Regression and Prediction of Body Weight in Two Quail Colour Lines

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Abstract

Body weight is an important trait to poultry breeders and it plays an important role in determining several economic characteristics in farm animal. This study was carried out to develop prediction equation for weekly body weight in quails. A total of 200 unsexed 1- week old quails comprising of 100 white quail colour line and 100 black quail colour line were used. Data were collected on body weight using an electric weighing scale. The data collected on body weight of the quails were subjected to correlation analysis to determine the body weight of quails in different ages. Simple linear regression was used to predict quails' weight at different ages. In both quail colour lines, significant ($p< 0.05$) correlations were obtained between measurements of body weight made at different ages. The predictive equation for quail's body weight was associated with varying levels of R^2 (0.000-0.9467). Significant ($p< 0.05$) difference was observed among the white and black quail colour line from weeks 0-3 of age. The white quail colour was significantly higher in body weight than that of black quail colour line. The comparatively higher level of R^2 was associated with prediction equation of the quail body weight in week 2 (independent variable) having 0.984 in week 3(dependent variable) in white quails, while the black quails is having 0.733 in week 2(dependent variable) in week 0 (independent variable). This suggests that body weight can be predicted fairly accurately within 0-3 weeks of age using simple linear regression function. The study concluded that selection of body weight in quails can be made within 0-3 weeks of life, thereby shortening the generational interval and improving genetic progress in selection for increased quail weight. The study recommends further investigation to ascertain the basis for varying value of R^2 in age specific linear regression function for prediction of body weight in quails.

Keywords: Body weight, Correlation, Regression, Plumage, Prediction Equation, Quails

Régression et Prédiction du Poids Corporel dans Deux Lignées de Couleurs de Cailles

Résumé

Le poids corporel est un trait important pour les éleveurs de volailles et joue un rôle crucial dans la détermination de plusieurs caractéristiques économiques chez les animaux d'élevage. Cette étude a été réalisée pour développer une équation de prédiction du poids corporel hebdomadaire chez les cailles. Un total de 200 cailles non sexées d'une semaine, comprenant 100 cailles de la lignée blanche et 100 cailles de la lignée noire, ont été utilisées. Les données sur le poids corporel ont été collectées à l'aide d'une balance électrique. Les données recueillies sur le poids corporel des cailles ont été soumises à une analyse de corrélation pour déterminer le poids corporel des cailles à différents âges. Une régression linéaire simple a été utilisée pour prédire le poids des cailles à différents âges. Dans les deux lignées de cailles, des corrélations significatives ($p< 0,05$) ont été obtenues entre les mesures du poids corporel prises à différents âges. L'équation prédictive du poids corporel des cailles était associée à des niveaux variés de R2 (0,000-0,9467). Une différence significative ($p< 0,05$) a été observée entre les lignées de cailles blanches et noires de la semaine 0 à 3 d'âge. Les cailles blanches avaient un poids corporel significativement plus élevé que celui des cailles noires. Le niveau de R2 comparativement plus élevé était associé à l'équation de prédiction

du poids corporel des cailles à la semaine 2 (variable indépendante) ayant 0,984 à la semaine 3 (variable dépendante) chez les cailles blanches, tandis que les cailles noires avaient 0,733 à la semaine 2 (variable dépendante) à la semaine 0 (variable indépendante). Cela suggère que le poids corporel peut être prédit de manière assez précise entre 0 et 3 semaines d'âge en utilisant une fonction de régression linéaire simple. L'étude a conclu que la sélection du poids corporel chez les cailles peut être effectuée dans les 0-3 semaines de vie, raccourcissant ainsi l'intervalle générationnel et améliorant le progrès génétique dans la sélection pour l'augmentation du poids des cailles. L'étude recommande des investigations supplémentaires pour déterminer la base des valeurs variées de R2 dans la fonction de régression linéaire spécifique à l'âge pour la prédiction du poids corporel chez les cailles.

Mots-clés : Poids corporel, Corrélation, Régression, Plumage, Équation de Prédiction, Cailles

Introduction

Japanese quail is the smallest poultry species farmed for egg and meat production, and it has also assumed as a worldwide importance to a laboratory animal (Alagawany *et al.,* 2014). However, with the ever-increasing human population and shortage of protein, the Japanese quail can be considered as one of the major sources of animal protein (Jatoi *et al*. 2013).

The Japanese quail is popular for its short generational interval and its husbandry is quite attractive as compared to conventional poultry, these birds are hardy and resistant to most tropical diseases. Japanese quails (*Coturnix japonica*) production in Nigeria is fairly recent but has become an integral part of the poultry industry even though it is still established in a small-scale level with an increasing demand due to its high nutritional value (Sati *et al.,* 2012).

The body weight of an animal is an important factor in livestock management, however in the poultry industry, body weight as well as body measurements are factors which help determine the productivity of a poultry enterprise. Body weight has been commonly used to measure body size and determine the age of the animals, and this leads to the development of improved animals genetically and faster. Assessment of body weight and linear body measurement have been found useful in quantifying body size and shape (Ibe and Ezekwe, 1994). Linear body measurement has also been used to predict live weight in poultry.

Body weight is the first approach to livestock characterization and improvement, report shows that body weight at a specific age is probably the most frequently used indicator of growth. According to Momoh and Kershima (2008) body weight is an important attribute that forms the basis for assessing growth. Prediction of body weight helps to determine the productive performance of the quails. Prediction of the body weight of quails has been set aside because of their small nature this has led to low utilization and awareness of the quails. This study aimed at evaluating the performance of the quail and also developing prediction equation for a better productivity and utilization of white and black quails color line.

Materials and Methods

Location and Duration of the Study

This experiment was conducted at the Poultry Unit, University of Abuja Teaching and Research Farm, Gwagwalada, FCT-Abuja. Gwagwalada falls within latitude 90° 4'N, longitude 7° 28'E, 1500mm (59.1in) rainfall annually, temperature ranges between 18.45°c (65.21°F) and relative humidity of 67% at 0900GMT (present). The location has a particular rainy and dry season with a unimodal rainfall pattern which for the most part sets up between mid-May to early June, and tops in the long periods of the months of July/August. The total yearly rainfall in the location is between 1284mm-1383mm. However, dry season starts from mid of October to end of

April. The area has a daily mean temperature of 30^0C in the raining season and 34^0C in the dry season (Meteorological Station of Nnamdi Azikiwe International Airport (MET), 2018). The experiment lasted for six weeks.

Experimental Animal and Management

A total of two hundred (200) one-week-old brown Japanese quail birds *(Cortunix cortunix japonica)* consisting one hundred (n=100) each of white quails and black quail were used for the study. The white and black quail colour lines were purchased at 1-week old obtained from a reputable Hatchery in Jos, Plateau State. The birds were housed in battery cage system under the same management conditions. On arrival the birds were given water with anti stress and then weighed individually at the beginning of the experiment and tagged for identification purpose. The experiment was carried out using completely randomized design. Supplementary heat was given during the first two weeks. Anti-stress was added into their drinking water. They were kept under the same management conditions throughout the study period. Standard commercial diet containing 22% crude protein/kg and 3000 kcal of ME/kg as well as water were provided *ad-libitum* during the rearing period. Standard management and medication were provided throughout the experimental period. Strict farm bio-security and standard hygienic precautions were maintained.

Parameter measured

Weekly body weight was taken for five weeks using a sensitive digital scale (Camry electronic digital scale)

Statistical analysis

Correlation and logistic regression analysis were carried out using SPSS software package (version 17.0, 2008).

Results and Discussion

Correlation and prediction equation for body weight at week 0 in white quail colour line

The regression and correlation between body weight at week 0 and subsequent weekly body weights, for white quail colour line is presented in table 1 ($p > 0.05$, 0.367 – 0.144). Between week 0 body weight and subsequent body weight in the white quail colour line. The correlation between week 0 body weight in white quail were significant ($p > 0.05$) at 1-5 weeks. The R^2 value for predicting body weight at week 0 (independent variable) varied with advancing age of the white quail colour line respectively

Table 1: Correlation and prediction equation for body weight at week 0 in white quail colour line

Dependent; weeks	Regression equation	R	R^2	Standard error	Sig
1	Y= 0.480x + 20.665	0.565	0.320	14.062	0.144
2	Y=0.574x + -1.291	0.597	0.357	13.674	0.118
3	Y=0.608x + -24.990	0.557	0.310	14.164	0.152
4	Y=0.552x + -15.285	0.447	0.200	15.252	0.267
5	Y=0.565x + -23.165	0.370	0.137	15.839	0.367

Y = dependent variable, X= independent variable.
White: independent variable; week 0

Correlation and prediction equation for body weight at week 1 in white quail colour line

The regression and correlation between body weight at week 1 and subsequent weekly body weights, for white quail colour line is presented in table 2 ($p > 0.05$, 0.687 – 0.930). between week 1 and subsequent body weight in the white quail. The correlation between week 1 body weight in white quail were significant ($p > 0.05$) at week 4 *and* 5. The R^2 value for predicting body weight at week 1 (independent variable) varied with advancing age of the white quail colour line respectively.

Table 2: Correlation and prediction equation for body weight at week 1 in white quail colour line

Dependent; weeks	Regression equation	R	R^2	Standard error	Sig
2	Y= 1.054x + -26.763	0.930	0.865	7.372	0.001
3	Y= 1.263x + -75.719	0.893	0.797	9.062	0.003
4	Y= 1.189x + -81.177	0.817	0.667	11.604	0.013
5	Y=1.237x +-101.707	0.687	0.473	14.597	0,016

Y = dependent variable, X= independent variable
White: Independent variable; week 1

Correlation and prediction equation for body weight at week 2 in white quail colour line

The regression and correlation between body weight at week 2 and subsequent weekly body weights, for white quail colour line is presented in in table 3 (p >0.05, 0.848 - 0.927). The correlation between week 2 body weight in white quail were significant (p > 0.05) at week 3 *and* 5. The R^2 value for predicting body weight at week 2 (independent variable) varied with advancing age of the white quail colour line.

Table 3: Correlation and prediction equation for body weight at week 2 in white quail colour line respectively

Dependent; weeks	Regression equation	R	R^2	Standard error	Sig
3	y= 1.229x + -51.100	0.984	0.969	3.119	0.009
4	y= 1.191x + -61.989	0.927	0.859	6.651	0.001
5	y= 1.347x + -101.271	0.848	0.720	6.683	0.008

Y = dependent variable, X= independent variable
White: Independent variable; week 2

Correlation and prediction equation for body weight at week 3 in white quail colour line

The regression and correlation between body weight at week 3 and subsequent weekly body weights, for white quail colour line is presented in table 4 (p >0.05, 0.882 - 0.965) between week 3 body weight in the white quail colour line was not significant (p < 0.05) at week 4 *and* 5. The R^2 value for predicting body weight at week 3 (independent variable) varied with advancing age of the white quail colour line.

Table 4: Correlation and prediction equation for body weight at week 3 in white quail colour line

Dependent; weeks	Regression equation	R	R^2	Standard error	Sig
4	Y= 0.993x + -12.801	0.965	0.931	3.721	0.000
5	Y= 1.122x + -45.404	0.882	0.779	6.683	0.004

Y = dependent variable, X= independent variable
White: Independent variable; week 3

Correlation and prediction equation for body weight at week 0 in black quail colour line

The regression and correlation between body weight at week 0 and subsequent weekly body weights, for black quail colour line is presented in table 5 (p >0.05, 0.034 - 0.856) between week 0 body weight and subsequent body weight in the black quail. The correlation between week 0 body weight and subsequent in black colour line were significant (p > 0.05) at week 1, 3 and 5. The R^2 value for predicting body weight at week 0 (independent variable) varied with advancing age of the black quail colour line respectively

Table 5: Correlation and prediction equation for body weight at week 0 in black quail colour line

Dependent; weeks	Regression equation	R	R^2	Standard error	Sig
1	Y= -0.028x + 49.936	0.066	0.004	4.060	0.876
2	Y= -0.552x + 100.206	0.856	0.733	2.103	0.007
3	Y= -0.226x + 74.121	0.497	0.247	3.532	0.210
4	Y= -0.455x + 106.992	0.764	0.583	2.627	0.027
5	Y= 0.016x + 45.552	0.034	0.001	4.067	0.937

Y = dependent variable, X= independent variable
Black: Independent variable; week 0

Correlation and prediction equation for body weight at week 1 in black quail colour line

The regression and correlation between body weight at week 1 and subsequent weekly body weights, for black quail colour line is presented in table 6 (p >0.05, 0.010 - 0.280) between week 1 body weight and subsequent body weight in the black quail. The correlation between week 1 body weight and subsequent in black colour line were significant (p > 0.05) at week 2,3,4 and 5. The R^2 value for predicting body weight at week 1 (independent variable) varied with advancing age of the black quail colour line respectively.

Table 6: Correlation and prediction equation for body weight at week 1 in black quail colour line

Dependent; weeks	Regression equation	R	R^2	Standard error	Sig
2	Y= 0,434x + 34.907	0.280	0.078	9.386	0.502
3	Y= 0.011x + 74.801	0.010	0.000	9.777	0.981
4	Y= 0.289x + 34.467	0.202	0.041	9.575	0.631
5	Y= 0.307x + 31.211	0.275	0.075	9.401	0.510

Y = dependent variable, X= independent variable
Black: Independent variable; week 1

Correlation and prediction equation for body weight at week 2 in black quail colour line

The regression and correlation between body weight at week 2 and subsequent weekly body weights, for black quail colour line is presented in table 7 (p >0.05, 0.023 - 0.547) between week 2 body weight and subsequent body weight in the black quail. The correlation between week 2 body weight in black colour line were significant (p > 0.05) at week 3,4 and 5 respectively. The R^2 value for predicting body weight at week 2 (independent variable) varied with advancing age of the black quail colour line respectively

Table 7: Correlation and prediction equation for body weight at week 2 in black quail colour line

Dependent; weeks	Regression equation	R	R^2	Standard error	Sig
3	Y= 0.033x + 91.146	0.046	0.002	6.310	0.913
4	Y= 0.506x + 29.165	0.547	0.299	5.287	0.160
5	Y= 0.017x + 92.545	0.023	0.001	6.316	0.957

Y = dependent variable, X= independent variable
Black independent variable; week 2

Correlation and prediction equation for body weight at week 3 in black quail colour line

The regression and correlation between body weight at week 3 and subsequent weekly body weights, for black quail colour line is presented

in table 8 (p >0.05, 0.226 - 0.796) between week 3 body weight in the black quail. The correlation between week 3 body weight in black colour line were significant (p > 0.05) at week 5. The R^2 value for predicting body weight at week3 (independent variable) varied with advancing age of the black quail colour line respectively.

Table 8: Correlation and prediction equation for body weight at week 2 in black quail colour line

Dependent; weeks	Regression equation	R	R^2	Standard error	Sig
4	Y= 1.041x + -19.210	0.796	0.634	5.408	0.018
5	Y= 0.230x + 82.514	0.226	0.051	8.706	0.591

Y = dependent variable, X= independent variable
Black: Independent variable; week 3

Discussion

The body weight of all birds progressed at every week of measurement in both colour lines (white and black quails), and the result in this study for both correlation and reliability of the prediction equation (R^2) ranged between low to high in this study. The result is in agreement with the findings of Jubril *et al.* (2021) for brown and black coloured Japanese quails, where the R^2 and correlation were generally low to high. However, according to Omeje and Nwosu (1986) the age of the animal is a major determinant of growth and physiological development of these animals and the relationship that exists between these variables can be exploited in the genetic improvement of these birds for body weight through selection at an earlier age of these birds under selection. The age development in most avian specie can be attributed to different phenotypic properties including the plumage colour of these birds. Giordani *et al.* (1993) also reported significant difference in the growth performance of different colour strains of birds in their experiment. According to Murawska, 2012 and Jubril *et al.* 2022 age has a highly significant influence on all linear body parameters as the bird develops as these factors can be used to exploited for directional selection and achieve breeding objectives. The highest R^2 values in both white (0.984) and black (0.796) lines were recorded at week 2. The variation in the values of R^2 for prediction equation for different colour lines and age in quails is consistent with existing literatures (Fayeye and Jubril, 2016 and Jubril *et al.* 2021). For instance, R^2 values between 0.005 and 0.921 were obtained from stepwise regression by Raji *et al.* (2010) and Jubril *et al.* (2020). Fayeye (2014) stated that it is possible to design selection programme in which a desirable genetic improvement in a certain trait is indirectly required by basing selection on a known trait to which they are positively correlated. Therefore, the positive correlation and R^2 between the body weight parameters recorded at different weeks in white and black quails shows that selection of body weight can be done early in an animal's life causing an improvement in genetic programme and body weight of quails can easily be predicted from body initial body weight parameters (Fayeye and Jubril, 2016 and Jubril *et al.* 2023).

Conclusion

The findings of this study suggest that there was a positive correlation between body weight parameter at different ages in both white and black quails. The high value R for linear regression equation obtained from 0-3 weeks in white and black quail colour line suggest the reliability of the linear regression function employed. Therefore, selection for quail based on body weight can be made early in the quail life which improves genetic progress and shortens the generational interval. It also showed the coefficient determination of R^2 values that did not follow any regular pattern as body weight parameters has the highest R^2 values in different colour lines at different ages (weeks) of the

quails, the white colour line quail recorded it highest R^2 value in week 2 while black colour line quail recorded it highest in week0. It can therefore be determined from present findings that the performance of white quails is superior in terms of higher correlation coefficient than the black quail colour line. From this study, it is recommended that further studies should be carried out to ascertain the basis varying value of R^2 in age specific linear regression function for predicting of body weight in the investigated colour line quails in Nigeria. In addition, further studies on prediction of body weight should be carried out on the other breeds or colour lines of quails for improved utilization and productivity

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