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ORIGINAL RESEARCH ARTICLE

Correlation between bodyweight and morphometric traits in early and late feathering Fulani and Yoruba ecotype chickens

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ABSTRACT
Knowledge of the relationship between body weight and morphometric traits is important in planning practical breeding programme for maximum economic returns. The present study was conducted to evaluate the correlation between bodyweight and morphometric traits in Fulani and Yoruba ecotype chickens segregating at the sex-linked feathering locus. Data was collected on the live body weight and 8 morphometric traits of early and late feathering Fulani and Yoruba ecotype chicks. Weekly data on body weight and morphometric traits (Tail Length, TL; Wing Length, WL; Shank Length, SL; Body Length, BL; Drumstick Length, DL; Keel Length, KL; Body Girth, BG; and Shank Diameter, SD) were tested for significance between genotypes. Data were further subjected to correlation analysis. Chicks belonging to Fulani-ecotype were significantly higher ($p<0.05$) than Yoruba ecotype in live body weight and most morphometric trait. Generally, the differences between weekly live weight and morphometric traits of early and late feathering chicks of the same ecotype were not significant ($p>0.05$). The Coefficients of phenotypic correlation between body weight and morphometric traits varied with feather segregating type, age of chicks and the traits being correlated. Generally, TL, BG and KL were significantly ($p<0.05$, $p<0.01$) correlated with body weight in 1 to 7 weeks old fast and slow feathering Fulani ecotype chicks. Further investigation was suggested to unravel the basis for the poor correlation between morphometric traits and body weight of fast feathering Yoruba ecotype chicks.

Key words: Body weight, Fast Feathering, Local chicken, Morphometric, Slow feathering

INTRODUCTION
Knowledge of the relationship between body weight and morphometric traits are important in planning practical breeding programme for maximum economic returns. Body size and body weight of chicken are not only important for economic reasons, they are important traits that underlay the adaptation of the birds to the production environment (Abdul–Rahman, 1989). Chineke (2005) stated that body weight and morphometric measurement are of significant importance in the life time performance of livestock and that the relationship between the two could be of benefit for local farmers in rural areas where there is poor accessibility to weighing scales. Estimates of correlation between body weight and body size and the use of morphometric measurements to predict body weight of chicken are common in literatures (e.g. Badubi *et al.,*2006; Bogale, 2008; Akanno*et al*. 2007; Raji *et al*., 2010; Yahaya *et al.*, 2012). However, the present study is important because there is no known work on the growth performance and correlation between body weight and morphometric traits in early and late feathering local chickens. The aim of the present study was to determine the correlation between body weight and morphometric traits of early and late feathering Fulani and Yoruba ecotype chickens.

MATERIALS AND METHODS
Location of the study
The experiment was carried out at the Department of Animal Production, University of Ilorin. Ilorin

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

Experimental birds and management practices

The 44 early and late feathering birds used as parent lines were developed in a previous chicken breeding project using the length of primary and covet feather in newly hatched chicks. The breeding plan in this study involves reciprocal mating between early feathering and late feathering Yoruba and Fulani ecotype chicken (Table 1). The breeding cocks and hens were housed separately in the battery cage. Semen collection was done using sterilized semen collection apparatus. Each of the cocks from which semen was collected was first massaged at the back, close to the tail. This was accompanied by a slight finger massage at the base of the tail. The thumb was then used to press the bird's abdomen directly beneath its vent. Semen released from Ductus differential was gently squeezed from the swollen papillae at the base of the phallus into the collecting tube. Freshly collected semen was aspirated into a syringe. The syringe containing semen was inserted into the inverted oviduct deep enough to deposit sperm close to the sperm storage gland in the vaginal. A total of 387 clean eggs were collected for incubation in electric Table incubator. The eggs were clearly labelled before setting them in the incubator. Candling was carried out on the 7th and 18th day of incubation, for the identification of fertile eggs and dead embryos, respectively. A total of 168 hatched chicks were weighed, tagged and identified as either early or late feathering by comparing the length of the primary and the covert feathers within the first three days post-hatched. A chick is classified as fast feathering if the coverts were shorter than the primary wing feathers, while chicks that were slow feathering have short primary feathers and coverts that were as long as the primary feathers. The fast and slow feathering Fulani and Yoruba ecotype chicks were arranged in a Completely Randomized Design to evaluate the effect of genotype on body weight performance. The chicks were raised on littered floor for 8 weeks. Birds were fed *ad-libitum* on a commercial broiler starter diet from zero to four weeks of age after which they were fed on growers' ration. Water was supplied *ad-libitum* to all the birds. Other management practices such as routine medication and sanitation were followed as recommended for chicken by NRC (1994).

Data collection and Statistical analysis

Live weight of chicks was measured using a sensitive scale (Hana, big boss) and Top loader scale. Body length (BL) was measured as the distance from the base of the comb to the base of the tail around the uropigial gland. Shank length (SL) was taken as the distance from the hock joint to the tarso-metarsus igit joint. Thigh length (TL) was the distance between the hock joint and the pelvic joint. Keel length (KL) was taken as the length of the cartilaginous keel bone or metasternum. Breast Girth (BG) was the length of the region of the largest breast expansion of ventrally positioned bird. Wing length (WL) was taken as the distance from the humorus – coracoids junction to the tip of the digit when the wing of the bird was stretched. Shank thickness (ST) was taken as the diameter of the tarso–metarsus junction below the spur. ST was measured with the aid of vernier calliper in mm.

Table 1: Breeding plan and the number of early and late feathering Chicken produced

Ecotype	Cross (♂x ♀)	No. of pairs	No. of progeny
Fulani	SF x FF	1:10	60
	FF x SF	1:10	40
Yoruba	FY x SY	1:10	38
	SY x FY	1:10	30
Total	-	4:40	168

FF, SF, FY, SY represent Fast feathering Fulani, Slow feathering Fulani, Fast feathering Yoruba, Slow feathering Yoruba, respectively

Table 2: Weekly body weight of early and late feathering Fulani and Yoruba ecotype chickens

Weeks	FF	SF	FY	SY	SEM (±)
0 (Hatch)	32.57[a]	29.72[a]	23.06[a]	24.68[b]	0.91
1	50.16[c]	43.08[b]	31.29[a]	33.44[a]	1.85
2	88.90[b]	85.80[b]	58.10[a]	62.59[a]	3.10
3	125.47[b]	109.10[b]	78.12[a]	101.86[b]	5.09
4	152.53[b]	139.95[b]	117.38[a]	115.00[a]	4.89
5	203.16[a]	195.50[a]	137.14[a]	168.57[a]	9.62
6	234.21[b]	234.75[b]	161.14[a]	205.71[b]	9.74
7	264.74[b]	268.50[b]	188.57[a]	225.71[a]	10.67
8	290.50[a]	292.11[a]	232.86[a]	257.14[a]	9.19

FF, SF, FY, SY represent Fast feathering Fulani, Slow feathering Fulani, Fast feathering Yoruba, Slow feathering Yoruba, respectively. TL, WL, SL, BL, DL, KL, BG, SD represent Tail Length, Wing Length, Shank Length, Body Length,; Drumstick Length, Keel Length, Body Girth, and Shank Diameter, respectively. Mean in the same row carrying the same superscript are not significantly different ($p>0.05$).

Data obtained from body weight and morphometric measurements were subjected to One-way Analysis of Variance using the General Linear Model. Regression analysis was also done using SPSS software (version 17, IBM SPSS, 2008).

RESULTS

The weekly body weights of early and late feathering Fulani and Yoruba ecotype chicks are shown in Table 2. There were no significant differences ($p>0.05$) in the weekly measurements of morphometric traits between early and late feathering Fulani ecotype chickens from 2 to 8 weeks of age. The differences between the weekly body weights of early and late feathering Yoruba ecotype chicken were generally not significant ($p>0.05$). However, early and late feathering Fulani ecotype chicks were generally heavier ($p<0.05$) in weekly body weight than early and late feathering Yoruba ecotype. The results of weekly measurements of morphometric traits in early and late feathering Fulani and Yoruba ecotype chickens are presented in Tables 3a, b. There were no significant differences ($p>0.05$) in most of the weekly measurements of morphometric traits between early and late feathering birds of the same ecotype. However, early and late feathering Fulani chicks had higher absolute values ($p<0.05$) in most of the 8 morphometric traits considered than early feathering and late feathering Yoruba ecotype chicken. Most of the estimates of correlation between body weight and morphometric traits of early and late feathering Fulani ecotype chickens were significant ($p<0.05$, Table 4). The correlations between body weight and morphometric traits were generally higher in fast feathering Fulani chicken than in fast feathering Yoruba ecotype chicken. The slow feathering Fulani ecotype had higher correlation between body weight and morphometric traits than fast feathering Yoruba ecotype chicken throughout the eight weeks of study. Generally, the estimates of correlation between body weight and morphometric traits in 1 week old birds were higher than estimates taken in 2 to 8 weeks old bird.TL, BG and KL were significantly ($p<0.05$, $p<0.01$) correlated with body weight in 1 to 7 weeks old fast and slow feathering Fulani ecotype chicks, except in 6 weeks old slow feathering Fulani ecotype chicks. DL and BG were significantly correlated ($p<0.05$, $p<0.01$) with body weight at weeks 1, 3, and 5 in slow feathering Yoruba ecotype chicken. The TL and WL of 1 week old chicks were significantly ($p<0.05$) correlated with body weight in fast feathering Yoruba ecotype chicks. Other estimates of correlation between morphometric traits and body weight of fast feathering Yoruba ecotype chicks were not significant.

DISCUSSION

The higher body weight of early and late feathering Fulani ecotype chicken in the present report agrees with Atteh *et al.* (1990) that Fulani ecotype chicken is superior in growth performance than other Nigerian ecotypes. A study conducted by Olawunmi *et al.* (2008) showed that Fulani-ecotype chicken that was raised under traditional

management had higher adult body weight than Yoruba ecotype.

Table 3a: Weekly morphometric traits of chicks produced from crosses between early and late feathering indigenous chickens

	Weeks	FF	SF	FY	SY	SEM (±)
TL	1	2.63^{c}	2.45^{b}	2.19^{a}	2.19^{a}	0.07
	2	3.47^{b}	3.43^{b}	2.62^{a}	2.94^{a}	0.09
	3	4.32^{b}	4.10^{b}	3.38^{a}	4.14^{b}	0.11
	4	4.84^{a}	4.64^{a}	4.12^{a}	4.14^{a}	0.10
	5	5.00^{b}	5.02^{b}	4.07^{a}	4.57^{b}	0.11
	6	5.39^{b}	5.58^{b}	4.64^{a}	5.00^{b}	0.11
	7	5.80^{a}	5.84^{a}	5.43^{a}	5.50^{a}	0.14
	8	6.58^{b}	6.50^{b}	6.07^{a}	6.21^{a}	0.07
WL	1	6.31^{a}	5.84^{a}	5.25^{a}	5.21^{a}	0.20
	2	8.53^{c}	8.10^{c}	7.12^{b}	7.00^{a}	0.18
	3	10.16^{b}	9.81^{b}	8.50^{a}	9.14^{b}	0.18
	4	11.32^{c}	11.00^{c}	9.75^{a}	10.00^{b}	0.18
	5	12.68^{b}	12.80^{b}	11.71^{a}	11.57^{a}	0.17
	6	13.84^{b}	14.45^{b}	13.43^{b}	13.00^{a}	0.17
	7	14.79^{b}	15.10^{b}	14.43^{a}	13.57^{a}	0.19
	8	16.32^{b}	16.10^{b}	15.71^{b}	14.86^{a}	0.20
SL	1	2.35^{b}	2.12^{a}	2.00^{a}	2.12^{a}	0.05
	2	2.82^{b}	2.76^{b}	2.06^{a}	2.19^{a}	0.11
	3	3.89^{b}	3.57^{a}	3.12^{a}	3.21^{a}	0.08
	4	4.21^{b}	4.00^{a}	3.50^{a}	3.64^{b}	0.09
	5	4.08^{b}	4.18^{b}	3.57^{a}	4.00^{a}	0.08
	6	5.08^{a}	5.18^{a}	4.71^{a}	4.79^{a}	0.09
	7	5.61^{a}	5.65^{a}	5.50^{a}	5.21^{a}	0.08
	8	6.21^{a}	6.25^{a}	6.14^{a}	6.00^{a}	0.06
BL	1	11.08^{b}	10.81^{b}	9.50^{a}	9.50^{a}	0.17
	2	14.16^{c}	13.67^{a}	12.25^{a}	12.88^{a}	0.20
	3	17.26^{b}	17.05^{b}	14.62^{a}	15.86^{b}	0.28
	4	19.37^{b}	18.81^{b}	17.00^{a}	16.86^{a}	0.27
	5	20.47^{a}	20.75^{a}	19.00^{a}	19.86^{a}	0.28
	6	22.05^{b}	22.55^{b}	20.29^{a}	21.43^{b}	0.30
	7	24.00^{a}	24.35^{a}	22.57^{a}	22.86^{a}	0.38
	8	25.89^{a}	25.95^{a}	23.57^{a}	24.29^{a}	0.38

FF, SF, FY, SY represent Fast feathering Fulani, Slow feathering Fulani, Fast feathering Yoruba, Slow feathering Yoruba, respectively. TL, WL, SL, BL, DL, KL, BG, SD represent Tail Length, Wing Length, Shank Length, Body Length,; Drumstick Length, Keel Length, Body Girth, and Shank Diameter, respectively. Mean in the same row carrying the same superscript are not significantly different ($p>0.05$).

Fayeye *et al.* (2006) stated that heavy chicken ecotype laid bigger eggs compared with light ecotype. Although, there was no significant difference between the weekly body weight of early and late feathering chickens in this study, O'Sullivan *et al.* (1991) observed that the reproductive performance of early feathering females was superior to those of late feathering breeder hens due to an association between the allele for late feathering and an endogenous viral locus ev21, which encodes for avian leucosis virus. The present results on morphometric measurements generally agree with the earlier submission of Abdul–Rahman (1989) that the Fulani ecotype chicken is superior to the Yoruba-ecotype in body size measurements. The work of Olawunmi *et al.* (2008) showed that the Fulani ecotype chicken were generally higher than Yoruba ecotype in mean live weight, wing and shank length, body, thigh and toe length, beak length and breast. The phenotypic correlations between body weight and morphometric traits of early and late feathering Fulani-ecotype chicken

agree with the report of Badubi *et al.,* (2006) on Botswana local chicken.

Table 3b: Weekly morphometric traits of chicks produced from crosses between early and late feathering indigenous chickens

Weeks		FF	SF	FY	SY	SEM (±)
DL	1	3.45[b]	3.24[b]	2.75[a]	2.69[a]	0.08
	2	4.24[a]	3.68[a]	3.50[a]	3.68[a]	0.11
	3	4.95[b]	4.93[b]	3.81[a]	4.57[b]	0.13
	4	5.79[a]	5.64[a]	5.12[a]	5.43[a]	0.11
	5	6.42[c]	6.26[c]	5.50[a]	5.64[b]	0.12
	6	6.87[a]	6.87[a]	6.21[a]	6.50[a]	0.12
	7	7.21[a]	7.52[a]	6.64[a]	6.94[a]	0.13
	8	7.79[a]	7.98[a]	7.43[a]	7.14[a]	0.15
KL	1	2.32[b]	2.07[b]	1.50[a]	1.75[a]	0.09
	2	3.10[c]	3.29[c]	2.31[a]	2.50[b]	0.12
	3	4.50[b]	4.21[b]	3.25[a]	3.57[b]	0.16
	4	4.82[b]	4.48[b]	3.69[a]	3.71[a]	0.12
	5	4.76[b]	4.68[b]	3.86[a]	4.36[b]	0.12
	6	5.32[a]	5.45[a]	4.71[a]	4.71[a]	0.11
	7	5.86[b]	6.12[b]	5.36[a]	5.67[b]	0.10
	8	6.68[a]	6.82[a]	6.07[a]	6.29[a]	0.12
BG	1	10.53[b]	9.95[b]	8.75[a]	9.00[a]	0.17
	2	11.21[a]	11.67[b]	10.25[b]	10.12[a]	0.23
	3	12.68[b]	12.24[a]	10.25[a]	11.43[b]	0.32
	4	13.58[a]	13.19[a]	11.88[a]	12.71[a]	0.32
	5	14.74[b]	14.35[b]	12.29[a]	13.29[a]	0.32
	6	15.16[b]	15.25[b]	13.57[a]	14.29[a]	0.23
	7	16.53[a]	16.80[a]	15.57[a]	15.86[a]	0.20
	8	17.79[a]	17.85[a]	16.43[a]	16.14[a]	0.25
SD	1	1.19[a]	1.08[a]	1.50[a]	1.07[a]	0.07
	2	1.51[b]	1.39[b]	3.59[b]	1.04[a]	0.36
	3	2.08[b]	1.99[b]	2.44[b]	1.75[a]	0.09
	4	2.12[a]	1.98[a]	2.06[a]	1.89[a]	0.07
	5	2.00[a]	2.05[a]	3.56[a]	1.93[a]	0.26
	6	2.62[a]	2.74[a]	3.01[b]	2.54[a]	0.36
	7	2.91[a]	2.90[a]	3.03[a]	2.79[a]	0.08
	8	3.05[a]	3.16[a]	4.82[a]	3.04[a]	0.27

FF, SF, FY, SY represent Fast feathering Fulani, Slow feathering Fulani, Fast feathering Yoruba, Slow feathering Yoruba, respectively. TL, WL, SL, BL, DL, KL, BG, SD represent Tail Length, Wing Length, Shank Length, Body Length,; Drumstick Length, Keel Length, Body Girth, and Shank Diameter, respectively. Mean in the same row carrying the same superscript are not significantly different ($p>0.05$).

It also agrees with the reports of Bogale (2008) on local Himalaya chickens. Yahaya *et al.* (2012) obtained high correlation coefficients of 0.86- 0.97 and 0.86- 0.97 between body weight and morphometric traits in Hubbard and Arbor Acre broiler strains, respectively. The significantly high correlation between body weights and morphometric traits suggest that body measurements such as TL, BG and KL can be used to construct predictive equation for body weight in the investigated population. Body weight is a measure of the overall body growth or the sum of the increases in sizes of different structural components. Therefore, the non-significant correlation between body weight and all the morphometric traits beyond week 1 in fast feathering Yoruba ecotype chicks require further investigation as this contradicts earlier reports on chicken (Adebambo *et al.*, 1996) and quail birds (Ojo *et al.,* 2013).

CONCLUSION AND RECOMMENDATION

The study confirmed earlier reports on the correlation between body weight and

morphometric traits in chicken genotypes. The poor correlation between morphometric traits and body weight of fast feathering Yoruba ecotype chicks need further investigation.

Table 4: Correlation between Body weight and morphometric traits in crossbred chicks produced from early and late feathering Fulani and Yoruba ecotype chicken

Age	Crosses	TL	WL	SL	BL	DL	KL	BG	SD
1	FF	0.72**	0.80**	0.80**	0.76**	0.73**	0.73**	0.80**	-
	SF	0.75**	0.90**	0.62**	0.61**	0.40	0.83**	0.71**	-
	FY	0.82*	0.85**	-	0.73*	0.17	0.46	0.17	-
	SY	0.74*	0.61	0.67	-0.35	0.75*	0.79*	0.74*	-
2	FF	0.66**	0.73**	0.78**	0.86**	0.75**	0.80**	0.75**	0.58*
	SF	0.71**	0.55**	0.54*	0.47*	0.57**	0.67**	0.74**	-
	FY	-0.20	0.68	0.08	0.34	0.05	-.23	0.30	1.00**
	SY	0.60	0.69	0.67	0.61	0.66	0.77*	0.83*	-0.56
3	FF	0.72**	0.78**	0.90**	0.79**	0.31	0.92**	0.83**	0.57*
	SF	0.80**	0.78**	0.91**	0.83**	0.84**	0.83**	0.78**	0.42
	FY	0.15	0.45	0.67	0.28	0.17	0.28	0.04	0.99**
	SY	0.72	0.58	0.71	0.93**	0.91**	0.70	0.83*	0.34
4	FF	0.49*	0.40	0.06	0.40	0.33	0.56*	0.67**	0.30
	SF	0.50**	0.68**	0.35	0.47*	0.59**	0.59**	0.68**	0.32
	FY	0.03	-0.48	-0.01	-0.58	0.16	-0.16	-0.16	0.98**
	SY	0.42	0.24	0.36	0.52	0.56	0.13	0.61	0.71
5	FF	0.76**	0.25	0.61**	0.85**	0.91**	0.83**	0.84**	0.60**
	SF	0.77**	0.50**	0.72**	0.79**	0.78**	0.80**	0.72**	0.32
	FY	-0.27	-0.76	-0.64	0.09	0.29	0.59	0.59	0.99**
	SY	0.85*	0.44	0.63	0.87*	0.92**	0.40	0.80*	0.91**
6	FF	0.75**	0.37	0.60**	0.61**	0.89**	0.47*	0.58**	0.49*
	SF	0.70**	0.70**	0.69**	0.65**	0.64**	0.22	0.71**	0.29
	FY	0.14	-0.63	-0.37	0.35	-0.07	0.03	-.03	1.00**
	SY	0.77*	0.50	0.67	0.56	0.85*	0.53	0.65	0.52
7	FF	0.52*	0.38	0.84**	0.68**	0.75**	0.47*	0.62**	0.71**
	SF	0.45*	0.69**	0.52*	0.50**	0.91**	0.60**	0.61**	0.13
	FY	-0.37	-0.27	-0.60	0.24	0.09	0.11	0.11	0.99**
	SY	0.43	0.35	0.83*	0.58	0.12**	0.62	0.68	0.96**
8	FF	0.20	0.22	0.54*	0.77**	0.79**	0.68**	0.17	0.44
	SF	0.07	0.41	0.34	0.75**	0.84**	0.66**	0.14	0.10
	FY	-0.15	-0.73	-0.69	0.47	0.68	-0.01	-0.01	1.00**
	SY	0.55	0.27	0.47	0.69	0.73	0.77	0.16	0.35

FF, SF, FY, SY represent Fast feathering Fulani, Slow feathering Fulani, Fast feathering Yoruba, Slow feathering Yoruba, respectively. TL, WL, SL, BL, DL, KL, BG, SD represent Tail Length, Wing Length, Shank Length, Body Length,; Drumstick Length, Keel Length, Body Girth, and Shank Diameter, respectively. *,**Correlation value significant at α levels of 0.05 and 0.01, respectively.

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