
Platelets (Thrombocytes) ($\times 10^{12}$/L)	100	2.62 ± 0.09	2.87 ± 0.14

$^{a, b}$ – means on the same row having different superscripts are significantly ($P < 0.05$) different, N – Sample size

Table 3. Effect of strain on the haematological indicators of both Dominant brown (D-192) and Hyline brown strains of laying chickens

Indicators	N	Dominant brown (D-192) layers	Hyline brown layers
Packed cell volume (%)	100	27.97 ± 0.32	28.79 ± 0.36
Haemoglobin (g/L)	100	94.3 ± 0.11	96.7 ± 0.12
White Blood Cells ($\times 10^9$/L)	100	14.97 ± 0.49	15.60 ± 0.51
Red Blood Cells ($\times 10^{12}$/L)	100	2.43 ± 0.04	2.49 ± 0.04
Neutrophils (%)	100	24.43 ± 1.22	21.76 ± 1.02
Lymphocytes (%)	100	72.54 ± 1.22	74.54 ± 1.06
Basophils (%)	100	0.48 ± 0.08	0.41 ± 0.09
Eosinophils (%)	100	1.66 ± 0.16^{b}	2.09 ± 0.17^{a}
Monocytes (%)	100	1.01 ± 0.15	1.20 ± 0.15
Platelets (Thrombocytes) ($\times 10^{12}$/L)	100	2.56 ± 0.11^{b}	2.93 ± 0.11^{a}

$^{a, b}$ – means on the same row having different superscripts are significantly ($P < 0.05$) different, N – Sample size

RESULTS

Effect of season on the haematological indicators of Dominant brown (D-192) and Hyline brown layer chickens

Table 2 shows the effect of season on the haematological indicators of both Dominant brown (D-192) and Hyline brown strains of laying chicken. There was a significant difference ($P < 0.05$) in the two seasons compared (rainy and dry seasons) for some of the haematological indicators analysed. The rainy season with higher mean values, had higher ($P < 0.05$) packed cell volume (29.65 ± 0.32%), red blood cells ($2.65 \pm 0.03 \times 10^{12}$/L), haemoglobin (10.01 ± 0.11g/%) and eosinophil (2.5 ± 0.16%) while the dry season had a significantly higher ($P < 0.05$) white blood cells counts ($19.16 \pm 0.36 \times 10^{9}$/L) only and there was no significant difference ($P > 0.05$) in the values of the other indicators.

Effect of strain on the haematological indicators of the brown layer chickens

The effect of strain on haematological indicators is presented in Table 3. It was observed that Hyline brown had significantly higher values ($P < 0.05$) of eosinophils (2.09 ± 0.17%) and platelets ($2.93 \pm 0.11 \times 10^{12}$/L) compared to Dominant brown (D-192) layers.

DISCUSSION

The high values of pack cell volume and haemoglobin obtained during the rainy season are in accordance with the results of Awotwi and Aboagye (1995) in laying hens. They concluded that low environmental temperature as a result of cold weather enhances erythropoiesis. The result of this study is supported by the report of Menon et al. (2013) who found that high ambient temperature decreases red blood cell counts. The value of the white blood cells counts obtained which was significantly higher in the dry season is similar to Olayemi and Arowolo (2009) who obtained a higher mean value of white blood cells in the dry season for Nigerian ducks. Nathan et al. (1976) reported that the total white blood cells counts were impaired following the exposure to heat.

Higher mean value of platelets indicates that the process of clot-formation, that is, blood clotting would be faster than that with a lesser mean value of platelets which might result in excessive loss of blood in the case of an injury. Also, higher mean value of eosinophils indicates a better chance of combating multicellular parasites and some harmful bacteria. However, genotype does not have a significant effect ($P > 0.05$) on most of the indicators analysed. The significant variation observed could be a reflection of inherent genetic differences amongst the two strains of laying chickens (Agaie and Uko, 1998) while the similarities observed may be a result of the traits that are highly conserved in both genotypes. The observed variations in the haematological indicators could also be a way of delineating genetic variation in animals (Egena and Aloa, 2012).

CONCLUSION

Genotype was observed not to have a significant effect on most of the haematological indices measured except in eosinophils and platelets where Hyline brown had higher mean values. The hypothesis was thus not supported by the results as there was no significant impact of genotype on the haematological profile measured. This could be attributed to the inherent genetic differences between the two strains of birds and could be useful in the selection of individuals with higher breeding value. Season was found to have significant effect on the major haematological indicators as it was observed that there was an increase in the packed cell volume, haemoglobin, red blood cells and eosinophils during the rainy season compared to the hot, dry weather conditions while the white blood cells were higher in the dry season. This therefore makes the rainy season, which is the recommended season for optimal production more favourable for layer production under tropical conditions. On the other hand, the adverse effect of dry season can be mitigated by providing artificial means of making the environmental conditions conducive like provision of coolants, heat extractors and use of materials that do not conduct heat for optimal production. Moreover, it is of great importance to reduce the level of stress on laying birds during the dry season to enhance their optimal egg production.

Further comparative assessment can be carried out by challenging the immunity of the birds to provide more information on survivability and adaptability of the laying birds raised in tropical conditions.

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STATEMENT ON THE WELFARE OF ANIMALS

Ethical approval: The experiment was conducted following the code of ethics for animal experimentation with prior approval by the University's Animal Ethics Committee.

CONFLICT OF INTEREST STATEMENT

There is no conflict of interest with any individual or organization regarding the materials discussed in the manuscript.

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