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Haemoglobin Polymorphisms in the Nigerian Indigenous Chickens

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Abstract: Haemoglobin (Hb) alleles and their frequencies as well their effect of some phenotypic characteristics were studied in local (LB) and Exotic Birds (EB) (Meat-type strain). Blood samples were collect from the local birds and exotic birds. The local birds were from reputable commercial farm. Blood samples were analyzed for haemoglobin types determined by cellulose acetate electrophoresis. The result showed that Hb genotypes were the same for exotic birds (AA) and also the phenotype characteristics studied were uniform but the local birds varied in Hb type and phenotype characteristics. The frequencies of HbA and HbA in local birds were 0.68 and 0.33, respectively and genotype frequencies HbAA (0.35) and Hb AB (0.65) and frequencies of HbA in exotic bird was 1.00 with genotype frequency of 100%. The local birds' population was found to be in Hardy-Weinberg's equilibrium while the exotic birds were not. This suggests that the sample was a mixture of subpopulations with different gene frequencies. The relations among the investigated genotypes, plumage and shank colors were discussed..

Key words: Indigenous chicken, polymorphisms, haemoglobin

INTRODUCTION

Nigerian indigenous chickens have been existing as pure breed chicken for a long time, under free range system of husbandry. However, with the introduction of improved foreign breeds, the raising scale of Nigeria indigenous chicken have drastically reduced and this could lead to extinction of these chickens and consequently to significant reduction in supply of animal protein to the populace. Because of their make up, it is likely that their genes will be useful in future for genetic improvement within the species.

Comparatively, it has been shown that local chickens posses some inherent advantages over their exotic breed counterpart, these include; good fertility and hatchability, strong egg shell, better flavour of meat and yolk colour higher degree of adaptability to prevailing condition, ease of rearing and ability to breed naturally[1-3] adaptive characteristics. From nutritional stand point, the search for possible alternative feed ingredient has aimed at reduced cost of production in modern day poultry production and this has reduced the desire to improve our birds in order to breed birds of desirable body weight at an early market age as well as laying birds with satisfactory performance. Oluyemi and Oyenuga[4] suggested that the indigenous fowl may potentially belong to their light or heavy breeds and that as first step in improving the performance of such bird certain base line information are needed.

Genotype characterization, especially hemoglobin in birds is useful in classification of these indigenous stock for genetic improvement, since gene in blood groups and biochemical polymorphisms have now become valuable raw materials for estimating genetic constitution, variability and relationships among pairs of population. Sonaiya[5] observed from survey study visit on station and on farm research that the problem of smallholder poultry producers revolves around disease control. Feed supplementation, housing and the use of unimproved breeds. This study therefore aimed at determining haemoglobin genotype in Nigeria indigenous chicken and meat strain type of exotic chicken, characterization of the chicken into population and document gene and genotype frequency at Hb locus. This will be useful as marker for improving economic trait within the species.

MATERIALS AND METHODS

Blood samples collected from local and exotic birds (meat type) were analyzed far haemoglobin polymorphisms. The local birds were purchased from open market supplied by rural farmers under the extensive system of husbandry. As a result, records on the birds were nonexistent, while exotic birds were from reputable

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commercial farms where they were managed intensively. Available record showed that they were in good state of health.

2.5 mls of Blood samples were collected from the birds through jugular venipucture. A potion of the vein was blocked to prevent flow back of blood and get the required quantity; the blood was drawn into labeled vacutainer tubes containing drops of anticoagulant (EDTA). Blood contamination was prevented by using separate syringes and needle for individual birds.

Haemoglobin typing was accomplished using cellulose acetate electrophoresis.

Serum and plasma was removed by the use of plastic pipette and 10-15 mls of cold 0.155 m NaCl was added to wash the red cells. The remaining serum and plasma and the samples were centrifuged.

Cold distilled water was added to the sedimented cells to release the haemoglobin by haemolysis. The haemolysates were removed with a transfer pipette and stored in test tube at 10 and 15°C before electrophoresis.

Cellulose acetate strips were prepared and labeled. They were soaked in tris EDTA borate buffer (TEB pH 8.6) and blotted slightly with filter paper to remove excess buffer.

Electrophoresis was performed using Shandon southern electrophoresis tank. The strips were then dried in the open air for some minutes. The direct gene counting method was used to score the resulting haemoglobin bands after eletrophoresis

- A single faster band (in an animal) was designated as the AA homozygote
- The presence of a single slower band was designated as BB homozygote
- The presence of both bands was designated AB hererozygote

ESTIMATION OF GENOTYPE FREQUENCY

Genotype frequency was calculated as follows

$$\frac{\text{No of AA}}{\text{Total No}} \times \frac{100}{1}$$

$$\frac{\text{No of AB}}{\text{Total No}} \times \frac{100}{1}$$

$$\frac{\text{No of BB}}{\text{Total No}} \times \frac{100}{1}$$

ESTIMATION OF GENE FREQUENCY

Using the expressions gene frequencies were calculated as follows:

$$P = \frac{(2N_{AA} + N_{AB})}{2N}$$

P = Gene frequency of allele A

Q = Gene frequency of allele B

$$Q = \frac{(2N_{BB} + N_{AB})}{2N}$$

where N = Total number of individual sampled

N_{AA} = Observed genotype number for AA

N_{AB} = Observed genotype number for AB

N_{BB} = Obseved genotype number for BB

Phenotypic characteristics studied, plumage and shank colour were identified and scored.

RESULTS

The distribution of Haemoglobin (Hb) genotypes and gene frequencies of Hb alleles are shown in Table 1.

Using chi-square analysis, it was found that the distribution of genotype frequencies on the basis of expected proportion under Hardy Weinberg Law was normal in local bird's population while exotic population deviated significantly from Hardly Weinberg's equilibrium ($X^2_{0.05} = 5.991$).

From the above, the frequency of Hb allele for white + black was highest (1.0) compared with black + brown, while the frequency of HbB allele for brown + black was highest (0.39) compared with (0.0) and (0.2) in white and black, respectively.

Highest frequency (0.83) for HbB allele of brown plumage was the highest (0.38) and black + white was the lowest (0.25).

From Table 4, the distribution of Hb genotype for female were 4 (40%) for Hb for AA and 6 (60%) for HbAB with their corresponding gene frequency of 0.70 and 0.3 respectively. Also in female, the distribution of HbS genotype, AA was 3 (30%), AB, 7 (70%) with their gene frequencies, 0.6 and 0.35, respectively.

DISCUSSION

There were remarkable variations with the local fowl as two haemoglobin variants, A and B alleles were identified with corresponding detectable genotype HbAA and HbAB. This showed that the population of these indigenous fowl is heterogenous and thus, suggest that there are no pure breeds of local fowl in Nigeria in the strict sense of genetic homozygosity with regards to the hemoglobin locus.This is in agreement with observation made by Ibe[6] that chicken flock in Nigeria consist of two categories, improved and unimproved and further

Table 1: Distribution of haemoglobin (Hb) penotypes and gene frequencies of (Hb) alles

		Phenotype frequencies						Gene frequency	
Breed	No.	AA	(frequency) %	AB	(frequency) %	BB	(Frequency) %	A	B
LB	20	7	35	13	65	0	0	0.65	0.33
EB	30	30	100	0	0	0	0	1.0	0.0

LB = Local birds, EB = Exotic birds

Table 2: Phenotypic characteristics and genotype frequencies of the exotic birds

		Phenotype frequencies						Gene frequency	
Breed	No.	AA	(frequency) %	AB	(frequency) %	BB	(Frequency) %	A	B
Black	20	7	35	13	65	0	0	0.65	0.33
Brown EB	13	2	23.01	11	76.9	0	0	0.61	0.39

Table 3: Plumage colour and genotype distribution of the local birds

		Genotype frequencies						Gene frequency	
plumage colour	No.	AA	(frequency) %	AB	(frequency) %	BB	(Frequency) %	A	B
Brown	8	2	25	6	75	0	0	0.65	0.33
Black	3	2	66.7	1	33.3	0	0	0.83	0.17
B+W	4	2	50	2	50	0	0	0.75	0.3
Br.+B	5	2	40	3	60	0	0	0.7	0.3

Table 4: Genotype and gene frequency of the different sexes in the local birds

		Haemoglobin phenotype frequencies						Gene frequency	
Sex	No.	AA	(frequency) %	AB	(frequency) %	BB	(Frequency) %	A	B
Male	10	4	40	6	60	0	0	0.7	0.3
Female	10	3	30	7	70	0	0	0.65	0.35

explained unimproved to be pure indigenous fowls and those derived as a result of uncontrolled random matting between indigenous and improved commercial type with no visible distinction.

Sonaiya[3] also reported that there are contentions that there are no more pure local chicken that all are crossed to various degree. This is because migrant genes became diffused and lost in the population since no selection in a specific direction was practiced.

In study, this also pointed out that the local indigenous fowl of Nigeria share both the characteristics of light and heavy breed by which poultry can be grouped based on utility because the exotic bird used in this study were meat strain (heavy birds) type with HbAA whilst native chicken was a mixture of both AA and AB Hb types. This agrees with Oluyemi[7] that indigenous fowl of Nigeria seems to posses both characteristics of light and heavy breeds but possess more of light breeds than that of heavy breeds. It appears generally, that sex is not important in the inheritance of haemoglobin.

Since all the exotic birds studied were of uniform phenotypic characteristics as well as the haemoglobin genotype, one may explain that the selection and method that synthesized the commercial strain had direct effect on the haemoglobin locus; although it may not be sufficient to explain the uniform plumage colour in the exotic strain. This is related to local birds and their uncontrolled mating with exotic birds have also led to accidental expression of some phenotype traits observed in exotic birds. White shank colour is notable in this study.

The result of this study is subjected to some limitation being that the sample size for the analysis was small. However an attempt has been made to obtain what can be considered a beginning into detailed biochemical studies of local chickens in Nigeria.

Due to inadequate facilities, financial constraints and animal resources encountered during the course of this work, further research should use lager data set involving more than one ecotype of local chickens, more exotic birds as well as more structural loci so as to clearly delineate the local birds population and provide a more comprehensive information on biochemical characterization of these birds.

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REFERENCES

1. Oluyemi, J.A., D.F. Adene and G.O. Tadoye, 1978. A comparism of indigenous fowl with white rock under condition ofdisease and nutritional stress. Trop. Anim. Health Prod., 11: 199-202.

2. Adetayo, A.S. and E.B. Sonaiya, 2001. Comparison of the performance of Nigeria indigenous chickens from three agro ecological zones. Livestock resources and Dev., 13: 2.
3. Sonaiya, E.B, I.K. Odubote, R. Badman, F. Demey, K. Wimmers and A. Valle Zaraate, 1998. Horsko uation of Nigeria Local ecotypes forgenetic variation, disease Resistance and Productivity. Proc. 25th Annual Conf. Nigeria Soc. Prod., pp: 316.
4. Oluyemi, J.A. and V.A. Oyenuga, 1971. A Preliminary Evaluation of Nigeria Indigenous Fowl; As Table Bird Proc. 7th Annual Conference of Agric Society of Nigeria kano.
5. Sonaya, E.B. and V.E. Olori, 1990. Village Chick in Egg Production in South Western Nigeria. In: ProceedingsfInternational workshop on rural poultry development (Ed.E.B. Sonaiya Organizers: FAO and IDRC in Conjunction with Obafemi Awolowo University, pp: 234-247.
6. Ibe, S.N., 1990. Increasing Rural Poultry Production by Improving the Genetic Endowment of Rural Poultry. In Rural Poultry in Africa. Proceedings of FAO Ile-Ife, pp: 8-81.
7. Oluyemi and Fetuga, 1977. Poultry production in warm wet climate.Macmillan publishers Limited London and Basinyotoke, pp: 20.