NSAP 47th Annual Conference (JOS 2022) CONFERENCE PROCEEDINGS
THEME: SECURING ANIMAL AGRICULTURE AMIDST GLOBAL CHALLENGES

HAEMOGLOBIN AND ALBUMIN GENOTYPES OF NIGERIAN INDIGENOUS CHICKEN IN DOMA LOCAL GOVERNMENT AREA OF NASARAWA STATE

Gambo. D, Shuaibu, A., Aguye, Y. L., Lerama, S. M., Yusuf, D. E., Mundi, I and Haruna, F. B.
Department of Animal Science, Faculty of Agriculture, Nasarawa State University Keffi, Nasarawa State
Correspondence Author: Email: gambodauda21@gmail.com and gambodauda@nsuk.edu.ng

Abstract

The study was conducted to determine the genotypes and genes frequency of the haemoglobin and albumin of Nigerian chicken using a base population from which the samples used undergone random mating and had not been selected. Blood samples were collected from 120 chicken and used for genotyping. Genotype and gene frequencies were calculated using Hardy Weinberge equation. Result obtained for chi-square analysis showed no significant (P>0.05) variation between the observed and the expected frequencies for both haemoglobin and albumin types. For the genotyping, majority of the genotypes were homozygous AA for hemoglobin and homozygous BB for albumin while heterozygous genotype (AB) came second to the two varying dominant homozygous in both instances. Two alleles A and B and three genotypes AA, AB and BB were observed for both haemoglobin and albumin. The genotypic frequencies of Hb AA, AB and BB were 0.60, 0.25 and 0.15 for haemoglobin and 0.17, 0.30 and 0.53 for albumin. Allelic gene frequency for A and B were 0.725 and 0.275 for haemoglobin and 0.325 and 0.675 for albumin. The prevalence of certain genes at their respective locus is suggestive of their importance to the adaptability, survival and production of these chicken in their natural harsh tropical environment. This could be used for future studies involving the use of more blood protein markers with a larger sample size. This may pave way for marker-assisted selection in the genetic improvement of indigenous chicken especially when they are correlated with productive economic parameters.

Keywords: blood protein, dominant, gene frequency, heterozygous, homozygous, polymorphism

INTRODUCTION

Genetic diversities in the indigenous livestock species in developing countries are valuable attributes or assets for production, adaptation and resistance of the indigenous animals to endemic disease (Arora *et al.,* 2011). Quantifying the structure of genetic diversity in different African chicken populations is of significance in optimizing genetic improvement, conservation and utilization strategies. Many technologies including DNA based technology are employed in diversity studies. DNA-based technologies are now the methods of choice for genetic characterization of livestock (Arora *et al.,* 2011); but its applications in developing countries are limited due to its complex technology, facilities and high cost. Protein polymorphism remain tremendously useful, in developing countries, because of their lower complexities, cost, simplicity involved in data interpretation and amount of genetic information accessed (Rege and Okeyo, 2006). The genetic variations of the chicken populations in the country need investigation so as to identify existing diversity within and between populations. The objective of the study was to investigate hemoglobin and albumin polymorphism of the Nigerian Local Chicken in Doma Local Government area of Nasarawa State.

MATERIALS AND METHODS

The total of 120 birds comprising of 60 cocks and 60 hens were used for the experiment. Blood samples were collected from the randomly selected chicken through the wing veins and used for haemoglobin and albumin genotyping.

About 3 ml of whole blood was collected from the wing vein of each apparently healthy bird into correspondingly labeled heparinized and un-heparinized tubes. Heparin was added to act as anti-coagulant and blood contamination was prevented by using separate syringes and needles for individual birds. These samples were kept refrigerated in ice packs and transported immediately to Dalhatu Araf Specialist Hospital for biochemical analysis. The blood samples were centrifuged at 4°C for 20 min at 3 000 rpm in order to separate plasma and erythrocyte. Erythrocytes was washed with 9 percent NaCl to free them from plasma proteins and was then lysed with four-fold cold distilled water in order to release the haemoglobin. Then plasma and haemolysates aliquots was stored at 4^{o}c prior to electrophoresis analysis. The lysed red blood cells were used to determine Haemoglobin. Similarly, un-heparinized blood samples were centrifuge at 4^{o}c for 20 minutes at 3000 rmp in order to separate serum for electrophoresis analysis of albumin (Alb). Electrophoresis polymorphisms of heamoglobin was been performed using cellulose acetate strips while Albumin was electrophoresed with Tris Citrate pH 8 as described by Akinyemi and Salako (2012)

Data analysis

The genotypes, alleles and gene frequencies were calculated by direct gene counting method. Hemoglobin and plasma albumin variability was estimated using the formula of Nyamsamba *et al*. (2003) as follows:

Genotypic frequency of AA = $FAA = \frac{NIAA}{NIS}$

Where FAA = Frequency of AA, NIAA = number of individual with AA and NIS = number of individual sampled,

Genotypic frequency of AB = $FAB = \frac{NIAB}{NIS}$ Where FAB = Frequency of AB, NIAB = number of individual with AA and NIS = number of individual sampled,

Genotypic frequency of BB = $FBB = \frac{NIBB}{NIS}$

Where FBB = Frequency of BB, NIBB = number of individual with BB and NIS = number of individual sampled

Estimation of Gene Frequency (Allelic Frequency)

Gene frequencies of Haemoglobin (Hb.) and Albumin (Alb.) alleles were estimated using the following formula:

$$P = \frac{2NAA + NAB}{2N}$$

$$q = \frac{2NBB + NAB}{2N}$$

Where:

p= gene frequency of allele A
q= gene frequency of allele B
N= total number of birds sampled
NAA= observed genotype number for AA
NAB= observed genotype number for AB

NBB= observed genotype number for BB
Data on alleles and of genotype frequencies of Hb and Alb were subjected to chi-square (χ^2) analysis to test for goodness-of-fit for observed and expected frequencies under Hardy-Weinberg equilibrium (HWE)

$$\chi^2 = \frac{(\text{Observed} - \text{Expected})^2}{Expected}$$

RESULT

Genotype and gene frequencies for haemoglobin and albumin of Nigerian Indigenous Chickens are presented in Table 1. Two alleles A and B and three genotypes AA, AB and BB were observed for both haemoglobin and albumin. The genotypic frequencies of Hb AA, AB and BB were 0.60, 0.25 and 0.15 for haemoglobin and 0.17, 0.30 and 0.53 for albumin. Allelic gene frequency for A and B were 0.725 and 0.275 for haemoglobin and 0.325 and 0.675 for albumin.

Table 1: Gene and genotype frequency distribution of blood heamoglobin and albumin of adult Nigerian Indigenous chicken

Locus	Genotype	Observed	Expected	χ^2	Genotype frequency	Gene frequency
Hb	AA	24	25.02		0.60	0.725
	AB	10	15.95	5.173	0.25	
	BB	6	3.03		0.15	0.275
	Total	40	40		1	1
Alb	AA	7	4.23		0.17	0.325
	AB	12	17.55	3.993	0.30	
	BB	21	18.22.		0.53	0.675
	Total	40	40		1	1

DISCUSSION

Haemoglobin (Hb)

Chi-square analysis for haemoglobin types indicated a non-significant variation in the frequencies of the observed and expected. This result is in agreement with the report of Yakubu and Aya (2012). This result has shown that the gene and genotype frequencies of the populations were in Hardy-Weinberg equilibrium, an indication that they were not affected by non-random mating, genetic drift, mutation, genetic migration and selection. The X^2 value obtained in this study was however lesser than significant 8.71 reported by Oguntunji *et al.* (2016) for Nigerian Indigenous guinea fowl.

The three haemoglobin types (Hb AA, Hb AB and Hb BB) determined by two co-dominant alleles (Hb A and Hb B) in the present study are consistent with those reported for chuckars and pheasants by Ugur *et al.* (2006). The genotype frequency observed in this study is in agreement with the earlier report of Yakubu and Aya (2012). Higher frequency of homozygous genotype Hb AA obtained in this study strongly agreed with homozygouse Hb AA reported for Muscovy ducks (Oguntunji and Ayorinde, 2015) and three varieties of Nigerian indigenous chicken (Yakubu and Aya, 2012). However, the result of this study is in contrast to higher genotype frequency of Hb BB been reported for two ecotypes of Nigerian local chickens (Ige *et al.*, 2013) and Nigerian domestic guinea fowl (Oguntunji *et al.*, 2016).

The agreement in gene and genotype frequencies of Hb in the population under study with some previous reports on indigenous poultry could probably be attributed to adaptability to natural environments since most local birds are highly adaptable.

Albumin (Alb)

The non-significant (P>0.05) effect of χ^2 (3.993) obtained in this study is lower than significant value (22.90) reported by Oguntunji *et al.* (2016) for Nigerian indigenous Guinea fowl. The higher genotype frequency obtained in this study for Alb BB strongly agreed with the findings of Ugur *et al.* (2006) who reported higher genotype frequency of Alb BB in Asian indigenous chickens. However, the genotype frequency obtained in this study for Alb BB disagree with the findings of Oguntunji *et al.* (2016) who reported higher genotype frequency of Alb AB in guinea fowl and Oguntunji and Ayorinde (2015) who reported higher frequency of Alb CC in Muscovy ducks.

CONCLUSION

Study was conducted using a base population from which the samples used undergone random mating and had not been selected. It was evident that majority of the genotypes were homozygous AA for hemoglobin and homozygous BB for albumin. In both instance, heterozygous genotype (AB) came second to the two varying dominant homozygous. The prevalence of certain genes at their respective locus is suggestive of their importance to the adaptability and survival of these chicken in their natural tropical environment. This could be used for future studies involving the use of more blood protein markers with a larger sample size. This may pave way for marker-assisted selection in the genetic improvement of indigenous chicken.

REFERENCES

Akinyemi, M. O. and Salako, A. E. (2012). Genetic relationship among Nigerian Indigenous sheep population using blood protein polymorphism. *Agricultural Science and Technology* 4(2): 378-382

Arora, R., Bhatia, S., Mishra, B. P. and Joshi, B. K. (2011). Population structure inIndian sheep ascertained using microsatellite information. Animal genetics 42:242-250

Ige, A. O., Salako, A. E., Ojedapo, L. O. and Adedeji, T. A. (2013). Biochemical characterization of indigenous Fulani and Yoruba ecotypes chicken of Nigeria. *African Journal of Biotechnology* Vol. 12(50), pp. 7002-7008,

4. Nyamsamba, D., Nomura, K., Nozawa, K., Yokohama, M., Zagdsuren, K.Y. and Amano,T. (2003). Genetic relationship among Mongolian native goat populations estimated by blood protein polymorphism. *Small Ruminant Research* (47): 171-181

Oguntunji, A. O. and Ayorinde, K. L. (2015). Blood protein polymorphism and genetic diversity in locally adapted Muscovy duck (Cairina moschata) in Nigeria AnimalGenetic Resources, 56: 9- 18.

Oguntunji, A. O., Ayorinde, K. L., Aremu, T. O. (2016). Biochemical Characterization of the Nigerian Indigenous Guinea Fowl (Numida meleagris). *Biotechnology in Animal Husbandry.* 32(3): 271-284.

Rege, J. E. O. and Okeyo, A. M. (2006). Improving our knowledge of tropical indigenous animal genetic resourse. Version II. Module 2. In J.M. Ojango, B. Mamfors &A.M. Okeyo, eds. Animal genetic training resource version 2, 2006. Nairobi, Kenya, International Livestock Research In Statute and Uppsala, Sweden, Swedish University of Agricultural Science.

Ugur, Z., Ismaila, K., Vahdettin, S. and Ibrahim, A. (2006). Haemoglobin polymorphism in Chuckar (Alectoris chuckar) and Pheasant (Phasianus colchicus). *Journal of Animal and Veterinary Advances* 5(11): 894–896.

Yakubu, A. and Aya V. E. (2012). Analysis of genetic variation in Normal Feathered,naked neckand Fulani ecotype Nigerian indigenous chickens based on Haemoglobin polymorphism. *Biotechnology in animal husbandry*, 28