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Genetic Distance between Populations of the TIV Local Chicken in the Derived Guinea Savannah Zone of Nigeria

Deeve. S. Gwaza[1], Wilfred. M. Igbayima[2] and Samuel. S. Chia[1]
[1]*Department of Animal breeding and Physiology, University of Agriculture, Makurdi. Nigeria.*
[2]*Department of Animal Production, University of Agriculture, Makurd,. Nigeria.*

Abstract: *A total of 1378 body linear measurements and body weight were obtained at four locations of about 30 kilometers minimum apart, from kastina-Ala local government area of Benue State. The data were subjected to the general linear model procedure and a discriminant analysis to estimate the effect of location and mahalanobis square (D^2) distance between locations. There was significant variation in body length, shank length, tail length, tail width and comb length due to location. There were also significant genetic distances between the locations; except between location 4 and 2. There is a wide genetic diversity in body dimensions between isolated populations of the Tiv local chicken ecotypes. Superior birds could be identified, selected and bred for genetic improvement.*
keywords: *Genetic - distance, local-chickens, ecotype and population.*

I. Introduction

Local chickens' ecotypes are adapted to local environmental conditions and diseases (AL-Aliyat, 2009). The local chickens contribute greatly to human supply of eggs and meat in tropical and subtropical areas. They are the only livestock, which could be kept by the poorest rural families (AL Aliyat, 2009). Horst (1989) considered the local chicken ecotypes as gene reservoir, especially, those genes that have adaptive values in the tropical conditions.

Nigerian local chickens had been grouped according to ecological zones on the bases of body size and body weight as light and heavy ecotypes (Momoh et al., 2007). Olori (1992) noted two ecotypes characterized as forest and savannah ecotypes. Nwosu (1979) reported three main strains among the forest ecotype. Oluyemi et al. (1982) also reported variation in many traits of the local chicken from south region of Nigeria. Adebambo et al. (2009) however found no significance differences in the genetic distance of local chickens from South west, North West and, Northeast ecological zones of Nigeria. The cited literature indicted that there appeared to be no consistency in literature about genetic diversity in the Nigeria local chicken ecotypes. However, most literatures accepted the existence of genetic diversity in the Nigeria local chicken ecotypes. Classification of genetic resources of the Nigeria local chicken ecotypes based on geographical locations appeared to provide a biased estimates of the genetic diversity (Pimm and Lawton, 1988) of the local chicken genetic resources of Nigeria. The genetic distinctiveness of an animal forms the basis for distinguishing it among different animal genetic resources and for assessing the available diversity (FAO 1984). The present, future improvement and sustainability of the local chicken's performance are dependent upon the existed genetic variation (Benitez, 2002). Therefore, the evaluation of the local chicken genetic resources includes the determination of genetic distance between the available populations (Hammond, 1994). The objectives of this study were to assess the genetic distance between populations of the of the Tiv local chicken ecotypes base on body linear measurement. To highlight the existence of genetic diversity between isolated populations of the ecotype that can be selected and bred for genetic improvement.

II. Materials And Methods

The study was conducted at Kastina-Ala local government area of Benue State, Nigeria, at four locations. The four locations were Weghgyina , Kenvanger , Kpuntyo and Udende villages that have a minimum distance of 30 Kilometers apart. These were rural farming communities that practiced crop livestock integration. Local chickens were the predominant poultry species owned.

Location. Kastina-Ala local government area is located between Latitude $7^{o}\ 11^{11}$ N and Longitude $9^{O}\ 20^{11}$ E. The mean annual rainfall was 1175mm. There were two seasons (dry and wet seasons). Temperature during the rainy season ranges from 21.7^{o}C-37.9^{o} C. The relative humanity was about 68 percent.

Animals management. The local chickens were reared under the free range production system. The birds seek for their own feed by scavenging kitchen waste, farm by-products and foraging for insects and worms. Cereal grains were offered occasionally as feed supplement. Water was provided though not ad-libitum. Medication was never provided. Incubation, hatching and brooding were all by natural processes.

Traits that were measured. The birds body linear measurements were taken in centimeters using a tailor's tape. Body weights were taking using a five kilogramme weighing balance. A total of 1378 measurements were taken on 1378 birds, consisting of 360 at Kpuntyo, 400 at Kenvanger, 320 at weghyina and 298 at Udende villages respectively. Traits measured were body length, body height, shank length, thigh length, tail length, tail width, comb length, comb height, wattle length, wattle height and body weight.

Statistical Analysis. The data generated were subjected to general linear procedure of SPSS, (2004) to estimate the effect of location, sex and their interaction on body dimensions of the birds. The following model was used.

$Y_{ijk} = \mu + L_i + S_j + (LS)_{ij} + e_{ijk}$

Where Y_{ijk} = Single observation

μ= population mean

L_i = effect of the ith location (i = 1, 2, 3, 4)

S_j = effect of sex (j = 1, 2).

$(LS)_{ij}$ = effect of location by sex interaction

e_{ijk} = error variance component

The data were also subjected to a discriminant analysis to estimate the Mahalanobis distance between the locations using the CANDISC procedure. The Mahalanobis squared distance (D^2) between locations was estimated by

D^2 (i/j) = (xi – xj) cov^{-1} ($\bar{x}$i – xj) (SAS, 1990).

Where D^2 = genetic distance between populations in a m- Dimensional space.

I_j = the element of the ith row and the jth column of the inverse matrix.

$\bar{x}_i$ – $\bar{x}_j$ = mean sets of original variables

Cov = covariance of the original data set.

III. Results

Univariate test. The analysis of variance indicated significant (p<0.05) effect of location on body length, shark length highly significant (p<0.001), thigh length (p<0.05), tail length (p<0.01), law width highly significant (p>0.001), comb length (p>0.05), comb height (p<0.05) and wattle length (p<0.05). Body weight and body height did not vary significantly (p>0.05) across the locations (Table 1). Sex effect on body measurement was highly significant (p<0.001) for all the traits measured. The effect of sex by location interaction significantly (p<0.05) affected only body height. The other interactions were not significant (p>0.05) (Table 1).

Multivariate Test. Mahalanobis squared distance (D^2) from location 1 to 2, 1 to 3 and 4 were o.64854, 0.92750 and 0.54760 respectively. Location 2 to 3 and 4 were 1.20128 and 0.15311 and the distance from location 4 to 1, 2 and 3 were 0.54760, 0.15311, and 0.99809 respectively (Table 2). The highest F-statistic value were recorded for Mahalanobis squared distance between location 1 and 2 (7.10656) followed by that between location 1 and 4 (4.56086). This was followed by the distance between location 2 and 3 (2.91620), location 1 and 3 (2.46385), location 3 and 4 (2.26458). The least F-statistics was obtained for the squared distance between location 2 and 4 (0.98429) (Table 3). There were significant (p<0.0) differences in F-statistics between location 1 and 2 (p<0.05), location 1 and 3 (p<0.02) and between location 1 and 4. Location 2 to 3 and between location 4 to 3 differed significantly (p<0.05) in the Mahalanobis squared distance between location 2 and 4 (Table 3).

Table 1 Analysis of variance result on effect of location, sex and their interactions on body linear measurement

Sources of variation	Degrees of freedom	Sum of suares	Mean squares	F-value
Location				
body length	3	42.090	14.030	1.456*
body height	3	16.089	5.363	0.766^{ns}
shank length	3	36.555	12.185	12.355***
tigh length	3	7.588	2.529	1.670*
tail length	3	48.522	16.174	5.333**
tail width	3	60.186	20.062	6.570*
comb length	3	21.674	7.225	4.068*
comb height	3	2.222	0.741	1.242*
wattle width	3	3.415	1.138	1.123^{ns}
wattle length	3	4.285	1.143	3.027*
body weight	3	0.055	0.018	0.421^{ns}
Sex				

body height	1	1386.483	1386.483	143.918***
body length	1	1597.375	1579.375	228.133***
shank length	1	242.961	242.961	246.347***
tigh length	1	273.679	273.679	180.696***
tail length	1	518.721	518.721	171.049***
tail width	1	41.409	41.409	13.562***
comb length	1	978.114	978.114	550.768***
comb height	1	346.610	346.610	581.304***
wattle width	1	153.011	153.011	150.939***
wattle length	1	276.316	276.316	585.657***
body weight	1	8.518	8.518	195.749***
Error				
body length	721	6947.788	9.636	
body height	721	5048.414	7.022	
shank length	721	711.092	0.986	
tigh length	721	1092.013	1.515	
tail length	721	2186.497	3.033	
tail width	721	2201.489	3.053	
comb length	721	1280.431	3.053	
comb height	721	429.905	0.596	
wattle width	721	340.172	0.472	
wattle length	721	730.897	1.014	
body weight	721	31.373	0.044	

* significant at 5 percent
*** significant at 1 percent

Table 2 Mahalanobis squared distance (D^2) to location.

From location	1	2	3	4
1	0	0.649	0.928	0.548
2	0.649	0	1.201	0.153
3	0.928	1.201	0	0.998
4	0.548	0.153	0.998	0

1, 2, 3 and 4 represents Weighyina, Kenvanger, Kpuntyo and Udende locations respectively..

Table 3 F-statistics for squared Mahalanobis distance (D^2) to Location.

From location	1	2	3	4
1	0	7.107**	2.464*	4.561**
2	7.107**	0	2.916*	0.984^{ns}
3	2.464*	2.916*	0	2.265*
4	4.561**	0.984^{ns}	2.265*	0

* Significant at 5 percent, ** significant at 10 percent, ns not significant at 5 percent.
1, 2, 3 and 4 represents Weighyina, Kenvanger, Kpuntyo and Udende locations respectively.

IV. Discussion

Effect of location on body linear measurement. The significant ($p<0.05$) effect of body length, thigh length, wattle length, comb length and comb width due to location indicated that these parameters varied between the isolated populations of the Tiv chicken ecotypes. The univariate test also indicated that shank length, tail length and width were most varied between the isolated populations. Gwaza et al. (2012) also reported variations in these traits between isolated populations of two Nigerian local chicken ecotypes. These parameters determine adaptation and fitness of the birds to their environment. The variation in these parameters between the isolated populations indicates existence of variation in the genetic resources between isolated populations of the Nigerian local chicken. Yakubu (2011) had reported variation in morphological traits of the African Muscovy ducks between populations.

Multivariate Test. The univariate analysis revealed differences in body dimensions between the isolated populations of the Tiv chicken ecotypes. This was due to the existence of genetic diversity between the isolated populations. The multivariate analysis also indicated that there was significant genetic distance between the isolated populations of the Tiv local chicken ecotypes. This may be due to both artificial and natural selection, genetic drift, random sampling arising from the cultural practices, and movement and settlement patterns of the Tiv rural farming communities. As the rural farmer's family size increases, some members of the farming communities relocate to new settlements taking along with them a small group of the local chicken from the original population to form a new population. The random sample of alleles in the just formed new populations is expected to grossly misrepresent the original population (Neil, 1996). When a new formed population is small, its founders can strongly affect the populations genetic make-up far into the future (http://www.pbs.org/wgbh/evolution /library/06/3/1-063-03.html) .

The difference in the gene frequencies between the original and the new populations may also trigger the groups to diverge significantly over the course of many generations (small et al., 2007). As the difference increases, the separated populations may become distinct, both genetically and phenotypically, with wide genetic distance as observed in this study. Natural and artificial selection, gene flow and mutation may have certainly contributed to this divergence. This indicated the existence of morphological variations due to genetic divergence of Nigerian local chicken populations. These morphological variations due to genetic diversity would exist between and within the Nigerian ecological zones and between Nigerian ethnic farming communities arising from selection induced by differed ethnic cultural practices, natural selection and mutation.

V. Conclusion And Recommendation

There was significant genetic diversity between isolated populations of the Tiv local chicken ecotypes. This diversity may have been induced by selection, genetic drift and random sampling due to different cultural practices of the local chicken farming communities. Superior birds could be identified, selected and bred for genetic improvement of the Nigerian local chickens' performance. There is need to conduct this study in other Nigerian ecological zones and ethnic farming communities to provide more information on genetic diversity of the Nigerian local chicken. This will provide unbiased estimates of genetic diversity within the Nigerian local chicken ecotype.

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