Influence of Sex on Relationship Between Morphometric Trait Measurement and Carcass Traits in Broiler Chicken Raised in Humid Tropic

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Abstract: This study was conducted to determine the influence of sex on relationship among carcass traits (carcass weight, breast, drumstick, thigh, wings) and morphometric traits (body weight, breast girth, keel length, shank length, thigh length, wing length and body length) in broiler chicken. And also to evaluate correlated relationship between the morphometric traits and carcass traits. The 60 broiler birds were divided into 2 treatment groups (male and female) each group was replicated thrice with 10 birds per replicate. The birds were rear in deep litter system till the attain 56 days of age, body weight and morphometric traits measurements were taken on the 56 day. The 18 birds (9 from each group) were randomly selected, slaughtered and the carcass traits measured and recorded. The data obtained from these studies were subjected to Pearson correlation analysis. The correlated relationship among most carcass traits and morphometric traits were significantly positive ($p<0.001$) with correlation coefficients ranging from 0.01-0.681 in Males (M) Females (F) and in combination of Males and Female (M+F). The correlation between morphometric traits and carcass traits showed that breast girth and live body weight were positively and significantly ($p<0.001$) correlated with all carcass traits in all the sex groups. The observed significant relationship among the morphometric traits and carcass traits as well as between morphometric traits and carcass traits is an indication of the existence of high level of dependency amongst these traits, thus improvement in any one of these traits would elicit a correlated response in the other traits. More so, the positive and significant correlated relationship between carcass traits and breast girth indicate that breast girth can be used as indirect selection criteria for carcass traits in broiler chickens.

INTRODUCTION

Poultry production is regarded as a means of livelihood and a way of maintaining a level of economic independence. The carcass yield of broiler chicken is of primary concern to the producer and consumer. Thus, poultry farmers have to select broiler strains and sex that will reach market weight at a reasonable age in order to maximize profit.

Information on correlation among the pre and post-slaughter traits is quite important in poultry breeding. This is because knowing which of the pre-slaughter traits affects which of the post-slaughter traits enables the breeder to predicts what kind of products to obtain at the end of breeding programme (Mendes *et al*., 2005; Mendes, 2009; Yakubu and Idahor, 2009). Size and shape of various parts are the major determinants of the overall size and shape of the live bird or carcass. According to Pinto *et al*. (2006), body weight at various ages and carcass characteristics are examples of variables that can indicate the usefulness of chicken for commercial purposes.

Performance testing which forms the basis for breeding work is difficult to conduct in the case of slaughter value parameters (Yakubu and Salako, 2009). Selection towards improving carcass characteristics requires reliable and easy to apply methods for estimating the performance and breeding value of poultry species (Kleczek *et al*., 2007).

Broiler producers are now focusing on carcass yield, especially with the payment of good prices for major components parts such as breast, thigh and drumstick (Shafey, 2003). Some factors are known to affect carcass yield of broilers, these factors include sex, breed, age nutrition and management (Sam, 2006; Sam *et al*., 2016; Havestein *et al*., 2003; Horniakova and Abas, 2009).

Several studies on correlation between carcass traits and linear body measurements showed high positive and significant correlations in poultry (Alphonsus *et al*., 2012; Sam, 2006; Shafey, 2003). The relationship between body weight and carcass traits was earlier studied by Musa *et al*. (2006), they reported significant positive correlation between live weight and carcass weight, breast muscle weight, leg muscle weight, heart weight, liver weight and abdominal fat weight but significant negative correlation between live weight and abdominal fat percentage in Anak breed. Positive genetic correlations of body weight with abdominal fat weight and abdominal fat percentage was also reported by Deeb and Lamont, (2002). In Anakbroiler strain, Ojedapo *et al*. (2008) found significant positive phenotypic correlations between live weight and carcass weight (0.95) shank weight (0.93) and breast muscle weight (0.97) but observed significant negative phenotypic correlation (-0.78) between live weight and carcass weight in Wadi Ross strain. The results obtained by Olawumi (2013) showed that all the carcass traits (dressing weight, eviscerated weight, carcass weight, breast muscle weight, back weight, thigh weight and drumstick weight) measured were good indicators of live weight.

It is necessary to have a good knowledge of the relationship between linear body measurements and carcass traits in broiler chicken to enable the breeder or farmer to predict important carcass parts from linear body measurements. There is paucity of information on the relationship between linear body measurements and carcass traits in Nigeria, most studies conducted have been on relationship between linear body measurements and live body weight. Therefore, the objectives of this study are to establish correlated relationship between linear body measurements and carcass traits and also to establish correlated relationship amongst the carcass traits in broiler chicken.

MATERIALS AND METHODS

Location and climate: The experiment was conducted at poultry unit in the research and experimental unit of Akwa Ibom State University Poultry farm, Obio Akpa Campus in Oruk Anam Local Government Area of Akwa Ibom State. The area lies between Latitude 4°30'N and Longitudes 7°'E and 8°00'E of the Greenwich Meridian. The area is in the humid tropical region, characterized by 2 seasons, rainy and dry which last respectively from March to November and from November to March. Other climatic parameters are heavy rainfall of 2000-2500 mm in the wet season, annual temperature range of 240-300°C and relative humidity range of 75-79% (SLUS-AK, 1989).

Experimental birds: A total of 60 day-old broiler chicks were purchased from a reputable hatchery and were used for the experiment. The birds were raised together for 7 weeks on deep litter pen and were separated into sexes on the eight week using comb color.

Feeding and management: Prior to the arrival of the birds the pens were washed and disinfected. On arrival, the birds were received and put in the brooding house. They were placed on intensive management system in a deep litter system. Antibiotic and vitamins were administered as at when due. Also, vaccines against Gumboro disease, Newcastle disease and coccidiosis were given at specifiedage intervals. Their beddings were made up of dry wood shavings to prevent coccidiosis outbreak and high level of hygiene was maintained throughout the experimental period to ensure unhindered conducive environment for growth and to lower mortality rate.

The chicks were distributed into two groups of 30 birds each (males and females) and each group was replicated thrice and each replicate of 10 birds were housed in a pen measuring 2×2 m commercial feed and water were provided *ad-libitum*. All necessary prophylactic medications and vaccines were also provided. The birds were weighed at the beginning of the experiment and weekly there after live body weight was taken on the last day of (i.e., day 56) of the experiment.

Slaughtering and dissection procedures: At the end of the experiment, 18 birds (9 males and 9 females) which were close to the mean body weight of the total birds in the 2 groups (males and females) were used for carcass analysis. This was done after starving the birds overnight, so as to obtain the true weight and to prevent contamination during slaughtering. The birds were weighed individually to obtain live body weight and linear body measurements were also done using a measuring tape (body length, shank length using length etc.) and results were recorded. The birds were slaughtered by cutting through the jugular vein with a sharp knife. The carcasses were scalded in hot water of about 800°C for a min and the feathers were plucked manually. The carcasses were eviscerated by cutting through the vent and the viscera were removed. Weights were obtained for the whole carcassand major component parts vizly: carcass weight, breast, drumstick, thigh, wing and back.

Data collection

Morphometric traits measurement: Prior to slaughtering linear body measurements were obtained using a measuring tape. Data collected were:

- Body weight: This was taken for individual birds measured in kg using measuring scale
- Breast girth: This was taken as the circumference of the breast around the deepest region of the breast using measuring tape in cm
- Keel length: It was taken as the length of the sternum in cm using measuring tape
- Shank length: was measured as the length of the tars-metatarsus from the hock joint to the metatarsal pad
- Thigh length: This was taken as the distance between hock joint and the pelvic joint using measuring tape in cm
- Wing length: It is the distance between the tip of the phalanges and the coracoids-humorous joint using measuring tape in cm
- Body Length: It was taken as the distance between the tip of the beak and the longest toe within the nail as describe by Yakubu and Salako (2009)

Carcass traits measurement: After slaughtering, data were also collected on carcass characteristics. Data collected were:

- Carcass weight: It was taken as the hot eviscerated carcass without feet, head and abdominal fat using digital weighing scale
- Breast weight: measured as the weight of the breast
- Drum stick: measured as weight of the drumstick
- Thigh: measured as weight of the thigh
- Wing: measured as weight of the wing
- Back: measured as weight of the back

The different parts were weighed using sensitive scale and were expressed in grams.

Statistical analysis: Pearson's correlation coefficients were determined between live body weight, linear body measurements and carcass traits and amongst the carcass traits using SPSS 2007 Version.

RESULTS AND DISCUSSION

Phenotypic correlations amongst morphometric traits in broiler chicken: The phenotypic relationship among live body weight and carcass traits of male, female and combination of Male and Female (M+F) birds are shown in Table 1. In male birds, positive correlations were observed among morphometric traits (r = 0.207-0.681), most of which were significant except correlation between shank length and breast width (r = -0.253) and keel length and shank length (r = -0.038). In females, live body weight and morphometric traits were positively correlated and their correlation coefficient (r) ranged from moderate to high (r = 0.438-0.724 respectively) except for correlation between breast width and breast girth (r = -0.503) breast girth and shank length (r = -0.379) breast girth and thigh length (r = -0.297) breast girth and wing length (r = -0.254) keel length and thigh length (r = -0.044) keel length and body length (r = -0.238) which were negatively correlated. In both sexes (Male+Female combine) live body weight and morphometric trait measurements were positively correlated and their correlation coefficient (r) range from moderate to high (0.267-0.729). These findings are in agreement with the reports by Ige *et al*. (2007) who reported positive phenotypic correlations among live body weight and linear body measurement in local fowls. These results indicate that selection for one of these morphometric parts will lead to improvement in the other.

Phenotypic correlations amongst carcass traits in broiler chicken: Correlation coefficients among carcass traits in Males (M) Females (F) and combination of Male and Female (M+F) are shown in Table 2. In male birds,

Table 1: Phenotypic correlations among morphometric traits in broiler chicken

Traits	LW	BRW	BRG	KL	SL	TL	WL	BL
Male								
LW	1.00	0.345	0.400*	0.376*	0.057	0.465*	0.358	0.459*
BRW		1.000	0.092	0.625**	-0.253	0.376*	-0.043	0.025
BRG			1.000	0.295	0.326	0.2	0.681**	0.590**
KL				1.000	-0.038	0.312	0.087	0.422*
SL					1.000	0.021	0.286	0.207
TL						1.000	0.352	0.266
WL							1.000	0.609**
BL								1.000
Females								
LW	1.00	0.256	0.236	0.438*	0.238	0.024	0.285	0.238
BRW		1.000	-0.503	0.166	0.656**	0.459*	0.724**	0.223
BRG			1.000	0.015	-0.379	-0.297	-0.254	0.152
KL				1.000	0.132	-0.044	0.042	-0.238
SL					1.000	0.283	0.630**	0.227
TL						1.000	0.640**	0.492**
WL							1.000	0.542**
BL								1.000
Males + Females								
LW	1.00	0.577**	0.349**	0.575**	0.346**	0.596**	0.596**	0.526**
BRW		1.000	-0.059	0.583**	0.469**	0.643**	0.604**	0.376**
BRG			1.000	0.218	-0.104	0.059	0.141	0.345**
KL				1.000	0.268*	0.410**	0.351**	0.267**
SL					1.000	0.419**	0.639**	0.372**
TL						1.000	0.729**	0.593**
WL							1.000	0.683**
BL								1.000

**p<0.01; *p<0.05; LW = Live Weight; BRW = Breast Width; BRG = Breast Girth; KL = Keel Length; SL = Shank Length; TL = Thigh Length; WL = Wing Length; BL = Back Length

Table 2: Phenotypic correlations among carcass traits in broiler

Traits	Carcass weight	Drumstick	Breast weight	Thigh weight	Wing weight	Back weight
Male						
Carcass weight	1.00	0.534	0.728*	0.704*	0.808**	0.174
Drum stick		1.000	0.227	0.309	0.794*	0.777*
Breast weight			1.000	0.772*	0.653	-0.351
Thigh weight				1.000	0.595	-0.118
Wing weight					1.000	0.339
Back weight						1.000
Females						
Carcass weight	1.00	0.624	0.692*	0.695*	-0.077	0.555
Drum stick		1.000	0.467	0.594	-0.205	0.475
Breast weight			1.00	0.832**	0.289	0.114
Thigh weight				1.000	-0.015	-0.061
Wing weight					1.000	-0.169
Back weight						1.00
Male+female						
Carcass weight	1.00	0.816**	0.777**	0.820**	0.839**	0.496*
Drum stick		1.000	0.621**	0.869**	0.713**	0.243
Breast weight			1.000	0.673**	0.869**	0.706**
Thigh weight				1.000	0.735**	0.232
Wing weight					1.000	0.510*
Back weight						1.000

**p<0.01; *p<0.05

positive correlation was observed in all the carcass traits except for breast weight and back weight (r = -0.351). In the female group there were positive correlation between carcass weight and breast weight (r = 0.692) carcass weight and thigh weight (r = 0.695) and breast and thigh weight (r = 0.832) but negative correlations were observed between some traits such as carcass weight and wing weight (r = -0.077) drum stick and wing weight (r = -0.205) thigh weight and wing weight (r = -0.015) thigh weight and back weight (r = -0.061) also wing weight and back weight (r = -0.169). In the combined Male and Female (M+F) group there were positive high correlations between all the carcass traits. This therefore, implies that selection for one carcass part will eventually lead to the improvement in other parts and can be used to predict the other. Similar result had earlier been reported

Table 3: Phenotypic correlation between non-invasive body measurements and carcass yield traits in broiler chicken

Traits	CARSWT	BRSWT	DRMSTK	THGWT	WGWT
Male					
LW	0.029	0.211	0.536	0.023	0.411
BRW	-0.201	-0.560	0.398	-0.559	0.169
BRG	0.494	0.562*	0.313	0.736*	0.650*
KL	-0.197	-0.053	-0.783*	0.071	-0.416
Females					
LW	0.449	0.115	0.383	0.114	0.516
BRW	0.019	0.327	0.131	0.206	-0.311
BRG	0.449	0.049	0.392	0.034	0.317
KL	0.300	0.567	0.381	0.429	0.243
Males+Females					
LW	0.344	0.481	0.486*	0.220	0.399
BRW	-0.628*	-0.783	-0.486*	0.599**	-0.443
BRG	0.438*	0.347	0.514*	0.625**	0.623**
KL	-0.472*	-0.538*	0.558*	0.285	-0.509*

**p<0.01; p<0.05; LW = Live Weight; RW Breast Width; G = Breast Girth; KL = Keel Length; SL = Shank Length; TL = Thigh Length; WL = Wing Length; BL = Back Length; CARSWT = Carcass Weight; BRSWT = Breast Weight; DRSTK = Drumstick; THGWT = Thigh Weight; WGWT = Wing Weight

in different strains of chickens (Ojedapo *et al*., 2008; Shafey *et al*., 2013; Sam, 2006). Sam (2006) indicated significant positive correlations among linear body measurement Abor acre broiler chicken.

Phenotypic relationship between morphometric traits and carcass traits in broilers: The phenotypic correlation between morphometric traits and carcass traits in broiler chickens are presented in Table 3. The results indicate that in male broilers, carcass weight was positively correlated with all morphometric traits (r = 0.023-0.536) breast weight had negative correlation with carcass traits except its relationship with breast girth which was positive and significantly correlated (r = 0.562). The relationship between breast girth and all the carcass traits were positive and highly significant with relationship with thigh weight being the highest (r = 0.736). In female broilers, all the morphometric traits were positively correlated with all carcass traits with correlation coefficient ranging from 0.019-0.567, except the relationship between breast width and wing weight which was negative (r = -0.311).

When males and females were considered, it was observed that live body weight and breast girth had significant (p<0.001) positive correlations with all carcass traits measured, the correlation coefficient ranged from 0.344-0.623. The results of these study is in line with the reports by Raji *et al*. (2010) Musa *et al*. (2006) who reported significant positive correlations between live body weight and breast weight, wing and fat weightsin their study. Ojedapo *et al*. (2008) also reported significant positive correlation between live body weight and carcass traits in Anka strain of broiler.

The high and significant correlation between breast girth and carcass traits in this study is in consonance with reports of several authors (Raji *et al*., 2010) in chickens Kleczel *et al*. (2006) in Muscovy ducks and Vali *et al*. (2005) in quails. The positive correlations between breast girth and carcass traits signifies pleiotropy effects of genes controlling these traits, thus suggesting that breast girth can be a good indicator of carcass traits in poultry. The negative, low and non-significant correlation between some body measurement (keel length and breast width) and carcass traits indicates that these traits may not be consider as reliable predictors of carcass traits in broilers. Kleczek *et al*. (2006) made similar observations in Muscovy ducks. Body measurement traits have been reported to plays an important role in predicting the carcass weight of broiler chicken Yakubu and Salako (2009).

CONCLUSION

The study reveal moderate to high positive relationship among morphometric traits measurements and carcass traits suggesting that improvement in one of these morphometric traits will lead to a positive response in the carcass traits. The positive and significant correlated relationship between carcass traits and breast girth suggest that breast girth can be used as indirect selection criteria for carcass traits in broiler chickens.

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