Plant Archives Volume 20 No. 2, 2020 pp. 6685-6688 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

USING THE EXTERNAL EGG TRAITS TO PREDICT THE SHAPE INDEX BY USING MULTIPLE LINEAR REGRESSION AMONG LOCAL AND COMMERCIAL CHICKEN

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Abstract

Egg shape index (%) have been used as a good indicator that linked with several traits in chicken and it seemed as phenomena for recognizing between and within the species. The aim of current study is using the multiple linear regression for predicting the shape index from the egg external parameters (egg weight, egg length and egg breadth). 360 eggs were used for four lines, two of them Kurdish local chicken (Black and Black brown neck) and two commercial strains (Isa brown and Ross). Result showed that significant differences ($P < 0.05$) were observed between the four lines in egg shape index, egg weight, egg length and egg breadth. Moreover the Egg shape index was more affected by the egg breadth for all the lines. The prediction of egg shape index using multiple regression analysis could be a good method for estimating the age, suitable age for hatching chicks and breeding value of chickens. Furthermore, the relationships existing between egg shape index and other parameters studied may be useful in breeding plan.

Key words: Multi-regression, weight, egg shape index, external traits.

Introduction

Chicken egg shape usually given by two figures, length and breadth (maximum diameter) (Narushin, 2005) and in 1975 first instrument was made to measure the egg shape with high accuracy (Reid *et al*., 1975). Several investigators link it to the Hatchability (Narushin and Romanov, 2002), eggshell strength (Nedomova *et al*., 2009), chicken embryo growth (Mortola and Al-Awam, 2010) and brood patches (Barta and Szekely, 1997).

Egg shape could varied between bird's species (Shaker *et al*., 2019b) and also within species (Shaker *et al*., 2016; Shaker *et al*., 2017; Shaker *et al*., 2019c), according to the age (Okruszek *et al*., 2006; Aziz *et al*., 2017), season (Nikolova and Kocevski, 2006), clutch (Zduniak and Antczak, 2003), Housing system (Tumova and Ebeid, 2005), feather color (Saatci *et al*., 2005), light type (Er *et al*., 2007) and time of the oviposition (Shaker *et al*., 2019d).

Mathematics of egg shape was studied faithfully by Nishiyama, (2012), who mention in his study of various egg shape and the evolution of egg. Egg breadth, which is one of most used shape index parameters increase significantly with age within chicken breed (Usman *et al*., 2014), but egg length was not. Several researchers investigated the heritability of shape index and it's ranged between (0.57, 0.58, 0.685) (Begli *et al*., 2010; Blanco *et al*., 2014; Pradeepta *et al*., 2015).

The aim of current study is to using the multiple regression equation for predicting the shape index from the egg external parameters (egg weight, egg length and egg breadth) by using two commercial chicken strains and two local Kurdish chicken.

Materials and Methods

Current experiment was done in the animal production department, directorate of Agricultural Research Center in Sulaimani-Republic of Iraq, during February 2019. A total of 360 eggs were used from two genetic groups of Kurdish local chicken (Black = 90; Black brown neck = 90) and two commercial chickens

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Table 1: Descriptive analysis of egg shape index, egg weight, egg length and egg breadth for the for lines B, BBN, Isa brown and Ross.

Line	N	Shape index (%)		Egg weight (g)		Egg length (mm)		Egg breadth (m)	
		Mean ± S.D	C.V.	Mean ± S.D	C.V.	Mean ± S.D	C.V.	Mean ± S.D	C.V.
Black	90	72.95±2.57 c	3.52	58.43±5.91 b	10.11	58.17±2.23 a	3.83	42.40±1.40 b	3.30
Black brown neck	90	75.07±3.20 b	4.26	61.45±3.29 a	5.35	57.98±2.33 a	4.01	43.46±0.90 a	2.07
Isa brown	90	75.20±2.65 b	3.52	58.49±3.98 b	6.80	56.98±2.03 b	3.56	42.81±1.15 b	2.68
Ross	90	77.49±3.35 a	4.32	56.29±3.98 c	7.07	51.58±3.33 c	6.45	39.96±3.00 c	7.50
P-Value		35.380		20.861		135.978		64.436	
Sig.		0.000		0.000		0.000		0.000	
S.D. = standard deviation, C.V.= coefficient of variation; a-c indicate significant differences between means.									

(Ross = 90; Isa brown =90). Eggs were weighted by using digital electronic balance with accuracy (0.01 g) and the egg length and breadth were measured by digital vernier instrument with accuracy (0.01 mm). Egg shape index was calculated according to the following equation, which was descripted by (Reddy *et al*., 1979).

$$\text{Egg Shape index (ESI)} = \frac{\text{Breadth (B)}}{\text{Length (L)}} \times 100$$

The data were analyzedusing descriptive statistics to calculate the mean, standard deviation and coefficient of variation,by using the SPSS (Version 20.0) software (SPSS, 2011). Moreover the effect of lines on the egg parameters was analyzed using general linear model (GLM) procedure and Duncan's multiple range test (Duncan, 1955) was used to test the difference between means. Pearson's correlation (r) between the variables was determined. Multiplelinear regression analyses were performed to determine the most influencing parameters on egg shape index and the model was as below:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + e$$

Where,

Y = Percentage of Shape index

a = Intercept

b = Partial regression coefficient

X = Independent variables (egg weight, egg length and egg breadth)

e= error

Result and Discussion

The descriptive analysis concerning the mean, standard deviation and coefficient of variation of the egg shape index, egg weight, egg length and egg breadth for the four lines Black (B), Black brown neck (BBN), Isa brown and Ross are shown in table 1. Egg shape index was higher in Ross and intermediate in both Isa brown and BBN and lower in B line, (77.49, 75.20, 75.07 and 72.95) respectively. Egg weight was higher in BBN, intermediate in both Isa brown and B and low in Ross line, (61.45, 58.49, 58.43 and 56.29) respectively. Egg length was higher in in both BBN and B, intermediate in Isa brown and low in Ross line, (57.98, 58.17, 56.98 and 51.58) respectively. Egg breadth was higher in BBN and intermediate in both Isa brown and B and low in Ross line (43.46, 42.81, 42.40 and 39.96) respectively. The coefficient of variation for the egg shape index was lowest in both B and Isa brown, which were 3.52. In egg weight was lowest in BBN (6.80). In egg length was in Isa brown (3.56). Finally, egg breadth was

Table 2: Phenotyping correlation among the egg shape index, egg weight, egg length and egg breadth, for the four chicken lines B, BBN, Isa brown and Ross.

Line	Traits	Shape index	Egg weight	Egg length	Egg breadth
Black	Shape Index (%)	1.000			
	Egg Weight (g)	- 0.033^{NS}	1.000		
	Egg length (mm)	- 0.593 ***	0.711 ***	1.000	
	Egg Breadth (mm)	0.388 ***	0.779 ***	0.510 ***	1.000
Black brwon neck	Shape Index (%)	1.000			
	Egg Weight (g)	- 0.319 **	1.000		
	Egg length (mm)	- 0.877 ***	0.686 ***	1.000	
	Egg Breadth (mm)	0.366 ***	0.680 ***	0.124^{NS}	1.000
Isa brown	Shape Index (%)	1.000			
	Egg Weight (g)	- 0.090^{NS}	1.000		
	Egg length (mm)	- 0.711 ***	0.729 ***	1.000	
	Egg Breadth (mm)	0.394 ***	0.833 ***	0.364 ***	1.000
Ross	Shape Index (%)	1.000			
	Egg Weight (g)	0.011^{NS}	1.000		
	Egg length (mm)	- 0.070^{NS}	0.510 ***	1.000	
	Egg Breadth (mm)	0.519 ***	0.439 ***	0.816 ***	1.000
***Correlation is significant at the 0.001 level; **Correlation is significant at the 0.01 level; *Correlation is significant at the 0.05 level; NS: Correlation is not significant.					

Table 3: Regression coefficients.

Line	Regression coefficients				R^2	SE	F.	Sig.
	Const.	b1	b2	b3				
B	71.953	0.000	-1.231	1.712	0.997	0.14184	9729.930	0.000
BBN	73.289	-0.019	-1.270	1.762	0.998	0.13277	17156.148	0.000
Isa brown	74.913	0.006	-1.290	1.716	0.997	0.14595	9729.665	0.000
Ross	76.899	0.009	-1.488	1.923	0.997	0.19091	9080.844	0.000

Table 4: Multiple regression equation.

Line	Shape index (%) Equation
Black (B)	ESI % = 71.953 – 1.231 L+ 1.712 B
Black brown neck (BBN)	ESI % = 73.289 – 0.019 W – 1.270 L + 1.762 B
Isa brown	ESI % = 74.913 + 0.006 W – 1.290 L + 1.716 B
Ross	ESI % = 76.899 + 0.009 W – 1.488 L + 1.923 B

the lowest in BBN, which was (2.07). Current result was support by Shaker *et al*., (2016) and Shaker *et al*., (2019a), who recorded higher shape index in BBN then the B line in Egg shape index. Moreover excced BBN to all the lines in egg weight and egg length.

Pearson's coefficient of correlation among the egg shape index, egg weight, egg length and egg breadth in the four lines are given in table 2. The egg shape index was negative correlated coefficient with egg weight; our result indicates that no significant correlated in B, Isa brown and Ross (-0.033, -0.090, -0.011) respectively, but significant negative correlation found ($P<0.05$) in BBN (-0.0319). Moreover, egg shape index was significant negative correlation coefficient with the egg length in B, BBN and Isa brown, which was moderate in B (r = -0.593) and strong in both BBN and Isa brown (r = -0.877, -0.771) respectively and non significant was in Ross. Egg shape index was significant positive correlated ($p<0.05$) with the egg breadth ranged from moderate for all lines B, BBN, Isa brown and Ross (0.388, 0.366, 0.394, 0.519) respectively. Another result was observed that egg breadth was significantly positive correlated with egg weight and egg length in (B, Isa brown and Ross), but in BBN the egg breadth was non-significant correlated with the egg length (0.124). Current data was approach to finding of Shaker *et al*., (2019d) who report that shape index in Ross was not correlated with egg weight and there is significant positive correlation between the Shape index and egg breadth. And vice versa the egg length which was significant negative correlation. Another study was found that the egg weight was significant positive correlated to the shape index in chicken (Shaker *et al*., 2019b), this finding may explain by difference in lines or the age of hens which, could have effect on the egg shape index.

The regression coefficients R2 and the level of statistical significant of model predicted the egg shape index among four lines given in table 3. Statistical significant of current experiment that all the models of the four lines were adequate for select the models. All the coefficient of determination among the four lines was high. Multiple regression equation of shape index % on the parameters (egg weight, egg length and egg breadth) for the four lines was follows table 3 and table 4. These equations imply that the increasing of egg breadth will increase the egg shape index and the effect of egg length was reverse. Moreover the equation of Black (B) line didn't have any egg weight effect, unlike of BBN, Isa brown and Ross. The variation between the lines equation was back for a reason of genetic effect (Shaker *et al*., 2016).

Conclusion

The prediction of egg shape index using multiple regression analysis could be a good method for estimating the age by estimate equation for each production age, suitable age for hatching chicks and breeding value of chickens. Furthermore, the relationships existing between egg shape index and other parameters studied may be useful in breeding plan.

Acknowledgement

The author acknowledges the financial assistance provided by the Agricultural research center in Sulaimani for the execution of this investigation.

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