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Estimation of Carcass Yield from Morphometric Traits of ROSS 308 Strain of Broiler Chicken Raised in Humid Zone of Nigeria

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Abstract

Carcass yield is an important trait in broiler production which determines the profitability of the enterprise. This research was done to establish the correlation between morphometric traits and carcass yield as well as estimate carcass yield from morphometric traits of ROSS 308 broiler chicken. A total of 50 mixed - sex 8 weeks broiler was used for this study. Morphometric traits studied were wing length (WL), keel length (KL), thigh length (TL), body girth (BG), and body height (BH) whereas carcass yield traits were dress weight, thigh weight, and breast weight being customers most preferred parts. Data collected were subjected to correlation and regression analysis to establish the relationship between morphometric traits and carcass yield as well as the estimation of carcass yield. Results of the relationship between morphometric traits and carcass yield indicated that all the morphometric traits were significantly ($p<0.05$) and positively correlated with all the carcass yield measured, with the highest correlation being between wing length and breast weight ($r= 0.932$) while the lowest was the correlation between dressed weight and keel length ($r= 0.201$) while the simple linear regression indicated that carcass traits could be predicted accurately with all the morphometric traits. However, multiple regression analysis indicated a higher accuracy (using R2 value) when more than one variable was included in the equation. It was concluded that the high and positive correlation between the studied morphometric traits and carcass yield in the ROSS 308 strain of broiler indicates that these morphometric traits are good indicators of carcass traits. It was also revealed that the inclusion of more than one variable gave a better prediction of the carcass traits.

Key words: Broiler chicken, Estimation, Morphometric, Carcass, Traits

1.0 Introduction

Over the years, poultry has contributed immensely to the animal protein supply of Nigeria. NBS (2022) reported that the poultry industry contributes about 25% to the Gross Domestic Product (GDP) of the country. Meat and eggs which are the most prominent products from poultry are good sources of animal protein (Sam et al., 2010; Essien et al., 2022). The economic importance of carcass yield in poultry production cannot be overemphasized. This is because it determines the market value of the birds (Alphonsus et al., 2012; Sam et al., 2018).

The information on the interrelationship between carcass yield and morphometric traits is necessary in recent times because consumer preference has changed from buying whole chicken to buying cut-up parts, partly due to the economic situation in the country (Sam et al., 2019). The recent change in consumers' needs has led to changes in the production priorities of breeders as well as the marketing strategies of farmers (Shafey et al., 2013). Broiler producers are presently paying more attention to carcass yield, particularly those parts that attract high prices (drumstick, thigh and breast). Several factors have been reported to affect the carcass yield of broilers chicken, some of which include sex, strain, housing, nutrition and management (Shafey et al., 2013).

Estimation of dressing percentage and measurements of parts of broiler cuts are the major methods in which broiler carcass yields are evaluated. This is achieved by slaughtering the birds and cutting them into parts needed by consumers before the yield can be evaluated. This process requires a lot of time and human and financial resources. Information on the relationship between carcass yield and morphometric traits may be used in the selection and breeding programs. Also, information on the carcass yield of broiler chicken is very important for the evaluation of market value and breeding purposes. The relationship between carcass yield and other morphometric traits in birds is of importance to poultry breeders. This is because the knowledge of the interrelationship between these traits will help the breeder determine the carcass yield without slaughtering the birds. It has been reported by Rosario et al (2008) that most biological traits of economic importance, body weight, morphometric traits and carcass traits are correlated, this is because of the pleiotropic effect of gene and gene linkage. There is a need to understand the interrelationship between these traits to help in predicting carcass traits from either body weight or morphometric traits. This will assist in evaluating carcass parameters from live birds without necessarily slaughtering them. Therefore, this research aimed to estimate carcass yield from morphometric traits of broiler chickens.

2.0 Materials and Methods

2.1 Experimental Site

The experiment was conducted at the Poultry Research and Teaching Farm of the Department of Animal Science, Faculty of Agriculture, Akwa Ibom State University, Obio Akpa Campus. This location is between latitudes 4º30ºN and 5º00N longitudes 7º30ºE and 8º00E. The annual rainfall of the area ranges from 3500 – 5000mm with a monthly temperature of 250ºC, and relative humidity between 60 – 90 % (AKSG, 2012).

2.2 Experimental Birds and Management

A total of 50-day-old broiler chicks of the Ross 308 broiler strain were sourced from Agrited Hatcheries in Ibadan, Oyo State, Nigeria. The birds were allotted to pens in the brooding section

and brooded for two weeks with electric bulbs and charcoal stoves as sources of heat. At the end of the second week, birds were transferred to the rearing pens and were raised for another six weeks. The usual management practices for broiler production as well as the recommended vaccination schedule were observed.

The chicks were fed ad libitum with a commercial broiler starter diet containing 24 % crude protein and 3000 kcal/kg metabolizable energy for four weeks of age. Thereafter the birds were given broiler finisher ration containing 21 % crude protein and 2800 kcal/kg metabolizable energy for up to eight weeks. Clean water was given ad libitum to the birds throughout the experimental period which lasted eight weeks.

3.3 Data Collection

At the end of eight weeks, data were collected on body weight, morphometric and carcass traits.

3.3.1 Morphometric Traits/ Carcass Traits:

All the morphometric traits were measured in cm using a tailors' tape as described by Sam et al. (2019). Ten birds closest to the average body weight of the population were used for carcass yield evaluation. The selected birds for carcass were fasted for 12 hours to reduce the volume of gut contents and bacteria; thereby, reducing the risk of contamination of the carcass during dressing and their fasted live weights were recorded. The birds were severed through the jugular vein and bled. They were then dipped in hot water for 1 minute and thereafter de-feathered. The head, neck and shank were removed to have the dressed weight. The carcasses were cut into different parts and the carcass yield was measured following the methods described by Sam et al. (2018).

All carcass weight measurements were taken using a sensitive weighing balance (S. Miller Digital Scientific Scale) and were expressed in grams.

3.3.2 Statistical Analysis

The degree of correlations between morphometric traits and carcass yield was obtained using Pearson correlation of SPSS (2018) version 23.

Data of morphometric traits at 8 weeks were regressed against carcass yield using simple and multiple regression procedures. The linear model used is as follows:

$$Y= a+bx \quad \text{.....Equation 3.1}$$

Where:

Y = the dependent variable (Carcass yield)
a = the intercept of the regression curve on the y-axis
b= regression coefficient
x= independent variable (morphometric traits)

The multiple regression model used is as follows:

$$Y= a+b_1X_1 + b_2X_2+ b_3X_3+b_4X_4+b5X_5 \quad \text{Equation 3.2}$$

Where:

Y = Dependent variable (carcass yield: dressed weight, thigh weight and breast weight),
a = intercept
b = regression coefficient,
X = independent variables (Morphometric traits: WL, KL, TL, BG and BH)

4.0 Results and Discussion

4.1 Descriptive Statistics of Body Weight, Morphometric Traits and Carcass Yield of ROSS 308

The means, standard deviation, minimum values, maximum values and coefficient of variation for body weight, morphometric traits (WL, KL, TL, BG and BH) and carcass yield (dressed weight, thigh weight and breast weight) of Ross 308 broiler chicken are presented in Table 4.1. The result indicates that body weight was 3.02 ± 0.31kg, while WL, KL, TL, SL, BG and BH were 19.53 ± 1.84cm, 16.34 ± 2.04, 19.44 ± 2.08, 8.77±1.03, 37.92±3.17 and 34.92 ± 2.80 respectively. The mean dressed weight was 1692.00±131.45g, thigh weight 262.00 ± 43.59, and breast weight 286.00 ± 28.90g respectively.

The coefficient of variation was 10.26% for body weight, and it ranged from 8.02% in body height to 11.74% in shank length among the morphometric traits. The coefficient of variations observed among the carcass yield was 7.77%, 16.64% and 10.10% for dressed weight, thigh weight and breast weight respectively. The moderate coefficient of variation (CV) observed in this study indicates the variability of these traits.

The results of this study on descriptive statistics of body weight indicated that the studied traits were higher than earlier reports by Amoa (2019) in Marshall and Abor acre strains of broiler chicken in the Southern Guinea Environment of Nigeria. The range of values for morphological traits was also higher than the reports of Ojedapo et al (2016) in Cobb and Marshal broiler chicken in the derived Savanna region of Nigeria. The differences observed in this study could be due to differences in the genetic makeup of the birds, the management system and the environment in which these birds were raised.

4.2 Correlation between Morphometric Traits and Carcass Yield of Broiler Chicken

The correlation between body weight, conformation traits and carcass traits is shown in Table 4.2. The results indicate a correlation coefficient (r) range of 0.201-0.95. The highest correlation coefficient value was observed between wing length and breast weight (r=0.932) while the lowest correlation coefficient was observed between dressed weight and keel length. Breast weight had a moderate to high significant ($p<0.05$) relationship in all the morphometric traits 0.932, 0.204, 0.544, 0.621, 0.585, for wing length, keel length, thigh length, body girth, and body height. Similarly, thigh weight also had a significant ($p<0.05$) and positive correlation with all the morphometric traits. Dress weight had a significantly high and positive correlation with body weight. Correlation expresses the relationship between economic traits of importance and the estimation of the correlation coefficient is very useful in breeding programs. This information could be used in predicting potential responses made from selection (Obike et al. 2016; Nweke-Okorocha and Chineke, 2022). Correlation also allows the estimation of the direction and magnitude of change in the dependent traits as a correlated response to the direct selection of

principal traits (Laxni et al., 2002). The significant and positive correlation between body weight, morphometric traits and carcass traits measured suggests that morphometric traits are good indicators for carcass traits and body weight. Therefore, improvement in body weight and morphometric traits will lead to a corresponding improvement in the carcass yield of broiler chicken. The result of this study aligns with the reports of other authors (Udeh et al., 2011; Nosike et al., 2017; Sam and Okon, 2022). It has been reported that morphometric traits play a lead role in the prediction of live body weight and carcass yields in broiler chickens as observed by Adenaike et al. (2022).

4.3 Prediction of Carcass Yield from Morphometric Traits

The prediction equations and coefficient of determination (R2) for predicting carcass yield from morphometric traits are presented in Table 4.3. The results indicate that the coefficient of determination R2 recorded in WL, KL, TL, BG and BH for predicting dressed weight was 55.18%, 70.01%, 73.03%, 62.22%, and 54.40%, respectively. When more than one morphometric trait was included in the model, it was observed that the R2 values increased as the number of variables increased (72.02%, 71.11%, 79.93% and 83.25% for WL+KL, KL+KL+TL, WL+KL+TL+BG and WL+KL+TL+BG+BH, respectively.

Similarly, the coefficient of determination relating to thigh weight was 62.24%, 71.15%, 54.47%, 53.31%, and 52.21% for WL, KL, TL, BG and BH, respectively. When more than one variable was included in the model R2 values obtained were 72.23%, 72.23%, 75.54% and 77.01% for WL+KL, KL+KL+TL, WL+KL+TL+BG and WL+KL+TL+BG+BH respectively.

The R2 values describing, the accuracy of predicting breast weight from morphometric traits indicate that WL, KL, TL, BG, and BH were 51.12%, 70.04%, 58.86%, and 57.70% respectively. Also 71.19%, 75.55%, 75.02%, and 79.04%, were R2 values for WL+KL, KL+KL+TL, WL+KL+TL+BG and WL+KL+TL+BG+BH, respectively. In the entire carcass parts studied (dressed weight, thigh weight and breast weight) it was observed that the R2 values were more than 50% in all the morphometric traits used, suggesting that any of the morphometric traits could be used to predict carcass yield in Ross 308. It is known that R2 value above 50% can be used to accurately predict any parameter (Altman et al. 2015). The result of this study agrees with the reports of Adeniji and Ayonide (1990) and Adeleke et al. (2004). The better prediction accuracy as more variables were included in the regression equation had earlier been reported by Ajayi et al. (2008). However, it was observed that in the entire carcass yields predicted when individual morphometric traits were used in the equation, BG gave the best fit. This suggests that BG could be the best predictor of carcass yield in broiler chickens. In all carcass traits studied, the highest R2 value was obtained when all the morphometric traits were included in the regression equation, suggesting that carcass yield could be predicted with better accuracy by a combination of all the morphometric traits.

R2 is the statistical measure in a regression model that determines the proportion of variance in the dependent variable. R2 value shows how well the data fit the regression model. The result from this study indicates that 50% and above of the variation in carcass yield was explained by the models.

Table 4.1: Mean values of Body weight (kg), Morphometric traits (cm) and Carcass yield (g) of ROSS 308 strain of Broiler Chicken at 8 weeks

Trait	Mean±SD	Maximum	Minimum	Coefficient of Variation
Body weight(kg)	3.02 ± 0.31	2.30	3.90	10.26
Wing length(cm)	19.53 ± 1.84	16.00	24.00	9.42
Keel length(cm)	16.34 ± 2.04	13.00	20.00	12.48
Thigh length(cm)	19.44 ± 2.08	13.00	20.00	10.70
Shank length(cm)	8.77 ± 1.03	7.00	11.00	11.74
Body girth(cm)	37.92 ± 3.17	28.00	44.00	8.35
Body height(cm)	34.92 ± 2.80	30.00	40.00	8.02
Dressed weight(g)	1692.00 ± 131.45	1477.00	1823.00	7.77
Drumstick (cm)	115.25 ± 25.00	101.00	124.00	21.69
Thigh weight(cm)	262.00 ± 43.59	210.00	314.00	16.64
Wing weight(cm)	198.50 ± 15.07	184.00	218.00	7.60
Breast weight(cm)	286.00 ± 28.90	250.00	323.00	10.10
Neck (cm)	52.50±14.36	37.00	72.00	27.35

SD-Standard deviation

Table 4.2: Correlation between Morphometric traits and Carcass Yield of ROSS 308 Strain of Broiler Birds at 8 weeks of Age

	BWT	WL	KL	TL	BG	BH	DRSWT	TWT	BRSWT
BWT	1	0.285*	0.263*	0.268*	0.340*	0.216	0.951*	0.537*	0.586*
WL		1	0.314*	0.502*	0.262*	0293*	0.567*	0.381*	0.932*
KL			1	0.209	0.332*	0.440*	0.201	0.215*	0.204*
TL				1	0.871*	0.231	0.461*	0.742*	0.544*
BG					1	0.538*	0.390*	0.829*	0.621*
BH						1	0.779*	0.882*	0.585*
DRSWT							1	0.860*	0.742*
TWT								1	0.327*
BRSWT									1

BWT=Body weight, WL=Wing length, KL=Keel length, TL=Thigh Length, BG=Body Girth, BH= Body height, DRSWT= Dressed weight, TWT= Thigh weight, BRSWT=Brest weight, *$p<0.05$

Table 4.3: Regression Equations for Predicting Live Weight, Dressed, Thigh and Breast weights Ross 308

Equation no	Equation	R^2
Live weight		
1	2.08+0.048WL	78.25
2	2.367+0.04KL	76.30
3	2.245+0.040TL	78.80
4	1.760+0.033BG	84.40
5	2.188+0.024BH	71.16
6	1.803+0.038WL+0.029KL	83.38
7	1.307+0.037WL+0.023KL+0.032TL	89.39
8	0.625+0.029WL+0.011KL+0.034TL+0.026BG	96.69
9	0.35+0.028WL+0.004KL+0.032TL+0.027BG+0.012BH	97.25
Dressed weight		
1	1578.78+5.794WL	58.18
2	1480.08+12.93KL	70.01
3	1565.482+6.507TL	73.03
4	1883.205-5.042BG	62.22
5	1757.20-1.867BH	54.40
6	1458.77+1.431WL+12.528KL	72.02
7	1397.11+1.282WL+11.719KL+4.003TL	71.11
8	1635.05+4.050WL+15.77KL+3.260TL-9.070BG	79.93
9	1841.29+0.426WL+20.984KL+4.965TL+9.556BG-8.905BH	83.25
Thigh weight		
1	204.601+2.938WL	62.24
2	186.678+4.597KL	71.15
3	242.983+0.978TL	54.47
4	277.946+0.420BG	53.31
5	250.52+0.329BH	52.21
6	164.59+1.48WL+4.176KL	72.23
7	164.609+1.483WL+4.177KL-0.001TL	72.23
8	211.50+2.029WL+4.975KL-0.147TL-1.788BG	75.54
9	248.76+248.76WL+5.917KL+0.161TL-1.875BG-1.609BH	77.01
Breast weight		
1	289.729-0.191WL	51.12
2	238.615+2.892KL	70.04
3	309.24-1.196TL	58.86
4	261.786+0.639BG	57.70
5	258.092+0.799BH	57.78
6	258.412-1.330WL+3.269KL	71.19
7	286.652-1.261WL+3.640KL-1.833TL	75.55
8	284.68-1.262WL+3.589KL-1.859+0.091BH	75.02
9	281.87-1.293WL+3.54KL-1.844TL+0.101BG+0.098BH	79.04

WL=Wing length, KL=Keel length, TL=Thigh Length, BG=Body Girth, BH= Body height

5.0 Conclusion

This study showed a high and positive correlation between, morphometric traits (WL, KL, TL, BG, and BH) and carcass yield (dressed weight, thigh weight and breast weight) indicating that improvement in morphometric traits will lead to an increase in carcass yield of ROSS 308 broiler chicken. It was also observed that carcass traits could be predicted from morphometric traits, but better accuracy could be obtained when more than one variable was included in the regression equation.

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