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ESTIMATION OF BODY WEIGHT FROM LINEAR BODY MEASUREMENTS IN TWO COMMERCIAL MEAT-TYPE CHICKEN

F. O. AJAYI, O. EJIOFOR, and M. O. IRONKWE

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ABSTRACT

The prediction of body weight from body girth, keel length and thigh length was studied using one hundred Ross and one hundred Anak Titan broilers. Data were collected on the birds from day-old to 9 weeks of age. Body measurement was regressed against body weight at 9 weeks of age using simple linear and non-linear (exponential and double-log) regression analyses. The relationship between body weight and body measurements were highly significant ($P < 0.001$). The coefficient of determination varied from 82.07 to 99.25%, 61.57 to 98.21% and 80.78 to 98.67% for body girth, keel length and thigh length respectively. Body weight was better predicted singly using body girth. The relationship was best described by the double-log function. The result of this study showed positive relationship between body weight and body measurements. It can therefore be concluded that body weight in commercial broilers could be predicted easily by farmers from any given value of the three body measurements without the use of sophisticated instrument.

KEY WORDS: Body weight, body measurement, regression function, commercial broilers.

INTRODUCTION

Growth is an increase in the amount of protein and mineral matter accumulated in the body (Campbell *et al,* 1994). There is wide variation in body weight and body measurements within a species. Even within breeds there is considerable variation in body measurements and body weight among individuals. Body weight and body dimension have been used as parameters for selection by local sellers and for research (Fitzhurgh, 1976). Breeders need to establish the relationships that exist between body weight and body measurements in order to be able to organize his breeding programme for efficient production and maximum economic returns. In places where scales are not readily available, prediction equations may be derived to predict body weight of animals (Ozoje and Herbert, 1997). This study was to assess the ability of linear body measurements to predict live body weight in two commercial meat-type chickens using three regression models.

MATERIALS AND METHODS

The experiment was conducted at the Teaching and Research Farm of the Rivers State University of Science and Technology, Port Harcourt. The birds were wing-tagged and fed *ad libitum* with commercial broiler starter diet (22 – 24% Crude Protein) from day-old to 5 weeks of age and commercial broiler finisher diet (20% Crude Protein) from 5 – 9 weeks of age. Clean water was supplied throughout the experimental period. Adequate floor and feeding spaces and vaccines were also provided.

Traits studied were body weight, body girth, keel length and thigh length. Measurements of growth traits were taken on the birds at an interval of 3 weeks (0, 3, 6 and 9 weeks) early in the morning before feeding the birds. Body weight of individual birds was taken with a top loading scale in grams and corrected to two places of decimal. Body girth, keel length and thigh length were measured in centimeters using a tape rule. Measurements of body girth, keel length and thigh length were regressed against body weight using both simple linear and non-linear (exponential and double-log) and multiple regression analysis (SAS, 1999).

$Y = a + b X$ ……………………(1) (linear)

$Y_1 = a_1 eb_1 X$ ………………… (2) (exponential)

$\text{Log } Y_2 = \text{Log} a_2 + b_2 \text{ Log } X$…………(3) (double – log)

Y, Y_1 and $\text{Log } Y_2$ are dependent variables (body weight) while X represents the independent variables (body girth, keel length and thigh length), b is the regression coefficient associated with independent variables, and a normally called the intercept represents the estimate of dependent variable when the independent variable is zero. Logarithmic transformation was performed on equation (2) to fit the model with the variable data resulting in the following equation:

$\ln Y_1 = \ln a_1 + b_1 x$

Regression equations were determined for Ross and Anak Titan commercial strains of broilers. The relationship between body weight and each of the measurements (body girth, keel length and thigh length) and multiple combinations of the measurements were also assessed and the coefficient of determination (R^2) was used to compare the accuracy of prediction.

RESULTS AND DISCUSSION

The regression equations and coefficients of determination for the fitted functions are presented in Tables 1 and 2. The results showed highly significant interrelationship ($P < 0.001$) between body weight and linear body measurements. The coefficient of determination varied from 61.57 to 99.25% and the magnitude of the coefficient of determination for each parameter in the regression equations shows the relative contribution of each body measurement to the body weight of bird for that particular strain of broiler.

The result indicated that as body girth, keel length and thigh length increases through selection, there will be a corresponding increase in body weight gain. This is in agreement with the conclusion of Adeleke *et al* (2004) that body weight can be predicted from linear measurements (breast girth and keel length) for crossbred egg-type chickens and Adeniji and Ayorinde (1990) for Cobb broiler strain.

In the two commercial broiler strains, the relationship between body weight and body girth, body weight and keel length and body weight and thigh length were best described by double-log. The coefficients of determination (R^2) varied from 90.17 – 99.25%. Exponential function described the relationships between body weight and body girth, body weight and keel length better than the linear function for both Ross and Anak Titan. However, the linear function described the relationship between body weight and thigh length better in the Ross genotype (R^2 = 97.11%) while exponential was better than the linear in the Anak Titan genotype (R^2 = 94.16% versus 80.78% respectively).

F. O. Ajayi, Department of Animal Science, Rivers State University of Science and Technology, Port Harcourt.
O. Ejiofor, Department of Animal Science, Rivers State University of Science and Technology, Port Harcourt.
M. O. Ironkwe, Department of Animal Science & Fisheries University of Port Harcourt, Port Harcourt.

Table 1: Estimate of parameters in simple linear, exponential and double-log functions fitted for body weight-body measurements relationship

Linear measurement	Functions	SE	R^2%	Sign
	Ross			
Body girth	Y = -1019.343 + 97.113 X	2.150	91.12	***
	Y_1 = 2.803e 0.148 X	0.002	94.55	***
	Log Y_2 = -2.299 + 2.8590 X	0.020	98.99	***
	Anak Titan			
	Y = -949.660 + 89.074 X	2.958	82.07	***
	Y_1 = 2.413e 0.165 X	0.001	97.46	***
	Log Y_2 = -2.704 + 2.956 X	0.018	99.25	***
	Ross			
Keel length	Y =- 604.180 + 957 X	4.305	90.12	***
	Y_1 = 3.430e 0.280 X	0.005	94.09	***
	Log Y_2 = 2.156 + 1.998 X	0.019	98.21	***
	Anak Titan			
	Y = -409.000 + 130.166X	7.30	61.57	***
	Y_1 = 3.125 e 0.268X	0.006	89.77	***
	Log Y_2 = 2.194 + 1.815X	0.043	90.17	***
	Ross			
Thigh length	Y = -746.320 + 212.499 X	2.60	97.11	***
	Y_1 = 3.460 e 0.298 X	0.008	84.87	***
	Log Y_2 = 0.959 + 2.583 X	0.036	96.24	***
	Anak Titan			
	Y = -793.484 + 201.393 X	6.980	80.78	***
	Y_1 = 2.733 e 0.369 X	0.006	84.16	***
	Log Y_2 = 0.366 + 2.781 X	0.022	98.67	***

*** P < 0.001

Table 2: Estimate of parameters in multiple linear, exponential and double-log functions fitted for body weight - body measurements relationship.

Linear measurement	Functions	SE	R^2%	Sign
	Ross			
Body girth (X_1) and Keel (length (X_2)	Y =- 921.911 + 72.549 X_1 + 47.063 X_2	14.321	91.25	***
	Y_1 = 3.033e 0.090 X_1 + 0.111 X_2	0.030	94.88	***
	Log Y_2 = -1.138 + 2.099 X_1 + 0.533 X_2	0.105	99.11	***
	Anak Titan			
	Y = -10.36 + 127.955 X_1 -70.552 X_2	7.486	84.42	***
	Y_1 = 2.493e 0.128 X_1 + 0.065 X_2	0.007	98.20	***
	Log Y_2 = -3.221 + 3.294 X_1 – 0.226 x_2	0.039	99.36	***
	Ross			
Body girth (X_1) and Thigh length (X_2)	Y= -657.842 - 23.077 X_1 + 260.360 X_2	5.734	97.33	***
	Y_1 = 2.485e 0.254 X_1 – 0.229 X_2	0.020	96.68	***
	Log Y_2 = -1.972 + 2.549 X_1 + 0.282 X_2	0.090	99.03	***
	Anak Titan			
	Y = -919.110 + 63.868 X_1 + 58.514 X_2	15.44	82.32	***
	Y_1 = 2.420e 0.158 X_1 + 0.014 X_2	0.022	97.46	***
	Log Y_2 = -1.664 + 1.931 X_1 + 0.976 X_2	0.102	99.49	***

***P < 0.001

The regression coefficient associated with independent variable X and partially representing the amount of change in Y for each unit change in X had a positive value in the relationships between body weight and body girth, body weight and keel length and body weight and thigh length. The implication of the positive value for the regression coefficient is that body weight gain increases directly with linear body dimensions (body girth, keel length and thigh length). In both Ross and Anak Titan broiler strains and between the body measurements, accuracy of prediction was better with body girth.

For the multiple regression equations, the reliability of the coefficients of determination increased when two body measurements are combined. For instance, the combination of body girth and keel length gave coefficient of determination of 99.11% and 99.36% respectively for Ross and Anak Titan broilers. This is in agreement with the findings of Adeniji and Ayorinde (1990) and Adeleke *et al* (2004). The very high R^2 obtained when body girth and keel length was used to predict the body weight suggest that the combination of two linear body measurement will be more appropriate since there is existence of variation in the maturing pattern of the various body parts in chicken

In conclusion, the results from this study demonstrated a positive relationship between body weight and body measurements components (body girth, keel length and thigh length) showing that increase in the growth rate of any of the components will increase live weight gain. This study also indicated that with Ross and Anak Titan broiler strains, body weight of birds could easily be predicted by farmers from any given value of the three body measurements without the use of sophisticated instrument.

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