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# Haematological and serum biochemical characteristics of four chicken genotypes in south-western, Nigeria

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## Abstract

*A total of 180 chicks were used to compare the haematological and serum biochemical characteristics of four chicken genotypes from south-western part of Nigeria. The chicks were grouped based on their genotypes in a Completely Randomized Design for the eight-week study. The genotypes considered were Normal Feather (NF), Naked Neck (NN), Frizzled Feather (FF) and Marshal Broiler (MB) chickens at 45 chicks per genotypes. At the end of the experiment, ten birds per genotype were drawn and their blood samples analysed for haematological and serum biochemical studies. The results showed that there were no significant (P>0.05) variations in the haematological and serum biochemical characteristics of the four chicken genotypes except for aspartate aminotransferase (AST) and alkaline phosphatase (ALP) for which the Marshall Breed (41.25±1.89 µ/l) and Naked Neck (287.98±19.82 µ/l) respectively had the highest values. Based on the results obtained in this study, it can be concluded that the four chicken genotypes used in this study had little or no haematological and serum biochemical deviations. The result obtained in this study will be helpful in creating a baseline data on haemato-biochemical profiles of indigenous chicken breeds in Nigeria which in turn can be used for assessing the health status of these birds, improving desirable breeds/traits and designing appropriate breeding strategies for indigenous poultry birds in the country.*

***Key words:*** Haematology, serum characteristics, indigenous, chicken, genotypes

## Description of Problem

Nigeria is endowed with different agro-ecological zones and diverse animal genetic resources of indigenous breeds (*1*). The Nigerian indigenous chickens (Naked neck, Frizzled and Normal feather) constitute about 80% of the 120 million poultry birds (*1*). An efficient way of assessing and characterizing different animal species is to evaluate their blood for environment dependent factors.

Blood plays an important role in the transportation of nutrients, metabolic waste products and gases around the body (*2*) and represents a means of assessing clinical and health status of animals (*3*). Various functions of the body are made possible by singular and collective actions of its constituents – the haematological and biochemical components (*4*). The haemato-biochemical profiles are most commonly used in nutritional studies of chickens (*5*), pigeon (*6*), guinea fowl (*7*), bronze turkey (*8*) and Japanese quail (*9*). Also, (*10*) reported that data from blood profiles could be exploited in the improvement of chicken stocks while (*11*) asserted that blood parameters help in the diagnosis of specific poultry pathologies and might serve as basic

knowledge for studies in immunology and comparative avian pathology.

Few literatures abound on characterization of Nigerian indigenous chicken based on haematological and serum biochemical parameters. This project was therefore designed to compare genotype effects on the haematology and serum biochemical characteristics with a view to generating a baseline data on haemato-biochemical profiles of some indigenous chicken breeds available in Nigeria. Assessment of variations in haematological parameters in Nigerian indigenous chicken would further help our understanding of diversity of these birds which are either low in numbers or threatened by extinction.

## Materials and Method

### Study location, sources of birds and experimental layout

The experiment was conducted at the Poultry unit of the Teaching and Research Farm of the Federal University of Technology, Akure, Ondo State, Nigeria. Akure is located on latitude 7$^{o}$ 5'N and longitude 5$^{o}$ 10'E in the rainforest zone of South Western Nigeria at an elevation of 200 m above the sea level. It has a mean annual temperature of about 31$^{o}$C (min. 26.9$^{o}$C and max. 34$^{o}$C) and relative humidity ranges between 68 – 86% during the rainy season and less than 50% during the dry season. The peak of rainfall occurs in July and/or September while February is the driest month of the year. Laboratory analyses of blood samples were carried out at the diagnostic laboratory of the Department of Animal Production and Health, the Federal University of Technology, Akure (FUTA).

A total of 180-day old chicks were purchased from the Federal University of Agriculture, Abeokuta (FUNAAB) Farm, Ogun State and segregated by genotypes as Normal Feathers (NF), Naked Necks (NN), Frizzled Feathers (FF) indigenous chickens and Marshall Broiler (MB) (an exotic chicken) at 45 birds per genotype in a Completely Randomized Design. The MB chicks were obtained from Fore-Sight Farms, Ibadan, Oyo State, Nigeria. The diet used in the study was formulated and produced at the FUTA Teaching and Research Farm feed-mill and contained 23.2% CP (22.8% CP on proximate) and 3185.49 kcal/kg ME.

### Sample and data collection

Having randomly drawn 10 birds per genotype, 5 ml of blood samples were taken from the jugular veins of each bird on the farm and 2 ml dispensed into Ethylene Diamine Tetra Acetate (EDTA) bottles and transported to the laboratory under cold condition within 2 hours of collection for analyses. The remaining blood samples (3ml) collected from these birds were dispensed into clean test-tubes and transported to the laboratory on a slanted rack (test-tube holder) and allowed to stand for about 4 - 5 hours till it clotted and a straw-coloured liquid which had gathered on top of the clotted blood was harvested by decanting it from the test-tube into a cryo-preservative container and stored at -20$^{0}$C before eventual analysis for serum biochemical indices: total protein (TP), albumin (ALB), globulin (GLB), Cholesterol (CHOL) alkaline phosphate (ALP), alanine aminotransferase (ALT) and aspartate aminotransferase (AST). All the serum biochemical indices were determined using a commercial kit of Randox Laboratories Ltd., Ardmore Diamond Road, Crumlin, Co. Antrim, United Kingdom, BT294QY.

Data on the effects of genotypes on the haematological and serum biochemical indices were estimated using the least-squares procedures according to the method of (*12*) statistical package. Where significant differences were observed, differences among means were tested using the Duncan's Multiple Range Test.

The statistical model used was:

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

Where

$Y_{ij}$= Individual value of the $j^{th}$ bird in the $i^{th}$ genotype (j = 1-45)

$\mu$ = General mean of the parameter

$T_i$ = Fixed effect of the $i^{th}$ genotype (i = 1-4)

$\varepsilon_{ij}$ = Residual error

**Results and Discussion**

As shown in Table 1, the normal feather (NF) genotype has the highest value in erythrocytes sedimentation rate (2.30±0.30 mm/hr) and marshal broiler (MB) had the least (1.50±0.29 mm/hr). Variation in haematological parameters among chicken genotypes with the exception in mean cell volume agreed with the report of (*13*), but the values for other parameters in this study were higher than previously reported for exotic chickens in Nigeria (*14, 15*). The present results agreed with the findings of (*16*) and (*17*). Reports from these authors indicated variability in haematological profiles among different breeds. The value of lymphocytes obtained from this investigation may simply demonstrate the immunological status of the indigenous chickens which are believed to be generally high. On the other hand, low lymphocytes values in exotic strains may explain the higher level of susceptibility to avian disease-causing agents compared with indigenous chickens that are relatively tolerant to many tropical poultry diseases (*18*). These authors reported that since the lymphocytes in avian species serves a phagocytic role as in mammals, they are mainly responsible for defense of the body against infections. Also, (*19*) reported that leukocyte counts as well as heterophils and lymphocytes ratio were used as indicators of stress responses and sensitive bio-markers that are crucial to immune functions. Previous reports stated that packed cell volume, haemoglobin and mean cell haemoglobin (MCH) are major indices for evaluating circulating avian erythrocytes and are very significant in the diagnosis of anaemia and also serve as useful indices of the bone marrow capacity to produce red blood cells as in mammals (*20*, *21*). The higher values for MCH values in this investigation in normal feathered birds compared to naked neck and frizzled birds probably reflect inherent genetic differences. This is in agreement with the findings of (*22*) though their findings disagreed with this study in the values of packed cell volume and haemoglobin which were lower in normal feathered birds. However, (*23*, *24* and *25*) attributed low values of packed cell volume and haemoglobin to poor nutrition especially protein deficiency whereas (*26*) attributed low erythrocyte values to system of management. These reasons cannot be advanced for variations found in our studies where all birds were subjected to common environment of feeding and management. Therefore, the only logical factor implicated is the genotype of the chickens.

It was also reported by (*21*) that high packed cell volume reading indicated either an increase in number of circulating red blood cell or reduction in circulating plasma volume. Reports by (*27*) and (*28*) earlier showed that variation in erythrocytes can be attributed to increased body temperature from increase ambient temperature, respiration, respiratory water loss and oxygen consumption of birds which in turn increase oxygen intake and partial pressure of oxygen in the blood. Increase in partial pressure decreases the production of red blood cells and consequently reduces the mean value of circulating erythrocytes. These mechanisms may partly explain the lower values of MCH that are associated with naked-neck and frizzle-feathered birds in this study. This may be the most likely mechanism by which the expression of naked neck and frizzle genotypes produce thermoregulatory effects. The lower mean values of Packed Cell Volume,

Haemoglobin and MCH were still within normal ranges as reported by (*29*). These authors reported normal avian Packed Cell Volume as ranging from 35% to 50% and a Packed Cell Volume less than 35% may be detrimental to the individual animal. These significant differences (P<0.05) which may be attributed to strain differences are consistent with *22* and *21*, strengthening the argument for inherent genetic differences. These results showed that frizzle feathered genotype generally had significantly (P<0.05) higher mean values in packed cell volume, haemoglobin, red blood cells, than their counterparts. Though the study did not consider sex as a source of variation, (*30*) attributed high mean values of erythrocytes in male birds as characteristic of gonadal and spermiogenetic development which occurs during the period of sexual maturation and at the onset of reproductive activity in breeding cocks. In a related report, (*31*) and (*23*) reported that matured males generally had higher erythrocyte values than females and reported that androgen stimulates erythropoiesis and increases the number of circulating erythrocytes and consequently, packed cell volume and haemoglobin in birds. Packed cell volume, haemoglobin and red blood cell (RBC) play important roles in better understanding of normal physiology, pathology and total health monitoring of birds (*15, 32*). These reports indicate that the levels of Packed Cell Volume and Haemoglobin concentration were major indices in evaluating circulating avian erythrocytes and were very significant in the diagnosis of anaemia. The concentrations of the haemoglobin (HB), basophils (BAS), monocytes (MON), heterophils (HET), lymphocytes (LYM) and eosinophils (EOS) were not significantly (P>0.05) influenced by the genotypic variations of the chickens. Also, the absolute haematological values viz: mean cell volume (MCV), mean cell haemoglobin (MCH) and mean cell haemoglobin concentration (MCHC) were not significantly (P>0.05) influenced by the genotypes. However, these results fell within the normal range of haematological values for chickens.

As shown in Table 2, the Total protein is highest in the MB genotype (61.97±15.15 g/l) and lowest in the NF (40.81±8.72 g/l), Albumin is very low in the MB genotype (18.24±4.83 g/l) compared to the other three genotypes. This report agreed with the findings of (*33*) who observed no significant difference (P>0.05) in the serum total protein, globulin, albumin and blood urea using cockerels fed with varying levels of tiger nut seed meal diets. The Naked Neck genotype was significantly different (P<0.05) from other genotypes and has the highest concentration of Alkaline phosphatase (287.98±19.82 µ/l) while other parameters fell within the normal range. The total protein, albumin, globulin, cholesterol and alanine aminotransferase concentrations were not significantly different (P>0.05) among all the breeds except for Aspartate aminotransferase and Alkaline phosphatase which were significantly different (P<0.05). The present study reveals that albumin were not affected by genotypes which means that the genotypes do not have any deleterious health challenges especially as related to the liver which denotes that they are quite hardy and very suitable for raising in semi-urban areas (*15*).

**Conclusions and Application**

Based on the results obtained in this study, it could be concluded that

1. The four chicken genotypes studied were not significantly different (P>0.05) in their haematological and biochemical characteristics except for Aspartate aminotransferase and Alkaline phosphatase indicating that the Nigerian indigenous chickens may

have originated from a common wild ancestor.

2. Further molecular studies are required to sufficiently substantiate the genetic similarities existing among them which would help in the context of future selection and improvement programmes of these genotypes;
3. More research on indigenous chickens should be carried out to capitalize on their haematological and biochemical profiles which might be an indicating factor to their immunity and adaptability to harsh environmental conditions.

**Table 1: Genotypic effects on haematological characteristics of experimental birds**

| Parameter/GNT | NF | NN | FF | MB |
|---|---|---|---|---|
| ESR (mm/hr) | 2.30±0.30 | 1.60±0.16 | 1.60±0.40 | 1.50±0.29 |
| PCV (%) | 25.00±0.63 | 26.70±0.65 | 28.40±1.43 | 27.50±1.04 |
| HB (g/100ml) | 8.33±0.21 | 8.90±0.22 | 9.45±0.47 | 9.15±0.35 |
| RBC ($x10^6/mm^3$) | 1.92±0.12 | 2.21±0.13 | 2.46±0.24 | 2.34±0.20 |
| BAS (%) | 2.90±0.10 | 2.70±0.15 | 3.00±0.15 | 3.00±0.41 |
| MON (%) | 12.20±0.73 | 13.10±1.00 | 12.50±0.92 | 12.50±1.04 |
| HET (%) | 21.20±0.93 | 22.50±0.91 | 21.80±0.85 | 20.00±0.82 |
| LYM (%) | 61.80±0.92 | 60.90±0.71 | 60.90±0.77 | 61.50±1.55 |
| EOS (%) | 1.90±0.10 | 1.80±0.13 | 1.80±0.13 | 2.00±0.04 |
| MCV (%) | 133.41±5.69 | 123.64±5.15 | 122.21±8.20 | 119.49±7.34 |
| MCH (%) | 44.46±1.90 | 41.21±1.71 | 40.69±2.77 | 39.75±2.42 |
| MCHC (%) | 33.32±0.04 | 33.33±0.03 | 33.28±0.03 | 33.27±0.04 |

*GNT Genotype, NF = Normal Feathered, NN= Naked Neck, FF= Frizzled Feathered, MB= Marshall Broiler, HB=Haemoglobin, MCV= Mean Cell Volume, MCHC= Mean Cell Haemoglobin Concentration, LYM= Lymphocytes, NEU= Neutrophils, MON= Monocytes, BAS= Basophils, PCV= Packed Cell Volume, ESR=Erythrocytes Sedimentation Rate, RBC=Red Blood Cell, EOS=Eosinophils*

**Table 2: Genotypic effects on serum biochemical characteristics of experimental birds**

| Parameter/GNT | NF | NN | FF | MB |
|---|---|---|---|---|
| TP (g/l) | 40.81±8.72 | 45.66±7.41 | 45.66±6.24 | 61.97±15.15 |
| ALB (g/l) | 24.99±4.19 | 31.01±4.11 | 32.28±4.38 | 18.24±4.83 |
| GLB (g/l) | 33.71±8.73 | 24.68±4.30 | 21.85±8.35 | 43.73±19.55 |
| CHOL (mg/dl) | 67.63±3.77 | 67.51±4.79 | 77.19±8.25 | 67.63±7.89 |
| ALP (µ/l) | $198.07±39.00^b$ | $287.98±19.82^a$ | $209.21±11.82^b$ | $202.05±61.47^b$ |
| ALT (µ/l) | 2.26±0.66 | 3.04±0.52 | 3.36±1.25 | 3.80±0.37 |
| AST (µ/l ) | $22.50±2.55^b$ | $30.20±3.08^b$ | $30.65±3.01^b$ | $41.25±1.89^a$ |

*[a,b]Means on the same row having different superscripts are significantly different (p<0.05), GNT= Genotype, FF= Frizzled feathered, MB= Marshall broiler, NF=Normal feathered, NN= Naked neck, ALP = Alkaline phosphatase, AST = Aspartate aminotransferase, CHOL = Cholesterol, ALT = Alanine aminotransferase, TP = Total protein, ALB = Albumin, GLB = Globulin*

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