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PREDICTION OF HAUGH UNIT THROUGH ALBUMEN HEIGHT AND EGG WEIGHT

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ABSTRACT

Haugh unit which introduced by Raymond Haugh in 1937 is the most scale used to measure the egg quality by equation (HU= 100*Log (h+7.57)-(1.7* W0.37). The aim of this research is to construct a Haugh unit prediction equation through albumen height and egg weight .1503101 value of Haugh unit were calculated using Microsoft Excel spreadsheet functions. The data of egg weight ranged from 40 to 65 gm by increment (0.01) gm, and albumen height from 4 to 10 mm by increment (0.01)mm. The results indicates that there was a significant positive correlation between Haugh unit and albumen height (0.969) and negative correlation between Haugh unit and egg weight (-0.215), and the analysis of variance results for regression showed that the mean square of the model including these two variables were highly significant (P≤0.0001) with coefficient of determination R2 (0.985) which indicate that the prediction equation (HU = 58.235-0.334 W +6.256A) can predict Haugh unit with high accuracy which was confirmed by a residual analysis test.

Keywords: Albumen height, Egg weight, Haugh unit, Prediction
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INTRODUCTION

An eggs is important in the human diet because it is inexpensive, nutritious food and its quality directly relates to human health (Aboonajmi and Najafabadi, 2012) The chicken egg is one of the finest foods, offering human an almost complete balance of essential nutrients with proteins, vitamins, minerals and fatty acids of great biological value (De Menezes *et al*,2012). Egg quality has been defined as its characteristics that affect its acceptability to the consumers. Yimenu et al (2017) indicate that the modern poultry industry is interested in evaluating alternative methods that can be used to measure quality parameters more quickly, and among the main quality parameters of interest is Haugh unit. Haugh unit introduced by Raymond Haugh at 1937 which is calculated by the equation = 100*Log (h+7.57)-(1.7*w0.37) (Morina et al,2015) where h represents albumen height, W is the egg weight . Sekeroglu and Altuntas (2008) pointed out that the height of albumen increases as the weight of eggs increases. Scott and Silversides (2000) found that the strain of layer affects albumen quality. Dikmen et al (2017), Yilidrim and Kaya (2017) found that egg quality affected by the housing system and layer age. Curtis et al (2005) also stated that egg quality affected by layer age. Adeolu and Okoleh (2011) stated that egg weight had a positive correlation with all internal egg traits except Haugh unit. Ahmadi and Rahimi(2011) indicated that internal egg quality may be affected by several factors such as hen strain, storage, age, induced molt,

nutrition, and disease, and understanding these factors help in the production of high-quality eggs. Duman *et al* (2016) studied the correlation between shape index and egg quality traits and he found a significant positive correlation with Haugh unit and albumen index but not significant on yolk index, yolk color, albumen pH, yolk and Albumen blood spot. Ukwu et al (2017) studied the effect of egg weight on egg quality traits, he did not find a significant effect of egg weight on Haugh unit. Onunkwo and Okoro(2015) In a study to develop a prediction equation for the egg internal quality traits from egg weight did not found a significant regression of albumen height and Haugh unit from egg weight where the equations in three varieties of Guinea fowls as follows: hu=83.831+0.127 x+0.296 (black), hu=108.612-0.507x +0.214 (lavender), hu=89.633-0.018x +0.188 (pearl) where X = egg weight.

The aim of the present study is to construct a reliable regression equation to predict the Haugh unit through weight of eggs and albumen height and to estimate correlation coefficients between these three variables. .

MATERIALS AND METHODS

This study was conducted on Haugh unit data, where 1503101 value of Haugh unit was calculated using the following equation which introduced by raymond Haugh in 1937:

$HU= 100* \log (H+7.57)- (1.7*W^{0.37})$

where HU= Haugh unit , H= Albumen height in mm, W= Egg wight in gm .These Haugh unit values calculated from 601 value of Albumen height ranged between(6 -10) mm with 0.01 increment (ie 4.00 , 4.01, 4.02, 4.03, 4.04 .....10), and 2501 value of egg weight ranged between(40 - 65) gm with 0.01 increment (ie 40.00, 40.01, 40.02, 40.03, ... 65), and the overlap of these two sets of values produced 1503101 value of Haugh unit, where each value of albumen height were taken with all values of egg weight, where these number of Haugh unit values obtained by helpful of Microsoft Excel spreadsheet functions especially auto fill function.

The three sets of values (Haugh unit, Albumen height, egg weight) entered in Anonymous 2007 program in three columns to find the relationship between them, especially correlation coefficient, and regression equation of Haugh unit as dependent variable, albumen height and egg weight as independent variables through different methods, and the following best regression equation which represent the relationship between them was obtained: (Al-Rawi, 1987)

Haugh unit = 58.235 – 0.334W + 6.256 H

which was confirmed by a residual analysis test.

. RESULT AND DISCUSION

The values of simple linear correlation coefficients between egg weight, albumen height , and Haugh unit is shown in table (1), there is a significant negative correlation coefficient ($P \leq 0.01$) between the egg weight and Haugh unit (-0.215) and a significant positive correlation coefficient between the albumen height and Haugh unit (0.969) While there was no correlation between the egg weight and the albumen height (0), and from previous studies, Sinha *et al* (2018) found high

correlation between Haugh unit and albumen height (0.934), Hou and Yang (2005) found a significant correlation between albumen height and Haugh unit (0.98), while (sekeroglu and altuntas 2009) did not found a significant correlation between egg weight and Haugh unit, Rathert et al(2011) found a significant correlation between egg weight and albumen height (0.60), (Shi *et al*, 2009) found that correlation coefficient between egg weight and albumen height was (0.092) and with Haugh unit (-0.139), Kul and Seker (2004) found a significant correlation (0.41) between egg weight and albumen height, and non significant correlation between egg weight and Haugh unit (0.11) in quail eggs.

Table(1): Correlation coefficient between , egg weight, albumen height. Haugh unit.

	Egg weight	Albumen height	Haugh unit
Egg weight	1	0	-0.215 **
Albumen height	0	1	0.969**
Haugh unit	-0.215**	0.969**	1

**correlation is significant(P<0.01)

Table (2): Results of the variance analysis of the regression, and it is noted that the mean square of regression, which include the two independent variables (egg weight and albumen height) were highly significant (P≤ 0.000).

Table (2): ANOVA table of regression model.

MODEL	Sum of squares	Df	Mean squares	F	Sig
Regression	185791093.000	2	92895546.520	48291170.960	0.00
Residual	2891439.874	1503097	1.924		
Total	188682532.900	1503099			

The coefficients of regression model include constant (58.235), egg weight W (-0.334), albumen height H (6.256), where all these coefficients show high significant effects (0.000), so the regression model to predict Haugh unit value from egg weight and albumen height is:

Haugh unit = 58.235 – 0.334W + 6.256 H.

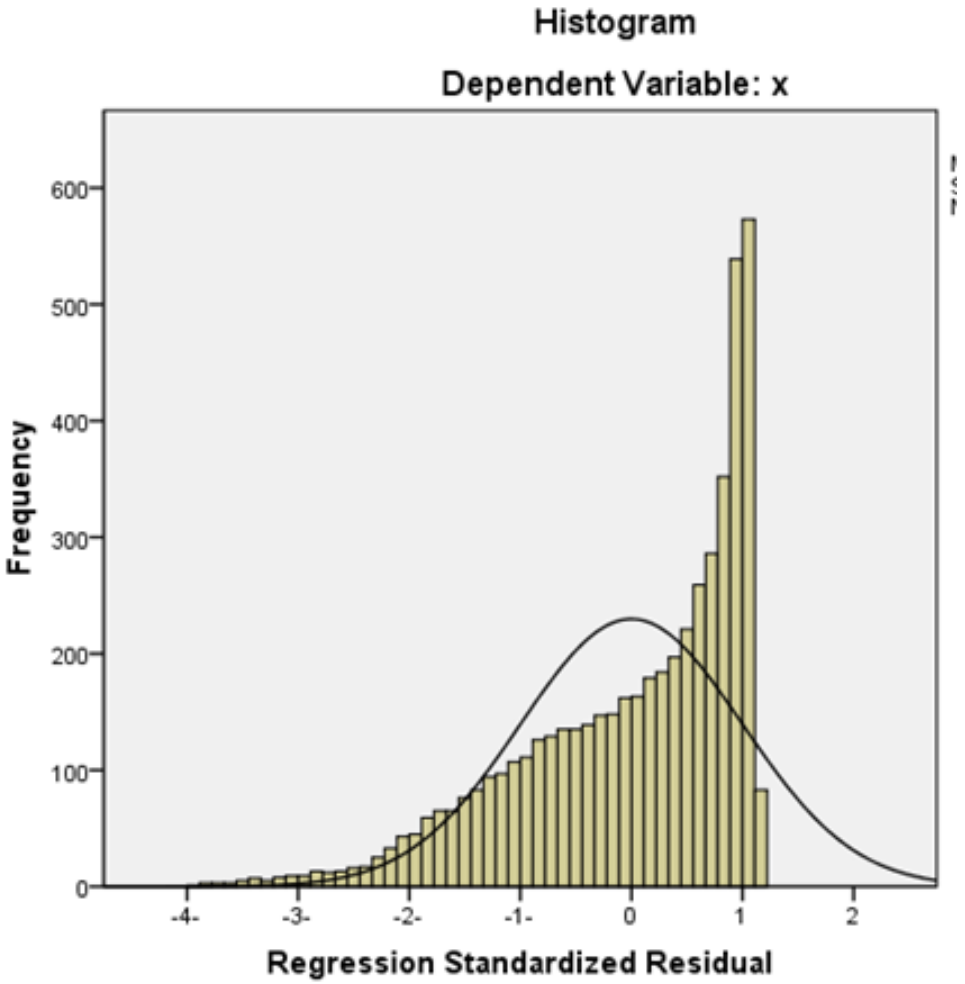
To examine the accuracy of regression model can be judged by verifying the hypothesis of normal distribution of errors and homogenization of its variance where it is noted from table (3) that the mean of residual and standard predicted value and standard residual equal to zero.

Table (3): Residuals statistica.

	Minimum	maximum	Mean	Std.deviation
Predicted value	61.2544	105.9206	84.1335	11.42564
Residual	- 5.57437	1.69474	0.0000	1.42819
Std. predicted value	- 2.002	1.907	0.000	1.000
Std. residual	-3.902	1.186	0.000	1.000

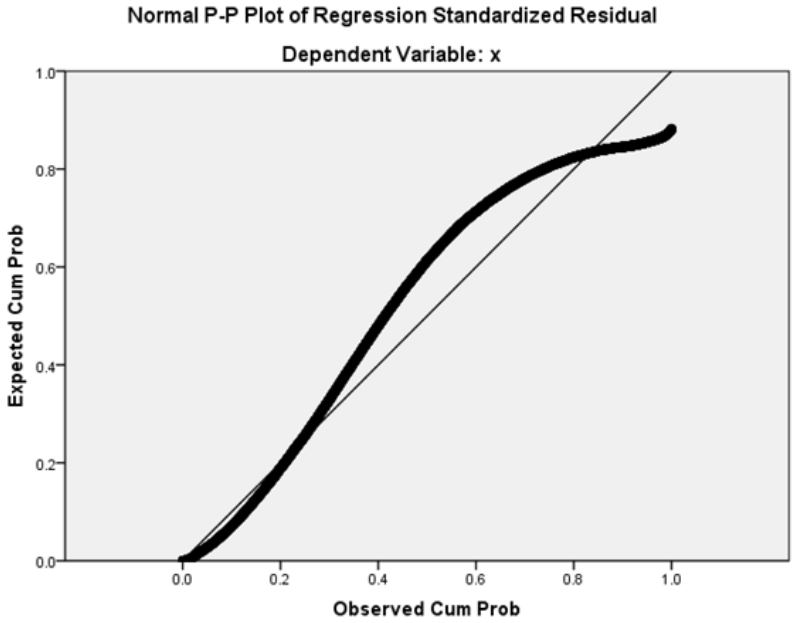
The residual of regression should follow a normal distribution where the residuals are the differences between the observed value and the predicted value, and in order to examine the normal distribution of residuals, were we can see the

normal p- p plot of regression as figure (1) shows that most of values located within the normal distribution curve, and from figure (2) noted that residuals are close to regression line and distributed normally and it takes the shape of crescent and its variance increased or decreased and not constant.



Figure(1): Normal distribution of residuals

Table (4) show a sample of calculated and predicted Haugh unit for different values of egg weight and albumen height ranged from (40–65) gm and (4–10) mm respectively, it is clear that predicted value are close to calculated values where the average of this differences was (-0.29) and the largest difference was (-5.025).



Figure(2): Normal P-P plot of regression standardized residual

Table(4): Calculated and predicted value of hugh unit*

EW(gm)	AH(mm)	HU calculated	HU predicted	Difference
40	4	69.14	69.899	-0.759
41	5	76.74	75.821	0.919
42	6	83.20	81.743	1.457
43	7	88.84	87.665	1.175
44	8	93.83	93.587	0.243
45	9	98.31	99.509	-1.199
46	10	102.37	105.431	-3.061
47	4	65.37	67.561	-2.191
48	5	73.64	73.483	0.157
49	6	80.58	79.405	1.175
50	7	86.58	85.327	1.253
51	8	91.85	91.249	0.601
52	9	96.55	97.171	-0.621
53	10	100.79	103.093	-2.303
54	4	61.62	65.223	-3.603
55	5	70.60	71.145	-0.545
56	6	78.04	77.067	0.973
57	7	84.40	82.989	1.411
58	8	89.94	88.911	1.029
59	9	94.86	94.833	0.027
60	10	99.28	100.755	-1.475
61	4	57.86	62.885	-5.025
62	5	67.60	68.807	-1.207
63	6	75.56	74.729	0.831
64	7	82.28	80.651	1.629
65	8	88.11	86.573	1.537

EW= Egg weight(gm), AH= Albumen height(mm), HU = Haugh unit

The (R) value of this model is (0.992), and R^2, adjusted R^2 is (0.985) which mean that regression model can predict Haugh unit value with high accuracy (98.5%).

التنبؤ بقيمة وحدة هو من بيانات ارتفاع البياض ووزن البيضة

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الملخص

تعتبر وحدة هو(Haugh) التي وضعت من قبل Raymond Haugh عام 1937 من أهم المقاييس المستخدمة في تقييم نوعية البيضة . يهدف هذا البحث إلى إيجاد المعادلة التنبؤية لقيمة وحدة هو (Haugh) اعتمادا على بيانات وزن البيضة وارتفاع البياض، حيث تم حساب 1503101 قيمة لوحدة هو باستخدام دوال برنامج مايكروسوفت اكسل لبيانات وزن البيضة تراوحت بين 40- 65 غم بزيادة مقدارها 0.01 غم وبيانات ارتفاع البياض تراوحت بين 4 - 10ملم بزيادة مقدارها 0.01 ملم، وقد أظهرت النتائج وجود ارتباط معنوي موجب بين وحدة هو وارتفاع البياض مقداره (0.959) وارتباط معنوي سالب مقداره (-0.215) بين وحدة هو ووزن البيضة. أظهرت نتائج تحليل التباين للانحدار أن متوسط المربعات للأنموذج الذي يتضمن هذين المتغيرين (وزن البيضة وارتفاع الألبومين) كان معنويا عاليا ($P\leq0.0001$) بمعامل تحديد يساوي (0.985) R^2 وهذا يدل على ان معادلة الانحدار ($HU=58.235-0.334W+6.256A$) حيث تمثل W وزن البيضة بالغرام وA ارتفاع البياض بالملم، يمكن استخدامها للتنبؤ بوحدة Haugh بدقة عالية وفقا لما أظهره تحليل البواقي.

الكلمات المفتاحية : ارتفاع البياض ، تنبؤ ، وزن البيضة ، وحدة هو .

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