



Principal Component Analysis of Morphological Characteristics of Indigenous Chickens in Borno State, Nigeria

Abdulyekeen O. ABDULRAHEEM, Abdulrazaq O. RAJI, Nurudeen K. ALADE, Jibril ALIYU, Ibrahim D. MOHAMMAD

Department of Animal Science, Faculty of Agriculture, University of Maiduguri, P.M.B. 1069, Maiduguri, Borno State.

e-mail of corresponding author: yekeeno@yahoo.com

Mobile phone: 08064001509

Abstract

Investigation on morphological characteristics of 198 normal feathered indigenous chickens of Central part of Borno State, North East Nigeria was carried out using Principal Component Analysis. Value for body weight (g), ornithological measurement (cm), wing span (cm), neck length (cm), back length (cm), keel length (cm), tail length (cm), thigh length (cm) and shank length (cm) were 1491.11, 60.80, 64.36, 13.39, 21.45, 11.99, 20.80, 13.10 and 9.34, respectively. Sexual dimorphism was observed in all the traits as higher values were obtained for males. The first Principal Component (PC 1) accounted for the greatest percentage (46.67 %) and is a descriptor of body weight, ornithological traits and wing span; the second Component (PC 2) accounted for 17.35 % and is a descriptor of neck length, thigh length and shank length; the third Component (PC 3) accounted for 11.12 %, of the total variance and it described keel length.

Key words: Principal Component Analysis, indigenous chickens, morphological characteristics, body weight, ornithological measurement

Introduction

The indigenous chickens in Nigeria are good scavengers and foragers. They have good maternal qualities, harder when compared with exotic breeds and have high survival rate with minimal care and attention (Salako and Ige, 2006). To their credits as well, they are repositories of unique genes that could be used in other part of the world (Adebambo, 2004) thus, the need for their conservation. Morphometric measurements have been found useful in contrasting size and shape of animals (McCracken *et al.*, 2000); Ajayi *et al.*, 2008). However, correlations between body dimensions may be different if the dimensions are treated as bivariates rather than multivariates. This could be traceable to the interrelatedness or lack of orthogonality of the explanatory variables. Multivariate analysis such as Principal Component Analysis would cater for this limitation (Yakubu *et al.*, 2009). Principal Component Analyses are a weighted linear combination of correlated variables, explaining a maximal amount of variance of the variables (Truxillo, 2003). This aids in data reduction, and breaks multicollinearity which may lead to a wrong inference in these variables. Despite the rich genetic nature of the indigenous chicken ecotypes, there is dearth of information on the description of their morphological traits in the North East, Nigeria using Principal Component Analysis. This study therefore aimed at investigating morphological characteristics of indigenous chickens in the Central part of Borno State, Nigeria using Principal Component Analysis.



Materials and Methods

Experimental site

Borno State lies between Latitudes 10⁰-13⁰ N and Longitudes 12⁰ – 15⁰ E. A greater part of the state lies on the Chad Formation. This State could be divided into broad relief regions; hilly/mountainous area of generally over 600 m above sea level, which cover the south and southeastern parts of the state; and plains of generally less than 600 m above sea level which dominate much of the central and northern parts of the State. The rainfall varies from 700 to 1000 mm in the southern part and 300 to 500 mm in the north (Ayuba *et al.*, 2003). Three seasons can be identified in the State: the cool dry (harmattan) season (October to March); the hot dry season (April - June); and rainy season (July - September). The hot season mean temperatures ranging between 39⁰ and 40⁰ C. Droughts are endemic. Two vegetation zones identified are Sudan and Sahel savanna. Agriculture of both crops and animals is the mainstay of the economy (Mohammad and Ahmad, 2014).

Experimental birds and morphological measurements

198 (male = 107, female = 91) adult normal feathered indigenous chickens were collected from three Local Government Areas from the Central part of Borno State for the study. 71 chickens were collected from Jere, 60 from Maiduguri and 67 from Konduga Local Government Areas. Body Weight (BW) of the birds was determined using a measuring scale. Ornithological Measurements (OM) was measured from the tip of the beak to the end of the tail when the bird is laid down on its back. Wing Span (WS) is the distance between the ends of the longest primaries with wings stretched. Neck Length (NL) was taken as the distance between the nape and the insertion of the neck into the body. Back Length (BL) was taken as the length from the insertion of the neck in to the body to the saddle. Keel Length (KL) was the distance between both vertical of the sternum. Tail Length (TL) was measured from the tip of a central rectrix to the point where it emerges from the skin. Thigh Length (TL) is the length from the notch of the shin bone-femur joint, to shin bone tarsus joint. Shank Length (SL) was taken as the length from the notch of the shinbone-tersus joint until the other end.

Statistical analysis

Data on morphological characteristics were analyzed using Statistical Package for Social Sciences (SPSS) Version 20. The suitability of data for Principal Component Analysis (PCA) was tested using Bartlett's of sphericity and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. Descriptive statistics of data was performed and PCA option of factor analysis was carried out. Factor loading was based on Eigen value of 1.00 and above, and the best descriptors were identified based on communality extraction factors closest to 1.00. The varimax option of orthogonal rotation was used in the rotation of the factor matrix.

Results and Discussion

The descriptive statistics of morphological characteristics of Borno State indigenous chickens was presented in Table 1. The mean value for body weight (g), ornithological measurement (cm), wing span (cm), neck length (cm), back length (cm), keel length (cm), tail length (cm), thigh length (cm) and shank length (cm) were 1491.11, 60.80, 64.36, 13.39, 21.45, 11.99, 20.80, 13.10 and 9.34, respectively. These values were higher in the males than females. The average body weight reported in this study (1491.1 g) is similar to 1.44±0.34 observed by Ige *et al.* (2012) in Frizzle feathered. However, the value is lower than 1.68±0.27 kg reported in Naked neck chicken (Ige *et*



al., 2012) and higher than 1.13 kg reported for normal feathered by Ikpeme *et al.* (2016). The ornithological measurement (60.80 cm) reported in this study is similar to 63.08 ± 10 cm in Anak Titan (Ajayi *et al.*, 2012) and lower than body length of 54.3 ± 0.046 obtained for normal feathered by Ajayi *et al.* (2012). The variations in values could not be unconnected with the variations in the climatic condition of the experimental environments.

Table 1: Descriptive statistics for morphological characteristics of indigenous chickens of Borno State

Trait	Mean	Standard Deviation	Male	Female
Body weight (g)	1491.11	284.165	1685.05	1263.08
Ornithological measurement (cm)	60.80	9.128	65.51	55.27
Wing span (cm)	64.36	8.59	68.53	59.45
Neck length (cm)	13.39	2.08	14.23	12.40
Back length (cm)	21.45	2.24	22.41	20.32
Keel length (cm)	11.99	1.71	12.34	11.59
Tail length (cm)	20.80	4.02	22.56	18.72
Thigh length (cm)	13.10	2.19	14.00	12.03
Shank length (cm)	9.34	1.62	10.05	8.51

Principal Component Analysis

The observed Bartlett's test (0.00) confirmed the suitability of the data for Principal Component Analysis. Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy observed (0.813) is higher than 0.60 considered adequate by Eydruran *et al.* (2010). The large communalities (0.631-0.856) are an indication that a large number of variance has been accounted for by the factor solution. A scree plot of Eigen values against their Principal Components is shown in figure 1. Table 2 showed Rotated Component Matrix, Eigen values and percentage of variance. The Principal Components accounted for 75.14 %. The Principal Components had Eigen values of 4.20 (PC 1), 1.56 (PC 2) and 1.00 (PC 3) which accounted for 46.67 %, 17.35 % and 11.12 %, of the total variance, respectively. The three factors were characterized by high positive loadings. The first was on body weight (0.621), ornithological measurement (0.879), wing span (0.792), back length (0.797) and tail length (0.854). It is a descriptor of body weight, ornithological traits and wing span. The second was on neck (0.778), thigh (0.884) and shank lengths (0.629). Thus, it is a descriptor of neck, and leg traits. The third was on keel length (0.903), a descriptor of keel length.

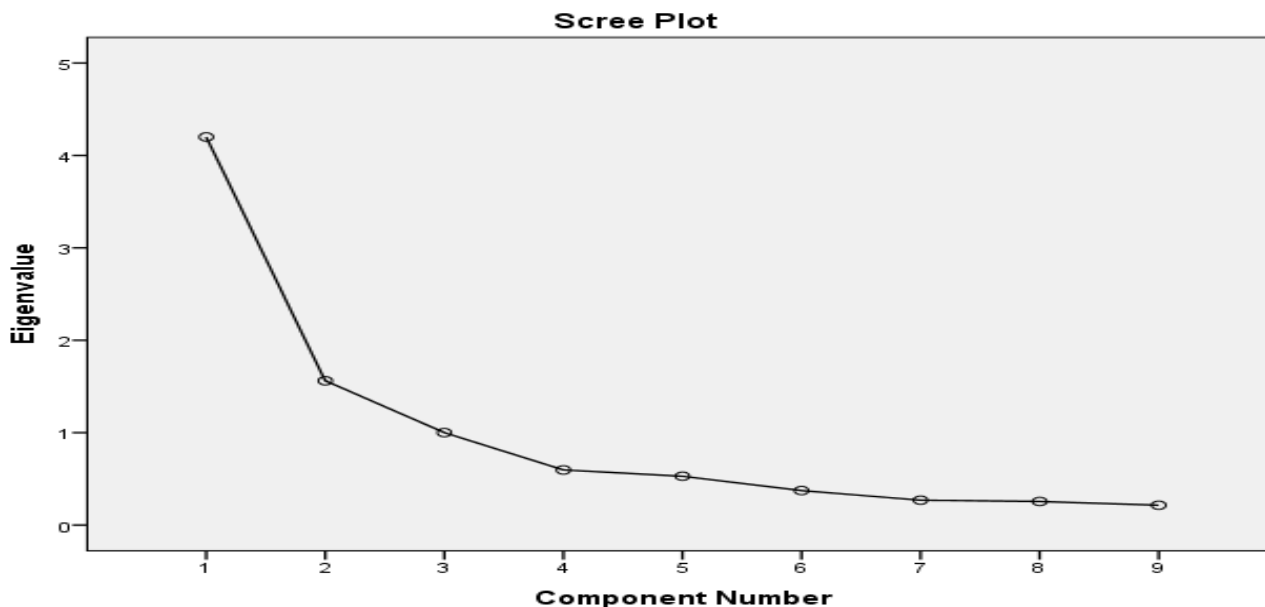


Figure 1

Table 2: Rotated Component Matrix, Eigen values and percentage of total variance of Borno State indigenous chickens

Trait	Component			Communality
	1	2	3	
Body weight	0.621	0.585	0.110	0.740
Ornithological measurement	0.879	0.189	0.035	0.810
Wing span	0.792	0.223	0.244	0.736
Neck length	0.274	0.778	-0.233	0.735
Back length	0.797	0.050	0.233	0.691
Keel length	0.181	0.086	0.903	0.856
Tail length	0.854	0.043	-0.015	0.731
Thigh length	-0.067	0.884	0.214	0.832
Shank length	0.214	0.629	0.435	0.631
Eigen values	4.200	1.562	1.000	
% of Total variance	46.67	17.35	11.12	

The first factor that accounted for the largest variance in this study maintains the usual trend in studies that used Principal Component Factor Analysis as reported by Yakubu *et al.*(2009) in chicken and Shahin and Hassan (2000) in rabbits. Ajayi *et al.*(2012) reported PC 1, PC 2 and PC 3 with high positive loadings, respectively for similar morphological traits in indigenous chickens as reported in this study.

Conclusion

The three principal components (PC 1, PC 2 and PC 3) obtained in this study could be useful in evaluating the indigenous chickens for breeding and selection purposes. The selection of these chickens for Principal Components will not cause a correlated response in terms of other Principal Components since correlation between Principal Components is zero.



References

- Adebambo, O.A. (2004). Animal genetics and the quality of life. *Proceedings of the 29th Annual Conference of the Genetics Society of Nigeria*, October 11-14, 2004, Abeokuta, Nigeria.
- Ajayi, F.O., Ejiofor, O. and Ironle, M.O. (2008). Estimation of body weight from linear body measurements in two commercial meat-type chickens. *Global Journal of Agricultural Science* 7:57-59.
- Ajayi, O.O., Mathew, A.A., Sanni, M.T., Yakubu, A., Peters, S.O., Imumorin, I.G., Ozoje, M.O., Ikeobi, C.O.N. and Adebambo, O.A. (2012). Application of principal component and discriminant analysis to morpho-structural indices of indigenous and exotic chickens raised under intensive management system. *Tropical Animal Production* 44:1247-1254.
- Ayuba, H. K., Aji, Y. M. and Msheliza, D. S. (2003). *Cultural Dynamics in Resources Utilization, Conservation and Management among Rural Communities in Borno State*. Salone Psycho-Educational Services, Maiduguri, Borno State, Nigeria pp98.
- Eyduran, E., Topal, M. and Sonmez, A.Y. (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.
- Ige, A.O., Salako, A.E., Yakubu, A., Ojedapo, I.O., Adedeji, T.A. and Adeoti, T.M. (2012). Comparison and prediction of morphological characteristics of frizzled feather and naked neck chicken in Derived Savannah zone. *PAT* 8(2):68-75.
- McCracken, K.V., Paton, D.C. and Aflon, A.D. (2000). Sexual size dimorphism of the Musk duck. *Wilson Bull.* 112:457-466.
- Mohammad, D. T. and Ahmed, F. F. (2014). The effect of insurgency on Borno State economy (2008-Oct. 2014). *Journal of Economics and Sustainable Development*, 6(16): 94-102.
- Shahin, K.A. and Hassan, N.S. (2000). Sources of shared variability among body shape characters at marketing age in New Zealand White and Egyptian rabbit breeds, *Ann. Zootec*, 49:435-445.
- Truxillo, C. (2000). *Multivariate Statistical Methods: Practical Research Applications Course Notes*. Cary, NC:SAS Institute.
- Yakubu, A., Ogah, D.M. and Idahor, K.O. (2009). Principal components as measures of size and shape in Nigeria indigenous chickens. *Thai Journal of Agricultural Science* 43(3):167-176.