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Influence of Age and Strain on Haematological and Blood Biochemical Indices in Broiler Chickens Reared in Derived Savanna Environment of Nigeria

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Abstract

This study was conducted to evaluate the influence of age and strain on haemotological and blood biochemical indices in broiler chickens reared in derived savanna zone of Nigeria. Three hundred broiler chickens of consisting hundred Ross (R), one hundred Anak (A) and one hundred Marshall (M); haematological and blood serum biochemical indices were then determined at 14, 28, 42 and 56 days for the three strains. The birds were reared for a period of 56days and data were obtained on the blood indices and analysed for fixed effect of ages and strain in a completely randomized design (CRD). Haemotological parameters include red blood cell (RBC), White Blood Cell (WBC), Haemoglobin (Hb), Packed Cell Volume (PCV), Mean Corpuscular Volume (M CV), Mean Corpuscular Haemoglobin (MCH). Mean Corpuscular Haemoglobin Concentration (MCHC), Heterophils (H), Lymphocyte (L), Monocytes (M), Eosinophils (EO) and Basophils (B). However the serum biochemical indices include the total protein (TP), Serum Albumin (SA), Serum Globulin (SG), Uric Acid (UA), Serum Glucose (SGL) and Serum Cholestrol (SC). The erythrocytic values shows significant ($P < 0.05$) different as a function of age. RBC count, PCV and Hb were highest for Anak strain for all ages considered. MCV values favoured the Marshall birds, with decrease values as birds attain ages. WBC, EO and B values were highest for Anak strain while H and L favoured the Ross birds. There were no significant ($P > 0.05$) different for Monocytes at all ages considered. Serum biochemical components showed significant ($P < 0.05$) differences at all ages.

Keywords

Broilers, Age, Strain, Haematology, Blood Biochemical, Derived Savanna

1. Introduction

Poultry population in Nigeria is estimated to consist of about 124 million chickens, 45 million guinea fowl and one million of each Turkeys, ducks (Lamrode, 1996) and pigeons (Ibrahim and Abdu, 1992). Poultry meat production particularly chicken meat has been very speedy over the last decades (Sola- Ojo and Ayorinde, 2009). Jaturashita, (2004) stated that demand for poultry meat is higher because of its superiority in health aspects when compared to red meat, comparably low contents of fat and cholesterol the relatively low price, the typical convenient portions and the lack of religious restriction. Large scale commercial poultry production was observed (Amao, 2009) as one quick and effective way of correcting the problem of animal protein intake deficiency while broiler birds are usually the most universal and important of all poultry as producers of meat for human consumption (Oluremi *et al*., 2009).

Investigations of normal blood indices of chickens are very much essential in diagnosing the various pathological and metabolic disorders. Blood can be used as diagnostic tools in order to assess the health status of individual or a flock. Determination of blood values of chicken are influenced by

age, sex, breed, climate, geographical location, season, day length, time of day, nutritional status, life habitat of species, present status of individual and such other physiological factors (Islam *et al*., 2004; Awotwi, 1991).

Many of the available information on haematological and serum biochemical values for broiler chickens in Nigeria and other West African countries have been obtained from temperate countries (Ojedapo *et al.*, 2006). Different strains of commercial broiler chickens are usually imported into Nigeria and little haematological and biochemical studies have been done on these chickens to provide a means of assessing their health status and perhaps different environments in the country which is also an indicator of their performances.

Reference blood profiles of broiler strains in natural conditions of different age of husbandry period are essential for interpretation of haematological test (Talebi, *et al*., 2005). It is desirable to know the normal blood values of broiler chickens under local conditions. Haematological and serum biochemical have been reported to provide valuable information for breeding purpose and immune status of animals (Ladokun, 2008; Kral and Suchy, 2000).

The aim of this study is therefore to investigate the influence of age and strain variation on haematological and biochemical indices of broiler chickens in derived savanna region.

2. Materials and Methods

2.1. Experimental Site

The research was carried out at the Poultry unit of Teaching and Research Farm of the Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria. Ogbomoso lies on the Longitude $4^{0}15^{1}$ East of the Greenwich Meridian and Latitude $8^{0}15^{1}$ North-East of the equator. It is about 145 kilometers North-Eastwards from Ibadan, the capital of Oyo state. The altitude is between 300 and 600 metres above sea level. The mean annual temperature is about 27°C while that of rainfall is 1247mm (BATC, 2004).

2.2. Experiment Birds and Management

A total of 300 day -old broiler chick comprising of Ross, Anak and Marshall strains, 100 each, was purchased from a reputable hatchery were used for the study. Each strain was identified by wing tag and also given a separate pen in an environmentally controlled brooder house. Wood shaving was used as litter materials and it was kept dry throughout the experiment period. All necessary vaccination were given when due and other environmental conditions were fully met the requirement laid down in the technical instructions of each strain for broiler breeding.

All the chicks were fed *ad libitum* with a commercial broiler starter diet containing 24% crude protein and 2880 kcal/kgME up to 4 weeks of age. Therefore, the birds were given broiler finisher ration containing 21% crude protein and 3000 kcal/kgME up to 8 weeks. Fresh cool drinkable water was given *ad libitum* to the birds throughout the experimental period.

2.3. Data Collection

Blood samples for analysis were taken from the three different strains of broilers chickens. (Ross, Anak and Marshall strains) forty- five broiler chickens of each strain were selected from four different age intervals 14, 28, 42 and 56 days were used.

Blood were collected from the chickens by venipuncture of wing vein at these age intervals (14, 28, 42 and 56days). Blood samples were collected into two different sets of bijou bottles. The first set of bottles contained Ethylene-diamine-tetra-acetic acid (EDTA anti coagulant) while the other set was without EDTA. Blood samples were labelled according to number, strain of chickens and date of sampling.

2.3.1. Heamatological Tests

The set with EDTA was used to determine Red Blood Cell (RBC), White blood Cell (WBC) using the improved Neubaucer haemocytometer, as described by Dacie and Lewis, (1991). Packed Cell Volume (PCV) was determined using the microhaematocrit method and haemoglobin (HB) using cyanomethaemoglobin method according to Coles (1986). Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin Concentration (MCHC) were determined as described by (Jain, 2000).

2.3.2. Serum Biochemical Tests

The set of samples bottles without EDTA were centrifuged in a micro centrifuge to generate centrifuge for serum for biochemical analysis. Total protein was determined using the Biuret method as described by Doumas, (1975), albumin using dye-binding technique with bromocresol green as described by Doumas and Biggs, (1972). Globulin by difference (total protein minus albumin) total cholesterol by enzymatic method as desribed by Allain *et al*., (1974). Urea by di-methyl monoxide method as described by Varley *et al*., (1980). Serum glucose by enzymatic method of Kaplan and Szabo, (1983).

2.4. Statistical Analysis

The data obtained were subjected to statistical analysis using the General linear model (GLM) procedure of SAS (2003) while means with differences were separated using Duncan multiple range test of the same packages. With fixed effects of age and strain on haematological and biochemical indices were considered using the following model:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + e_{ijk}$$

Where Y_{ijk} = Observation per strain
μ=Overall mean
α_i =Fixed effect of strain (1,2,3)
β_j = Fixed effect of age (14, 28, 42, 56days)
$(\alpha\beta)_{ij}$ =Interactive effect between strain and age
e_{ijk}= Random error

3. Results

The least square means of erythrocytic values of different broiler strains at different ages was shown in Table 1. The erythrocytic parameters except (MCH) differed significantly ($P < 0.05$) between groups of ages. With increasing in age the erythrocytics values such as Total RBC count, PCV, Hb, MCH and MCHC contents were significantly decreased ($P<0.05$) with age while only MCV contents shows a significant decreased ($P< 0.05$) with ages during the breeding period. The Total RBC count, PCV, Hb and MCH values obtained were highest for Anak birds at all considered ages, while the MCV and MCHC values were highest for the Ross strain broilers. Therefore there were significant ($P < 0.05$) interaction between age and strain for erythrocytic values of three strains of broiler.

Table 1. *Least square means of erythrocytic values of different broiler strains at different ages.*

Parameter	N	Strain	14days	28days	42days	56days
Total	45	Ross	2.66±0.10^{a}	2.76±1.30^{a}	2.78±1.12	2.96±0.12
RBC count	45	Anak	2.21±1.02^{b}	2.77±1.20^{0}	2.77±0.11	2.83±1.20
(x10^{6}/mm2)	45.	Marshall	2.55±0.12	2.70±1.11^{b}	2.71±0.20	2.79±0.10
PCV	45	Ross	35.10±1.10^{b}	7.11±0.11^{b}	38.00±1.22^{b}	38.01±0.25
(%)	45	Anak	36.98±1.11^{a}	38.12±1.12^{a}	38.96±0.32^{a}	40.00±0.11
	45	Marshall	32.91±0.21^{c}	35.01±0.13^{c}	36.01±1.20^{c}	38.25±0.32
	45	Ross	9.26±0.11^{b}	10.03±0.16^{b}	11.01±0.11^{b}	11.53$^{\pm}$1.20^{b}
HB	45	Anak	10.24±1.28^{a}	10.38±1.20^{a}	11.32±0.21^{a}	11.98±0.21^{a}
(g/dl)	45	Marshall	9.21±0.11^{b}	9.85±0.32^{c}	10.88±1.21^{b}	11.55±0.11^{b}
	45	Ross	117.02±23.10^{b}	116.18±22.30^{b}	110.48±21.21	102.52±33.01
MCV	45	Anak	112.12±22.30^{b}	110.42±24.00^{b}	111.64±32.14	112.90±42.20
(Fc)	45	Marshall	122.53±24.11^{a}	121.12±24.11^{a}	120.00±25.11	110.14±31.20
	45	Ross	27.00±1.10^{C}	30.18±0.32^{a}	30.48±0.21^{b}	31.42±0.21^{b}
MCH	45	Anak	29.10±0.42^{a}	30.00±0.41^{a}	34.14±1.14^{a}	35.42±1.21^{a}
	45	Marshall	28.10±0.11^{b}	28.50±0.38^{b}	30.00±1.11^{b}	30.13±1.25^{b}
	45	Ross	28.00±1.13	31.25±1.42	31.43±1.11^{b}	32.00±1.25
MCHC	45	Anak	28.01±0.34	31.20±1.23	31.45±0.03	32.10±1.32
	45	Marshall	28.02±0.11	31.22±0.14	31.40±0.08	32.05±0.11

^{abc} Means along the same column with at least one common superscript at the same age are not significantly different ($P>0.05$)
N = number of observation. RBC- Red Blood Cell, PCV- Packed Cell Volume, Hb-Haemoglobin, MCV-Mean Corpuscular Volume, MCH-Mean Mean Corpuscular Haemoglobin, MCHC- Mean Corpuscular Haemoglobin Concentration.

The least square means of leukocyte values of different broiler strains at different ages is shown in Table 2. The leukocytic values differed significantly except (monocytes) within groups of age ($P < 0.05$). With increasing age, total WBC counts, heterophils, lymphocytes, Eosinophils and basophils were significantly increased ($P < 0.05$) while only monocytes counts numerically decreased with the age of the broilers. The highest significant ($P<0.05$) values of the total WBC count, heterophil and lymphocytes counts were obtained in Anak birds. However, Anak strain had the highest significant ($P<0.05$) values for Eosinophils and basophils counts. The interaction between age and strain for leukocyte values were also significant ($P < 0.05$).

Table 2. *Least square means of leukocyte values of different broiler strains at different ages.*

Parameter	N	Strains	14days	28days	42days	56days
	45	Ross	25.18±1.38^{b}	26.18±1.22^{b}	27.20±1.20^{b}	27.81±2.11^{b}
WBC	45	Anak	27.28±2.35^{a}	27.39±1.45^{a}	28.00±0.68^{a}	29.85±1.35^{a}
(xl0^{6}/µl)	45	Marshall	26.00±1.44^{b}	26.21±1.40^{b}	26.81±342^{c}	27.25±1.40^{b}
Heterophils	45	Ross	10.21±1.12^{a}	8.32±0.11^{c}	8.11±0.14^{c}	7.01±0.85^{b}
(x 10^{3}/µl)	45	Anak	7.00±0.20^{b}	8.12±0.11^{c}	8.00±0.15^{c}	7.65±0.80^{c}
	45	Marshall	7.23±1.27^{b}	7.24±0.11^{b}	7.45±0.31^{b}	7.25±0.32^{b}
	45	Ross	10.45±0.15^{a}	10.85±0.14^{a}	12.81±0.10^{a}	14.88±0.35^{b}
Lymphocytes	45	Anak	8.15±0.10^{b}	8.31±0.11^{b}	12.32±0.22^{b}	15.00±0.18^{a}
(x 10^{3}/µl)	45	Marshall	7.23±1.27^{c}	1.11±0.88^{b}	12.30±0..10^{b}	14.30±0.45^{b}
	45	Ross	1.08±0.32	1.08±0.01	0.90±0.01	0.92±0.03
Monocytes	45	Anak	1.11±0.01	1.10±0.03	0.92±0.02	0.89±0.02
(x 10^{3}/µl)	45	Marshall	1.10±0.02	1.03±0.01	0.89±0.01	0.98±0.01
Eosinophils	45	Ross	0.87±0.04^{a}	0.73±0.02^{b}	0.85±0.02^{b}	0.91±0.01^{b}
(x 10^{3}/ µl)	45	Anak	0.88±0.01^{a}	0.93±0.01^{a}	0.99±0.02^{a}	1.00±0.01^{a}
	45	Marshall	0.70±0.02^{b}	0.74±0.07^{b}	0.79±0.02^{b}	0.90±0.02^{b}
Basophils	45	Ross	0.60±0.02^{b}	0.72 ±0.25^{b}	0.82±0.01^{b}	0.85±0.01^{c}
(x 10^{3}/µl)	45	Anak	0.70±0.32^{a}	0.85±0.11^{a}	0.98±0.32^{a}	1.04±0.32^{a}
	45	Marshall	0.62±0.14^{b}	0.71±0.24^{b}	0.80±0.11^{b}	0.90±0.44^{b}

^{abc} Means along the same column with at least one common superscript at the same age are not significantly different ($P>0.05$).
N = number of observation

WBC-White Blood Cell

Table 3 shows the least square means of biochemical indices of different broiler strains at different ages. There were significant ($P < 0.05$) age and strain differences during the serum biochemical indices measured, with increasing of age, serum total protein, serum albumin, serum globulin, uric acid and serum glucose were significantly increased. As the age increases, the Anak birds showed highest values for serum total protein, serum albumin, serum globulin and total serum cholesterols followed closely were the Ross and Marshall strains respectively.

Table 3. *Least square means of biochemical indices of different broiler strains at different ages.*

Parameter	N	Strains	14days	28days	42days	56days
Serum	45	Ross	50.24±3.11^{b}	52.45±6.32^{b}	53.42±3.32^{b}	54.34±4.45^{b}
Total protein	45	Anak	55.42±4.22^{a}	56.42±3.42^{a}	58.32±4.42^{a}	59.44±3.43^{a}
(gdl-1)	45	Marshall	50.44±1.45^{b}	51..34±3.44^{b}	52.43±6.23^{b}	54.43±4.33^{c}
Serum	45	Ross	29.00±4.11^{b}	29.58±3.44^{b}	29.98±4.77^{b}	30.00±3.22^{b}
Albumin	45	Anak	31.48±2.45^{a}	31.99±4.55^{a}	32.22±4.85^{a}	32.69±4.11^{a}
(gdl-1)	45	Marshall	28.95±3.33^{b}	28.36±4.35^{b}	29.00±3.44^{c}	31.00±1.33^{b}
Serum	45	Ross	21.24±1.00^{b}	22.87±0.35^{b}	23.44±0.47^{b}	24.84±0.83^{b}
Globulin	45	Anak	23.94±1.25^{a}	24.43±0.45^{a}	26.10±0.48^{a}	26.75±0.75^{a}
Uric acid	45	Marshall	21.44±1.28^{b}	22.48±0.32^{b}	23.43±0.11^{b}	23.43±0.85^{b}
(mg dl^{-1})	45	Ross	2.90±0.02^{a}	3.00±0.13^{a}	3.10±0.11^{a}	2.90±0.11^{a}
	45	Anak	2.70 ±0.11^{b}	2.78±0.14^{b}	2.85±0.24^{b}	3.10±0.14^{b}
	45	Marshall	2.68±0.32^{b}	2.72±0.15^{b}	2.80±0.14^{b}	3.20±0.14^{a}
Serum	45	Ross	61.75±3.45^{a}	62.88±2.14^{a}	64.32±1.45^{a}	65.00±2.11^{b}
Glucose	45	Anak	60.00±3.11^{b}	61.45±2.15^{b}	62.44±1.37^{b}	63.12±2.45^{a}
(gdl^{-1})	45	Marshall	60.25±1.57^{b}	61.37±2.44^{b}	62.35±1.45^{b}	63.32±2.47^{b}
Serum	45	Ross	140.16±20.30^{a}	125.91±15.28^{a}	120.85±13.45^{a}	118.10±12.11^{a}
Cholesterol	45	Anak	135.32±14.35^{b}	120.35±14.33^{b}	114.56±14.36^{b}	112.12±14.09^{b}
(mg/dl)	45	Marshall	134.46±15.60^{b}	120.10±15.65^{b}	116.34±15.00^{b}	113.62±14.66^{b}

^{abc} Means along the same column with at least one common superscript at the same age are not significantly different ($P>0.05$).
N = number of observation

4. Discussion

The intensive poultry husbandry system provides suitable atmosphere for using references blood indices of broiler chickens worldwide for interpretation of haematological and serum biochemical analysis in regards to immune status of commercial broilers "[20]", predicting potential resistance to environmental condition "[5]", developing new broiler strains that genetically resistant to poultry "[21]". The age related haemaological value in broiler strain obtained in this study has also been reported in different strains of chicken "[22]". The highest values between age and haemotological parameters contents of Anak, Ross and Marshall considered, while Anak strain were highly favoured was in agreement with the findings of "[23]". This could be an indicator, that is, using the blood profiles of chickens, the age of the birds should be considered as an important criterion in this regard. Meanwhile, the erythrocytic and leukocyte values observed in this study for the three strains of broiler chickens, the values were also in line with the findings of "[24]". These authors reported differences in erythrocytic and leukocytic values that existed between genetically developed broiler lines. However, a contrary values against this study were been reported by "[24], [25]". These authors reported higher values of haemotological indices for broiler, local, necked neck and white leghorn layers chickens in their respective studies. Meanwhile, the lower leukocyte values of the exotic broiler strains may correspond to environmental factors while compared with indigenous chickens.

It is observed in this present study that all other biochemical components changed significantly as a function of age. The age related biochemical indices obtained in this study were within the range of values reported by "[5], [21]". These ranges of results may due to proper maintenance of the osmotic pressure between the circulating fluid and fluid in the tissue species, so that exchanged of materials between the blood and the cells could be facilitated. But this study disagreed with the findings of "[26], [27]" who reported lower range of values for total protein, serum globulin and serum glucose broiler chickens. The differences might be due to environmental differences where these parameters were evaluated. In similar findings of "[28]" reported the superiority higher values than the present results which might due to the fact that, their birds are indigenous chickens and reared in the sub-humid tropical environment.

5. Conclusion

The experiment revealed both the haematological and serum biochemical indices of the three strains of broiler chickens. All the three strains of broiler had different values as the age increases with highest values obtained for Anak birds compared to other strains. However, highest Packed Cell Volume (PCV) and superior White Blood Cell (WBC), the total protein serum, serum globulin, and serum albumin of Anak bird serve as an indicator or ability of Anak birds to withstand pathogenic organisms. Anak and Ross strains could be utilized in crossbreeding programme in a way to produce individuals that are fit and more productive.

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