

Effect of genotype on haematology and serum biochemistry of Nigerian indigenous roosters (cockerels)

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ABSTRACT: An experiment was conducted to determine the haematology and serum biochemistry of three genotypes of Nigerian indigenous roosters. A total of twenty-seven roosters aged 8 months were used. They were divided into 3 treatment groups as T₁, T₂ and T₃, representing frizzled, naked neck and normal feathered roosters respectively. Each of the treatment group consisted of Nine (9) roosters, replicated 3 times with 3 roosters per replicate in a completely randomized design (CRD). They were fed grower mash for 35 days after which blood samples were collected for haematological and serum biochemical evaluation. The parameters measured included haemoglobin (Hb), red blood cell (RBC), white blood cell (WBC), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), total protein, albumin, urea, globulin, glucose, creatinine and cholesterol. The results of the study revealed that all the parameters measured showed no significant differences ($P > 0.05$) among the treatment groups although variations were observed among the different genotypes. More so, almost all the parameters measured are within the normal ranges for chicken.

Keywords: Blood chemistry, genotype, haematology, indigenous chicken.

INTRODUCTION

Indigenous chickens are widely distributed in the rural areas of tropical and sub-tropical countries where they are kept by the majority of the rural poor. The indigenous chicken constitutes 80% of the 120 million poultry types raised in the rural areas in Nigeria (RIM, 1992). They are self-reliant and hardy birds with the capacity to withstand harsh weather condition and adapt to adverse environment. They are known to possess qualities such as the ability to hatch on their own, brood and scavenge for major parts of their food and possess appreciated immunity from endemic diseases. Their products are preferred by the majority of Nigerians because of the pigmentation, taste, leanness and suitability for special dishes (Horst, 1989). In Nigeria, indigenous chickens were characterized along genetic lines of feather and plumage colour (such as normal or frizzled feathered), body

structure (such as naked neck, dwarf type) and colour variants (such as black, white, brown, mottled etc.). The frequency distribution of the normal feathered chicken was about 91.8% while that of frizzled and naked neck were 5.2 and 3.0% respectively in Bayelsa state of Nigeria (Ajayi et al., 2009). The use of blood examination as a way of assessing the health status of animals has been documented (Muhammad et al., 2000; Esonu et al., 2001; Churias, 2002; Iheukwumere et al., 2004; Iheukwumere et al., 2006; Iheukwumere et al., 2008; Oguike and Ude, 2008). This is because it plays a vital role in physiological, nutritional and pathological status of organisms (Muhammad et al., 2000; Iheukwumere and Okoli, 2002; Egbe-Nwiiyi et al., 2000; Taiwo and Ogunsami, 2003). Serum biochemical analysis is used to determine the level of heart, liver and kidney functions as well as to evaluate

protein quality and amino acid requirements in animals (Etim and Oguike, 2011). This study was therefore designed to determine the effect of genotype on haematological and serum biochemical parameters and invariably health status of Nigerian indigenous cockerels.

MATERIALS AND METHODS

Location of the study

The experiment was carried out at the Poultry Unit of the Students' Research and Teaching Farm of Federal College of Agriculture, Ishiagu, Ivo Local Government Area of Ebonyi State. The project site is located within latitude 5°56' North and Longitude 7°3' East, having a mean annual rainfall of 100-1,600 mm and a temperature of 27–33°C with an average relative humidity of 88% (Metrological unit of FCAI).

Experimental birds and management

A total of 27 birds were used for the study. They comprised three different genetic groups 9 frizzle, 9 naked neck and 9 normal feathered whose previous management background is unknown. They were purchased from local markets in South eastern Nigeria. The roosters were acclimatized for a period of two weeks. During this acclimatization, the cocks was given all the necessary medications which include; vaccination against Newcastle disease, and deworming. The birds were raised on a deep litter pen. They were fed using commercial feed (Grower Mash) diet (Table 1). Feed and water were given *ad-libitum* to the birds, while other management practices were also carried out.

Experimental design

The cockerels were randomly assigned to 3 treatment groups of 9 birds replicated 3 times with 3 birds per replicate in a Completely Randomized Design (CRD).

Blood collection and analysis

Blood samples of about 5 mls were collected using a sterile syringe and needle via wing vein puncture. About 2.5 mls of blood used for haematological studies was stored in a bottle containing anticoagulant; ethylene diamine tetra acetic acid (EDTA) to prevent clotting and subsequently analyzed. While the other 2.5 mls of blood meant for serum biochemical studies was collected into another sterile bottle and allowed to coagulate. The samples were centrifuged to harvest the sera. Haematological parameters measured include haemoglobin (Hb), packed

cell volume (PCV), red blood cell count (RBC), white blood cell (WBC) count. The blood constants: mean corpuscular haemoglobin concentration (MCHC), mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) were computed using appropriate formulae as described by Jain (1986). Haematological parameters were evaluated according to the procedure described by Davis and Lewis (1991). The serum biochemical assay was carried out using standard chemical procedures: total serum protein by Goldbery refractometer method as described by Kohn and Allen (1995), albumin and globulin by Bromocresol green (BCG) method as described by Randox (2006), creatinine was determined according to the procedure described by Boissness and Tausky (1995), while urea, glucose and cholesterol were determined by methods described by Baker and Silverton (1986). The analyses were carried out in the laboratory.

Statistical analysis

Data collected on haematology and serum biochemistry were subjected to one-way analysis of variance (ANOVA). The separation of significant means was carried out using Fishers Protected Least Significance Difference (LSD) as outlined by Steel and Torrie (2006). Statistical model that was used is:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where; μ = overall mean common to all observation, T_i = Effect of strain on the observation and e_{ij} = Error term.

RESULTS AND DISCUSSION

The haematological parameters of three Nigerian indigenous cockerels are shown in Table 2. There were no significant differences ($P > 0.05$) among the treatment groups in all the parameters measured: PCV, HB, RBC, MCHC, MCH. MCV and WBC values.

The range of PCV values is 37.67 to 39.00%, with the frizzle feathered having the highest numerical count of PCV 39.00%, followed by naked neck (38.00%) and then normal feathered had the lowest value of 37.67%. The PCV values obtained in this study were within the range of 25 to 45% reported for birds by Banerjee (2007) and Islam et al. (2004).

Haemoglobin values ranged from 12.77 to 13 g/dl. The frizzle feathered cockerels had the highest numerical value, followed by naked neck and then normal feathered cockerels: 13.17, 12.80 and 12.77%, respectively. These values were within the normal HB range of 7 to 13 g/dl reported by Banerjee (2007) for chickens. However, the HB values obtained in this study were higher than the range of 9.36 ± 0.01 to 9.39 ± 0.00 g/dl reported by Iheukwumere et al. (2006) for Nigerian indigenous

Table 1. Ingredients composition of the commercial concentrate (Top Grower's Mash) fed to the birds.

Ingredients Composition	Percent (%)
Crude Proteins	16.00
Fats and Oil	5.00
Crude Fibre	7.00
Calcium	1.00
Available Phosphorus	0.45
Lysine	0.75
Methionine	0.36
Salt (g)	0.30
Kcal/K Metabolisable Energy (ME)	2450

Table 2. Haematological characteristics of three Nigerian indigenous roosters.

Parameters	T ₁ F	T ₂ NK	T ₃ N	SEM
PCV %	39.00	38.00	37.67	11.16
HB (g/dl)	13.17	12.80	12.77	1.39
RBC (X10 ¹² /l)	4.33	3.76	3.62	0.58
MCHC (%)	33.75	33.68	33.88	0.11
MCH (pg)	30.52	34.11	35.31	26.22
MCV (fl)	90.42	101.26	104.46	134.07
WBC(x10 ¹² /l)	6.40	6.63	7.07	7.07

PCV-packed cell volume, HB-Haemoglobin, RBC-Red Blood Cell, MCHC-Mean Corpuscular Haemoglobin Concentration, MCH-Mean Corpuscular Haemoglobin, MCV-Mean Corpuscular Volume, WBC-White Blood Cell, F- Frizzled Feathered, NK-Naked Neck, N-Normal Feathered.

chickens, but lower than the range of 11.00±2.15 to 14.85±1.42 g/dl reported by Iheukwumere et al. (2008) for Nigerian local cocks. Since haemoglobin is responsible for cellular respiration which is important in metabolic reactions (Mc. Donald et al., 2002), a decrease in haemoglobin is an important determinant of anaemia which may probably lead to reduction in the oxygen carrying capacity of blood. Haemoglobin concentration in the blood has been associated with availability of nutrient to the animal (Esonu et al., 2001; Iheukwumere and Herbert, 2002; Egu and Ukpabi, 2015).

The RBC values ranged from 3.62 to 4.33 (x10¹²/l). The Frizzle feathered cockerels had the highest numerical value of 4.33 (x10¹²/l) in RBC, followed by the Naked neck cockerels which had 3.76 (x10¹²/l) and then the Normal feathered cockerels which had the lowest RBC value of 3.62 (x10¹²/l). The RBC values obtained in this study were within the normal range of 2 to 4 (x10⁶/mm³) reported by Jain (1993) for chickens except that of frizzle feathered cockerels which was slightly higher than the range. However, the RBC values obtained were lower than the range of 8 to 11 (x10⁶/mm³) reported by Simarakas et al. (2004) in Thai indigenous chickens.

MCHC values ranged from 33.68 to 33.88%. The normal feathered cockerels had the highest numerical value of 33.88% in MCHC, followed by Frizzle feathered and naked

neck cockerels which had 33.75 and 33.68% respectively. The MCHC values obtained in this study were lower than the value of 35.70% reported by Iheukwumere et al. (2002) in broiler chickens, but higher than the value of 30.56% reported by Ameh (2004) in Nigerian local cocks and the range of 33.20 to 33.40 g/dl reported by Egu (2017) in Harco cocks. However, the MCHC values obtained in this study were within the normal range of 26.0 to 35.0 g/dl reported by Banerjee (2007) for chickens and Islam et al. (2004) for local chickens in Bangladesh.

The MCH result ranged from 30.52 to 35.31 pg with the normal feathered having the highest count followed by naked neck while the frizzle feathered had the least MCH value as 35.31 and 30.52 pg respectively. Frizzled and naked necks are within the normal range of 30.7 to 34.10 for MCH reported by Ibrahim (2012) in chickens.

The MCV value ranged from 90.42 to 104.00 fl. The normal feathered had the highest value of 104.46 fl, followed by naked neck with value of 101.26 fl and frizzle feathered with least value 90.42 fl. The MCV range is in the normal range for chicken MCV count reported by naked neck (Ibrahim, 2012). Mean corpuscular volume (MCV) of blood is an indication of the average volume of blood cell (Lazzaro, 2003).

The WBC values ranged from 6.40 to 7.07 (x10¹²/l). Normal feathered had the highest count followed by naked

Table 3. Serum biochemical characteristics of three Nigerian indigenous roosters.

Parameters	T ₁ F	T ₂ NK	T ₃ N	SEM
Protein (g/l)	40.73	42.13	39.47	2.17
Albumin (g/l)	24.50	25.83	24.56	1.78
Globulin (g/l)	16.23	16.30	14.93	1.22
Urea (mg/dl)	35.61	36.17	35.50	6.52
Creatinine (mg/dl)	2.65	2.12	1.09	0.49
Cholesterol (mg/dl)	93.46	95.38	86.92	3.85

F- Frizzled Feathered, NK- Naked Neck, N- Normal Feathered.

and frizzle feathered with the values of 7.07, 6.53 and 6.40 ($\times 10^{12/l}$) respectively. Banerjee, (2007) reported the normal range for WBC of chicken as $9.31(\times 10^{12/l})$. The range from the result was far below this range thus, disagrees with it. Abnormal production of white blood cell in the blood of animals is usually associated with immune response by animals due to the presence of antigen (foreign body) in the body. The values of white blood cell also depict absence of infections since elevation of the cell suggests infection by micro-organisms especially bacteria (Aka et al., 2008; Sowande et al., 2008).

The serum biochemical parameters of three Nigerian indigenous cockerels are shown in Table 3. There were no significant differences ($P>0.05$) among the treatment groups in all the parameters measured: total protein, albumin, globulin, urea, creatinine and cholesterol values. Naked neck cockerels recorded the highest numerical value of 42.13 g/l in total protein followed by frizzle and normal feathered cockerels which had 40.73 g/l and 39.47 g/l respectively. The serum total protein values obtained in this study were higher than the range of 7.6 ± 0.27 to 8.2 ± 0.30 mg/dl reported by Iheukwumere et al. (2006) for Nigerian chickens. This variation in values of serum total protein may not be unconnected to the differences in breed and nutritional status of the birds (Esonu et al., 2001).

Naked neck cockerels recorded the highest numerical value of 25.83 g/l in serum albumin followed by the Normal feathered and the Frizzle cockerels which had 24.56 g/l and 24.50 g/l respectively. The serum albumin values obtained in this study were higher than the range of 3.1 ± 0.27 to 3.5 ± 0.22 mg/dl reported by Iheukwumere et al. (2006) for Nigerian chickens. Low albumin suggests poor clotting ability of blood and hence poor prevention of hemorrhage (Robert et al., 2000; Egu, 2017).

Naked neck cockerels recorded the highest numerical value of 16.30 g/l in serum globulin followed by the Frizzle and Normal feathered cockerels which had 16.23 g/l and 14.93 g/l respectively. The serum globulin values obtained in this study were higher than the range of 2.1 to 3.7 g/dl reported for birds by Banerjee (2007). Babatunde and Oluyemi (2006) opined that the higher the value of globulin, the better the ability to fight against disease. This implies that naked neck cockerels which recorded the highest value of 16.30 g/l in globulin could have the best ability to resist disease.

Naked neck cockerels recorded the highest numerical value of 36.17 mg/dl in serum urea followed by the Frizzle and Normal feathered cockerels which had 35.61 and 35.50 mg/dl respectively. The urea values obtained in this study were within the range of 30.46 ± 2.51 to 54.08 ± 0.11 mg/dl reported by Iheukwumere et al. (2006) in Nigerian chickens. However, the urea values obtained in this study were higher than the range of 10.20 to 29.74 mg/dl reported by Egu (2017) in Harco cocks. This disparity in urea values may be attributed to differences in breed and nutritional status of the birds. It has been observed that serum urea content depends on both the quantity and quality of protein supplied in the diet (Iheukwumere and Herbert, 2002).

Frizzle cockerels recorded the highest numerical value of 2.65 mg/dl in serum creatinine followed by the naked neck and normal feathered cockerels which had 2.12 and 1.09 mg/dl respectively. The serum creatinine values obtained in this study were within the range of 1 to 2 mg/dl reported for birds by Reece and Swenson (2004) and Banerjee (2007) except Frizzle cockerels whose creatinine value was slightly higher than the range. However, the creatinine values obtained in this study were lower than the range of 18.00 to 18.50 mg/100ml reported by Iheukwumere et al. (2002) in broiler chickens. Creatinine measurement is used exclusively in the assessment of kidney function. The rate of production of creatinine is constant and elevations of plasma creatinine are indicative of under excretion suggesting kidney impairment. Stockham and Scott (2007) reported also that creatinine along with blood urea nitrogen concentration is an excellent indicator of protein metabolism and kidney function.

Naked neck cockerels recorded the highest numerical value of 95.38 mg/dl in serum cholesterol, followed by the Frizzle and Normal feathered cockerels which had 93.46 and 86.92 mg/dl respectively. The cholesterol values obtained in this study were within the normal range of 52 to 148 mg/dl reported by Banerjee (2007) for birds. This implies that the cockerels may not face the risk of myocardial infarction usually associated with high blood cholesterol content and emaciation due to low serum cholesterol (Frandsen, 2002). A decrease in plasma cholesterol concentration has been reported to result in a reduction in the plasma concentrations of insulin-like

growth factor and progesterone and consequently delayed or inhibited ovulation (Maciel et al., 2010).

The assessment of the nutritional and health status in livestock can be made by determining certain blood metabolite concentrations (Ndlova et al., 2007). The authors further reported that certain factors like physiological status of an animal, breed, nutrition, season and age may affect the concentration of blood biochemical parameters. Ihrig et al. (2001) and Mohri et al. (2007) reported that blood biochemical parameters have been shown to be subject to change with age in many animal species.

Conclusion

The results of this study indicate that haematology and serum biochemistry of the Nigerian indigenous roosters may not be influenced by genotype. Though variations were observed in all the parameters measured, there were no significant differences among the three genotypes. Also, most of the values obtained are within the normal ranges for chickens.

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