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Haematological and Serum Biochemical Indices of Local and Exotic Chickens in a Subhumid Tropical Environment

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Abstract: Haematological and serum biochemical evaluations of Nigerian local and exotic chickens genotypes were carried out in this study. A total of 250 chickens were used for study. These consist of 50 adult birds from each genotype of normal feather, naked neck, frizzled feather, Dominant Black and Dominant Blue genotypes. Each genetic group was divided into five replicates (ten birds per replicate) in a completely randomized design. There were significant ($P<0.05$) differences between the genotypes in the mean values of white blood cell (WBC) count, red blood cell (RBC) count, packed cell volume (PCV) and haemoglobin concentration (Hb). The mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) mean corpuscular haemoglobin concentration (MCHC) also showed significant difference ($P<0.05$). However, Dominant Black and the frizzled feather were significantly superior in all the parameters examined. With the exception of RBC which was significantly ($P<0.05$) higher in the Dominant Black (3.55±0.02). There were significant ($P<0.05$) differences between the genotypes in the total protein, albumin, cholesterol, urea, creatinine, complete blood count, calcium and phosphorus of the genetic groups. The normal genotype however, had the highest significant albumin (1.90±0.07ml) and a lowest creatinine value of (0.44±0.04ml) compared to other chicken genotypes .The present results of blood parameters revealed that the packed cell volume, hemoglobin and other values were significantly ($P>0.05$) higher in the Nigerian local chicken compared to the exotic counterpart. The results indicated that haematological and biochemical values can be used in the classification of birds into genetically distinct subgroups. The present haematological and s biochemical values can be utilized in crossbreeding programmes in order to produce individuals that are fit and more productive.

Key words: Haematology · Biochemical parameters · Genotype · Chicken

INTRODUCTION

The local chickens are one of many local resources for poor people living in the rural areas, which could be harnessed and utilized for poverty alleviation [1]. However, a number of major genes or gene complexes have been identified in the genome of the Nigerian local chicken population [2]. Among these major genes are the feather distribution (Naked neck) and the feather structure (Frizzle) genes. These unique genes have been reported to ameliorate tropical heat stress and enhance the performance of chicken in possessing them [3]. The conventional methods of selection have been noted to involve more time, money and labour [4]. Many genetic researches are now directed towards investigating the relationship between physiological, biochemical and metabolic products/markers and the productive efficiency of farm animals. Haematological traits were studied with a view to explain the physiological basis of performance trait and may help to identify a selection criterion which can be used in early life [5].

Environmental extremes have deleterious effects on the productive performance and wellbeing of all domestic animals. Hot ambient temperatures above the zones of thermo-neutrality for domestic poultry affect performance and overall adaption to the climatic region [6].The genetic makeup of an individual always interacts with the environment. Individuals found to be superior in one environment may not be able to maintain their superiority in another environment. This causes the variation in the performance of individual in a different environment [7].

In the semi-humid tropics, there is dearth information on immunological parameters of native and exotic chickens, especially those with tropically relevant genes.

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This limits objective database da which could be tapped from it, in order to design appropriate breeding strategies. It also affects the classification into distinct genetic groups. Therefore, the present study was embarked upon to evaluate the haematological and serum biochemical values of Nigeria local and exotic chickens in a sub-humid environment.

MATERIALS AND METHODS

Study Area: The research was carried out at the Poultry Unit of the Livestock Teaching and Research Farm of Ambrose Alli University Ekpoma, Edo State. the The study area was in Ekpoma,,which lies between Lat 6.44°N and Log 6.8°E and has a prevailing tropical climate with a mean annual rainfall of about 1556mm. The mean ambient temperature ranges from 26°C in December to 34°C in February and relative humidity ranges from 61% in January to 92% in August with yearly average of about 82%. The vegetation represents an interface between the tropical rainforest and the derived savanna.

Feeds and Feeding: The birds were fed *ad libitum* on starter marsh containing 20% crude protein and 2996 Kcal/kg Metabolizable Energy (ME) from Day old-4weeks of age . Then, growers marsh containing 15.86% crude protein and 2716 Kcal/kg ME was offered to the birds from 4-15weeks of age. Breeders' marsh with 16.80% crude protein and 2823 Kcal/kg ME was provided from 15-24weeks of age. Clean water was supplied continuously *ad libitum* throughout the experimental period.

Blood Sample Collection: Blood samples were collected from the jugular vein using sterile disposable needles (21-guage) and syringes from chicken during overnight fasting before, during and after the end of the experiment. Specimen for haematological studies were collected separately in tubes containing ethylene diamine tetra-acetic acid (EDTA) as anticoagulant. Samples for biochemical analysis were collected into anti-coagulant free tubes and allowed to clot for two hours at room temperature and centrifuged for ten minutes at 2000 rpm to separate the serum .

Haematological Parameters Assay: These include packed cell volume (PCV) o, red blood cell (RBC) and white blood cell (WBC) counts and haemoglobin concentration (Hb), using haematocrit, improved Neubauer haemocytometer and Wintrobe's micro-haematocrit and , respectively. The erythrocyte indices; mean corpuscular volume (MCV) and mean corpuscular haemoglobin concentration (MCHC) were computed according to [8].

Biochemical Parameters Assay: Serum protein, albumin, globulin and urea were analyzed using sigma assay kits, while glucose and creatinine were determined according to Slot [9], uric acid according to Henry *et al.* [10] and cholesterol according to Roschlan *et al,* [11].

Statistical Analyses: Data obtained were analyzed using the General Linear Model [12]. The model was as specified below:

Table 1: Composition of the experimental diets.

Ingredient	Starter diet	Growers diet	Breeders diet
Maize	45.95	55.45	56.95
Groundnut cake	25.00	15.00	20.00
Wheat offal	18.00	20.00	15.00
Fish Meal	3.00	1.50	2.00
Bone Meal	2.00	2.00	2.00
Limestone	5,00	5.00	5.00
*Premix	0.25	0.25	0.25
Salt	0.30	0.30	0.30
Lysine	0.25	0.25	0.25
Methionine	0.25	0.25	0.25
Total	100.00	100.00	100.00
Calculated CP (%)	20.17	15.86	16.80
ME (kcal/kg)	2996.40	2716.00	2823.14

*Premixcontained:VitaminA1500i.u;VitD_3,3000iu;VitE12,iu;VitaminK2.4mg;thiamine3.0mg;Riboflavin,6.0mg;pyriooxine4.8mg; 1000mg;nicotinic acid 43mg;calcium panthotenic acid 12mg; 0.6mg;Vitamin B12 0.024mg;vitamin B2 5mg; folic acid 12mg; chlorine chloride,350mg manganese,56 mg, Iodin1mg; Zinc 50mg, copper, 400mg; Iodine,20mg; cobalt, 1.25mg, selenium,4.8mg

The Model Is Stated Thus:

$Y_{ijk} = \mu + S_j + P_k + (SP)_{jk} + e_{ijk}$

where

Y_{ijk} = The parameter of interest
μ = Overall mean for the parameter of interest
S_j = Fixed effect of j^{th} sex (j = 1-2)
P_k = Fixed effect of k^{th} genotype (1-5)
$(SP)_{jk}$ = Interaction effect of j^{th} sex and k^{th} genotype.
e_{ijk} = Random error associated with each record (normally, independently and identically distributed with zero mean and variance ó²å).

Duncan Multiple Range Test was used to separate the means that are significantly differenct [13].

RESULTS AND DISCUSSIONS

Haematological parameters are good indicators of the physiological status of animal and its changes are of value in assessing the response of animals to various physiological situations [14]. The results of the haematological parameters of the Nigerian local and exotic chickens are presented in Table 2.

There were significant difference (P<0.05) between genotypes in the mean values of count WBC, RBC HB, PCV, MCV, MCH) and MCHC . The mean values obtained in the present study falls within the normal physiological range [15- 17].The higher PCV, HB and WBC values in the frizzle genotype are in agreement with the findings of [18]. Although these higher values were attributed to a higher weight gain as well as a reduction in heat load the frizzle genotype, reported PCV was higher in naked neck genotype compared to that of the fully feathered genotype[19] . This could be a boost in the growth and productive life of the former. However, the present results are inconsistence with the PCV, RBC and HB values given by Oke *et al.* [20], where no significant (p<0.05) genotype effect was observed. These variations could be attributed to environment and season since PCV in birds is reported to be seriously affected by stress or adverse conditions [21]. Similar observations were reported by Njidda *et al.* [22] who observed decreased PCV (24-27%) as a result of adverse weather conditions. The result of the RBC also showed that the feed contained high quality dietary protein and the animals were free from diseases since the values fall within the normal range. Hb values of the experimental birds were higher than the values reported by Njidda *et al.* [22]. The different environment might be the possible explanation, though the result shows that the vital physiological relationship of Hb with oxygen in the transport of gases (Oxygen and Carbondioxide) to and from the tissues of the body has been maintained and was normal. The significant increase in the WBCs must have agreed with the reports of Emenalom *et al.* [23] who reported that it is probable that the birds were immunologically challenged. The elevated leukocyte counts of all the birds could be a physiological adjustment presented against negative antigenic effect. This may largely be informed of the associated inherent resistance to tropical diseases. It is noteworthy that the subsisting ecological conditions support several vectors and parasites of economic significance. The serum biochemical parameters of the five chickens genotypes were presented in Table 3.

The mean values of total protein, albumin, urea, cholesterol, creatinine, full blood count, calcium and phosphorus of the genetic group were also significantly (P<0.05) influenced. However,the present results are inconsistent with the values of total protein, albumin, urea, cholesterol, creatinine, given by Ladokun *et al.* [24] who observed no significant(P<0.05) genetic effect in their study. Moreover, the normal feather genotype had a significantly higher (P<0.05) albumin content 1.90, 1.74, 1.62,1.61 and 1.49 m l and a lower 165.22 % full blood count values. The present findings are inconsistenti with the report of earlier workers [25, 18, 19]. Serum parameters are important in the proper maintenance of the osmotic pressure between the circulating fluid and the fluid in the tissue space so that the exchange of materials between

Table 2: Mean values of haematologcal parameters in relation to Genotype.

Traits	Normal	Frizzled	Naked neck	Dominant Blue	Dominant Black
WBC ($\times 10^3/\mu$)	21.50± 2.21^d	28.13±0.06^a	27.65±0.16^b	27.23±0.53^c	28.23±0.20^a
RBC ($\times 10^6/\mu$)	2.85±0.15^d	3.32±0.01^b	3.18±0.09^c	3.18±0.24^c	3.55±0.02^a
PCV (%)	37.73±1.91^d	46.40±0.40^a	42.60±1.06^b	40.80±2.88^c	46.60±0.34^a
Hb (g/dl)	12.78±0.92^c	15.96±0.09^a	14.29±0.43^b	12.36±1.33^c	16.37±0.08^a
MCV (fl)	133.86±1.54^d	141.19±2.10^a	134.91±2.67^b	130.82±3.48^e	134.45±1.03^c
MCH (pg)	44.53±0.96^d	48.57±0.09^a	45.32±0.53^c	41.57±0.90^e	45.63±0.05^b
MCHC (%)	33.21±0.62^c	34.37±0.90^a	33.52±0.21^b	31.79±0.94^d	34.28±0.07^a

a, b,c,d,: Means in the same row with different superscripts are significantly different (p<0.05)

Table 3: Mean values of serum biochemical parameters in relation to Genotype.

Traits	Normal	Frizzle	Naked neck	Dominant blue	Dominant black
Total protein(ml)	5.20±0.18^{b}	6.16±0.19^{a}	4.62±0.03^{d}	4.63±0.03^{d}	4.94±0.25^{c}
Albumin(ml)	1.90±0.07^{a}	1.74±0.05^{b}	1.61±0.03^{c}	1.62±0.02^{c}	1.49±0.11^{d}
Cholesterol(mg/dl)	89.78±2.41^{c}	69.70±0.37^{e}	93.00±4.51^{b}	107.80±4.98^{a}	71.60±11.54^{d}
Urea(ml)	5.19±1.21^{a}	4.60±0.37^{b}	3.90±0.23^{cd}	3.40±0.22^{d}	4.37±0.30b^{c}
Creatinine(ml)	0.44±0.04^{b}	0.86±0.08^{a}	0.45±0.11^{b}	0.46±0.31^{b}	0.46±0.18^{b}
Rb counts(%)	165.22±0.63^{e}	212.00±3.58^{a}	179.80±4.48^{c}	173.30±3.18^{d}	184.00±0.42^{b}
Calcium(mg/dl)	9.34. ±0.18^{c}	9.35±0.19^{c}	11.30±0.03^{a}	10.51±0.03^{b}	8.47±0.25^{d}
Phosphorus(mg/dl)	4.14±0.04^{b}	4.34±0.07^{b}	3.37±0.11^{c}	5.50±0.31^{a}	4.17±0.18^{b0}

a, b, c, d: Means in the same row with different superscript are significantly different ($p<0.05$)

Table 4: Mean values of haematological parameters in relation to sex.

Parameters	Male	Female
WBC ($\times10^{3}$/ul)	28.5±0.07^{a}	24.88±0.93^{b}
RBC ($\times10^{6}$ /ul)	3.54±0.05^{a}	2.93±0.09^{b}
PCV (%)	46.71±0.42^{a}	39.30±1.23^{b}
Hb (g/dl)	15.83±0.04^{a}	13.00±0.55^{b}
MCV (fl)	135.36±1.08^{b}	134.76±0.52^{a}
MCH (pg)	46.28±0.34^{a}	44.04±0.67^{b}
MCHC (%)	34.48±0.08^{a}	32.44±0.41^{b}

a, b: Means in the same row with different superscripts are significantly different ($P<0.05$)

Table 5: Mean values of serum biochemical parameters in relation to sex.

Parameters	Male	Female
Total protein (ml)	5.48±0.17^{a}	4.75±0.10^{b}
Albumin (ml)	1.66±0.06^{b}	1.68±0.03^{a}
Cholesterol (mg/dl)	100.54±5.10^{a}	72.64±1.98$_{b}$
Urea (ml)	3.45±0.21^{b}	5.04±0.40^{a}
Creatinine (ml)	0.62±0.08^{a}	0.46±0.01^{b}
Rbs (%)	185.17±3.28^{a}	181.36±4.06^{b}
Calcium (mg/d)	8.89±0.24^{b}	10.68±0.31^{a}
Phosphate (mg/dl)	4.15±0.11^{b}	4.46±0.21^{a}

a, b: Means in the same row with different superscripts are significantly different ($P<0.05$)

the blood and cells could be facilitated. They also contributed to the viscosity and maintenance of the normal blood pressure and PH. The lower creatinine which is a waste product found in the muscle from a high energy storage compound. All the values obtained from the minerals were all within range as reported by Anon, [26] and Herbert [27]. The implication is that breeds/strain may affect the electrolyte values. The significant genotypes and sex differences found for haematological and serum biochemical values are suggestive of the existence of genetic variation. The higher values of calcium, phosphorus, urea and albumin in females than males might be attributed to various physiological factors associated with females. For examples, during egg formation and egg-laying, females are in restless and excited condition [27].

CONCLUSION

This study revealed that the packed cell volume, hemoglobin and other values were significantly ($P>0.05$) different with higher mean value in the Nigerian local chicken compared to the exotic counterpart. This is an indication that haematological and serum biochemical values can be used in the classification of birds into genetically distinct subgroups. The present haematological and serum biochemical values can be utilized in crossbreeding programmes in order to produce individuals that are fit and more productive.

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