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Relationship Between Body Weight and Growth Traits of Crossbred Fulani Ecotype Chicken in Derived Savannah Zone of Nigeria.

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Abstract

This study was conducted to determine the genetic relationship between body weight and growth trait of crossbred Fulani ecotype chicken at different ages. The data used in this study were obtained from hybrid of a cross between Harco Black (Cock) and Fulani ecotype chicken (Hen) raised for twelve weeks. Growth traits measured were body weight (BW), shank length (SL), wing length (WL), body length (BL), beak length (BKL), keel length (KL), neck length (NL) and body girth (BG). The correlation procedure of SAS was used to generate Pearson's correlation coefficient between body weight and other measured traits. Genetic correlation between body weight and linear body measurement were generally positive and significant ($P<0.05$) at all ages. The values ranged from 0.13 - 0.99 at week 2, 0.27 - 0.98 at week 4, 0.3 - 0.98 at week 6, 0.23 - 0.98 at week 8, 0.3 - 0.98 at week 10 and 0.24 - 0.99 at week 12. Highly significant correlation coefficients were obtained between BW and BG, BW and BL, BW and WL, BW and KL, BW and BKL at all ages. In conclusion, meaningful improvements can be made through selection of pair of traits that were positive and significant.

Keywords: Correlations, body weight, Body measurement, chicken.

Introduction

Poultry keeping is of great significance to Nigerian households since more than 68% of farmers raise chickens, ducks and pigeons under semi intensive system (Asafa and Ayodele, 1997). Though poultry industry has experienced tremendous growth in recent years, the growth has been with exotic chickens only. There is need to improve the productivity of Nigerian local chickens that are up till now, characterized by small body weight, small egg size and few number eggs (Nwagu and Nwosu, 1994; Adebambo *et al*., 1999). Olawoyin (2006) concluded that genetic improvement of Nigerian indigenous cockerels could help to alleviate the problems of animal protein shortage especially in the rural areas.

Despite their shortcomings, Nigerian indigenous chickens are suitable for the development of layer strain for the tropical environment (Ayorinde, 1986). This is because they possess some inherent advantages which include good fertility and hatchability, better flavor of meat and egg, high degree of adaptability to prevailing conditions, high genetic variance in their performance, hardiness, disease tolerance, ease of rearing and ability to breed naturally

(Adedeji *et al.*, 2008). Reports have shown that indigenous fowls possess great potentials for genetic improvement through breeding programmes (Omeje and Nwosu, 1983; Nwosu, *et al.*, 1985; Ikeobi, *et al.*, 1996; Adebambo, *et al.*, 1999; Peters, 2000; Adedeji, *et al.*, 2008; Adebambo, *et al.*, 2009).

Crossbreeding of the local stock with an exotic commercial stock could take advantage of artificial selection for productivity in the exotic birds and natural selection for hardiness in the indigenous birds (Adebambo *et al.*, 2009). Moreover, birds with better production performance can result from the combining ability of best performing exotic lines and the indigenous chicken. However, the first approach in livestock characterization and improvement, apart from evaluation of its production performance, is the evaluation of body size and conformation (Ibe, 1989). Body weight has been commonly used to measure body size. Assessment of body weight and linear body measurements has been found useful in quantifying body size and shape (Ibe and Ezekwe, 1994). Linear body measurements have also been used to predict live weight in poultry (Monsi, 1992; Gueye, 1998).

Use of coefficients of correlation to examine the relationships between measurements of size and shape in poultry has been reported in Chicken (Ibe, 1989; Yakubu *et al*., 2009). This correlation procedure describes the interrelationships that exist among the body traits. The knowledge of genetic parameters is essential for any genetic improvement program. Information regarding correlation coefficient estimates is very useful in animal breeding as a means to predict potential response to, or progress from, selection. Since production traits are interrelated, considerations of such relationships are very relevant to selection for improvement. There are scanty studies on correlation relationships between body weight and growth traits of poultry in derived savanna zone of Nigeria

This study was therefore carried out to investigate and establish the genetic relationship between body weights and body parameters of crossbred Fulani ecotype chicken at different ages, with the objective of providing empirical values on association between body weight and growth traits.

Materials and Methods

This research work was carried out at the Poultry Unit of the Teaching and Research Farm, Ladoke Akintola University of Technology Ogbomoso, Oyo State Nigeria. This area is located at South-West area of Nigeria and lies on longitude 4^0, 5^1 East of Greenwich meridian and latitude 8^0, 7^1 of the North Equator. It is 300m to 600m above sea level with an average temperature of 27^0C, 1247 mm annual rainfall and 80% relative humidity (Oladuntan, 1999).

The experimental birds consisting of 4 Harco black (cocks) and 40 Fulani ecotype chicken (hen) were used for this research. The birds were wing-tagged individually for identification purposes and were exposed to natural day light. Each dam was at the same time inseminated with 0.1ml of fresh undiluted semen twice a week from same sire throughout the period of insemination. Fertile eggs from inseminated birds were collected on a daily basis and were pedigreed along sire and dams lines. Only eggs with good shape and unbroken shells were separated and stored at room temperature and relative humidity of 70-80% before they were set in a kerosene fuelled table type incubator.

The eggs were set along sire line at temperature of 38 – 39°C and at humidity of 55 – 56% for the first eighteen days. The temperature was increased from 39°C to 40°C and humidity of 70 – 75% from nineteenth day to hatching time.

Immediately after hatching, the chicks were tagged for easy identification and their weights were obtained and recorded using a sensitive scale (Hana, big boss) according to their genotype. All the birds were raised under the same intensive management system where routine and occasional practices were duly observed throughout the period. All the chicks were maintained up to 12 weeks of age. The chicks were fed *ad-libitum* on a commercial broiler starter diet from zero to four weeks of age after which they were fed on grower's ration. Parameters monitored were body weight (BW), shank length (SL), wing length (WL), body length (BL), breast girth (BG), keel length (KL), beak length (BKL), and neck length (NL). The parameters were measured according to the methods described by Ige (2011).

Statistical Analysis and Model

The data collected were analyzed with Pearson's coefficients of correlation (r) and it was achieved using SAS software.

The operational model for Pearson correlation is as follows;

$$r = \frac{\sum X_i Y_i}{\sqrt{\sum X^2 i \sum Y^2 i}}$$

Where r = Pearson's product moment correlation coefficient

Xi = the first random variable of the i^th LBM or Body weight

Yi = the second random variable of the i^th LBM or Body weight

Results

Tables 1 to 6 show the genetic correlations of body weight and growth traits at weeks 2, 4, 6, 8, 10 and 12. All coefficients of correlation for all growth traits studied were positive and significantly correlated (P< 0.05) with body weight. Genetic correlation of body weight and growth traits at week 2 are presented on Table 1, with values ranging from 0.13 - 0.99. Very strong and positive correlation existed between bodyweight and body girth (0.99), body weight and wing length (0.83), body weight and shank length (0.70), body weight and body length (0.78). Similarly, within growth traits, very strong and positive correlation were observed between wing length and beak length (0.98), wing length and neck length (0.94), body length and beak length (0.92), while low but positive correlation coefficients (P>0.05) were observed between body weight and kneel length (0.44), wing length and kneel length (0.13), beak length and kneel length (0.34), body length and kneel length (0.44), shank length and kneel length (0.33).

Table 2 shows genetic correlation coefficients at week 4, in which the values were positive and significant (P<0.05) between body weight and body length (0.73), bodyweight and beak length (0.77). Within growth traits, highly significant correlations were observed between shank length and body girth (0.84), wing length and kneel length (0.99), wing length and body length (0.97), body length and neck length (0.96), body length and kneel length (0.92), beak length and neck length (0.96) and kneel length and body girth (0.70).

Genetic correlation coefficients of body weight and growth traits at week 4 are depicted in Table 3. The values ranged from 0.02 - 0.99, with very strong and positive correlation (P<0.05) observed between body weight and wing length (0.94), and between body weight and body girth (0.91). Within growth traits, highly positive correlation coefficients were recorded between shank length and body length (0.91), shank length and kneel length (0.97), shank length and body girth (0.76), wing length and beak length (0.94), wing length and neck length (0.98), body length and kneel length (0.95), body length and neck length (0.98), body length and body girth (0.96), kneel length and neck length (0.97), kneel length and body girth (0.83), neck length and body girth (0.95). However very low but positive coefficient of correlation (P>0.05) were observed between body weight and neck length (0.22), shank length and beak length (0.14), beak length and kneel length (0.02). The correlation coefficient between body weight and growth traits for week 8 are presented in Table 4. The values obtained were positive and high and ranged from 0.13 - 0.99. Highly significant correlations (P<0.05) were observed between body weight and kneel length (0.98), body weight and wing length (0.94), bodyweight and body girth (0.84), shank length and wing length (0.99), shank length and kneel length (0.97), shank length and body girth (0.99), wing length and neck length (0.96), wing length and body girth (0.98), beak length and neck length (0.88), beak length and body girth (0.83), kneel length and neck length (0.90), kneel length and body girth (0.85), and neck length and body girth (0.99).

Table 5 shows coefficients of correlation between body weight and growth traits at week 10. The values were high and positive and ranged from 0.30 - 0.98. Highly significant values were obtained between body weight and kneel length (0.99), body weight and neck length (0.97), body weight and body girth (0.92), body weight and wing length (0.99), shank length and kneel length (0.91), shank length and kneel length (0.96), shank length and body girth (0.91), wing length and beak length (0.99), wing length and neck length (0.95), wing length and kneel length (0.93), beak length and kneel length (0.99), beak length and neck length (0.98), beak length and body girth (0.93), kneel length and neck length (0.99), kneel length and body girth (0.97), neck length and body girth (0.98). Table 6 presents the genetic correlations among body weight and growth traits at week 12. The values were generally low (P>0.05). Highest value was obtained between neck length and body girth (0.89) while the lowest value was obtained between shank length and kneel length (0.10).

Table 1: Genetic correlation among body weight and linear body measurements of crosses of Harco Black (HB) and Fulani ecotype chicken (FE) at week 2

	BW	SL	WL	BL	BKL	KL	NL	BG
BW	-	***0.70	***0.83	***0.78	**0.70	^{NS}0.44	*0.60	***0.99
SL	-	-	***0.98	**0.67	***0.91	^{NS}0.34	***0.33	***0.78
WL	-	-	-	*0.54	***0.98	^{NS}0.13	***0.94	**0.63
BL	-	-	-	-	***0.92	***0.75	^{NS}0.44	**0.56
BKL	-	-	-	-	-	^{NS}0.34	***0.99	***0.79
KL	-	-	-	-	-	-	^{NS}0.45	***0.85
NL	-	-	-	-	-	-	-	***0.86
BG	-	-	-	-	-	-	-	

Key: BW: Body weight, SL: Shank length, WL: Wing length, BL: Body length, BKL: Beak length, KL: Keel length, NL: Neck length, BG: Body girth
****significant at P<0.05, **significant at P<0.01, ***significant at P<0.001***

Table 2: Genetic correlation among body weight and linear body measurements of crosses of Harco Black (HB) and Fulani ecotype chicken (FE) at week 4

	BW	SL	WL	BL	BKL	KL	NL	BG
BW	-	***0.89	**0.68	***0.77	***0.74	**0.64	*0.50	***0.99
SL	-	-	^{NS}0.266	^{NS}0.34	^{NS}0.35	^{NS}0.22	*0.59	***0.84
WL	-	-	-	***0.97	***0.96	***0.99	***0.97	***0.72
BL	-	-	-	-	***0.85	***0.92	***0.95	***0.73
BKL	-	-	-	-	-	***0.96	***0.95	***0.78
KL	-	-	-	-	-	-	***0.99	**0.70
NL	-	-	-	-	-	-	-	**0.56
BG	-	-	-	-	-	-	-	-

Key: BW: Body weight, SL: Shank length, WL: Wing length, BL: Body length, BKL: Beak length, KL: Keel length, NL: Neck length, BG: Body girth
****significant at P<0.05, **significant at P<0.01, ***significant at P<0.001***

Table 3: Genetic correlation among body weight and linear body measurements of crosses of Harco Black (HB) and Fulani ecotype chicken (FE) at week 6

	BW	SL	WL	BL	BKL	KL	NL	BG
BW	-	*0.54	***0.99	***0.89	***0.90	^{NS}0.46	^{NS}0.22	***0.91
SL	-	-	^{NS}0.44	***0.91	^{NS}0.14	***0.99	***0.94	***0.78
WL	-	-	-	^{NS}0.31	***0.94	^{NS}0.35	***0.98	^{NS}0.229
BL	-	-	-	-	^{NS}0.30	***0.95	***0.98	***0.97
BKL	-	-	-	-	-	^{NS}0.02	^{NS}0.24	*0.54
KL	-	-	-	-	-	-	***0.97	***0.83
NL	-	-	-	-	-	-	-	***0.96
BG	-	-	-	-	-	-	-	-

Key: BW: Body weight, SL: Shank length, WL: Wing length, BL: Body length, BKL: Beak length, KL: Keel length, NL: Neck length, BG: Body girth
****significant at P<0.05, **significant at P<0.01, ***significant at P<0.001***

Table 4: Genetic correlation among body weight and linear body measurements of crosses of Harco Black (HB) and Fulani ecotype chicken (FE) at week 8

	BW	SL	WL	BL	BKL	KL	NL	BG
BW	-	***0.90	***0.94	*0.55	^{NS}0.42	***0.98	***0.78	***0.85
SL	-	-	***0.99	^{NS}0.13	***0.77	***0.97	***0.98	***0.99
WL	-	-	-	^{NS}0.24	***0.71	***0.99	***0.96	***0.98
BL	-	-	-	-	*0.53	^{NS}0.38	**0.65	^{NS}0.3
BKL	-	-	-	-	-	*0.58	***0.88	***0.83
KL	-	-	-	-	-	-	***0.90	***0.85
NL	-	-	-	-	-	-	-	***0.99
BG	-	-	-	-	-	-	-	-

Key: BW: Body weight, SL: Shank length, WL: Wing length, BL: Body length, BKL: Beak length, KL: Keel length, NL: Neck length, BG: Body girth
****significant at P<0.05, **significant at P<0.01, ***significant at P<0.001***

Table 5: Genetic correlation among body weight and linear body measurements of crosses of Harco Black (HB) and Fulani ecotype chicken (FE) at week 10

	BW	**SL**	**WL**	**BL**	**BKL**	**KL**	**NL**	**BG**
BW	-	***0.83	***0.99	^{NS}0.43	***0.80	***0.99	***0.98	***0.92
SL	-	-	***0.74	***0.86	***0.84	***0.96	***0.91	***0.91
WL	-	-	-	^{NS}0.30	***0.96	***0.95	***0.93	***0.85
BL	-	-	-	-	^{NS}0.46	*0.57	**0.62	***0.75
BKL	-	-	-	-	-	***0.99	***0.98	***0.93
KL	-	-	-	-	-	-	***0.99	***0.97
NL	-	-	-	-	-	-	-	***0.98
BG	-	-	-	-	-	-	-	-

Key: BW: Body weight, SL: Shank length, WL: Wing length, BL: Body length, BKL: Beak length, KL: Keel length, NL: Neck length, BG: Body girth
****significant at P<0.05, **significant at P<0.01, ***significant at P<0.001***

Table 6: Genetic correlation among body weight and linear body measurements of crosses of Harco Black (HB) and Fulani ecotype chicken (FE) at week 12

	BW	**SL**	**WL**	**BL**	**BKL**	**KL**	**NL**	**BG**
BW	-	**0.62	***0.82	^{NS}0.14	***0.93	***0.84	^{NS}0.23	^{NS}0.33
SL	-	-	*0.52	***0.87	^{NS}0.28	^{NS}0.01	***0.91	***0.95
WL	-	-	-	^{NS}0.45	***0.77	***0.99	^{NS}0.37	^{NS}0.28
BL	-	-	-	-	^{NS}0.24	^{NS}0.41	***0.99	***0.98
BKL	-	-	-	-	-	***0.98	^{NS}0.15	*0.52
KL	-	-	-	-	-	-	^{NS}0.33	^{NS}0.23
NL	-	-	-	-	-	-	-	^{NS}0.98
BG	-	-	-	-	-	-	-	-

Key: BW: Body weight, SL: Shank length, WL: Wing length, BL: Body length, BKL: Beak length, KL: Keel length, NL: Neck length, BG: Body girth
****significant at P<0.05, **significant at P<0.01, ***significant at P<0.001***

Discussion

Correlation coefficients indicate the strength of a linear relationship between two traits and thus provide useful information about the traits involved for the purpose of breeding and improvement plan. The coefficients of correlation from this study varied from strong to low, positive and significant at most of the ages considered. Values obtained for coefficients of correlation at week 2 agreed with literature values reported by Okon *et al.* (1996) where moderate to high and positive ranges of genetic correlations between body weight and body measurements were observed at this age in their study. This shows that favourable relationships exist among traits that had higher correlation coefficients, It further explains that such traits could be collectively included in the selection index to achieve positive genetic progress (Ojo, 2010)

Correlation coefficient was consistently high between body weight and body girth throughout the ages considered in this study, except at week 12 where low but positive correlation coefficient was recorded between the two traits. Lilja (1983) reported a high value of 0.93 between the two traits. This shows that body girth is a reliable criteria to evaluate body weight of chicken and other livestock. Szabone (1997) shared the same opinion. The low value obtained at older age (12 weeks) in this study indicates that no reasonable genetic progress can be made as the chickens grow older.

High genetic correlation coefficient was also found between body weight and body length at weeks 2, 4 and 8 (0.78 - 0.89). Similar result was obtained by Raji *et al.* (2009) in matured local Muscovy ducks. Okoro and Ogunde (2006) equally recorded high and positive coefficients of correlation between body weight and other growth traits and it was concluded that these traits are good indicators of bodyweight. Okpeku (2003) reported that body weight was positively correlated with body length and chest circumference among local chicken in Edo state.

In conclusion, the high, positive and significant correlations between body weight and linear body measurements indicate that these easily measured parts can be used as criteria for selection of body weight in poultry. Selection for any of, or a combination of traits of economic importance can be done at 2, 4, 6, 8 and 10 weeks, at which time high, positive and consistent significant correlations between the desired traits.

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