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PHENOTYPIC CORRELATIONS BETWEEN LIVE BODY WEIGHT AND CARCASS TRAITS IN ARBOR ACRE BREED OF BROILER CHICKEN

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ABSTRACT
This study was aimed at determining the relationship between live body weight and carcass traits in Arbor Acre broiler chicken. Fifty day-old broiler chicks were purchased and raised on deep litter system until 56 days of age. At maturity, ten birds were randomly selected for carcass evaluation. The analyzed data showed that live weight has statistically significant ($P<0.01$) positive phenotypic correlation with dressing weight, eviscerated weight, carcass weight, breast muscle weight, back weight, thigh weight and drumstick weight. There was also statistically significant ($P<0.01$) positive regression coefficient between live weight and all the carcass traits. In addition, significant ($P<0.01$) positive phenotypic correlations among the various carcass traits were indicated in this study. The obtained results showed that all the carcass traits measured were good indicators of live weight, and that anyone of them could be used to predict its value. There is a gene linkage effect operating on these traits. Therefore, in a situation whereby the live weights of birds are not measured before slaughter, the weight of any of the component parts could be used to determine the live weight since there was strong association between live weight and all the carcass traits.

KEYWORDS: Arbor Acre; chicken; live weight; dressing weight; regression coefficient.

INTRODUCTION

There is an increasing demand for broiler meat due to its tenderness and unique taste when compared with spent layers' meat. Nowsad *et al*. (2000) reported that spent hens meat contained higher moisture and less protein than broilers' meat. In the past, broilers were sold whole but due to high cost of production leading to exorbitant price of whole chicken coupled with reduced purchasing power, customers now demand for chicken parts to reduce financial burden on family finances. According to Ewart (1993), there was a dramatic increase in the proportion of birds being grown for portioning and further processing, and this is the situation in all countries where broilers are raised for human consumption. The industry requires breeds of broilers with fast rate of growth, more lean meat and less fat. There is evidence that there are differences in body weight among strains of chickens (Musa *et al*., 2006a; Leeson *et al*., 1997). In addition, strain and sex effects on carcass traits had been reported in literature (Ahn *et al*., 1995; Cherian *et al*., 1996; Jaturasitha *et al*., 2008; Zhao *et al*., 2009). Previous findings have indicated positive and significant correlations between live weight and body dimensions, that is, anybody dimension can be used to predict the body weight of an animal. In cane rat, Kolawole and Salako (2010) reported a positive relationship between live weight and body length and heart girth. In local fowls, Ige *et al*. (2007) reported positive phenotypic correlation between body weight and linear measurements, while Razuki *et al*. (2011) reported significant strain differences in body weight at different ages among breeds of broiler chickens. As regards relationship between body weight and carcass traits, Musa *et al*. (2006b) reported significant positive phenotypic correlation between live weight and carcass weight, breast muscle weight and abdominal fat weight, but significant negative phenotypic correlation between live weight and abdominal fat percentage in Anka breed. Studies on chicken meat qualities by Musa *et al*. (2006c) revealed that colour density was positively related with pH, tenderness and water holding capacity of the meat. Previous studies (Chambers, 1990; Deeb and Lamont, 2002; Le Bihan-Duval *et al*., 1998) had reported positive genetic correlations of body weight with abdominal fat weight and abdominal fat percentage. In addition, Musa *et al*. (2006b) reported positive phenotypic correlation between live weight and carcass weight, breast muscle weight, leg muscle weight, abdominal fat weight, heart weight and liver weight in broiler chickens. In Anak broiler 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. It is imperative to know the association existing between live weight and carcass traits of all meat producing animals as the knowledge of this will enable us to predict the body weight from body parts and vice versa. In view of the reason given above, this study was carried out to estimate the phenotypic correlations and regression coefficient between live weight and carcass traits in Arbor Acre broiler chicken breed raised under intensive management practices.

MATERIALS AND METHODS

Study location The study was carried out at the Animal Breeding Unit, Teaching and Research Farm, Ekiti State University, Ado-Ekiti between September, 2010 and December, 2010. Ado-Ekiti is situated along latitude $7^{0}31^{1}$ and $7^{0}49^{1}$ North of the Equator and longitude $5^{0}71^{1}$and

$5^{0}27^{1}$East of the Greenwich meridian. The city falls under Derived Savannah zone. The city enjoys two separate seasonal periods namely, Rainy (May-October) and Dry (November-April) seasons.

TABLE 1: Descriptive statistics of the carcass characteristics of Arbor Acre broiler chicken

Traits	No.	Means	Sx	Range	
				Min	Max
Live weight (g)	30	2115	317.09	1550	2800
Dressing weight (g)	30	1965	304.61	1400	2700
Eviscerated weight (g)	30	1717	276.16	1250	2400
Carcass weight (g)	30	1603	270.04	1150	2200
Breast weight (g)	30	443.77	93.91	292	618
Back weight (g)	30	298.13	53.08	197	389
Thigh weight (g)	30	223.1	40.87	162	326
Drumstick weight (g)	30	203.57	40.13	135	299

Management and Experimental birds

A total number of 50 broiler day-old chicks of Arbor Acres were purchased from local hatcheries and raised on deep litter for 56 days (8 weeks) in the breeding unit of the farm. The chicks were brooded using coal pot to supply heat for the first three weeks of life. Antibiotics and vitamins were administered as and when due. Also, vaccines against Infectious Bursae and Newcastle diseases were given at specified age intervals. Their beddings are 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 death rate. The birds were fed *ad libitum* with starter mash (1-4weeks) containing 3000Kcal/KgME, 22%CP and finisher feed (4-8weeks) containing 3100Kcal//KgMe, 20%CP.

Data collection

At the age of 56 days, 10 birds were randomly selected after starving them overnight. The birds were weighed individually to obtain live body weight, and thereafter slaughtered, bled, scalded and plucked. After the removal of feathers, the carcasses were eviscerated and dissected manually into various parts such as breast muscle, back muscle, drumstick, thigh muscle, wings, legs and giblets (heart, liver and gizzard). The different parts were weighed using sensitive scale and were expressed in grammes.

Data analysis

The breed's data on live body weight, dressing weight, eviscerated weight, carcass weight, breast muscle weight, back weight, thigh weight and drumstick weights were analyzed using Pearson Correlation analysis as per SAS (2001).

RESULTS AND DISCUSSION

The mean values (Table 1) relating to live weight, dressing weight, eviscerated weight, carcass weight, breast muscle weight, back weight, thigh weight and drumstick weight were estimated, respectively as 2115g, 1965g, 1717g, 1603g, 443.77g, 298.13g, 223.1g, and 203.57g. These results when expressed in percentages were as follows: dressing weight (92.91%), eviscerated weight (81.18%), carcass weight (75.79%), breast weight (20.98%), back weight (14.1%), thigh weight (10.55%), and drumstick weight (9.63%) of the live weight.

In this study (Table 2), statistically significant ($P<0.01$) positive phenotypic correlation ($r = 0.983$) was found between live weight and dressing weight in broiler chicken, and this implies that there was a strong association between the two traits. The high correlation values indicate that this breed has small amount of feathers and blood since dressing weight was obtained after slaughter and de-feathering. Furthermore, there is statistically significant ($P<0.01$) positive phenotypic correlation ($r = 0.98$) between live weight and eviscerated weight.

TABLE 2: Phenotypic correlations between live weight and carcass traits of Arbor Acre broiler chicken

Traits	Live weight	Dressing weight	Eviscerated weight	Carcass weight	Breast weight	Back weight	Thigh weight	Drumstick weight
Live weight	1	0.983^{xxx}	0.980^{xxx}	0.987^{xxx}	0.889^{xxx}	0.964^{xxx}	0.951^{xxx}	0.915^{xxx}
Dressing weight		1	0.987^{xxx}	0.992^{xxx}	0.907^{xxx}	0.964^{xxx}	0.956^{xxx}	0.921^{xxx}
Eviscerated weight			1	0.990^{xxx}	0.909^{xxx}	0.955^{xxx}	0.957^{xxx}	0.931^{xxx}
Carcass weight				1	0.921^{xxx}	0.960^{xxx}	0.957^{xxx}	0.921^{xxx}
Breast weight					1	0.854^{xxx}	0.872^{xxx}	0.802^{xxx}
Back weight						1	0.918^{xxx}	0.878^{xxx}
Thigh weight							1	0.897^{xxx}
Drumstick weight								1

$^{xxx}P<0.001$

This also implies that this trait is a good indicator of live weight, and could be used to predict the live weight of broiler chicken. Also, in this study there was statistically significant ($P<0.01$) positive phenotypic correlation ($r = 0.978$) between live weight and carcass weight. The high correlation value reported in this study was comparable to

the value (r =0.95) reported for Anak breed by Ojedapo *et al*. (2008) and Musa *et al*. (2006a) who had r = 0.995 in fat and lean chicken breeds. This trait appeared to be another good indicator of live weight, and the obtained result corroborates the findings of Musa *et al*. (2006a,b) and Ojedapo *et al*. (2008) who both recorded strong association between live weight and carcass weight in different breeds of broiler chickens. However in contrast, Deeb and Lamont (2002) reported significant (P<0.05) unfavourable positive correlation between the two traits in different strains of broiler chicken.

In addition, statistically significant (P<0.01) positive phenotypic correlation (r =0.889) was found between live weight and breast muscle weight in this breed. This was comparable to the value (r =0.97) reported for Anak breed by Ojedapo *et al*. (2008). The obtained result indicates that the latter could be used to predict the value of the former, and this implies that a heavier bird will doubtless give an appreciable breast portion compared to a small-sized one. The result was in agreement with the findings of Musa *et al*. (2006a,b) and Ojedapo *et al*. (2008) who also recorded positive and high correlation between the two traits. Similarly, there was statistically significant (P<0.01) positive phenotypic correlation (r =0.964) between live weight and back muscle weight. It was obvious that the latter has very strong association with the former, and anyone could be used to predict the other. It also implies that back weight is a good indicator of live weight.

In the current study, there was a very high and positive phenotypic correlation between body weight and carcass traits, and according to El-Labban (1999), this could be as a result of pleiotrophic effects of genes and linkage effects which operate on these traits. Therefore, any attempt to perform phenotypic selection on one trait will consequently result in improvement of the other.

As observed in this study, there was statistically significant (P<0.01) positive phenotypic correlation between thigh weight (r=0.981) and drumstick weight (r=0.915) with live weight. The two carcass traits seem to possess strong relationship with carcass weight, and they could be used to predict its value which in turn is useful in estimating the live weight of broiler chicken in a situation whereby the body weight of the bird could not be measured before slaughter. The result corroborates the findings of Musa *et al*. (2006a) who reported positive correlation between leg weight and live weight in fat and lean chicken breeds. The result of this study was also consistent with the findings of Ojedapo *et al*. (2008) who found positive correlation between shank weight and live weight in Anak breed and Wadi Ross chicken breeds. As regards relationship among other carcass traits, dressing weight has statistically significant (P<0.01) positive phenotypic correlation values with eviscerated weight (0.987), carcass weight (0.992), breast muscle weight (0.907), back weight (0.964), thigh weight (0.956) and drumstick weight (0.921). The obtained result indicates that all the aforementioned traits are good indicators of dressing weight, and anyone of them could be used to predict its value.

Furthermore, carcass weight has significant (P<0.01) positive phenotypic correlation with breast muscle weight (0.921), back weight (0.96), thigh weight (0.957) and drumstick weight (0.921). It implies that these traits are good determinants of carcass weight, that is, knowing the value of anyone of them will assist in predicting the amount of carcass in broiler chicken. The result was compatible with those obtained by Mallard and Douaire (1988), Musa *et al*. (2006a,b) and Ojedapo *et al*. (2008) who both reported strong association between carcass weight and some carcass traits. In the same vein, there exists significant (P<0.01) positive phenotypic correlation between breast muscle weight and back weight (0.854), thigh weight (0.872) and drumstick weight (0.802).

TABLE 3: Regression coefficient values between live weight and carcass characteristics in Arbor Acre broiler chicken

Traits	Live Weight		
	Regression Coefficient (±SE)	R^2%	Level of Significance
Dressing weight (g)	1.023±0.036	96.62%	xx
Eviscerated weight (g)	1.125±0.044	95.95%	xx
Carcass weight (g)	1.148±0.046	95.65%	xx
Breast weight (g)	3.00±0.29	79.05%	xx
Thigh weight (g)	7.38±0.45	90.42%	xx
Drumstick weight (g)	7.23±0.60	73.73%	xx

^{xx}P<0.01

It therefore, means that the latter traits are good determinants of the former, and this agrees with the findings of Musa *et al*. (2006) who observed significant positive association between breast muscle weight and leg muscle weight. It was equally indicated in this study that thigh weight has significant (P<0.01) positive phenotypic correlation (0.897) with drumstick weight. It is worthy of note to discover that the latter is a good indicator of the former, and could be used to predict its value in a situation whereby the field data on the trait were missing.

The regression coefficient values (Table 3) describes the relationship between live weight and some carcass traits. The coefficient of determination (R^2) varied from 79.05% and 96.62% for breast muscle weight and dressing weight, respectively. The coefficient of determination (R^2) was employed to determine the accuracy of prediction, and the obtained values in percentages were 96.62%, 95.955, 95.65%, 79.05%, 90.42% and 83.73%, respectively for dressing weight, eviscerated weight, carcass weight, breast muscle weight, thigh weight and drumstick weight with live weight. The results showed that live weight has significant (P<0.01) positive association with all carcass traits. The observation of positive regression coefficient indicates that live weight directly influences the proportion

of other traits associated with carcass. When it increases, other traits increase in weight accordingly, but the reverse is the case when live weight decreases due to any unfavourable conditions. The result was compatible with the findings of Peters *et al*. (2006) who reported significant positive regression coefficient for live weight and body measurements in chickens.

CONCLUSIONS

- It was obvious from this study that there exits significant ($P<0.01$) positive phenotypic correlations between live weight and all carcass traits in broiler chicken.
- Both phenotypic correlation and regression coefficient employed gave the same results, and any of the two could be used to evaluate the relationship between live weight and carcass traits.
- In addition, the study revealed the positive relationship among the various carcass traits. This implies that all the carcass traits are good determinants of live weight, and anyone of them could be used to predict its value.

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