



HAEMATOLOGY AND IMMUNE RESPONSE OF THREE NIGERIAN LOCAL CHICKEN STRAINS AT DIFFERENT AGES

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ABSTRACT

This study was assessed the effect of genotypes on immune response traits in three Nigerian indigenous chickens at week 4, 8 and 12 of age. A total of sixty (60) Nigerian indigenous chickens, consisting of twenty (20) each of normal feathered chickens, frizzle feathered chickens and naked neck chickens were reared for the research and blood samples were collected from these birds for haematological analysis. The research lasted for 12 weeks. The haematological parameters assessed were: Pack cell volume (PCV), White blood cell (WBC), Red Blood Cell (RBC), Eosinophils (Eos), Monocytes (Mono), Haemoglobin (Hb), Lymphocytes (Lym), Heterophils (Heter), Basophils (Bas). The result showed that RBC was significantly ($p < 0.05$) higher in frizzle feathered chickens, followed by naked neck and normal feathered chickens respectively. WBC was significantly ($p < 0.05$) higher in frizzle feathered but lower in normal feathered while Eosinophils, basophils and lymphocytes were significantly ($p < 0.05$) higher in frizzle feathered chicken.

keywords: Immune response, Genotype, Hematology, Traits, Disease.

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INTRODUCTION

Poultry sector is revealed to be the fastest segment of animal and livestock industry in Nigeria. In most developing countries all over the world, chicken largely dominates the flock of poultry composition and about 98% of the total poultry population kept in Africa (Ibe, 2021).

Local chicken seems to be resistant to adverse conditions when compared with their exotic counterpart as a result of some unique adaptive features developed over a long period of random mating in their natural ecosystem. Although there exist phenotypic variations amongst Nigeria local chickens such as frizzle feather structure, naked neck, normal neck feather and modifier effects which allows for rearing under different

conditions as well as providing a range of products and functions, Nigerian local chicken is still found to be self-reliant and hardy birds with the capacity to withstand harsh weather condition and adapt favorably (Ikpeme *et al.*, 2016).

Local chickens are still the option for supplying the human population with protein and income. Due to their short generation interval and their products, chickens are preferred by majority of Nigerians, having the potentials of providing proteins and meats that can meet the demand of the citizen globally (Nosike *et al.*, 2020).

About 35% of the total household income in Nigeria particularly the Niger Delta region is from poultry and livestock production (Ibe, 2021).

The main problem of Nigerian local chicken is that they are poor producers of meat and egg compared to their modern counterpart (exotic breeds) which have been selected genetically over time. This has led to the improvement of the local strains to deliver more to the nation's protein requirement, increased productivity in terms of growth rate, meat and egg and consequently reduces the rate at which they are being replaced by commercial strains. Livestock and poultry are also seen as important resources that support the livelihood of farmers, consumers and labourers throughout the World. Controlling diseases incur recurrent expenditure beside posing hazards to human health and threatening animal welfare. Disease like Newcastle adversely affects the production and economics by increasing the cost of production and decreasing the production rate (Liza *et al.*, 2022). Genetic resistance to disease is a powerful tool to control and prevent diseases and thereby improving production and dividend in livestock and poultry (Liza *et al.*, 2022).

This study is therefore initiated towards assessing the anti-viral activity amongst improved Nigerian local chicken based on their immune response traits. This may therefore contribute to the genomic knowledge on the efficacy of production of Nigerian local poultry stock. The information garnered will serve as significant contribution to the Nigerian poultry industry towards genomic improvement and selection.

The objectives of this study is to determine the haematology and immune response traits in Nigerian local chicken at age 4, 8 and 12 weeks.

MATERIALS AND METHODS

Experimental Site

The study was carried out at the Poultry unit, Teaching and Research Farm of the Department of Animal Science, University of Uyo. Akwa Ibom State, Nigeria. Uyo is found between latitude $4^{\circ}31'N$ and 45°

$31'S$ and longitude $7^{\circ}31'E$ and $45^{\circ}35'W$. The altitude of the area is 38m above the sea level and a mean rainfall of 200mm. The relative humidity is 79% with average temperature of $28^{\circ}C$ (University of Uyo meteorology station, 2019). Haematological analysis was carried out at the Biochemistry Laboratory University of Uyo, Uyo, Nigeria.

Experimental birds

A total of sixty day-old chicks of Nigerian indigenous origin which comprises of Normal feathered, frizzle feathered and naked-neck were purchased from Federal University of Agriculture, Abeokuta Poultry's Farm.

Housing and Management of birds

The housing system used in this research was intensive system (deep litter) of management. Chicks from each genetic group were randomly selected and individually identified by wing tagging according to genotype by sex. The chicks were vaccinated on arrival. Vaccination and medication were done routinely. The chicks were transferred to a previously disinfected and prepared brooder house with beddings to prevent disease outbreak. Wood shavings were laid and lighting sources: stove and electricity bulb provided heat. Starter mash and water were given *ad libitum*. The beddings were changed weekly if wet. The standard management practice was strictly adhered for 3 weeks of the brooding phase of the experiment.

Feeds and Feeding

The chicks were fed on a proprietary starter ration (CP 23.01% and ME 3462kcal/kg) from day old to 3 weeks. Then 20% crude protein and 3000 kcal/kg ME from grower ration was fed to the chickens from 4 to 5 weeks of age. Thereafter, birds were fed with commercial finisher ration (17% crude protein and 2850 kcal/kg ME) from 6 to 12

weeks when the experiment was terminated. Feed and water were provided *ad libitum* throughout the experimental period.

Data Collection

Data were collected for hematological studies. Hematological parameters determined were Packed cell volume (PCV), White blood cell (WBC), Red blood cell (RBC), Hemoglobin (Hb). Blood sample was collected from the wing vein of 88 randomly selected chickens according to their genotype and sex. Thirty-three (33) were from naked neck, 20 from Frizzled feathered and 35 from normal feathered and stored in the EDTA bottle for the hematological analysis. Hematological parameters were collected at different ages (4, 8 and 12 weeks) of the birds in the course of the experiment.

Statistical analysis

Data obtained were subjected to descriptive statistics and ANOVA of SPSS (2017) software and their means were separated by Duncan multiple range test of the software.

RESULTS

Effects of Nigerian indigenous chicken genotypes on their immune response at week 4 of age.

The effects of Nigerian indigenous chicken genotypes on their immune response at week 4 of age is as shown in Table 1 below. The results showed that Frizzle feathered chicken recorded significantly ($P < 0.05$) high value of 1.414 ± 0.24 cell/McL in Eosinophil than Normal feathered chicken with 0.968 ± 0.21 cell/McL and Naked neck (0.660 ± 0.24 cell/McL) at week 4 of age. However, Normal feathered chicken (0.96 ± 0.21 cell/McL) and Naked neck chicken (0.660 ± 0.24 cell/McL) were statistically ($P > 0.05$) similar in their mean values. Frizzle feathered chicken had significantly ($P < 0.05$) higher values ($1.261 \pm 0.27 \mu\text{m}$) for basophil than normal feathered chickens ($0.782 \pm 0.24 \mu\text{m}$) and Naked neck ($0.314 \pm 0.27 \mu\text{m}$) at week 4 of age. Normal feathered chicken ($0.782 \pm 0.24 \mu\text{m}$) was significantly ($p < 0.05$) higher than $0.314 \pm 0.27 \mu\text{m}$ of naked neck chickens for the same trait at week 4. However, there was no significant ($P > 0.05$) difference existing in the PCV, Haemoglobin, RBC, Heterophils, Lymphocytes and Monocytes at week 4 of this study in Table 1 below.

Table 1: Effects of Nigerian indigenous chicken genotypes on their immune response at week 4 of age.

Trait	GEOTYPES		
	Frizzle Feathered	Naked Neck	Normal
Packed cell volume (mL)	29.378 ± 1.49	31.400 ± 1.50	28.787 ± 1.31
Haemoglobin (mL)	9.889 ± 0.50	10.330 ± 0.50	9.688 ± 0.44
Red blood cell (m/mm ³)	2.534 ± 0.13	2.522 ± 0.13	2.536 ± 0.11
White blood cell (g/dl)	13.496 ± 0.73	12.647 ± 0.73	13.101 ± 0.64
Heterophils (um)	32.725 ± 2.10	29.943 ± 2.11	32.882 ± 1.84
Lymphocytes (k/uL)	63.847 ± 2.07	67.723 ± 2.08	64.622 ± 1.81
Eosinophils (cell/McL)	1.414 ± 0.24^a	0.660 ± 0.24^{bc}	0.968 ± 0.21^b
Basophils (um)	1.261 ± 0.27^a	0.314 ± 0.27^c	0.782 ± 0.24^b
Monocytes (ml)	0.917 ± 0.34	1.244 ± 0.34	0.910 ± 0.29

Values are expressed as mean $\pm$ SD. ^{a-c} Means with different superscripts along the same row are significantly ($p < 0.05$) different.

The immune response traits of three Nigerian indigenous chicken genotype at week 8 of age.

The immune response traits of three Nigerian indigenous chicken genotype at week 8 of age is as shown in Table 2 below. There was no significantly ($p>0.05$) difference in all the haematological parameters used to assess the immune

response on Nigerian indigenous chickens (Frizzle feathered, Naked neck and Normal feathered) genotypes measured in this study at week 8 of age except for Basophils and Monocytes where the significant higher values were obtained for naked neck and normal feathered chicken respectively as shown in Table 2 below.

Table 2: The immune response traits of three Nigerian indigenous chicken genotype at week 8 of age

Trait	Frizzle Feathered	Naked neck	Normal Feather
Packed cell volume (mL)	31.443± 1.209	29.019± 1.209	30.342± 1.209
Haemoglobin (mL)	10.402±0.412	9.697± 0.413	10.047 ± 0.360
Red blood cell (m/mm ³)	2.599± 0.114	2.465± 0.115	2.461± 0.100
White blood cell (g/dl)	12.444 ± 1.142	11.910 ±1.14	12.965± 0.99
Heterophils (um)	28.039 ± 2.091	28.162±2.09	28.891±1.82
Lymphocytes (k/uL)	70.236± 1.970	69.841±1.97	69.216±1.72
Eosinophils (cell/McL)	0.520± 0.150	0.535±0.15	0.534±0.13
Basophils (um)	0.375±0.230 ^b	0.405±0.23 ^a	0.294±0.20 ^c
Monocytes (ml)	0.827±0.280 ^c	1.05±0.28 ^b	1.063±0.25 ^a

Values are expressed as mean±SD. ^{a-c}Means with different superscripts along the same row are significantly ($p < 0.05$) different.

Effects of Chicken genotypes on the immune response traits of three Nigerian indigenous chicken at week 12 of age

Effects of Chicken genotypes on the immune response traits of three Nigerian indigenous chicken at week 12 of age is as shown in Table 3 below. The results showed that Frizzled feathered chicken recorded significantly ($P < 0.05$) high value of WBC (15.96±1.25mL) than naked neck chicken with (15.629±1.25mL) and Normal feathered (13.832±1.09mL) at week 12 of age measured. Naked neck was significantly ($p<0.05$) higher (31.494±1.78) in Heterophil than frizzle feathered (26.917±1.78um) and Normal feather (26.786±1.55um) while frizzle feathered and normal feathered were statistically similar in their mean values. In lymphocyte, Frizzle (70.218±1.60k/uL) and Normal feathered (69.483±1.40k/uL)

chickens were similar ($p>0.05$) and significantly ($p<0.05$) higher than those of naked neck chicken (65.409±1.61k/uL). However, Normal feathered chicken was significantly ($P<0.05$) higher (1.150±0.25 k/uL) than naked neck (0.71±0.29 k/uL) and Frizzle feather (0.635±0.29k/uL) respectively. Although naked neck and Frizzle feathered were similar ($p>0.05$) at week 12 of age as shown in Table 3 below.

DISCUSSION

The results showed that Frizzle feathered chicken recorded significantly high value for Eosinophil than Normal feathered chicken and Naked neck chicken at week 4 of age. Normal feathered chicken and Naked neck chicken were similar for Eosinophils.

There was no significant ($p>0.05$) difference existing in PCV, Hb, RBC, Heterophil,

Lymphocytes and Monocytes at week 4 in this study (Table 1). This result is in line with the work of Akinbinu *et al.* (2022) who worked on the determination of immune

response traits in Nigerian indigenous chickens challenged with Newcastle Inactive Antigen.

Table 3: Effects of Chicken genotypes on the immune response traits of three Nigerian indigenous chicken at week 12 of age.

Trait	GENOTYPES		
	Frizzle Feathered	Naked Neck	Normal Feather
Packed cell volume (mL)	34.663±1.52	35.036±1.52	34.052±1.33
Haemoglobin (mL)	11.488±0.51	11.750±0.51	11.332±0.45
Red blood cell (m/mm ³)	2.883±0.15	2.968±0.15	2.860±0.13
White blood cell (g/dl)	15.961±1.25 ^a	15.629±1.25 ^{ab}	13.832±1.09 ^c
Heterocytes (um)	26.917±1.78 ^b	31.494±1.78 ^a	26.786±1.55 ^{bc}
Lymphocytes (k/uL)	70.218±1.60 ^a	65.409±1.61 ^c	69.483±1.40 ^{ab}
Eosinophils (cell/McL)	1.471±0.28	1.417±0.28	1.504±0.25
Basophils (um)	0.635±0.29 ^{bc}	0.71±0.29 ^b	1.150±0.25 ^a
Monocytes (ml)	0.754±0.34	0.962±0.35	1.117±0.30

Values are expressed as mean±SD. ^{a-c}Means along the same row with different superscripts are significantly ($p < 0.05$) different.

From the results in Table 2, there was no significant ($p > 0.05$) difference in all the haematological parameters used to assess the immune response on Nigerian indigenous chicken's genotypes (Frizzle feathered, Naked neck and Normal feathered) measured in this study at week 8 of age (Table 2). This result is not in tandem with Akinbinu *et al.* (2022) in which high significant values were recorded for Frizzle feathered, naked-neck and normal feathered respectively.

The Frizzle feathered chicken had significantly ($p < 0.05$) higher value for white blood cell than Naked neck chicken and Normal feathered chicken at week 12 of age. Naked neck was significantly ($p < 0.05$) higher in heterophil, while frizzle feathered and Normal feathered chickens were similar for the same parameter. Frizzle and Normal feathered chickens were similar for

lymphocytes but higher than those obtained for the Naked neck chicken (Table 3).

The Packed cell volume obtained in this study were showing a rapid increase in values with age, and the highest PCV values though not significant, were observed at week 12 of age. This is not in line with the research findings of Addass *et al.* (2017) and Nosike *et al.* (2017) on indigenous chickens. This could be due to age group effect as observed on PCV. Increased PCV shows a better transportation and thus results in an increased primary and secondary polythelia. According to Adedibu *et al.* (2018), PCV value may be useful markers for predicting spermatozoa maturation in testes, sexual maturity and the onset of semen production. PCV is the volume of the red blood cells in the blood. Higher PCV values are usually due to a higher weight gain as well as reduction in heat load. Selection of Nigeria local chicken high PCV

would therefore lead to a boost in the growth and productive life. PCV can serve as a trait for selection of Nigeria local chicken for improved growth and productive life of bird through improved weight gain and heat-tolerance (Nosike *et al.*, 2017).

The red blood cell of chickens in this study decreases as age of the chicken increases. This may be as a result of dietary effect since young chicks consume less amount of feed compared to grown up chickens (Nyaulingo, 2018). Normal red blood cell production requires diet containing protein, iron, copper, vitamin B₂, B₆, B₁₂ and folic acid (Nyaulingo, 2018).

The effects of chicken's genotype on white blood cell at week 12 of age showed higher significant ($p < 0.05$) value for frizzle feather. This is similar to the finding of the study conducted by Chineke *et al.* (2016) on variation in haematological parameters on Nigerian native chickens which was reported that normal-feathered birds had higher ($p < 0.05$) mean values compared to frizzled feathered and naked neck genotypes except for albumin, red blood cell, white blood cells and mean cell haemoglobin concentration. Nosike *et al.*, (2017) also observed the effect of genotype on WBC to be highly significant ($p < 0.05$) in naked neck chicken genotype. The test for WBC levels is very important to detect and measure the ability of the body to destroy diseases. A high level of WBC may be due to immunological challenge which may be largely informed by the associated inherent resistance to tropical diseases (Nosike *et al.*, 2017). It is also noteworthy that the subsisting ecological condition support several vectors and parasites of economic significance.

Naked neck chickens had the highest value for heterophils at week 12 of age. The observation in this work is not in tandem with the report of Opoola *et al.* (2020) that reported no significant difference in the quantity of heterophils produced in Nigerian indigenous

chicken. The significant value of heterophils recorded for Naked neck chicken in this study may be an indication that heterophils are part of WBC and have the phagocytic ability regardless of the presence or absence of antibodies.

Frizzle feather had a significant ($p < 0.05$) effect on the blood lymphocyte. This observation is in line with the report of Nosike *et al.* (2017), who observed that lymphocyte of naked neck showed high significant ($p < 0.05$) difference. According to Falcones *et al.* (2020), lymphocytes which is a fraction of the white blood cells are natural killer cells and are able to kill cells of the body that do not display MHC class 1 molecules, or display stress markers such as MHC class 1 polypeptide-related sequence A (M/C-A). The higher the lymphocytes, the better and stronger the immune system of the animal. These cells play both an immediate and delayed role in response to infection or inflammation. Increased numbers of lymphocytes are associated with most viral infections and some bacterial infections whereas decreased numbers of lymphocytes are characterized by steroid exposure, immunodeficiency and renal failures. For Eosinophils, Basophils and Monocyte to show significant ($p < 0.05$) effect in different ages in Tables 1 to 3 is an indication that there is absence of stress reaction, steroid and some allergic reactions. This observation is in line with the report of Onyishi *et al.* (2017) who reported a low value of the same parameters that increase with age.

CONCLUSIONS AND RECOMMENDATIONS

- Frizzle feathered genotype recorded the highest significant effect on immune response traits (Red blood cells, Eosinophils, Basophil, white blood cells and lymphocyte), which makes it

- highly recommended and preferable.
- Naked neck and normal feathered chicken genotypes had their effect on only heterophil, monocyte and Basophil respectively at different stages of growth.
- Frizzle feathered male and naked neck female had the highest effects on four different immune response traits (Basophil, white blood cell, lymphocyte and red blood cells for frizzle feather male) and (Haemoglobin, Red blood cell, monocyte and packed cell volume for naked neck female) respectively.
- The haematological parameters of local chicken was affected by genotype.
- WBC could serve as a marker indicating immunity and inherent resistance to tropical poultry diseases and parasites.

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