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RESEARCH ARTICLE
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Effects of genotypes on Body weight and Morphometric body parameters in some adult Nigerian Local Chickens based on Normal and Rare feather types

Sola-Ojo, F.E[1]*., Ibiwoye, D.I, Asogwa N.T[2]. Abubakar, I .A[1] Yusuf, O.A[1]. Babalola F.A[1] and Babatunde, A.O[1].

[1]Department of Animal Production, Quantitative, Molecular and Functional Genomics Unit, Facult∃y of Agriculture, University of Ilorin, Kwara State, Nigeria
[2]Central Research and Diagnostic Laboratory, Ilorin, Kwara State, Nigeria.

ABSTRACT

Haemoglobin polymorphism in some adult local chickens of the North Central region of Nigeria was determined using cellulose acetate electrophoresis. Blood samples were collected from one hundred and eleven (111) local chickens. The chickens included 94 normal feathers and 7, 6 and 4, respectively for the rare feather gene types (frizzle; FF, silky; sh and Naked neck ; Nana). Genotype frequencies were calculated using simple descriptive statistics and subjected to Chi square analysis to determine how the observed distribution of haemoglobin types in the chickens fits with the expected. From the total number of observation the results showed that, 24.32, 43.24 and 32.43% of the population were HbAA, HbAB and HbBB, respectively. Eighty six (86) females and 25 males were studied and the frequencies of haemoglobin type were 22, 38 and 26 for Hb AA, Hb AB and Hb BB, respectively for the females while 20% of the male were Hb AA 40% were obtained for HbAB and HbBB . The normal feathered chickens had 21 Hb AA, 44Hb AB and 29 HbBB, the frizzle feather chickens had 3 Hb AA and Hb BB and 1 Hb AB, Silky feathers chickens in the population studied had 1 HbAA, 2 HbAB and 3 HbBB while Naked neck had 2 HbAA, 1 HbAB and 1 HbBB. The Chi square analysis results indicated that all the populations were of different haemoglobin type and distribution of observed frequencies fits into the expected with lower Chi test values obtained for all genotypes in the factors considered. Haemoglobin genotypes detected affected body weight, body girth, and beak length, while feather types affected body height and shank diameters among the population of chickens studied. This study indicated that the population of chickens with adaptive rare feather gene is low. Also, majority of the Nigerian local chickens studied had more of heterozygotes Hb AB and homozygotes recessive Hb BB haemoglobin type, thus concerted effort to conserve Nigerian local chickens with homozygote Hb AA haemoglobin type is recommended .

Key words: Electrophoresis, Haemoglobin type, Frizzle, Naked Neck, and Silky.

Introduction

In Nigeria, Indigenous chickens were characterised along genetic lines of feather (such as normal or frizzled feathered) body structure (such as naked neck, dwarf types and colour variants (such as black, white, brown, mottled, etc.). The frequency distribution of the normal feathered chicken was reported to be 98.20%, 1.2% for naked neck while those of were said to be 0.60 % in Nigeria Fulani Ecotype chickens Sola-Ojo and Ayorinde (2011). Researches have shown that

***Corresponding author:** Sola-Ojo, F.E
Department of Animal Production, Quantitative, Molecular and Functional Genomics Unit, Faculty of Agriculture, University of Ilorin, Kwara State, Nigeria
Tel: +234 (09030127649), E-mail: ibiwoyedemilade8@gmail.com

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these adaptive major genes affects productive adaptability to tropical climates and management conditions and are associated with productivity survivability under heat stress conditions because they are thermoregulatory and tropically relevant (Horst, 1989). In Nigeria, local chickens with adaptive and subjective traits are getting endangered due to negative selection against their population and negligence on the part of poultry producers and breeders because an effective methods of improving them for optimum production performance and their population increment to meet the ever increasing demand for poultry product has not been given due attention.

Genotype specification is very important for description of the genetic constitution of a population as it provides the nature of the genotypic differences in any population (Falconer, 1980). Blood protein polymorphism have been used by researchers as a marker to study evolutionary relationships in genotypes of mammals and between different breeds of sheep, deer, goat, chickens and rabbit (Kalab et al., 1990; Emerson and Tate, 1993; Buchanan et al., 1994; Guney et al., 2003; Malan et al., 2003 and Chineke et al., 2007). An animal can have a gene for specific substance which can be detected in the blood by appropriate procedures including cellulose acetate electrophoresis to reveal the presence or absence of specific substance that is directly related to genotype (Adebambo, 2004). Determination of genetically controlled biochemical polymorphisms of blood proteins is a useful tool to characterize livestock breeds and populations as it contribute to the knowledge of genetic similarity and the distance between such animals (Zaragora et al., 1987; Omitogun, 2004). Haemoglobin is a blood protein that is responsible for transportation of oxygen and carbon dioxide in the blood of vertebrates and are associated with fitness in population, they are important in demonstration of relationship between genetic information and protein structure (Chineke et al., 2007). Also, causes of a variety of genetic disorders that might arise from blood can be detected through haemoglobin type (Peters et al., 2004). It has also been reported that haemoglobin of any vertebrate is not homogenous, it vary within a population and revealed more about the molecular basis of human, animals and medical genetics than any other system (Chineke et al., 2007). Information on haemoglobin is useful in getting some facts about process of evolution at both the molecular and population levels. Normal and different variants of haemoglobin are usually identified by standard laboratory techniques with the use of cellulose acetate electrophoresis. Studying haemoglobin type in Nigerian local chickens of different feather type will be a useful tool to characterise them within their population and provides information that will contributes to the existing knowledge on their genetic diversity as well as similarity and reveal their level of fitness with respect to their population size.

This study was therefore designed to determine frequencies of haemoglobin type among some Nigerian local chickens found in the North central part of Nigeria using the cellulose acetate electrophoresis technique.

Materials and Method

Experimental Chickens

One hundred and fifty Adult chickens (both sexes) were randomly purchased from three different major poultry market in Ilorin, Kwara State, Nigeria. Ilorin is located in the North Central region of Nigeria located at latitude 9.0820° N and longitude 8.6753° E of the equator. The chickens were winged tagged according to feather type and taken to a private research farm (Fair and Firm, Limited, Ilorin Kwara State) with facilities to house the chickens for acclimatization for a period of two weeks, during which they were dewormed, vaccinated and fed formulated growers mash according to NRC (1994). Feed and water were provided for the birds *ad libitum*. At the end of the acclimatization period, thirty

nine mortalities were recorded and one hundred and eleven chickens were left for haemoglobin typing. The surviving adult chickens were re-grouped into different pens according to their feather type before blood collection for cellulose acetate electrophoresis.

Blood collection and Preparation

The wing of each bird were disinfected and carefully cleaned to locate the vein and blood were collected through brachial venipuncture using 2Ml syringe into a well labelled EDTA bottles according to chickens feather type without cross contamination with the use of a syringe per bird. The blood sample was taken to the Central Research Laboratory, Ilorin, Kwara State, Nigeria for haemoglobin typing using the cellulose acetate electrophoresis procedure. One ml of the whole blood was placed in centrifuge tube that has been labelled according to numbers given to each chicken sampled based on their feather type. 10-15 µl of cold 0.155 ml sodium chloride was added to wash the red cell, the sample was re-centrifuged for haemoglobin to be released after haemolysis of sedimented cells by addition of distilled water. The supernatant was removed and subsequently used for cellulose acetate electrophoresis.

Cellulose Acetate Electrophoresis Procedure

A Gene buffer (DANSUTECH Genotype Buffer) containing Tris EDTA and Boric Acid (Manufactured by Dansutech Resources Nig. Enterprises) was prepared by dilution with 1000ml of distilled water. Cellulose Acetate paper strip was soaked in the Buffer for 30 minutes and bloated with filter paper to remove excess buffer; 0.1µl of the haemolysed blood was carefully loaded to the acetate paper and placed on the bridge in an humidified electrophoresis tank that has been connected to a power supply (Model DY-300 for Electrophoresis) and set to run for 15 minutes at 300 volts. The sample end was directly placed at the anode point and the movement of the protein type towards the cathode was observed for 15 minutes to note a clear separation of the haemoglobin band; after which the acetate paper was removed with forceps and soaked in Ponceau S (Acid Red 112) solution for 5 minutes for perfect staining of the band, then washed in glacial acetic acid solution for another 5 minutes and gently stirred in 95% absolute methanol for clearer observation of the band. Movement of the haemoglobin bands towards the cathode was interpreted as described below:

A Single faster band was identified to be AA Homozygote

A Single slower band was identified to be BB Homozygote

A Double bands containing both faster and slower band was identified to be AB Heterozygote.

Frequencies of Haemoglobin type observed in all the samples were calculated as described by Salako and Ige (2006).

Statistical Analysis

Simple Descriptive statistics of the SPSS Version 22 (2013) software package was used to calculate the frequencies of haemoglobin type according to their feather type and sex of the chickens. One way analysis of variance of the SPSS package was used to analyse the effects of haemoglobin types and feather types on body weight and morphometric characteristics of the chickens and significant differences between their mean determined using Duncan (1955) of the same software package. The effects of feather types and haemoglobin types on body weight and morphometric parameters were determined using the model:

$Yij = \mu + a_i + b_j + eij$

Y = Overall measurements

μ = Overall mean

a_i= Effects of i^{th} parameters (Body weight and Morphometric body parameters)

b_j= Effects of j^{th}factors (Feather types, haemoglobin type)

eij= random residual error.

Results

The results of the study as presented in Table 1 showed that 24.32, 43.24 and 32.44% of the total number of chickens examined irrespective of sex were of HbAA, HbAB and HbBB, respectively, with 25.60% of female being HbAA, 44.20% of the female were HbAB and 30.20% were HbBB. For the male chicken, the distribution of haemoglobin types were 20% for HbAA and 40% for HbAB and HbBB. Based on feather types, out of all the chickens genotyped, 84.68% were of normal feather and their haemoglobin types were distributed among HbAA, HbAB, and HbBB at the rate of 22.30, 46.80 and 30.90% respectively. 6.31% of the population had frizzle feather and the haemoglobin types were 14.30% for HbAb, while those of homozygotes Hb AA and Hb BB were 42.90%. The silky feathers within the population were 5.41% with haemoglobin type distribution of 16.70, 33.30 and 50% for HbAA, HbAB, and HbBB, respectively. In population of 3.6% Naked neck chickens examined HbAA were 45%, with 25% each of Nana chickens having HbAB and HbBB. Table 1 also showed a high correlations between the expected values for all the haemoglobin types when sex and feather types were considered and indicated that the observed distribution of data fits with the distribution that is expected .

Table 1. Frequencies of haemoglobin type and their distribution based on Sex and feather type in some Adult Nigerian Local chickens.

Factors	Variants	Observed Populations	Detected Hb Type	% distribution of Hb Type	Observed Hb type Frequencies	Expected Hb type Frequencies	χ^2 Test Value
Sex	Female	86	AA	25.60	22	21	0.06
			AB	44.20	38	37	0.02
			BB	30.20	26	28	0.13
	Male	25	AA	20.00	5	6	0.19
			AB	40.00	10	11	0.06
			BB	40.00	10	8	0.44
Feather Type	Normal Feather	94	AA	22.30	21	23	0.15
			AB	46.80	44	41	0.28
			BB	30.90	29	30	0.07
	Frizzled Feather	7	AA	42.90	3	2	0.99
			AB	14.30	1	3	1.35
			BB	42.90	3	2	0.24
	Silky feather	6	AA	16.70	1	2	0.15
			AB	33.30	2	3	0.14
			BB	50.00	3	2	0.50
	Naked Neck	4	AA	45.00	2	1	0.96
			AB	25.00	1	2	0.31
			BB	25.00	1	1	0.07

Table 2 results showed significance ($p<0.05$) differences in Body height, Beak length and shank diameter of the chickens when feather type was taken into consideration. Local chickens with silky feather had higher value for body height and beak length while those of frizzle feather had higher ($p<0.05$) for shank diameter. Evaluating the effects of body weight and morphometric body parameters as shown in Table 3 indicated that body weight, body girth and beak length of the Local chickens with HbAA, HbAB and HbBB differed, with highest value obtained for those chickens with heterozygotes Hb AB for body weight, while those with HbBB had highest value for body girth and beak length.

Table 2. Effects of feather type on Body weight (g) and Morphometric parameters (cm) of some Adult Nigerian Local chickens.

	FEATHER TYPES				
Growth Traits	Frizzle	Naked Neck	Normal	Silky	SEM
Body weight	0.986	1.075	1.159	1.000	0.034
Body Height	22.000^{b}	22.500^{b}	22.117^{b}	24.667^{a}	0.364
Body Length	33.043	32.500	33.213	34.583	0.191
Body Girth	30.857	27.000	30.106	28.833	0.469
Shank Length	5.500	5.500	5.723	5.500	0.050
Drumstick Length	10.714	9.700	10.868	12.250	0.218
Thigh Length	11.143	11.075	9.775	10.167	0.179
Beak Length	2.757^{a}	3.000^{a}	1.189b	3.133^{a}	0.421
Keel Length	9.500	9.250	7.202	9.333	0.490
Wing Length	13.429	12.375	12.144	14.167	0.376
Shank Diameter	8.971^{a}	3.250^{b}	2.529^{b}	3.700^{b}	0.667

Means on the same row with different superscripts differed significantly ($p<0.05$).

Table 3. Effects of Haemoglobin types on Body weight (g) and Morphometric parameters (cm) of some Adult Nigerian Local Chickens.

	FEATHER TYPES			
Growth Traits	AA	AB	BB	SEM
Body weight	0.944^{b}	1.317^{a}	1.040^{ab}	0.160
Body Height	22.222	22.000	22.639	0.212
Body Length	33.400	35.534	32.758	0.225
Body Girth	28.670^{b}	29.579^{ab}	31.475a	0.243
Shank Length	5.741	5.656	5.694	0.030
Drumstick Length	11.000	10.758	10.986	0.116
Thigh Length	9.748	9.492	10.647	0.348
Beak Length	1.382^{ab}	1.283^{b}	1.750^{a}	0.139
Keel Length	7.278	7.146	8.250	0.305
Wing Length	12.204	12.208	12.625	0.102
Shank Diameter	2.619	2.600	3.894	0.324

Means on the same row with different superscripts differed significantly ($p<0.05$).

Discussion

In this study, three haemoglobin genotypes, AA, AB and BB were detected and this corroborate the general observation of A and B alleles and their corresponding genotypes been reported to be AA, AB and BB in different species by several authors (Evans et al., 1956; Maxwell and Baker, 1980; Zaragoza et al., 1987; Tunon et al., 1989, Salako and Ige, 2006). From this study, it was clearly observed that there were diversity in the populations of Nigerian local chickens found in some parts of North Central Nigeria with respect to haemoglobin type as they are of different genotypes and this correspond

with the assertion of Salako and Ige, 2006 that local birds are of diverse genotypes while their exotic counterparts had 100% Hb AA. In this study, majority of the population had homozygotes HbBB and heterozygotes HbAB while a few number possess Hb AA genotypes.

Body height, beak length and shank diameter varied across the feather types examined with silky feather having the highest value for body height and beak length, this results correspond with the findings of Sola-Ojo and Ayorinde (2009) that genetic diversity existed within the Fulani Ecotype chickens with respects to body weight and morphometric body parameters.

In this study, haemoglobin genotypes detected had significant effects on body weight, body girth and beak length of the chickens observed with those of Hb AB and BB having higher body weight compared to Hb AA, this could be due to the fact that the populations of chickens observed have been in existence due to chance and there has been no thorough selection for parent of next generation with respect to desirable homozygotes dominant Hb type and the local chickens studied have been surviving through chance and natural selection.

Conclusions

1. Majority of the population examined with respect to both sexes were of Normal feather with highest population of heterozygote HbAB followed by those of homozygotes Hb BB, while few numbers of Homozygotes Hb AA genotypes were recorded.

2. The population of local chickens studied had few numbers of chickens with rare adaptive genes.

3. The studied local chickens with rare Frizzle feather and Naked neck gene had higher percentages of homozygotes Hb AA genotype.

4. 50% of the chickens with rare Silky feather genes are of homozygotes Hb BB genotypes.

5. Body height, beak length and shank diameter were different across the feather type examined Body height and beak length were of highest value for those that have silky feather gene, while those with frizzle feather gene had the highest value for shank diameter .

6. The Hb types, AA, AB and BB found in the population studied had significant effects on body weight, body girth and beak length.

7. There is need for further study to examine the cross breeding effects of local chickens population with respects to inheritance of haemoglobin type with the expectation of providing information on how to increase the population of chickens that are fit to compete and thrive favourably in tropical harsh condition.

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