PRELIMINARY SCREENING ON NIGERIAN CHICKEN-TYPES FOR EXTINCTION PROBABILITY

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Target Audience: Animal Scientists, Animal Breeders, Researchers, Veterinary Professionals, Students

Abstract

This study was conducted in Borno state to assess the extinction risk of sixty (60) 6-Nigerian indigenous chicken-types; normal feathered, frizzle feathered, naked neck, shank feathered, crested feathered and rose comb based on a range of socio-economic and genetic factors. The research employed data from 60 households and examined variables including population size (POS), changes in population over the last five years (CHA), disease control (DC), economic development (ECO), cultural importance (CUL), and conservation practices (CON). Genetic diversity was assessed using heamoglobin polymorphism. The estimated extinction probabilities for the genotypes calculated based on these factors revealed an overall extinction probability of 0.58 indicating a moderate to high risk of extinction. Frizzle feathered and naked neck chickens had the highest extinction risks (0.78 and 0.73) while shank feathered chicken had the lowest (0.28). Genetic analysis revealed varying levels of genetic distinctness between and among the chicken types, with the naked neck and normal feathered chickens showing the greatest genetic differentiation. These findings underscored the importance of targeted conservation efforts, including improved production systems, disease control, and strategic breeding programmes, to reduce extinction risks and preserve the genetic diversity of these Nigerian chicken-types. This result should be confirmed using advanced nucleic acid-based technique.

Keywords: extinction probability, conservation potential, genetic diversity, heamoglobin polymorphisms, indigenous chicken-types

Description of Problem

The domestication of birds' such as chicken production as well as incidental products such as faecal droppings and feathers is known as poultry farming. The country's standing poultry population as at 2018 is about 180 million birds, a substantial increase from about 151 million birds (1). The nutritional benefits derived from poultry products such as animal protein and other nutrients is attributable to its relevance as the world major source of food. Demand for poultry products across African continent will increase by 60% especially in Nigeria, its largest market (2). Currently, present consumption across the continent is almost 100 million tons for both poultry meat and egg products while in Nigeria, 192.69 metric ton is consumed annually (3).

The indigenous chickens also known as native or local chickens in Nigeria are mostly found in rural areas. They are good scavengers as well as foragers. They have good maternal qualities, hardier when compared to the exotic breeds and have high survival rates with minimal care and attention (4). However, high losses of village chickens due to diseases poses a serious threat to food security and livelihood of many rural families in Nigeria (5), especially those states afflicted by rapid population growth due to unconditioned influx of insurgency displaced people. These chickens are facing extinction which would compromise the flexibility of future

breeding measures and enhance rural development (6). Poultry genetic resources are considered to be the most endangered and under-conserved, and strategic approaches to conservation at the national level need to be developed and implemented. The (7) concept is widely used as a formal approach to rational decision making in livestock conservation. The approach combines genetic diversity assessed at the molecular and extinction probabilities estimated by socio- economic factors to derive conservation priorities of breed based on their conservation potential (8). Having aware of the fact that conservation potential is assessed using molecular and socio-economic factors as proposed by (7), the preliminary screening can be done using heamoglobin polymorphisms together with socio economic factors in order to have first-hand information on conservation potentials of the indigenous chicken-types. The Objective of this study therefore was to conduct preliminary screening of genetic diversity on six Nigerian indigenous chickens at the heamoglobin polymorphisms level and to derive conservation priorities of the chickens.

Materials and Methods

The research was conducted at University of Maiduguri, Borno state with latitude and longitude approximately 11.5097° N and 12.9789° E. Borno state falls in the Sahelian region (semi-arid zone) of west Africa which is characterized by short duration of rainfall which varies from 2-4 months (June - September) which is approximately 300 to 500 mm per annum. The ambient temperature ranges from 25-28 °C in December to January and higher in April and March which the range 34- 45 °C.

Data and blood sample collection

A total of sixty (60) adult Nigerian chickens genotypes of both sexes were collected in Borno state comprising six chicken genotypes namely, normal feathered (10), frizzle feathered (10), naked neck (10), shank feathered (10), crested (10) and rose comb chickens (10) each. Sixty (60) blood samples were collected from the sixty (10 from each genotype) chickens and were genotyped for heamoglobin using Cellulose Acetate Electrophoresis procedures. Data generated on general socio-economic factors were collected from sixty (60) households who provided chickens for blood samples. A structured questionnaire was administered to 10 households per chicken genotype. Information on change of the total population size over the last five years, distribution of breed, degree or risk of indiscriminate crossing, disease control, production system of the breed was captured during the interview.

The scoring method suggested by (9) was adopted for the 11 variables which are the most relevant factors affecting the survival and extinction probability of the indigenous chickens. This represents different aspects, such as population description, environmental impact and present value of the chicken genotype. Values of the other variables were calculated from the household survey.

The extinction Probability of genotype, *Zi* was computed as the sum of the values of the 11 variables. If a genotype was considered to be completely safe, the value of the extinction probability is equal to zero and this value will be 1 if a breed is certain to go extinct. The sum of eleven variables was rescaled to a value from 0.1 to 0.9 as follows:

$$Z_i = \frac{0.8}{1.7} \times \sum_{a=1}^{11} z_{ia} + 0.147$$

Genetic distance matrices were derived from allele frequencies of bootstrap samples. All bootstrap samples were of equal size (10) genetic distance *dxy* was used for all trees.

$$d_{xy} = \frac{1}{2} \frac{\sum_a (x_a - y_a)^2}{1 - \sum_a x_a y_a} + \cdots$$

Where x_a and y_a are frequencies of the allele drawn in population x and y.

Genetic diversity between and within the six chicken genotypes was assessed at heamoglobin (genotype) level. Genetic diversity tree was constructed from the genetic distance of the six chicken genotypes.

Results and Discussion

Table 1 presents the estimated extinction probabilities (z) of six Nigerian indigenous chicken-types based on various socio-economic factors. The overall average estimated extinction

Table 1: Estimated extinction probabilities (z) of six Nigerian chickens-types

Chicken-type	POS	CHA	DIS	CRO	DC	PS	ORG	CON	ECO	SPE	CUL	Total	z
Normal	0.20	-0.10	0.00	0.10	0.09	0.10	0.10	0.30	0.05	0.10	0.05	0.99	0.53
Naked neck	0.26	0.14	0.20	0.10	0.09	0.06	0.10	0.30	0.09	0.03	0.05	1.42	0.73
Shank feathered	0.30	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.05	0.00	0.00	0.45	0.28
Crested	0.30	0.00	0.00	0.00	0.10	0.10	0.10	0.30	0.05	0.10	0.05	1.10	0.58
Rose	0.30	-0.10	0.10	0.10	0.10	0.10	0.10	0.30	0.05	0.00	0.05	1.10	0.58
Frizzle	0.30	0.20	0.19	0.09	0.09	0.08	0.09	0.30	0.085	0.00	0.09	1.515	0.78
Mean													0.58

POS= total population size, CHA=change of total population size over the last five years, DIS= distribution of the chicken-type, CRO= degree or risk of indiscriminate crossing, DC= disease control, PS= production system, ORG= organization of farmer, CON= established conservation scheme, ECO= economic development, SPE= special use of the chicken, CUL=socio-cultural importance, z= extinction probability

probability of chicken genotypes was 0.58, with frizzle (0.78) and naked neck (0.73) having the highest while the shank feathered (0.28) and normal feathered (0.53) had the lowest. The average extinction probability across all the chicken types (0.58) indicates a moderate to high risk of extinction for the evaluated Nigerian chicken- types.

On the other hand, the shank and normal feathered chickens are within the moderate limit. The result therefore suggests quick conservation strategies for frizzle and naked neck chickens. Population size (POS) of naked neck (0.26) and normal feathered chickens (0.20) had relatively lower values compared to others. For the Economic development (ECO), a consistent value of 0.05 across all the chicken types as recorded in this study underscores the critical influence of economic factors on the survival of these genotypes. This suggests that economic incentives or policies supporting poultry farming may significantly impact them
sustainability. Frizzle chicken have a notably higher value (0.09) for CUL in this category compared to others. This indicates their unique cultural significance, which paradoxically coexist with their high extinction probability. The frizzle chicken, with a total score of 1.515 and extinction probability (z) of 0.78, is particularly at risk. This result is an indication that enhanced focus on established conservation efforts is needed, particularly for frizzle and naked neck chickens. The result on Disease control (DC) suggests that addressing disease vulnerabilities through better veterinary practices can reduce extinction across all the chicken-types and various socio-economic factors. This shows the significant relationships between extinction risks and factors like population size, disease control, economic development, and cultural significance. Figure 1 gives the genetic relationships and evolutionary divergence of the six Nigerian chicken types. The normal chicken-type formed a clearly separate branch in the evolutionary tree. The distinctiveness of normal feathered chickens suggests limited gene flow with the other types, which may result from their genetic stability or lack of adaptive traits (11). The naked neck chicken formed an intermediate cluster, connecting the normal chickens to more closely related groups like crested and frizzle, an adaptive type in tropical environments due to its heat-tolerant phenotype (12). The genetic separation of naked neck chickens underlines their adaptive significance and selective breeding for heat stress resistance. In the evolutionary tree, frizzle, crested and rose chickens cluster closely together. These chicken types may have been selectively bred for phenotypic traits such as feather structure (Frizzle) and crests, leading to low genetic divergence. The clustering of frizzle, crested, and rose chickens reflects low genetic differentiation, likely due to shared traits and gene flow (13).

Conclusions and Applications

1. The study revealed a moderate to high risk of extinction for indigenous Nigerian chicken-types.
2. Frizzle feathered and naked neck chickens were most vulnerable.
3. Targeted conservation programmes should be developed and implemented for frizzle feathered and naked neck chickens due to high extinction probabilities.

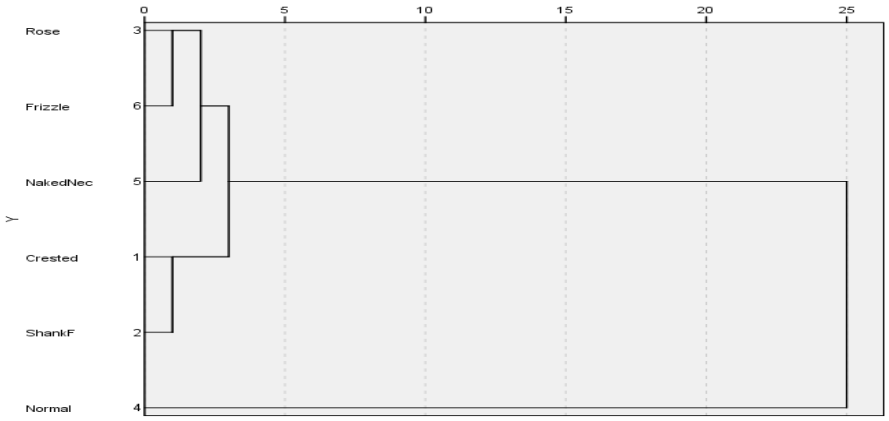

Figure 1: Evolutionary tree of six Nigerian chicken-types

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