# ASSESSMENT OF GENETIC DISTANCE AND SIMILARITIES AMONG INDIGENOUS CHICKEN POPULATIONS IN KANO-STATE, NIGERIA

**I.U. Zango*, I.O. Suleiman, F. Bibi-Farouk, A. Abubakar, M.A. Musa**
Department of Animal Science, Bayero University, Kano-Nigeria.
**Corresponding Author E-mail:* ibrahimubaz@gmail.com

**ABSTRACT**
*The study was conducted to examine the genetic diversity of three populations of indigenous chicken in Kano State, Nigeria. A total of 249 matured free-ranging chickens between the ages of 6 -24 months were sampled. Three genetic groups of indigenous chicken were identified in the study location which includes normal feathered (Nf), frizzle feathered (Ff) and naked neck (Na) and 2mL of blood samples obtained from 8 birds per genotype were used for the study. Genomic DNA was extracted individually from the sampled blood using Quick DNA Kits (©Zymo-Spin Research Kit). Five microsatellite markers were used for genotyping. Genetics Analysis in Excel Software (GenAlEX software version 6.5) was used for band analysis. The result showed relatively high genetic diversity which is essential for the populations. The chicken populations had degrees of genetic similarity of (0.840-0.925) and genetic distance of (0.078-0.084). High genetic distance of (0.084) was observed between Nf and Ff. It was concluded that the populations were not isolated and the microsatellite markers used were highly informative and can be used in future studies involving chicken populations.*
**Keyword: Genetic Distance, Genetic Similarity, Indigenous Chickens**

## INTRODUCTION

Domestic chicken (*Gallus gallus domesticus*) was estimated to have chromosome number as 2n = 78 (Pollock and Fechheimer, 1976), showing the sex chromosomes Z and W, and female as heterogametic sex (Nakamura *et al.,* 2004). Indigenous chickens (IC) express various genes for egg and meat production, heat tolerance, feed efficiency, disease resistance, growth rate and feather type (Singh *et al.,* 2001). The existence of various ecotypes was due to the product of mutation and recombination, genetic drift, adaptation, migration, selection pressures, artificial selection, activities of man and available nutrition (Barker, 1994). IC Hve been reported to exhibit high genetic variability which indicate their potential for genetic improvement (Dana and Vander Waaij, 2011). The Nigerian indigenous chicken is a dual-purpose bird that is used both for meat and egg production in the rural and peri-urban areas of the country. They are found in large numbers distributed across different agroecological categories under a traditional family based scavenging management system (Sonaiya and Olori, 1990). The IC are well adapted to the adverse tropical conditions, stresses diseases resistance and low management inputs (Ikeobi *et al.,*1996: Adeleke *et al.,* 2011). The IC contain a highly conserved genetic system with high levels of heterozygosity (Wimmers *et al.,* 2000). Genetic diversity is the variation of alleles and genotype present in a population (Sheriff and Alemayehu, 2017) and it is the product of interaction between environment and genetic effects which leads to differentiation of morphological, physiological and productive traits that provide selection criterion for genetic improvement (Gambo *et al.,* 2022). The objective of this study was to evaluate an existing genetic variation within and among the IC populations in Kano State. Kano is one of the oldest cities in Nigeria. It is located at the Northern region specifically at North-western part of Nigeria. It has a total land area of 20,131km$^2$ (Khalil *et al.,* 2015).

## MATERIALS AND METHODS

The study was conducted at eight randomly selected locations in Kano State, Nigeria. They include; Minjibir, Kumbotso, Gezawa, Dawakin kudu, Wudil, Kura, Madobi and Tudun wada. Kano State is a typical tropical area located between latitudes 10˚30'N and 12˚38'N and longitudes 7˚45'E and 9˚29'E. The three genetic groups: *Na*, *Ff* and *Nf* were phenotypically identified in the selected villages. Twenty-four (24) blood samples (eight samples from each genotype) were randomly selected for the analysis. Two millilitres (2mL) of blood was collected from brachial vein using a 2mL sterile syringe and stored in Ethylene Di-amine Tetra Acetic Acid (EDTA) tube. The birds were physically restrained to avoid injury. All experimental procedures were carried out in accordance with the guidelines of the

Institutional Animal Ethics Committee (IAEC). Laboratory analysis for DNA extraction, purification and amplification were done at the National Veterinary Research Institute (N.V.R.I), Jos, Plateau State.

**DNA Extraction and Polymerase Chain Reaction (PCR)**

Genomic DNA was extracted individually from the sampled blood using Zymo-Spin research kit (ZR kit/DNA MiniPrep) according to the manufacturer's procedure. Five microsatellite loci which are among the suggested markers by FAO (2011) were used for genotyping. The primers were ADL0268, LEI0166, MCW0183, MCW0222 and MCW0067.

**Electrophoresis**

Gel electrophoresis was conducted on 1% Agarose gel to separate DNA according to size. DNA is negatively charged and is drawn towards the positive electrode. Smaller fragments moved down the gel faster and moved through the gel matrix. Thus, allows band to be distinguished which differs in its size. PCR products were genotyped to determine specific allele.

**Statistical Analysis**

Nei's genetic distance and identity per population was computed, the bands were subjected to GenAlex software version 6.5 (Peakall and Smouse, 2012). The population matrix was used to compared the distance between the different population and indicate their relationship. The result was compared with Nei's (1978) unbiased genetic distance and identity calculated to assess their genetic diversity.

**RESULTS AND DISCUSSION**

**Genetic Similarities**

The similarity values for the IC populations studied were presented in table 1. The table showed that *NF* was related to *Na* with a similarity value of 0.925. It was observed that the similarity value between *Nf* and *Ff* is 0.919. Lowest similarity value was found between *Na* and *Ff* (0.840). Table 2 represented the unbiased genetic similarity values when all sources of error are removed from analysis. Adeleke *et al.,* (2011) observed genetic similarities of 0.4983, 0.3632 and 0.441 between *Na* and *Ff*, *Nf* and *Ff, Na* and *Nf* respectively. However, high genetic similarity estimates maybe because of the effect of small population size, high selection pressure in closed population, inbreeding and minimal or null immigration of new genetic materials into the population (Canon *et al.,* 2006). According to Abebe, Mikko and Johansson (2015), mating individuals that are genetically identical can also result to a high genetic similarity.

**Genetic Distances**

The genetic distance of the chicken populations studied was presented in table 3. Highest value was observed between *Na* and *Ff* (0.174). The unbiased genetic distance values give the when all sources of error are removed from the analysis represented in table 4. The result of the study is lower than report of Adeleke *et al.;* (2011) who found the genetic distance of (0.5585) between *Nf* and *Na* and the distance between *Nf* and *Ff* is 0.6368. Wimmers *et al.;* (2000) observed genetic distance between the Nigerian chickens ranged from 0.05 to 0.15. Okamato *et al.;* (1999) reported small genetic differentiation among the Laos chicken populations studied. Hillel *et al.;* (2003) showed that genetic distance measures based on gene frequencies were in agreement with the genetic diversity of these populations, indicating that these approaches fit the history of domesticated chickens well.

**Table 1: Nei's Genetic Similarities among Population of Indigenous Chicken Populations**

| | Nf | Na | Ff |
|---|---|---|---|
| Nf | 1.000 | | |
| Na | 0.925 | 1.000 | |
| Ff | 0.919 | 0.840 | 1.000 |

**Table 2: Nei's Unbiased Genetic Similarities among Population of Indigenous Chicken**

| | Nf | Na | Ff |
|---|---|---|---|
| Nf | 1.000 | | |
| Na | 0.984 | 1.000 | |
| Ff | 0.974 | 0.888 | 1.000 |

**Table 3: Nei's Genetic Distance among Population of Indigenous Chicken**

| | Nf | Na | Ff |
|---|---|---|---|
| Nf | 0.000 | | |
| Na | 0.078 | 0.000 | |
| Ff | 0.084 | 0.174 | 0.000 |

**Table 4: Nei's Unbiased Genetic Distance among Population of Indigenous Chicken**

| | NF | Na | Ff |
|---|---|---|---|
| NF | 0.000 | | |
| Na | 0.016 | 0.000 | |
| Ff | 0.026 | 0.119 | 0.000 |

## CONCLUSION

The study showed relatively high genetic diversity, thus are good reservoir of allelic diversity which is essential for the populations to be more adaptive to environmental changes. The chicken populations had degrees of genetic similarity of (0.840-0.925) and genetic distance of (0.078-0.084) and none of the genotype exhibited genetic uniqueness. Therefore, it can be concluded that the populations were not isolated and can be used for genetic improvement.

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