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Morphometric Traits and Correlation between Body Weight and Body Size Traits in Isa Brown and Ilorin Ecotype Chickens

Research Article

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ABSTRACT

Data collected in 2012 on 400 chickens were subjected to two-way analyses of variance to estimate body weight, morphometric traits as well as the correlation between body weight and morphometric traits in Isa Brown and Ilorin ecotype chickens. The studied morphometric traits were comb length, beak length, head length, neck length, body length, wing length, shank length, thigh length, toe length, breast length, and breast breadth. The results showed that genotype, sex and genotype × sex interaction significantly ($P<0.05$) affect body weight and morphometric trait measurements. Isa Brown chicken had a significantly higher ($P<0.05$) matured body weight than Ilorin ecotype birds. Isa Brown birds had higher ($P<0.05$) morphometric traits than Ilorin ecotype birds except for toe length. Male birds had higher body weight ($P<0.05$) and were also higher in most of the morphometric trait measurements than female birds. Interactions between genotype and sex were significant ($P<0.05$) for body weight and morphometric traits, except for breast length and breast breadth. Morphometric traits measured in young birds were significantly ($P<0.05$) correlated with body weight (0.68-0.95) except for wing length in Isa Brown and breast length in Ilorin ecotype chicken. Correlations between body weight and morphometric traits in adult Isa Brown birds were higher (0.27-0.95) than correlations between body weight and morphometric traits in Ilorin ecotype chicken (0.02-0.91). A significant negative correlation was obtained between body weight and beak length (-0.72) in Isa Brown and between body weight and wing length (-0.35) in Ilorin ecotype chicken. Morphometric traits measured on male birds were more highly correlated with body weight (0.68-0.95) than in female chickens, except for breast breadth. The present study showed that the two genotypes could be adequately characterised using morphometric indices. The study further revealed that morphometric indices like body length and comb length can be adequately used to predict body weight of birds in the two genotypes. However, the negative correlation obtained between body weight and wing length in Ilorin ecotype chicken requires further investigation to determine its basis for chicken adaptation.

KEY WORDS genotype, interaction, linear indices, Nigerian chicken.

INTRODUCTION

Growth is a complex and highly dynamic physiological process that begins immediately after a zygote is formed and it continues until maturity. Components of growth, such as body weight and morphometric measurements, are important factors to both poultry breeders and meat processors (Adeniji and Ayorinde, 1990). Body weight for instance, plays an important role in the determination of several other economically important traits and in determining market price in farm animals (Momoh and Kershima, 2008).

Morphometric traits are the quantitative analyses of the structure, shape, and size of an organism. The derivation of body weight from body measurements (i.e. morphometric traits) has been reported to be a practical and easy technique, especially among rural poultry breeders with lack of resources (Semacula *et al.* 2011). Maciejowski and Zeiba (1982) reported that morphometric traits such as shank length and diameter were indicators of leg development while body girth was an indicator of breast development. Aside its use as indicator of body weight, morphometric traits can further be use to develop breeding strategies via optimum combination of body measurements (Chineke *et al*. 2002) to achieve maximum body weight and economic returns. Phenotypic correlation estimates between body weight and morphometric traits could guide the breeder in the choice of body size traits to incorporate into his selection index. Nigeria has as estimated 175 million highly heterogeneous chicken populations, of which the local chicken accounts for more than 60 percent (Fayeye, 2011). The genetic resource base of indigenous chicken in Nigeria and other tropical countries is rich and should form the basis for genetic improvement and development of new breeds.

According to Olawunmi *et al.* (2008), characterisation of indigenous chickens is a necessary pre-requisite for indigenous breed development and the development of rural poultry. This study was conducted to measure body weight and morphometric traits of Isa Brown and Ilorin ecotype chickens and to determine the correlation between body weight and morphometric traits in the two genotypes.

MATERIALS AND METHODS

Location of the study

The study was carried out in Ilorin metropolis. Ilorin is located between the rainforest of the Southwest and Savannah grassland of Northern Nigeria. It bears the co-ordinates of 8° 30' 0" North, 4° 33' 0" East and lies on an altitude of 305 m, 1001' above sea level. Its annual rainfall, relative humidity and day temperature are 600-1200 mm, 65-80% and 33-37 °C, respectively.

Experimental animals

A total of 200 Isa Brown (comprising 50 adult male, 50 adult females and 100 mixed-sex growers) and 200 Ilorin-ecotype chickens (comprising 50 adult male, 50 adult females and 100 mixed-sex growers) were used for the estimation of body weight and morphometric traits. Ilorin ecotype chickens were obtained from two retail outlets in Ilorin metropolis while Isa Brown chickens were obtained from the Department of Animal production (University of Ilorin). This helped to check intermingling between the two genotypes.

Data collection

Data collection was carried out in the first half of 2012. Measures of live weight and morphometric traits were taken using a weighing scale and a measuring tape for all evaluated chickens. The measured morphometric traits were comb length, beak length, head length, neck length, body length, wing length, shank length, thigh length, toe length, breast length, and breast breadth. Body weight (kg) and morphometric measurements (cm) were measured as described by Olawunmi *et al.* (2008).

Statistical analysis

Least square mean and standard deviation for each body parameters was splitted on the basis of genotype and sex using the SPSS (2001) package. The same package was used to obtain estimates of correlation among morphometric traits and body weight. The mathematical model for determining the effect of genotype and sex was as follows:

$$Y_{ijk} = \mu + G_i + S_j + GS_{ij} + \ell_{ijk}$$

Where:

μ: the common mean.

Y_{ijk}: the data obtained on the k^{th} bird belonging to genotype i and sex j.

G_i and S_j: fixed effects of genotype and sex, respectively.

GS_{ij}: the interaction effect between genotype i and Sex j.

ℓ_{ijk}: the error term assumed to be normally distributed, assuming N~ (0, 1).

RESULTS AND DISCUSSION

The effects of genotype, sex and genotype × sex interaction for body weight, toe length, breast length and breast breadth of chicken are presented in Table 1. Isa Brown chicken had significantly higher (P<0.05) matured body weight (1.76±0.50 *vs.* 1.36±0.31) and breast length (13.34±2.44 *vs.* 12.84±1.76) than Ilorin ecotype birds. There was no significant difference (P>0.05) in toe length of the two genotypes.

Male chicken had significantly higher (P<0.05) matured body weight, toe length, and breast length than female birds. Interaction between genotype and sex was significant (P<0.05) for body weight and breast length but not for toe length and breast breadth. The effects of genotype, sex, and genotype × sex interaction for comb length, beak length, head length, and neck length are presented in Table 2. Isa Brown chicken had significantly higher (P<0.01) comb length (9.69±6.25 *vs.* 3.89±1.66), neck length (8.39±2.36 *vs.* 6.52±1.00), and head length (7.54±1.32 *vs.* 6.17±0.79) than Ilorin ecotype birds.

Table 1 Effects of sex, genotype, and genotype × sex interaction on body weight toe length, breast length and breast breadth of chicken

Variables			N	Mean±SD	F calculated	P-value
Body weight	Sex	M	100	1.92±0.35[a]	632.685	0.000
		F	100	1.20±0.21[b]		
	Genotype	IB	100	1.76±0.50[a]	190.706	0.000
		IE	100	1.36±0.31[b]		
	Interaction	G × S	400	*	30.591	0.000
Toelength	Sex	M	100	6.18±0.71[a]	63.384	0.000
		F	100	5.33±0.82[b]		
	Genotype	IB	100	5.85±0.89[a]	3.061	0.082
		IE	100	5.67±0.84[a]		
	Interaction	G × S	400	NS	2.269	0.134
Breast length	Sex	M	100	14.05±1.92[a]	64.442	0.000
		F	100	12.12±1.88[b]		
	Genotype	IB	100	13.34±2.44[a]	4.351	0.038
		IE	100	12.84±1.76[b]		
	Interaction	G × S	400	*	47.689	0.000
Breast breadth	Sex	M	100	5.86±1.14[a]	3.169	0.077
		F	100	5.62±1.07[a]		
	Genotype	IB	100	5.21±1.04[a]	58.836	0.000
		IE	100	6.27±0.91[b]		
	Interaction	G × S	400	NS	0.588	0.444

The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SD: standard deviation; * (P<0.05) and NS: no significant.
N: number of birds per group; M: male birds; F: female birds; IB: Isa Brown chicken; IE: Ilorin ecotype chicken and G × X: genotype × sex.

Table 2 Effects of sex, genotype, and genotype×sex interaction on comb length, beak length, head length and neck length of chicken

Variables			N	Mean±SD	F calculated	P-value
Comb length	Sex	M	100	10.47±5.50[a]	1328.00	0.000
		F	100	3.11±1.09[b]		
	Genotype	IB	100	9.69±6.25[a]	825.79	0.000
		IE	100	3.89±1.66[b]		
	Interaction	G × S	400	*	504.13	0.000
Beak length	Sex	M	100	1.30±1.36[a]	566.97	0.000
		F	100	3.16±0.68[b]		
	Genotype	IB	100	1.64±1.72[a]	226.93	0.000
		IE	100	2.82±0.66[b]		
	Interaction	G × S	400	*	330.68	0.000
Head length	Sex	M	100	7.17±1.27[a]	19.23	0.000
		F	100	6.54±1.22[b]		
	Genotype	IB	100	7.54±1.32[a]	91.27	0.000
		IE	100	6.17±0.79[b]		
	Interaction	G × S	400	*	11.62	0.001
Neck length	Sex	M	100	8.08±2.44[a]	51.14	0.000
		F	100	6.82±1.26[b]		
	Genotype	IB	100	8.39±2.36[a]	111.58	0.000
		IE	100	6.52±1.00[b]		
	Interaction	G × S	400	*	168.21	0.000

The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SD: standard deviation; * (P<0.05) and NS: no significant.
N: number of birds per group; M: male birds; F: female birds; IB: Isa Brown chicken; IE: Ilorin ecotype chicken and G × X: genotype × sex.

Male chickens had significantly higher (P<0.01) comb length, head length and neck length than female birds. Interaction between genotype and sex was significant (P<0.01) for comb length, beak length, head length and neck length.

The effects of genotype, sex, and genotype × sex interaction for body length, wing length, shank length, and thigh length of chickens are presented in Table 3. Isa Brown chickens had a significantly higher (P<0.05) body length, wing length and thigh length than Ilorin ecotype birds.

Male chickens had significantly higher (P<0.05) body length and thigh length than female birds.

Interaction between genotype and sex was significant (P<0.05) for body length, wing length, shank length, and thigh length.

Morphometric traits measured in young birds were significantly (P<0.05) correlated with body weight (0.68-0.95) except for wing length in Isa Brown and breast length in Ilorin ecotype chicken (Table 4). Correlation estimates between body weight and morphometric traits in adult Isa Brown birds were generally higher (0.27-0.95) than estimates obtained for Ilorin ecotype chicken (0.02-0.91) (Table 4).

A significant (P<0.05) negative correlation was obtained between body weight and beak length (-0.72) in Isa Brown and between body weight and wing length (-0.35) in Ilorin ecotype chicken. Correlation between morphometric traits and body weight in male birds were generally higher (0.68-0.95) than in female Isa Brown and Ilorin ecotype chickens, except for breast breadth (Table 4). Body length and comb length had higher correlation when compared to the other morphometric measurements in the two genotypes.

The differences between Isa Brown and Ilorin ecotype chicken in morphometric trait measurements were similar to the results of morphometric measurements in birds of different genotypes (Islam and Dutta, 2010; Ogah, 2013).

Table 3 Effects of sex, genotype, and genotype × sex interaction on body length, wing length, shank length and thigh length of chicken

Variables			N	Mean±SD	F calculated	P-value
Body length	Sex	M	100	23.72±1.79[a]	80.68	0.000
		F	100	21.64±2.21[b]		
	Genotype	IB	100	23.83±1.89[a]	97.78	0.000
		IE	100	21.53±2.01[b]		
	Interaction	G × S	400	*	4.80	0.030
Wing length	Sex	M	100	12.31±2.61[a]	10.25	0.002
		F	100	12.89±1.59[b]		
	Genotype	IB	100	14.27±1.58[a]	329.24	0.000
		IE	100	10.94±1.18[b]		
	Interaction	G × S	400	*	23.070	0.000
Shank length	Sex	M	100	5.44±0.79[a]	11.87	0.001
		F	100	5.87±0.99[b]		
	Genotype	IB	100	5.59±0.98[a]	0.74	0.392
		IE	100	5.70±0.87[a]		
	Interaction	G × S	400	*	12.90	0.000
Thigh length	Sex	M	100	12.73±2.49[a]	70.82	0.000
		F	100	11.51±1.19[b]		
	Genotype	IB	100	13.55±1.83[a]	388.48	0.000
		IE	100	10.69±0.97[b]		
	Interaction	G × S	400	*	135.78	0.000

The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SD: standard deviation; * (P<0.05) and NS: no significant.
N: number of birds per group; M: male birds; F: female birds; IB: Isa Brown chicken; IE: Ilorin ecotype chicken and G × X: genotype × sex.

Table 4 Estimates of Pearson correlation between body weight and morphometric traits in Isa Brown and Ilorin ecotype chickens of different sex and age

	Grower		Adult		Sex	
Trait	IB	IE	IB	IE	M	F
Comb length	0.82*	0.95*	0.95*	0.91*	0.90*	0.87*
Beak length	0.68*	0.57*	-0.78*	-0.02	-0.71*	0.65*
Head length	0.75*	0.87*	0.73*	0.36*	0.88*	0.84*
Neck length	0.74*	0.75*	0.88*	-0.24*	0.92*	0.35*
Body length	0.80*	0.89*	0.56*	0.80*	0.69*	0.65*
Wing length	0.03	0.92*	0.39*	-0.35*	0.86*	0.76*
Shank length	0.87*	0.83*	0.27*	-0.26*	0.49*	0.27*
Thigh length	0.69*	0.91*	0.94*	0.05	0.89*	0.87*
Toe length	0.75*	0.89*	0.59*	0.60*	0.43*	0.28*
Breast length	0.70*	0.05	0.88*	0.34*	0.69*	0.51*
Breast breadth	0.79*	0.84*	0.42*	0.36*	-0.00	0.11

* (P<0.05).

Ogah (2013) observed a genotype associated differences for body weight, body length, thigh-length, keel length, and body-width between naked-neck and frizzle feathered chickens in which the highest values were recorded for the latter in most of the traits. The body weights of adult Isa Brown and Ilorin ecotype chickens in this study were higher than those reported by Olawunmi *et al.* (2008) for Yoruba ecotype chicken. According to the same authors Yoruba chickens had lower mature weight when compared to Fulani ecotype chicken.The large standard deviations associated with the body weights of Isa Brown and Ilorin ecotype chicken suggest substantial variations within the two genotypes. However, further studies on heritability of body weight and morphometric traits are needed to determine the best method to achieve genetic improvement in the two genotypes. The higher body weight and morphometric measurements in male chickens compare to the females in this study agrees with the report of Olawunmi *et al.* (2008) who observed a significantly higher values for comb length, wing length, shank length, and breast breadth in male Yoruba and Fulani ecotype chickens. The closeness in measurement of shank length between Ilorin ecotype and Isa Brown (a laying strain) indicated a good potential for egg production in the indigenous Ilorin ecotype chicken.The use of beak length in instituting differentiation between different populations is not traditionally strong because of routine debeaking among commercial birds. This may account for the smaller beak length of the commercial (Isa Brown) birds in this study.

The significant correlations between body weight and morphometric measurements suggests that body weight in Isa Brown and Ilorin ecotype chicken could be reliably predicted using morphometric traits such as head length, neck length, body length, and breast breadth. Breast breadth has been reported to be a good indicator of meatiness in most poultry species (Adebambo *et al.* 1996) therefore the observed similarity in breast breadth of the two genotypes suggests equal merit in meatiness. The smaller body weight and morphometric measurements of Ilorin ecotype chickens appears to have aided in this ecotype fitness to the tropical environment and to scavenging rearing conditions. Decrease of body weight and size are parts of birds' adaptation for survival under the tropical scanvenging rearing conditions (Yeasmin and Howlider, 1998; Broady *et al.* 1984). Several authors (Horst, 1998; Abdul-Rahman, 1989; Badubi *et al.* 2006) had stated that the environment is crucial in the phenotypic appearance of individual chickens in the tropics. The positive correlation observed between body weight and morphometric traits in this study agrees with earlier studies on chicken (Ibe and Nwakalor, 1987; Adeniji and Ayorinde, 1990), pigeon (Hassan and Adamu, 1997), duck (Raji *et al.* 2009), and quail (Ojo *et al.* 2013).

The observed relationship between body weight and body length in the present study agrees with the submissions of Ojo *et al.* (2013) that body length is one of the best predictors of body weight.

CONCLUSION

The present study showed that both Isa Brown and Ilorin ecotype chickens could be adequately characterised using morphometric indices. The study further revealed that morphometric indices like body length and comb length could be adequately used to predict the body weight of birds in the two genotypes. However, the negative correlation obtained between body weight and wing length in Ilorin ecotype chicken require further investigation to determine its basis for chicken adaptation.

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