

*Original Research***Varimax Rotated Principal Component Analysis of Adaptability Traits in Haringhata Black Chickens Raised Under Intensive Management System**

Saikhom, R.¹, Sahoo, A. K.¹, Taraphder, S.¹, Pan, S.², Sarkar, U.¹, Ghosh, P. R.³,
Bhattacharyya, D.⁴ and Baidya, S.⁵

W.B.U.A.F.S., 37 K. B. Sarani, Kolkata- 700037, INDIA

¹Department of Animal Genetics and Breeding

²Department of Livestock Production and Management

³Department of Veterinary Physiology

⁴Department of Livestock Products Technology

⁵Department of Veterinary Parasitology

*Corresponding author: subhash.taraphder@gmail.com

Rec. Date:	May 25, 2017 08:57
Accept Date:	Nov 11, 2017 15:01
DOI	10.5455/ijlr.20170525085724

Abstract

Principal Component Analysis was carried out on Haringhata Black Chickens to identify the best component for explaining the variability of adaptability trait of birds at 18th week of age. The descriptive statistics showed that the mean body measurements were 20.15±0.20 cm, 69.14±0.41 cm, 17.32±0.34 cm, 5.25±0.13 cm, 8.77±0.14 cm, 3.64±0.10 cm and 13.11±0.18 cm for wing length, wing span, tail length, central toe length, shank length, shank diameter and thigh length, respectively. Highly significant ($P < 0.01$) positive correlations were recorded for all the morphometric traits studied. The highest correlation was obtained between wing length and thigh length ($r = 0.85$) while correlation between shank diameter and tail length ($r = 0.29$) was observed to be the lowest. Principal component analysis revealed that First Principal Component had highly correlated with thigh length (0.94), wing length (0.93), shank length (0.92), wing span (0.91) and shank diameter (0.84). This component explained maximum variability of about 76.02 % of the total variation in the original variables for adaptability and may be used as selection criteria for describing the adaptability of indigenous Haringhata Black chickens.

Key words: Haringhata Black Chicken, Morphometric Traits, Principal Component Analysis

How to cite: Saikhom, R., Sahoo, A., Taraphder, S., Pan, S., Sarkar, U., Ghosh, P., Bhattacharyya, D. & Baidya, S. (2018). Varimax Rotated Principal Component Analysis Of Morphometric Traits Of Haringhata Black Chickens Raised Under Intensive Management System. International Journal of Livestock Research, 8(6), 139-144. doi: 10.5455/ijlr.20170525085724

Introduction

Haringhata black chicken breed, an important poultry breed mainly found in Nadia and North 24 Parganas district of West Bengal, India. This breed of poultry was reported to have existed as early as 1984 (Archarya *et al.*, 1984). Adaptability of breed in a particular region is important for economic point of view. This is not only controlled by single trait but a number of traits and others factors are involved in it. Measurement of this parameter in a way other than conventional weighing and grading seems appropriate for overall gain (Ogah *et al.*, 2009). Principal Component Analysis (PCA) thus multivariate mathematical procedure that transforms a number of possibly correlated variables into a smaller number of uncorrelated variables known as Principal Components which are arranged in such a way so that the first few retain most of the variation present in the original variables (Jolliffe, 2002). Keeping this aspect in view, the present study was carried out to obtain fewer measurements components that define the adaptability of this breed using principal component analysis.

Materials and Methods

Appraisal of Data

Data were recorded on 113 randomly selected experimental indigenous Haringhata Black Chickens at Haringhata Poultry Farm. The wing length (cm), wing span (cm), tail length (cm), central toe length (cm), shank length (cm), shank diameter (cm) and thigh length (cm) of Haringhata Black Chicken were recorded 18th week of age. The metric measures were recorded using tape rule following Adeleke *et al.*, (2011), Francesch *et al.* (2011), Scott (1982) and Ceballos *et al.* (1989). The obtained data were eventually used for Principal Component Analysis (PCA).

Statistical Analysis

The statistical analysis of this study was performed using the SPSS (Windows version 22, IBM Corp. 2013) statistical package. Pooled data for both the sexes was used for analysis. Mean, standard deviation and coefficient of variation of adaptability traits were calculated using the descriptive statistic of this software. Pearson correlation coefficients among the body measurements of adaptability traits were calculated and the correlation matrix was the primary data required for Principal Component Analysis (PCA). The correlation matrix obtained was subjected to Bartlett's sphericity test whether it was an identity matrix i.e. each variable correlated to itself or a correlation matrix full of zeros. The data set was further tested for their appropriateness to PCA using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy which tested whether the partial correlations among variables were small. A KMO

measure of 0.60 and above was considered as adequate (Eyduan *et al.*, 2010) for PCA. Then PCA was performed using this software to identify the best component for adaptability of this poultry breed.

Results and Discussions

Descriptive Statistics

The descriptive statistics for adaptability traits of indigenous Haringhata Black Chickens at 18th week of age has shown in Table 1. The mean body measurements were 20.15±0.20 cm, 69.14±0.41 cm, 17.32±0.34 cm, 5.25±0.13 cm, 8.77±0.14 cm, 3.64±0.10 cm and 13.11±0.18 cm for wing length, wing span, tail length, central toe length, shank length, shank diameter and thigh length, respectively. Tail length varied more (CV = 17.09 %) while wing span (CV = 6.52 %) varied the least.

Table 1: Mean, standard deviation and coefficient of variation for adaptability traits of Haringhata black chicken

Parameter	Mean ± SE	SD	CV (%)
Wing length (cm.)	20.15±0.20	1.57	7.79
Wing span (cm.)	69.14±0.41	4.51	6.52
Tail length (cm.)	17.32±0.34	2.96	17.09
Central toe length (cm.)	5.25±0.13	0.49	9.33
Shank length (cm.)	8.77±0.14	0.87	9.92
Shank diameter (cm.)	3.64±0.10	0.30	8.24
Thigh length (cm.)	13.11±0.18	1.12	8.54

Pearson Correlation Coefficient

Pearson correlation coefficients among the adaptability traits of Haringhata black chicken have been presented in Table 2.

Table 2: Correlation coefficient among the adaptability traits of Haringhata black breed of chicken

Traits	Wing Length	Wing Span	Tail Length	Central toe Length	Shank Length	Shank Diameter
Wing span	0.79**					
Tail length	0.58**	0.69**				
Central toe length	0.58**	0.55**	0.51**			
Shank length	0.80**	0.72**	0.61**	0.65**		
Shank diameter	0.46**	0.42**	0.29**	0.42**	0.44**	
Thigh length	0.85**	0.73**	0.60**	0.65**	0.84**	0.43**

Correlation coefficients were all highly significant ($p < 0.01$)

Highly significant ($P < 0.01$) positive correlations were recorded for all the adaptability traits studied. The significantly highest correlation was obtained between wing length and thigh length ($r = 0.85$) while correlation between shank diameter and tail length ($r = 0.29$) was observed to be the lowest. These estimates of correlation coefficient obtained in the present study are comparable with those reported by

Egena *et al.* (2014). The positive and significant ($P < 0.01$) correlations among the body measurements of adaptability traits observed in the experimental birds indicated high predictability among the variables owing to pleiotropic effect of gene. This, therefore, provides a basis for the genetic manipulation and improvement of this native stock of Haringhata black chicken.

Bartlett's Sphericity Test

The applicability of PCA was determined based on Bartlett's Sphericity test result. It is observed that the Chi-Square value for Bartlett's test of Sphericity for adaptability traits was 577.57 ($P < 0.01$). Hence, the data set could be used for PCA.

Kaiser-Meyer-Olkin (KMO) Measure

In this present investigation, the Kaiser-Meyer-Olkin (KMO) measures for adaptability traits were 0.88 (Table 3). The estimated KMO values indicated that the sample size was adequate to apply PCA. The observed high value of KMO measure of sampling adequacy for adaptability traits revealed that correlations between the variables were not related to the remaining variables outside each sample correlation.

Table 3: Eigen Values and Percentage of Total Variance along with the Rotated Component Matrix and Communalities for Production Traits of Haringhata Black Breed of Chicken at 18th week of age

Traits	PC1	PC2	Communalities
Wing Length	0.92	0.02	0.87
Wing Span	0.90	0.02	0.82
Tail Length	0.76	-0.01	0.57
Central Toe Length	0.79	-0.05	0.62
Thigh Length	0.02	0.99	0.89
Shank Length	0.94	-0.01	0.85
Shank Diameter	0.85	0.01	0.71
Eigen Values	4.45	1.00	-----
% of the Variance	63.63	14.31	-----
Cumulative % of the Variance	63.63	77.93	-----
Bartlett's Test of Sphericity	577.57 ($P < 0.01$)		
KMO Measure	0.88		

Communalities

The value of the communalities for adaptability traits are furnished in the Table 3. It was observed that the communalities ranged from 0.57 (tail length) to 0.89 (thigh length) of Haringhata black chicken. The high values of communalities gave further acceptance to the appropriateness of PCA. The communalities values for wing length and shank length were 0.272 and 0.037 respectively in Indigenous Nigerian

Chicken (Egena *et al.*, 2014) whereas the values were 0.754 and 0.820 for wing length and shank length respectively in male, and 0.777 and 0.102 respectively in female Muscovy duck (Ogah *et al.*, 2009). High Communalities values of variables for Haringhata black chicken showed how well these variables are predicted by the retained factors in PCA.

Eigen Value

The Eigen values measured for adaptability traits of Haringhata Black Chicken and presented in Table 3. The PC1 Eigen value was 4.45 while PC2 Eigen value was 1.00. The present finding of Eigen values (greater than one) revealed that the contribution of each standardized variable to principal component extraction is significant.

Percentage of the Total Variance

The percentage of the total variance computed for different principal components of the adaptability traits and presented in Table 3. The two principal components PC1 and PC2 altogether accounted for 77.93 % (highest) of the total variance present in the seven original variables. It is also observed that the percentage of variability of adaptability traits for PC1 was much higher (63.63%) than PC2 (only 14.31%) at 18th weeks of age of Haringhata black chicken.

Loadings Factor

In the present investigation two principal components PC1 and PC2 were extracted for adaptability traits. The adequate variations in the pattern of loadings of the adaptability trait on each PC were evident from the Table 3. PC1 had high positive loadings on shank length (0.94), wing length (0.92), wing span (0.90), shank diameter (0.85), central toe length (0.79) and tail length (0.76) while PC2 had high positive loading only with thigh length (0.99).

The high loading factor on shank length and wing length in the present study were in close conformity with the results obtained by Ogah *et al.* (2009) and Egena *et al.* (2014) who also reported high factor loadings of 0.892 on shank length and 0.840 on wing length respectively. Also, the results of the present study were in close agreement with those of Udeh *et al.* (2011) who reported high positive loadings on wing length (0.766 in Marshal Broiler and 0.897 in Arbor Acre Broiler), thigh length (0.789 in Arbor Acre Broiler) and shank length (0.885 in Marshal Broiler). The positive and high loading factors in the present investigation indicated that these five traits are most equally important for describing the adaptability of Haringhata Black Chicken out of the total seven traits considered for PCA.

Conclusion

The first PC provided an adequate summary of the data for adaptability purpose and seven explanatory variables have been reduced to five components. First PC explaining 63.63% of the total variation for

adaptability trait could be sufficient for almost any application of adaptability point of view. Hence, the relevance of PCA as a multivariate statistical tool was evidenced in the reduction of large number of explanatory variables into components that gave a better performance of adaptability of Haringhata black chicken. Hence, it is concluded that the PC1 obtained from the PCA for adaptability traits may be used in selection programme of Haringhata black chicken.

Acknowledgement

The financial support of this research work was funded by the Department of Science and Technology under the Ministry of Science and Technology, Government of India, by awarding Dr. Reshma Saikhom the Inspire Fellowship during Ph.D. Degree Programme, without which this work could have not been completed.

References

1. Acharya RM and Bhat PN. 1984. Livestock and poultry genetic resources of India. IVRI Research Bulletin No. 1. Indian Veterinary Research Institute, Izatnagar (U.P.), India.
2. Adeleke MA, Peters SO, Ozoje MO, Ikeobi CO, Bangbose AM and Adebambo OA. 2011. Genetic parameter estimates for body weight and linear body measurements in pure and crossbred progenies of Nigerian indigenous chickens. *Livestock Research for Rural Development*. 23(1): <http://www.lrrd.org/lrrd23/1/adel23019.htm>
3. Ceballos P, Molina J, Franco A and Palacios B. 1989. Manual del Anillador. (ICONA – MAPA), (Madrid): 94–113
4. Egena SSA, Ijaiya AT, Ogah DM. and Aya VE. 2014. Principal component analysis of body measurements in a population of indigenous Nigerian chickens raised under extensive management system. *Slovak Journal of Animal Science*. 47: 77 – 82.
5. Eydurán E, Topal M and Sonmez AY. 2010. Use of factor scores in multiple regression analysis for estimation of body weight by several body measurements in brown trouts (*Salmo trutta* fario). *International Journal of Agriculture and Biology*. 12: 611- 615.
6. Francesch A, Villalba I. and Cartana M. 2011. Methodology for morphological characterization of chicken and its application to compare Penedesenca and Empordanesa breeds. *Animal Genetic Resources*. 48: 79–84.
7. Jolliffe IT. 2002. *Principal Component Analysis*. 2nd ed. Springer
8. Latshaw JD and Bishop BL. 2001. Estimating body weight and body composition of chickens by using non-invasive measurements. *Poultry Science*. 80 (7): 868-873
9. Ogah DM, Alaga AA and Momoh MO. 2009. Principal component factor analysis of the morphostructural traits of Muscovy duck. *International Journal of Poultry Science*. 8 (11): 1100-1103.
10. Scott B. 1982. Clave del observador de aves. In S.A. Omega, ed., Barcelona: 13.
11. Udeh I and Ogbu CI. 2011. Principal component analysis of body measurements in three strains of broiler chicken. *Science World Journal*. 6: 11 – 14.