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Short Communication

Predicting post-broken traits using the pre-broken traits as regressors in the eggs of helmeted guinea fowl

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Data on egg weight (g), egg length (mm) and egg width (mm) were taken and recorded on three hundred eggs (300) selected at random before they were broken to obtain data on shell weight (g), shell thickness (mm), shell ratio (%), shape index (%), egg surface area (cm^2), unit surface shell weight (cm^2/mg), yolk weight (g), yolk diameter (mm), yolk height (mm), yolk index (%), yolk ratio (%), haugh unit (%), albumen weight (g) and albumen height (mm). A number of equations were developed to predict various egg traits like egg weight from egg length and width, shell weight from the values of egg length, width and weight, eggshell thickness from egg length, width and weight, Albumen height from egg weight, width and length, Height of egg albumen from egg weight, width and length and weight of egg yolk from egg weight and width.

Key words: Egg weight, egg length, egg width, predict.

INTRODUCTION

The quality of table/hatching eggs depends on a number of traits which include egg weight, egg length, egg width, shell weight, shell thickness, shell ratio, shape index, egg surface area, unit surface shell weight, yolk weight, yolk diameter, yolk height, yolk index, yolk ratio, haugh unit, albumen weight and albumen height if other management conditions and health status of the birds are not the limiting factors (Khurshid et al., 2003). Among the traits mentioned above, egg weight, length and width are the only parameters which could be determined before breaking the eggs, while information on rest parameters are usually determined after the eggs have been broken.

It is therefore expedient to probe if the values of these traits covary in a systematic way so as to facilitate predictions of other components that could only be measured after breaking the egg from those determined before breaking it. Different tools, which include covariance, correlation and regression analyses, could be used as measure of association in making predictions. However, regression analysis is indeed the single most important useful measure of association which can be used to explain the amount of change in one variable as a result of a unit change in the value of other variable since we have control over the first variable and can measure it essentially without error (Glover and Mitchell, 2001).

Farooq et al. (2001b) reported positive correlations between egg weight, shell weight and shell thickness in Japanese quails. Farooq et al. (2001a) also reported significant and positive association of egg weight with egg length and width of Fayoumi eggs. This type of information on egg weight along with other egg parameters will open the domain for trying out various prediction equations in order to predict each of the parameters. Prediction of egg quality traits prior to marketing for table is the prerequisite for economic production of eggs. The present study is therefore, an effort to predict egg quality factors in guinea fowl using various egg traits as independent variables.

MATERIALS AND METHODS

The present study was conducted on eggs of guinea fowl maintained on deep litter floor at the aviary unit, Ekiti State Agricultural Development Project, Ikole Ekiti. Data on egg weight (g), egg length (mm) and egg width (mm) were taken and recorded on three hundred eggs selected at random before they were broken to obtain data on shell weight (g), shell thickness (mm), shell ratio (%), shape index (%), egg surface area (cm^2), unit surface shell weight (cm^2/mg), yolk weight (g), yolk diameter (mm), yolk height (mm), yolk index (%), yolk ratio (%), haugh unit (%), albumen weight (g)

and albumen height (mm).
Egg shape index was calculated using the following definition given by Panda (1996).

$$\text{Egg shape index} = \frac{\text{Egg width}}{\text{Egg length}} \times 100$$

Egg surface area, unit surface shell weight, shell ratio, haugh unit, yolk index, yolk ratio, albumen weight, albumen index and albumin ratio were estimated using the following formulae presented by (Altan and Akbas, 1998):

$$S = 3.9782\ W^{0.75056}$$

S = Egg surface area (cm^2)
W = Egg weight (mg), 3.9782 and 0.75056 are constants

$$\text{Unit surface shell weight (mg/cm}^2\text{)} = \frac{\text{Egg weight (mg)}}{\text{Egg surface area (cm}^2\text{)}}$$

$$\text{Shell ratio (\%)} = \frac{\text{Shell weight}}{\text{Egg Weight}} \times 100$$

$$\text{Haugh unit (HU)} = 100 \text{ Log } (H - \frac{\sqrt{G}\ (30W^{0.37} - 100)}{100} + 1.9$$

Where
HU= Haugh unit (g)
H= observed albumin height (mm)
G= gravitational constant, 32.2
W= observed weight of egg

$$\text{Yolk index (\%)} = \frac{\text{Yolk height}}{\text{Yolk diameter}} \times 100$$

$$\text{Yolk ratio (\%)} = \frac{\text{Yolk weight}}{\text{Egg weight}} \times 100$$

Albumen weight (g) = Egg weight – (Yolk weight + Shell weight)

$$\text{Albumen index (\%)} = \frac{\text{Albumen weight}}{\text{Egg weight}} \times 100$$

$$\text{Albumen ratio (\%)} = \frac{\text{Albumen weight}}{\text{Egg weight}} \times 100$$

The following model was used for prediction of egg weight, shell weight and shell thickness, using egg length, width and egg weight as independent variables in different cases:

$$y = a + bx + e$$

Where "y" was response variable, "a" the intercept, "b " the partial regression coefficients, "x " the regressors, and "e " the residual term (Wonnacott and Wonnacott, 1985).

RESULTS AND DISCUSSION

Prediction of egg weight from egg length and width

Egg weight can be predicted with sufficient accuracy (P<0.01) from egg length and width one by one. The R^2 of the fitted model was 21.10% for egg length and 16.82% for egg width. Therefore anyone of the following two equations could be used for predicting egg weight from egg length (eq. 1) or egg width (eq. 2):

$$y = 41.595-0.599x \qquad \text{(eq. 1)}$$
$$y = 39.318-0.205x \qquad \text{(eq. 2)}$$

Where; "y" is the predicted egg weight, "x " the egg length (cm) for equation 1 and "x " the egg width (cm) for equation 2. This report is in tandem with the work of Khurshid et al. (2003) though their research work was on quails.

Predicting shell weight from egg length, width and weight

Shell weight is one of the two important external egg quality traits that cannot be assessed until and unless the eggs are broken. However, prediction equations can be developed to obtain information about these traits without breaking the eggs. Shell weight can be predicted accurately (P < 0.01) from the values of egg length, width and weight. The R^2 value of the fitted model as reported in this study was 8.8 % (equation 3). Equally, shell weight could be predicted with sufficient accuracy (P<0.01) from egg length, width and weight one after the other. The R^2 values of the fitted models were 7.4% for egg length, 8.2% for egg width and 8.4% for egg weight. Any one of the following four equations can be effectively used for predicting eggshell weight from egg length, width and weight (eq. 3), egg length (eq. 4), egg width (eq. 5), and egg weight (eq. 6).

$$y = 3.716+0.04561x_1 + 0.170x_2 - 0.00831x_3 \qquad \text{(eq. 3)}$$
$$y = 3.789+0.07572x \qquad \text{(eq. 4)}$$
$$y = 3.587+0.179x \qquad \text{(eq. 5)}$$
$$y = 4.549-0.0101x \qquad \text{(eq. 6)}$$

Where
"y" is the predicted eggshell weight "x_1", "x_2" and "x_3" the respective measurements of egg length, width and weight in cm in equation 3, "x" represents egg length, width and weight in equations 4, 5 and 6 respectively. This report is in consonance with the work of Farooq et al. (2001b) who reported significant association of shell weight with egg width in Fayoumi eggs thus providing a good ground for the prediction equations.

Predicting eggshell thickness from egg length, width and weight

Shell thickness was predicted with sufficient accuracy (P < 0.01) from egg length (eq. 7), width (eq. 8), weight (eq. 9) and from the three parameters jointly (eq. 10). The R^2 values of the fitted models were 3.10, 4.1, 3.5 and 3.8% respectively. GulNawaz (2002) reported significant association of shell thickness with egg width thus providing a good ground for the following prediction equations. The following equations were developed for predicting shell thickness from egg length, width and weight jointly and singly respectively:

$y = 0.267+0.003756x_1+ 0.01463x_2 + 0.003754x_3$ (eq. 7)
$y = 0.459+0.003673x$ (eq. 8)
$y = 0.431+0.01451x$ (eq. 9)
$y = 0.337+0.003608x$ (eq. 10)

Where
"y" is the predicted eggshell thickness, "x_1", "x_2" and "x_3" the respective measurements of egg length, width and weight in cm in equation 7, "x" represents egg length, width and weight in equations 8, 9 and 10 respectively.

Predicting albumen height from egg weight, width and length

Albumen height was predicted with enough accuracy (P<0.01; adjusted R = 68.44 %; eq. 11) from egg weight, width and length using the following equation;

$y = -14.241 + 0.997x_1 - 0.464x_2 - 0.170x_3$ (eq. 11)

Where "y" is the predicted height of albumen, "x_1" the egg weight, "x_2" the egg width and "x_3" the egg length.

Height of egg albumen can also be predicted from egg weight, width and length seriatim (p<0.01; adjusted R = 65.38, 31.10 and 31.80% respectively). The following equations were developed for predicting height of egg albumen from egg weight, width and length;

$y = -16.774 + 1.003x$ (eq. 12)
$y = 24.236 - 0.690x$ (eq. 13)
$y = 29.097 - 0.836x$ (eq. 14)

Where "y" is the predicted height of albumin, "x " the egg weight, the egg width and the egg length in equations 12, 13 and 14 respectively.

Predicting weight of egg yolk from egg weight, length and width

Weight of egg yolk was predicted with accuracy (P<0.01; Adjusted R = 2.00 %; equation 17) from egg weight, width and length.

$y = 10.525+0.01093x_1 + 0.295x_2 +0.124x_3$ (eq. 15)

Where "y" is the predicted weight of egg yolk, "x_1" the egg weight, "x_2" the egg length and "x_3" the egg width respectively.

Weight of egg yolk can also be predicted from egg weight, width and length (P<0.01 and R^2 = 60.00 %; 8.50 and 17.70% for equations 16, 17 and 18 respectively).

The following equations were developed for predicting weight of egg yolk from egg weight, width and length one by one.

$y = 12.224+0.007073x$ (eq. 16)
$y = 11.708+0.161x$ (eq. 17)
$y = 11.494+0.314x$ (eq. 18)

Where "y" is the predicted weight of yolk, "x" the egg weight, the egg width and the egg length in equations 16, 17 and 18 respectively

Conclusions and Recommendations

*Egg weight was better predicted when egg length was used as regressor, however, egg width could also be used for predicting egg weight.
*Egg shell weight was predicted with better accuracy from egg length, width and weight when used as regressors jointly than when they are used singly.
*Shell thickness was predicted with sufficient accuracy from egg width, length and weight. It could also be predicted from egg weight, length and width one by one.
*Weight of egg albumen could be predicted with enough accuracy from egg weight.

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