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Hematology and external egg quality parameters of three Nigerian indigenous chicken genotypes

Abstract

The study was conducted to determine the hematology and external egg quality parameters of three Nigerian indigenous chicken genotypes. Three genotypes of 90 pureline indigenous chickens were bred and assigned randomly into three treatments with each treatment replicated thrice with 10 birds per replicate, using standard manage mental practices. A total of one hundred eggs were collected from each genotype and external egg quality parameters were evaluated using digital electric balance, micrometer screw gauge and Vernier calipers. Hematological examinations such as Packed Cell Volume (PCV), Hemoglobin count (Hb), Red Blood Cell (RBC), White Blood Cell (WBC), Platelets count, Lymphocytes count (Lymph.), Mean Corpuscular Hemoglobin concentration (MCHC), Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Volume (MCV), Heterophils count, Monocytes count and Erythrocyte Sedimentation Rate (ESR) were done using standard procedures. Significant differences ($P<0.05$) among the genotypes were observed for PCV, Hb, platelets count, MCH, Lymph and heterophils count. Only shell thickness was found to be significantly different ($P<0.05$) for external egg quality parameters among the genotypes. Naked neck, frizzle feather and normal feathered chickens were observed to have the heaviest, longest and widest eggs; highest PCV values; and highest heterophils count respectively. The study concluded that, with the haematological and external egg quality parameters of the three genotypes of the Nigerian indigenous chickens studied, improvement programmes may be carried out for commercial egg and meat production in Nigeria, using these three genotypes.

Keywords: genotypes, hematological parameters, egg quality, venire caliper, digital electric balance, micrometer screw gauge

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Description of problem

Information about haematological parameters and external egg quality parameters of Nigerian indigenous chickens is limited and not even available to farmers. In many species of birds especially chicken, normal values for hematological parameters were measured and a comprehensive data base was established of their blood profile. The Nigerian indigenous chicken breeds have been reported to have many advantageous gene complexes that could be harnessed in the development of meat or egg type chicken suitable for use in the tropics.[1] Among these major genes are the Naked necked, Frizzled and Normal feathered. In the other hand, many researchers have evaluated normal haematological parameters of industrial and commercial hybrid chickens.[2,3] Information about hematological and external egg quality parameters of indigenous chickens are limited therefore, this study was carried out to evaluate the haematological and external egg quality parameters of three strains of indigenous chickens.

Materials and methods

The study was carried out in the Students' Demonstration Farm of the Federal College of Animal Health and Production Technology, Apata, Ibadan, Nigeria. It is situated at Latitude 7^0 22' 39'' N and Longitude 3^0 54' 21'' E. A total of 90 birds hatched from the pure parent stock of Frizzle feather, Normal feather and Naked Neck local chickens were used for the experiment. Each genotype represented a treatment and each treatment was replicated three times with 10 birds per replicate. All treatments were subjected to routine management practices and their behavior was fully monitored. Pullets were placed on grower diet and fed at the rate of 80-90g/ bird/ day. The grower feed contained 15% crude protein and 2550Kcal metabolizable energy (ME) per kg of feed. The chickens were provided with square wooden nesting boxes for laying. Eggs were collected twice a day at 10.00am and 3.00pm respectively.

Data collection

External egg quality parameters

At the end of the 26th week, eggs were collected from each of the genotypes and external quality parameters were evaluated as described by Fayeye et al.[4] External egg quality parameters analyzed include egg weight, egg length, shell thickness, egg width, percentage weight and shell surface area. These were analyzed using digital electric balance, Vernier calipers and micrometer screw gauge respectively.

Haematological Parameters

At the end of the twenty eighth week, blood was collected from seven birds per replicate. 5 mls of blood was collected from the birds with the aid of sterile syringes via the jugular vein into sample bottles containing EDTA (Ethylene Diamine Tetra Acetic Acid). Samples were thereafter taken to the Main Research Laboratory, Department of Veterinary Medicine, University of Ibadan to determine the packed cell volume (PCV), hemoglobin count (Hb), the red blood (RBC) and white blood counts (WBC), platelets level, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), lymphocytes, monocytes, eosinophils and neutrophils.

The ethical standard for handling of live animals was followed as set by Nigerian Institute of Animal Science (NIAS). All data collected were subjected to Analysis of Variance in a generalized linear model (GLM) of the Statistical Analysis System Institute.[5]

Results

The mean haematological parameters of three genotypes of the Nigerian local chicken (Frizzled feather chicken, Normal feather and Naked neck) are presented in (Table 1). There are significant differences (P<0.05) in haematological parameters among genotypes for PCV, Hb, platelets, MCH, lymphocytes count, and neutrophils count. Value of PCV ranges between 29.44%-33.25% and that of Hb ranges between 9.06g/dl and 10.96g/dl. RBC ranges between $4.49\times10^{12/l}$ and $5.07\times10^{12/l}$, Platelets ranges from $7.78\times10^{9/l}$ to $10.00\times10^{9/l}$; MCH ranges from 18.22Pg to 25.13Pg; Lymphocytes count ranges between 26.67% to 44.33% while heterophils count ranges from 56.89% to 75.56% respectively. However, significant differences (P<0.05) were not observed in WBC, MCV, MCHC, Monocytes count and ESR. The mean external egg quality parameters of three genotypes of local chicken (Normal feather, Naked neck and Frizzled feather chicken) are presented in (Table 2). The parameters considered were; egg weight, egg length, shell thickness, shell weight, egg width, Haugh Unit, percentage shell weight and shell surface area.[6] No significance differences (P<0.05) were observed among the three genotypes in all parameters except for shell thickness. Shell thickness ranged between 0.40mm and 0.47mm and was highest in the Normal feathered chickens.

Table 1 Mean haematological parameters of the Nigerian Indigenous Chickens

Parameters	FF	NF	NN	Reference*
PCV (%)	33.25±2.87[a]	27.67±3.50[b]	29.44±6.62[ab]	35.90-41.00
Hb (g/dl)	10.96±0.96[a]	9.06±1.22[b]	9.39±2.46[ab]	7.00-13.00
RBC (×1012/l)	4.49±1.47	5.07±1.13	4.61±1.44	4.21-4.84
WBC (×109/l)	7.20±2.74	8.71±3.00	8.67±3.07	4.07-4.32
Platelets (×109/l)	10.00±0.00[a]	7.78±1.56[b]	7.78±2.54[b]	1.50-3.60
MCV (FL)	30.00±0.00	30.11±0.33	30.00±0.00	81.60-89.10
MCH (Pg)	25.13±6.01[a]	18.22±4.68[b]	22.44±7.65[ab]	27.20-28.90
MCHC (%)	33.00±0.00	33.00±0.00	33.00±0.00	32.41-33.37
Lymph. (%)	32.88±4.58[b]	26.67±11.60[b]	44.33±2.24[a]	20.00-50.00
Heterophils (%)	66.63±4.90[b]	75.56±9.68a	56.89±6.62[c]	40.00-75.00
Monocytes (%)	0.63±0.52	0.78±0.44	0.89±0.33	5.00-10.00
ESR (mm/hr)	4.25±2.05	4.33±3.84	4.89±2.03	8.00-12.00

a,b,c: Means in the same row with different manuscripts are significantly different (P<0.005)

Key: FF=frizzled feathered; NF=normal feathered; NN=normal feathered, PCV=Packed Cell Volume; Hb=Haemoglobin count; RBC=Red Blood Cells count, WBC=White Blood Cells count; MCV=Mean Corpuscular Volume, MCH=Mean Corpuscular Haemoglobin; MCHC=Mean Corpuscular Haemoglobin Concentration, ESR=Erythrocyte Sedimentation Rate

Table 2 Mean external egg quality parameters of the Nigerian Indigenous Chickens

Parameters	FF	NF	NN
Egg weight (grams)	38.00±4.06	37.38±2.33	38.33±3.08
Egg length (mm)	50.30±1.74	50.34±2.06	51.00±7.05
Shell thickness (mm)	0.43±0.03[a]	0.47±0.02[b]	0.40±0.04[a]
Shell weight (grams)	3.44±0.53	3.63±0.52	3.44±0.53
Egg width (mm)	37.00±1.50	37.08±0.83	38.31±3.35
Haugh unit	16.88±8.16	15.41±5.26	18.15±5.63
Shell weight (grams)	9.12±1.51	9.20±1.17	8.98±1.29
Shell surface area (mm^2)	51.46±3.65	52.72±2.05	51.78±2.71

a,b: Means in the same row with different manuscripts are significantly different (P<0.005)

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Discussion

Hematological parameters

Although the reference values of avian haematological indices have been recorded by Mitruka & Rawnsley,[7] only a few studies on hematology for the local Nigerian chickens have been published so far. Haematological parameters were used extensively in avian medicine as physiological indicators and disease diagnostic tools.8 Sex, age and nutrition are the major factors affecting avian hematology,[9,10] although the variation in this study might be due to genotypic differences since all the hens were fed same feed and were of the same age. The difference in hematological values among local chickens reared in different regions potentiate its investigation to diagnose the health status of the birds.[11] The information gained from investigation of haematological values, disease diagnosis and managerial factors are the main tools for developing new lines of birds which are genetically able to resist different diseases.8 Results of PCV in the three genotypes were lower than the normal range of 35.90-41.00 proposed by.[12] These results are indicative of anemia in the chickens of the three genotypes. Frizzled feather had the highest mean value (33.25%), followed by naked neck and normal feathered with corresponding values of 29.44% and 27.67% respectively. The result obtained in this study partially agreed with that reported by Solomon and Udoh[13] who reported the superiority of the naked neck gene in PCV compared to that of the fully feathered. The author further stated that this could be a boost to the growth and productive life of the former. Results in (Table 2) show that Hb concentration of chickens in the three genotypes were within the normal range of 7.0-13.0g/dl for healthy chickens[7] and the range of 4.0-14.0g/dl by Lewis[14] Normal feathered chickens had the lowest Hb concentration (9.06g/dl), followed by naked neck (9.39g/dl) while frizzled feathered chickens had the highest value (10.96g/dl). The value for Hb concentration obtained for frizzled feathered chickens was within the normal range of 11.4±2.75g/dl for healthy frizzled feather chickens.[15] The values obtained in this study, however slightly differ from those obtained by Solomon and Udoh.[16] They reported mean Hb concentration values of 9.24g/dl, 8.91g/dl and 8.05g/dl for normal feather, naked neck and frizzled feather respectively. Ologhobo et al.,[17] observed that an increase in WBC count above the normal range is an indication of the presence of exogenous substances and foreign bodies in the body of an animal. In this study, there was no case of such abnormal rise in the values of WBC. The WBC obtained in this study were within the normal range of $3.0\text{-}60\times10^{6/l}$ opined by Mitruka & Rawnsley[7] and Lokhande et al.[18] Results reveal that normal feathered chickens had the highest count ($8.71\times10^{6/l}$), followed by naked neck ($8.67\times10^{6/l}$) and frizzled feather ($7.20\times10^{6/l}$). The results suggest greatest ability of the normal feathered chickens in fighting infections, compared to other genotypes. This may be responsible for their highest population and adaptability amongst the three genotypes across Nigeria.

Lymphocytes are important in forming barriers against local disease conditions and may be involved in antibody formation.[19] In this study, normal feathered chickens had the least lymphocytes value (26.67%) while the naked neck chickens had the highest value (44.33%) and these values fall within the range values for normal birds[7] which suggested that the birds had strong immune system. Many authors have reported a large variation mainly in lymphocytes due to age and nutritional conditions of animals.[20,21] But the results obtained from this study disagree with these reports since all birds used were of the same age and were subjected to the same feeds. The difference in lymphocytes count across the three genotypes in this study might be due to genotypic variation.[8] The heterophil is the most common granulocyte found in birds. The normal range of heterophils is between 40%- 75%.[7] Its changes in number and characteristics can occur with consideration to the bird's state of health since even subtle problems such as stress, low grade infection and mild inflammation can occur.[22] The values of heterophils obtained in this study fell within the range values of normal birds and were in accordance with those previously reported by Adeyemo[22] for laying birds. RBC varies depending on whether the birds are juveniles or adults and the genotype of the birds being examined and the results obtained in all treatments in this study fell in the range of values for normal birds.[7] Monocytes which closely resembles neutrophils in that they are actively motile and phagocytic in action, leaving the blood stream to ingest micro-organisms and other foreign materials which have been introduced into the tissues, had values way lower than the range for normal birds.[7] This result totally differs from that obtained by Adeyemo,[23] who observed that values obtained were slightly above the range values for normal birds. The lower values obtained for monocytes might be due to genetic and/or seasonal variations. The ESR in the naked neck was the highest and differed statistically from the rest of the two genotypes. MCHC values were the same across the genotypes and nearly the most of the previous research supported this present study.[3,9,24,25]

External egg quality parameters

The shell thickness of the eggs laid by the normal feathered was significantly higher than those laid by the frizzled feather and naked neck chickens. Mean shell thickness were 0.47mm, 0.43mm and 0.40mm respectively. There were no significant differences in the mean values of shell thickness for frizzled feathered and naked neck chickens. Fraga et al.,[26] reported that egg shell quality of naked neck could be related to a higher Cholecaicipherol synthesis from 7-dehydrocholesterol deposit on these birds in an area of the body without feather, thus being the receptor of the indirect solar radiation. Also, the values fall within range according to Babangida et al.,[27] and Olomu.[28] Shell thickness did not show significant difference among the genotypes studied. However, eggs with thick shell wall are desirable to withstand externally applied force, thus preventing breakage of egg and this is an economic indicator for commercial poultry producers and consumers. The result obtained in this study is higher than the values reported by Yakubu et al.,[29] Momoh et al.,[30] In their various studies, naked neck produced heavier shell weight than the remaining genotypes. The result obtained in this study is comparable to the light ecotype reported by Momoh et al.[30] & Nonga et al.,[31] but slightly lower than values produced by heavy ecotypes.[30] Significant positive correlation between egg length and egg weight, egg width and egg weight, shell weight and egg weight, shell weight and egg width, egg index and egg width, in all the three phenotypes compares favorably with.[29,32] In this study egg width is indicated to be a good estimator of egg shape index. Omeje and Nwosu, (1988)28 reported that egg shape index could be used as a criterion for determining stiffness of eggshell. Furthermore, the values between egg width and egg length in naked neck and frizzle feathered chickens agreed with (Yakubu *et al*., 2008; Olawumi and Ogunlade, 2008).[29,32–36]

Conclusion and recommendation

The study concluded that genotypic differences ($P<0.05$) slightly affected both haematological and external egg quality parameters and these parameters are not far from the standard ones we have for the

exotic genotypes currently used for commercial poultry production. The influence is as result of genetic variability across the genotypes of Nigerian local chickens studied. It is therefore recommended that these three genotypes of local chickens in Nigeria can be improved upon and especially the naked neck gene can be incorporated in poultry production programmes so as to harness and utilize the potential effects of this gene. This will aid in planning breeding programmes for selection of economic traits in general (meat and egg) poultry production.

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None.

Conflict of interest

None.

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