



Phenotypic Relationships between Body Measurements of Indigenous Chickens in Borno State

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Abstract

Phenotypic correlations between morphological characteristics of 600 indigenous chickens (naked neck, normal and frizzled) from the central and southern parts of Borno state were determined. Data on morphometric traits were collected over three seasons in the study area and analyzed. The traits measured were Body weight (BW), Ornithological measurement (OM), wing span (WS), neck length (NL), back length (BL), keel length (KL), tail feather length (TFL), thigh length (THL) and shank length (SL). The mean body weights for normal, frizzled and naked neck chickens were 1481.66, 1250.21 and 1655.73 g, respectively while Cocks and hens had mean BW of 1628.58 and 1248.98 g. Sex and genotype had highly significant ($P < 0.01$) effects on all measurements. Correlation analysis revealed that the highest positive (0.81) correlation was between OM and BL and the lowest (0.00) between KL and NL for naked neck chickens. The highest negative (-0.33) correlation was between TL and KL and lowest (-0.01) between BW and TFL for frizzled. In general, correlations coefficients between morphometric traits were higher for normal feathered and naked neck than frizzled. BW had significant ($P < 0.05$) positive relationships with all body measurements except KL in frizzled (0.13) and naked neck (0.18) which were not significant ($P > 0.05$). Coefficients of correlation were generally higher for chickens in the south than those in central. Similarly, cocks had higher coefficients between morphometric traits than hens. The medium to high relationships between most traits for these birds could mean that selection for improvement of one trait may lead to improvement in the other.

Keywords: Normal, Frizzled, Naked neck, Ornithological measurement, Improvement

Introduction

The most widely distributed farm animal species in Nigeria are the poultry with larger percentage under the rural extensive management system while only 21% are intensively managed (FAO, 2019). The role played by these birds in the livelihood of the rural populace cannot be over emphasized (Lasagna *et al.*, 2020). This is because they do not only contribute to animal protein intake, they also play a vital role in revenue generation of resource-limited local families and used for socio-cultural benefits (Mbuza *et al.*, 2016). They have good maternal qualities and have high survival rate with minimal care and attention (Salako and Ige, 2006). The indigenous chickens are preferred

to the exotic because of their low cost of production, scavenging nature and adaptability to harsh environmental conditions (Habimana *et al.*, 2019).

In most of African countries, the productivity of indigenous chicken is low compared to the exotic strains as they lay less than 100 eggs per hen per year and weigh between 0.80 and 1.80 kg at maturity which is not sufficient to meet the needs of the teeming population (Mahoro *et al.*, 2017). Their low productivity has hindered their potential to improve the livelihood of smallholder farmers, thus failing to contribute considerably to eradication of rural poverty (Habimana *et al.*, 2019). However, improvement of some

economic traits of these birds would go a long way to arrest the situation.

Traits in farm animals are numerous and many are not independent of each other, rather they are associated in one manner or the other, and this gives the idea of correlation between characters (Ibe, 1998). According to Ikpeme *et al* (2016), the importance of estimating correlation between characters is to measure the extent of association between one trait and the other. Ibe (1998) stated that phenotypic correlations between two characters is the correlation between their observed values and this arises from correlation between genetic and environmental effects affecting the two characters. Phenotypic correlation gives the proximate indication of genetic correlation as such, it plays a vital role in animal breeding. Indigenous chickens of Borno state have not been subjected to conscious selection for improvement. This work therefore was to examine the morphological characteristics of indigenous chickens in Borno state and the strength of the relationship that exists between.

Materials and Methods

Study area

The research data were collected from the central and southern zones of Borno State. The state falls within Latitudes 10⁰ and 13⁰ N, Longitudes 12⁰ and 15⁰ E. The state is divided into hilly area of generally over 600 m above sea level and covers the southern part of the state and plains of generally less than 600 m above sea level which dominate much of the central and northern parts (Ayuba *et al.*, 2003). The annual rainfall varies from 700 to 1000 mm in the southern part and 300 to 500 mm in the north. Three seasons identified in the State were, dry cold (October to March); the dry hot (April - June); and wet season (July - September). The ambient temperatures are high all year

round, with hot season mean temperatures ranging between 39⁰ and 42⁰ C. Two ecological zones are identified: the Sudan and the Sahel Savanna (Mohammad and Ahmed, 2014).

Data collection

Data on morphometric measurements were collected over three seasons in the south and central parts of Borno State. The data was obtained from 600 adult indigenous chickens extensively reared in six Local Government Areas covering the central (Jere, Maiduguri and Konduga) and southern parts (Damboa, Biu and Chibok) of Borno State, Northeast, Nigeria. Nine measurements were taken on each bird. The measurements were body weight (g), ornithological measurement, wing span, and neck, back, keel, tail feather, thigh and shank lengths (cm). Birds were weighed using an electronic scale (precision, 1 g) and all morphological measurements were taken using a measuring tape (± 1 mm). The measurements were carried out following the methodology proposed by Francesch *et al.* (2011) developed for morphological characterization of chickens.

- Body weight: live weights of the birds determined on the same day by the same operator.
- Ornithological measurement: measuring from the tip of the beak to the end of the tail when the bird is laid down on its back.
- Wing span: distance between the ends of the longest primaries with wings stretched. On the work table/board, maintain the joints of the wings as stretched as possible.
- Neck measurement: the bird was immobilized on its left hand side on the work table/board by an operator stretching legs with one hand and the neck with the other hand, another operator took the measurement of the

- distance between the nape and the insertion of the neck into the body.
- Back length:- length from the insertion of the neck in to the body to the saddle.
 - Keel length:- distance between both vertical of the sternum (Processus carmine and processus xiphoideus) laying the birds on its back.
 - Tail feather length:- length from the tip of a central rectrix to the point where tail feather emerges from the skin.
 - Thigh length:- length from the notch of the shin bone-femur joint, to shin bone tarsus joint.
 - Shank length: tarsus length.

Statistical analysis

Data collected on morphological traits were analyzed using the software; SPSS 20.0 (SPSS, 2011). The data was subjected to Analysis of Variance with sex and genotype as fixed factors. The Pearson’s correlations sub routine of the same software was used to determine the relationships between the morphometric traits.

Results and Discussion

Morphological characteristics of indigenous chickens

The effects of sex and genotype on morphometric traits of indigenous chickens are presented in Table 1. The results revealed that sex and genotype had significant (P<0.01) effects on all the measurements.

Table 1: Effects of sex and genotype on morphological measurements of indigenous chicken strains in the central and southern parts of Borno State

Trait	Strain			Sex		F-ratio	Sig.
	Frizzle feathered	Naked neck	Normal feathered	Cock	Hen		
Body weight (g)	1250.21	1655.73	1481.66	1628.58	1248.98	70.473	.000
Ornithological measurement(cm)	60.07	67.21	64.39	67.33	59.76	21.838	.000
Wing span (cm)	56.78	65.62	67.13	67.69	60.50	99.983	.000
Neck length (cm)	12.55	13.90	13.50	13.99	12.53	27.553	.000
Back length (cm)	20.64	22.98	22.12	22.71	20.93	49.061	.000
Keel length (cm)	10.94	13.11	11.66	12.17	11.20	62.779	.000
Tail length (cm)	19.16	21.85	22.34	22.69	20.10	41.526	.000
Thigh length (cm)	12.16	13.51	13.09	13.52	12.22	34.079	.000
Shank length (cm)	8.49	9.47	9.05	9.49	8.35	43.401	.000

Naked neck chickens had higher values for all the traits, followed by normal and frizzle feathered. This may imply that the naked neck chickens were bigger in size than the other genotypes. By implication, naked neck could be the bird of choice to develop indigenous broiler chickens. This result is in line with those of Ige *et al.* (2012) who observed higher body weight (1.69 kg) for naked neck than frizzle feathered (1.44 kg) chickens from the Southwest of Nigeria. Sexual dimorphism was

in favour of the cocks as they were superior to the hens for all the measurements.

Correlation coefficients between body measurements of indigenous chickens (normal, naked neck and frizzled)

Phenotypic correlations between body weight and linear measurements of indigenous chickens (normal, frizzled and naked neck) are shown in Table 2. The positive estimates ranged from 0.00 to 0.81 while the negative coefficients were from -0.33 to -0.01. The

highest positive (0.81) correlation was observed between ornithological measurement and back length and the lowest value (0.00) was observed between keel length and neck length both in naked neck. On the other hand, the highest negative (-0.33) correlation coefficient was recorded between tail feather length and keel length (naked neck) and tail feather length and shank length (frizzled) while the least value (-0.01) was between body weight and tail feather length in frizzle feathered chickens.

Body weight had significant ($P < 0.05$) positive correlations with all the traits except for insignificant ($P > 0.05$) negative correlation with tail feather length (-0.01) in frizzle feathered. In line with this, keel length had high significant positive correlations with shank length (0.29) in frizzle, thigh length (0.42) and shank length (0.55) in naked neck. The trait also had significant ($P < 0.05$) negative correlations with ornithological measurement (-0.22), wingspan (-0.24) and tail feather length (-0.20) in frizzle feathered. It also expressed significant negative correlations with ornithological measurement (-0.33) and tail feather length (-0.33) in naked neck.

The highest positive correlation observed between ornithological measurement and back length is an indication that the best predictor of ornithological measurement would be the back length in naked neck. The positive correlations between body weight and other linear measurements in all the strains as observed in this study suggest that those traits should be considered during selection to improve body weight in these chickens. High positive correlation implies that selection for a trait may lead to a correlated response in the other traits if the traits are highly heritable (Yakubu *et al.*, 2009). This is because traits with high positive correlations would yield rapid improvement when subjected to selection. At the same time, high negative correlations

between traits should be critically considered in improvement programme as selection for one trait may have a negative influence on another. The result of this study suggests that wing span could be the best predictor of body weight in normal feathered. The keel length had high significant negative correlation with tail feather length in naked neck. This is an indication that selection for this trait could have negative impact on keel length in these birds which is a relevant element in commercial meat production.

The high significant ($P < 0.05$) positive correlation estimates reported by Ige *et al.* (2012) between body length (ornithological measurement) and other body measurements is in line with the report of this study. Contrary to this report is the observation of Ikpeme *et al.* (2016) who reported low to medium negative correlations with body measurements of indigenous chickens of Southeast Nigeria. The reason for the deviation in the reports could be differences in geographical locations, age of bird, season as well as ecotypes.

Coefficients of correlation between morphological traits in indigenous chickens of the central and southern zones of Borno is presented in Table 3. The correlations were generally high and positive in the two zones. In the central, it ranged from 0.10 to 0.69 and the highest value (0.69) was observed between ornithological measurement and tail feather length while the least (0.10) was between ornithological measurement and thigh length. In the south, the values ranged from 0.28 to 0.70 between tail feather length and keel length, body weight and back length (as well as thigh length and back length). These results suggest that body weight and thigh length could be the best predictors of back length. Correlations between body weight and other traits were high, positive and significant ($P < 0.01$) in both zones indicating that these measurements could be good predictors

Table 2: Phenotypic correlations between morphological traits of three (normal, above diagonal), (frizzle, below diagonal), (naked neck, second diagonal) indigenous chicken populations

TRAIT	BW	OM	WS	NL	BL	KL	TFL	THL	SL
BW									
Normal		0.55**	0.60**	0.48**	0.50**	0.32**	0.34**	0.46**	0.46**
Frizzle		0.23**	0.41**	0.45**	0.30**	0.13 ^{ns}	-0.01 ^{ns}	0.50**	0.30**
Naked neck		0.40**	0.42**	0.52**	0.48**	0.18*	0.22*	0.43**	0.35**
OM									
Normal			0.71**	0.43**	0.68**	0.17*	0.62**	0.14 ^{ns}	0.21*
Frizzle			0.68**	0.31**	0.65**	-0.22**	0.68**	0.04 ^{ns}	-0.17*
Naked neck			0.37**	0.44**	0.81**	-0.30**	0.75**	-0.03	-0.14 ^{ns}
WS									
Normal				0.40**	0.68**	0.27**	0.57**	0.26**	0.23**
Frizzle				0.38**	0.53**	-0.24**	0.52**	0.24**	-0.07 ^{ns}
Naked neck				0.29**	0.49**	0.19 ^{ns}	0.45**	0.24**	0.20*
NL									
Normal					0.27**	0.16**	0.37**	0.51**	0.36**
Frizzle					0.25**	-0.03 ^{ns}	0.16*	0.51**	0.19*
Naked neck					0.33**	0.00 ^{ns}	0.30**	0.22*	0.10 ^{ns}
BL									
Normal						0.24**	0.54**	0.16*	0.20*
Frizzle						-0.03 ^{ns}	0.54**	0.16*	0.01 ^{ns}
Naked neck						-0.08 ^{ns}	0.64**	0.08 ^{ns}	0.02 ^{ns}
KL									
Normal							0.08 ^{ns}	0.24**	0.38**
Frizzle							-0.20*	0.16*	0.29**
Naked neck							-0.33**	0.42**	0.55**
TFL									
Normal								0.02 ^{ns}	0.15**
Frizzle								-0.23*	-0.33**
Naked neck								-0.10 ^{ns}	-0.15 ^{ns}
THL									
Normal									0.50**
Frizzle									0.39**
Naked neck									0.45**

**=P<0.01, *=P<0.05, ns=not significant

BW=Body weight, OM=Ornithological measurement, WS=Wingspan, NL=Neck length, BL=Back length, KL=Keel length, TFL=Tail feather length, THL=Thigh length, SL=Shank length

Table 3: Phenotypic correlations between morphological traits (Central, above) and (Southern, below) of indigenous chickens of Borno state

	BW	OM	WS	NL	BL	KL	TL	THL	SL
BW		0.60**	0.63**	0.52**	0.57**	0.29**	0.44**	0.53**	0.47**
OM	0.65**		0.66**	0.40**	0.67**	0.17**	0.69**	0.10 ^{ns}	0.33**
WS	0.67**	0.64**		0.36**	0.62**	0.31**	0.65**	0.29**	0.33**
NL	0.67**	0.65**	0.68**		0.23**	0.11 ^{ns}	0.33**	0.49**	0.34**
BL	0.70**	0.68**	0.68**	0.68**		0.28**	0.56**	0.14 ^{ns}	0.29**
KL	0.54**	0.47**	0.40**	0.57**	0.62**		0.13 ^{ns}	0.28**	0.38**
TL	0.40**	0.46**	0.50**	0.53**	0.46**	0.28**		-0.06	0.22**
THL	0.67**	0.47**	0.59**	0.67**	0.70**	0.51**	0.45**		0.50**
SL	0.64**	0.45**	0.46**	0.57**	0.55**	0.46**	0.39**	0.50**	

**=P<0.01, *=P<0.05, ns=not significant

BW=Body weight, OM=Ornithological measurement, WS=Wingspan, NL=Neck length, BL=Back length, KL=Keel length, TFL=Tail feather length, THL=Thigh length, SL=Shank length

Table 4: Phenotypic correlations between morphological traits (Cocks, above) and (Hens, below) of indigenous chickens of Borno state

	BW	OM	WS	NL	BL	KL	TL	THL	SL
BW		0.49**	0.54**	0.38**	0.46**	0.32**	0.27**	0.42**	0.31**
OM	0.28**		0.62**	0.30**	0.68**	0.14 ^{ns}	0.63**	0.04 ^{ns}	0.05
WS	0.43**	0.62**		0.28**	0.56**	0.21**	0.59**	0.23**	0.17**
NL	0.34**	0.40**	0.42**		0.13 ^{ns}	0.14 ^{ns}	0.30**	0.42**	0.24**
BL	-0.35**	0.61**	0.67**	0.31**		0.32**	0.49**	0.08 ^{ns}	0.11 ^{ns}
KL	0.22**	-0.11 ^{ns}	0.07 ^{ns}	-0.01 ^{ns}	-0.01 ^{ns}		0.01 ^{ns}	0.28**	0.39**
TL	0.11 ^{ns}	0.57**	0.53**	0.26**	0.56**	-0.09 ^{ns}		-0.07 ^{ns}	0.05
THL	0.32**	-0.02	0.19**	0.42**	0.08 ^{ns}	0.16**	-0.11 ^{ns}		0.47**
SL	0.24**	-0.07 ^{ns}	-0.02 ^{ns}	0.09 ^{ns}	-0.04 ^{ns}	0.32**	-0.13 ^{ns}	0.31**	

of body weight in the chickens. In general, coefficients of correlation between the same traits were higher for birds in the south compared to the central zone. Correlations between morphological traits for the sexes of indigenous chickens ranged from low to high (Table 4). The values were generally positive in the cock and ranged from 0.01 (keel length and tail feather length) and 0.68 (ornithological measurement and back length). In the hen, the highest (0.67) positive coefficient was recorded between back length and wing span while the least (0.07) between keel length and wingspan. Negative correlation coefficients ranged from -0.13 (keel and back length) to -0.01 (shank length and tail feather length). Body weight had strong and positive correlations with all the morphological traits showing selection for improvement in the traits could lead to improvement in body weight of the chickens. Generally, coefficients of correlation between morphometric traits in cocks were higher than in the hens.

Conclusion

Naked neck chickens were superior to other genotypes (normal and frizzled) in body weight and most body measurements. Similarly, trend was observed for cocks compared to hens. Medium to high, positive and significant correlation coefficients were recorded between the body measurements and body weight. This may indicate that selection for improvement in the body measurements could lead to improvement in body weight of the chickens.

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