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Original Contribution

CANONICAL DISCRIMINANT ANALYSIS OF MORPHOMETRIC TRAITS IN INDIGENOUS CHICKEN GENOTYPES

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ABSTRACT

Morphological traits and live weight data collected from three Nigerian indigenous chicken genotypes naked neck (nn), frizzled feather (FF) and normal feather (NN) chickens was evaluated for diversity study, using canonical discriminant analysis, the parameters evaluated include body weight (BW), body length (BL), chest circumference (CC), shank length (SL), thigh length (TL), keel length (KL), wing length (WL) and body width (BD). The frizzled feathered were heavier and had longer keel length, significantly better than other genotypes, with naked neck had the least of all body parameters. Two discriminant functions were extracted accounting for 100% total variance. BW, TL and BD had the highest discriminatory power of all the variables. The pair wise square mahalanobis distance show closer relationship between normal feather and naked neck (3.371 and greater distance between normal feathered and frizzled feathered chicken (4.620). The morphological distance will help in understanding genetic diversity of the chicken genotypes and can help to initiate programme for the preservation of the chicken genetic resources.

Key word: diversity, normal feather, naked neck, agro-ecological zone, ecotype, distance

INTRODUCTION

The indigenous chickens in Nigeria are reported to have variable morphological identity, carrying genes that have adaptive values to the tropical environment. A number of studies have been carried out on the performance characteristics of the various genotypes of Nigeria chickens (1, 2). These chicken genotypes (naked neck, frizzled feathered, normal feathered, dwarf and slow feathering) have proven very useful and required to be maintained. The frequency distribution of the normal feather chicken was about 91.8%, while that of frizzle and naked neck were 5.2 and 3.0% in the southern part of Nigeria (3). These major genes are becoming economically interesting in modern breeding system, as they act as sex markers and disease resistant factor (4).

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Classifications have also been on the bases of location. There are various ecotypes of local chicken in the different agro ecological zones in Nigeria as reported by (5, 6). The present and future improvement and sustainability of indigenous chicken production system are dependent upon the availability of this genetic variation. Indigenous breeds represent a huge reservoir of chicken genome. Their continued use in a low input small scale village production system serve as a cheap in situ conservation technique that needs to be encouraged and supported (7).

Knowledge on the distribution of chicken genetic diversity will be useful in optimising both conservation and utilization strategies for indigenous chicken genetic resource. Morphological variation may be the result of phenotypic plasticity, local adaptation, ecological character displacement or the interaction of any of this process.

Canonical discriminant analysis is a multivariate technique that describes the relationship between two or more variable set through linear combinations that are maximally correlated (8) allows for discovering dominant gradients of variation among groups. The goal is to elucidate how variation among groups is maximized and variation within group is minimized along a gradient thus helpful in understanding genetic relatedness and diversity study in poultry .Multivariate discriminant analysis of morphological traits has been successfully used to estimate genetic variation within and between local breeds (9, 10, 11). Abdelqader et al. (12) reported that body weight, body length, heart girth and height at hip showed the largest discriminatory power between three Jordanian chicken genotypes.

The objective of this study was to assess genetic diversity of the three chicken genotypes (naked neck, frizzled feathered and normal feathered) on the basis of phenotypic characteristics.

MATERIALS AND METHODS

Study location and traits measured. The data used for this study was collected from 1260 adult male chickens genotypes (740 normal feathered, 315 frizzled feathered and 205 naked neck chicken) reared by rural farmers around Lafia metropolis of Nasarawa State, Nigeria.

The traits studied include body weight (BW), body length (BL), chest circumference (CC), shank length (SL), thigh length (TL), keel length (KL), wing length (WL) and body width (BD). The data of weight was taken by direct measurement using digital kitchen scale, while length were estimated using graduated flexible tape in centimetre, as outline by (13, 14).

Statistical analysis

Means and standard deviations of the body weight and body measurements by genotypes were determined. Univariate analysis was employed to determine the effect of genotype on the morphological traits using general linear model (GLM).Canonical discriminant analysis was performed using (15) SAS CANDISC procedure for the phenotypic variability study where differences between genotype were obtained by F-test($p<0.05$) over the square mahalanobis distance$\{D^2=(x_i-x_1)s^{-1}(x_i-x_l)\}$ in which x_i and x_l are the means of samples variances and sample covariances common to all genotypes as defined by Mahalanobis (16) and presented by Rao (17). Discriminant analysis is a multivariate statistical procedure that mathematically defines a special discriminant function to separate a study population by one classification variable (treatment subgroups). The numeric value of the discriminant function is different for each subject, and the treatment subgroup determined from discriminant analysis may or may not be the same as the actual treatment subgroup. The more subjects with the same classified and actual treatment of the subgroup are, the better effect of the separation is.

The obtained total sample standardized canonical coefficient and total variance was explained by each canonical variable. The discriminant function can use several quantitative variables, each of which makes an independent contribution to the overall discrimination. Taking into consideration the effect of all quantitative variables, this discriminant function produces the statistical decision for guessing to which subgroup of classification variable each subject belongs. Assuming a multivariate normal distribution of quantitative variables within each level of classification variable, a parametric method generates either a linear discriminant function (equal within-class covariance) or a quadratic discriminant function (unequal within-class covariance). In either case, the discriminant function is a weighted combination of all quantitative variables.

RESULTS AND DISCUSSION

The means and standard deviations of the morphological traits of the three genotypes are presented in **Table 1**. Genotype – associated differences ($p<0.05$) were observed in body weight, body length, thigh length, keel length and body width with higher values recorded for frizzle feathered chickens in most of the traits, there was however similarity in some morphological traits between naked neck and frizzled feathers birds in wing length and chest circumference. The significant higher values recorded for frizzled feathered chicken in this work is consistent with reports of (4, 18). Who reported that frizzled chicken gain more weight than other chicken genotypes? Horst (4) further stated that the naked neck and frizzled feather genes confers superiority in some production characters in tropics.

Table 1. *Mean and standard deviation of the morphological traits of the three genotypes*

Traits	*Genotypes*		
	Normal feathered	Frizzled	Naked neck
1 BW	1.58(0.35)	1.71(1.08)	1.52(0.75)
2 BL	33.20(19.75)	33.20(4.35)	30.00(6.05)
3 CC	10.82(1.82)	10.42(5.77)	10.43(1.86)
4 SL	11.22(13.34)	10.22(1.52)	10.03(1.34)
5 TL	14.62(2.14)	14.68(1.71)	14.04(1.55)
6 KL	19.84(10.84)	20.16(3.78)	18.05(3.14)
7 WL	20.78(11.92)	19.49(2.67)	19.46(2.73)
8 BD	12.99(1.69)	12.03(1.81)	12.40(1.68)

B - body weight, BL - body length, CC - chest circumference, SL - shank length , TL - thigh length , KL - keel length, WL - wing length and BD - body width.

Eigen values, variance proportion, canonical correlation and standardized discriminant coefficient of the most discriminating variables are presented in **Table 2**. Two discriminant function were extracted, the significance of the discriminant function tested with Wilks Lambda (0.895, 0.956) and Bartlett's test (chi-square 60.580 $P<0.001$, 24.565 $P<0.01$) for the two functions, this provided validity for the canonical discriminant analysis, similar to what Rosario et al. (19) and (14) obtained. On obtaining weighing the power of each of the eight original independent variable to discriminate between the three genotypes, body weight, thigh length and body width were retained as most discriminant variable, this is consistent with the findings of (12) on three Jordanian chickens.

Table 2. *Summary of canonical discriminant functions*

Function	Eigen values	Cumm. Variance	Can. Corr	λ	Chi Square	Sign
1	0.068	59.7	.253	.895	60.580	0.000
2	0.046	100	.210	.956	24.565	0.001

Table 3 present the total – sample standardized canonical coefficient and total variance explained by each canonical variable. The first canonical variable (Can1.) or fisher linear discriminant function explain 59.7% of the total variation , which can be considered moderate and Can2 explained 40.3% of total variation. It is clear that for the total traits use in this study both canonical variables extracted were necessary to explain the total variation (100%). The canonical discriminant analysis performed here help in weighing each original traits contribution to each of the two canonical variables, this observation was similarly reported by (19). The first canonical variable Can 1 loaded highly for body width and body weight in the inverse, while the Can 2 loaded for thigh length, keel length and body length. These traits that loaded high in the two Can1 and Can2 demonstrate their relevance in discriminating between the genotypes. This was further reaffirmed by the extraction of standardize canonical discriminant function coeffient **Table 4**, except for the keel length.

Table 3. *Total sample standardized canonical coefficient and total variance explained by each canonical variable*

Variable	Can1	Can2
1 Body weight	-0.504	0.093
2 Body length	-0.057	0.388
3 Chest circumference	0.029	0,204
4 Shank length	0.130	0.116
5 Thigh length	-0.264	0.559
6 Keel length	-0.094	0.453
7 Wing length	0.108	0.179
8 Body width	1.051	-0.79
9 Total variance	0.597	0.403

Table 4. *Standardized canonical discriminant function coefficient*

	Function 1	Function 2
1 Body weight	-.503	-.208
2 Thigh length	-,260	.894
3 Body width	1.028	.064

The pair wise square mahalanobis distance and probability values for the contrast between genotypes is presented in **Table 5**. The naked neck and normal feathered chicken were the closest and the largest distance was between frizzled and normal feathered chicken, lower than what Rosario et al. (19) obtained from broiler chicken population. The low distance obtained from this study is consistent with the findings of (19) who use molecular approach to evaluate genetic distance and reported no significant genetic distance between ecotypes from three agro ecological zones explained by the homogeneity resulting from intermix of germ plasm.

Table 5. *Pairwise square mahalanobis distance and probability value for the contrast between genotypes*

Genotype	NN	FF	nn
NN	0	4.620	3.371
FF	***	0	3.757
nn	***	***	0

***P<0.001 NN=normal feather, FF=frizzle nn= naked neck

CONCLUSION

The use of canonical discriminant analysis in evaluating morphometric between three Nigerian indigenous chicken populations has help in understanding the genetic relatedness between the genotypes. Of the total variables considered they were reduced to only two canonical variables with body weight, body width and thigh length as important variables for discriminating the genotypes. The frizzled feathered chickens stand out in performance and distance between the genotypes, making it possible for formulating improvement programme for indigenous chicken.

REFERENCES

1. Ozoje, M. O., Ikeobi, C. O. N., Adebambo, A. O. and Adenowo, J. A. Occurring patterns and frequencies of colour genes in some indigenous poultry species in Nigeria. *Tropical Journal of Animal Science*, 2:151-162, 1999.
2. Ikeobi, CON, Ozoje, M.O., Adebambo, O. A. and Adenowo, J. A.. Frequency of feetfeathering and comb type genes in the Nigerian local chicken. *Pertanika J. of Tropical Agricultural Science*, 24:147-150, 2001.
3. Ajayi, F.O. and Agaviezor, B.O. Phenotypic characterization of indigenous chicken in selected local government area of bayelsa state. Nigeria. *Proceedings of the 3rd Nigerian international poultry summit feb. 22-26 Abeokuta*, pp 75-78. 2005.
4. Horst, P. Native fowls as reservoir for genomes and major genes with direct and indirect effect on adptability and their potential for tropical oriented breeding plans *Arch Gelflugella*, 5313:63-69, 1989.
5. Nwosu, C. C. Characterization of the local chickens in Nigeria and its potential for egg and meat production. *Proceedings of the first National seminar on poultry production Dec. 11-13 Ahmadu Bello University Zaria*, pp 187-210.: 1979.
6. Olori, V. E. An evaluation of two ecotypes of the Nigerian indigenous chicken. *Msc Theses OAU Ile Ife*, 1992.
7. Ajayi, F. O. Nigerian Indigenous chicken: A valuable gentic resource for meat and egg production. *Asian J. Poult. Sc*., 4, (4), 164-172 . 2010.
8. Tabachnick, B. G. and Fidell, L. S .Using multivariate statistics Alyn and Bacon. A Person Educ. Company, Boston, 2001.

9. Jordana, J., Ribo, O. and Pelegrin, M. Analysis of genetic relationships from morphological characters in Spanish goat breeds. *Small Rumin. Res*., 12: 301-314, 1993.
10. Herrera, M., Rodero, E., Gutierrez, M. J., Pena, F. and Rodero, J. M. Application of multifactorial discriminant analysis in the morphostructural differentiation of Andalusian caprine breeds. *Small Rumin. Res*., 22: 39-47: 1996.
11. Zaitoun, I. S., Tabbaa, M. J. and Bdour, S. Differentiation of native goat breeds of Jordanon the basis of morphostructural characteristics. *Small. Rum. Res*., 56: 173-182, 2005.
12. Abdelqader, A., Wollny, C. A. B. and Gauly, M. On farm investigation of local chicken biodiversity and performance potentials in rural areas of Jordan.Anim. *Genetic Resource inform*., 43: 49-59, 2010.
13. Ogah, D. M. Analysis of morphological traits of geographically separated population of indigenous Muscovy duck. *Inter. Journ. of Poult.Sc*., 8, (2), 179-182, 2009.
14. Ogah, D. M., Momoh, O. M. and Dim, N. I. Application of canonical discriminant analysis for assessment of genetic variation in Muscovy duck ecotypes in Nigeria. *Egypt Poult.Sc*., 31, 11, 429-436, 2011.
15. SAS package. Statistical analysis system. Users guide statistic SAS. *Institute inc Cary*, USA. 1999.
16. Mahalanobis, P. C. On the generalised distance in statistics. *Proceedings of Natural Institute of Science*, 2, 49-55, 1936.
17. Rao, C. R. Advanced statistical methods in biometric research. *John Wiley and Sons*, New York (NY), 1952.
18. Nwachukwu, E. N., Ibe, S. N. and Onyeocha, K. C. Growth performance of F2 crosses of normal local, necked neck and frizzle chicken x Arbor acre broiler breeder stock. *In proceeding of Genetics Society of Nigeria Annual Conference*, 85-87, 2005.
19. Rosario, M F., Silva, M. A. N., Coelho, A. A. D., Savino, V. J. M. and Dias. C. T. S. Canonical discriminant analysis applied to broiler chicken performance. *Animal*. 2, 419-429, 2008.