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PRINCIPAL COMPONENT ANALYSIS OF INTERNAL EGG TRAITS FOR FOUR GENETIC GROUPS OF LOCAL CHICKEN

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ABSTRACT: This study was carried out to investigate the relationship among egg weight and their components in four genetic lines of Kurdish local chicken. 299 eggs were collected from four genetic lines of Kurdish local chicken. After collection, egg weight, yolk weight, albumin weight and shell weight were weighted to nearest (0.01g). The Two principal components (PC1 and PC2) were extracted in Black, Black with brown neck, White shank feather and white non-feathering shank, which explained (82.71, 80.45, 84.09, and 76.40) respectively, of total variation. Significant differences were observed between the four genetic lines (Black, Black with brown neck, white with shank feather, and white non-feathering shank). We found that egg weight highly ($P<0.001$) correlated with yolk (r^2= 0.900, 0.822, 0.898, 0.690) respectively, albumin weight (r^2= 0.498, 0.575, 0.524, 0.845) and shell weight (r^2= 0.525, 0.549, 0.649, 0.339). It was concluded that egg weight and their component significantly differences among the groups due to the differences in genotypes. These finds could be used to improve egg quality and for selection criteria.

Key words: Chicken – Internal - egg - traits - PCA

INTRODUCTION

Chickens were domesticated before 8000 years ago for cockfighting (Thomson, 1964), eggs and meat production (Wood-Gush, 1959a) and also for crowing (Kuwayama et al., 1996). Therefore, many breeds were arisen that differ significantly in many traits such as egg weights and their components, which mainly effect on Customer desire (Stadelman and Cotterill, 1977), hatchability rate (Pinowska et al., 2002; Abiola et al., 2008), and Survival of chicks (Alabi et al., 2012). The inheritance of internal and external traits for the chicken egg was investigated by many researchers (Obeidah et al., 1977; Chen et al., 1993; Suk and Park, 2001) due to huge of unique genes it has. A decade ago many attempts have been done to study the internal egg traits (Abdulla et al.,2016; Shaker and Aziz, 2017), and external traits (Mohammed et al., 2016; Shaker et al., 2016) for the Kurdish local chickens to characterize these genetic lines, they found significant differences between the genetic lines in these traits. Consequently, principal component analysis is a mathematical procedure has been used to describe the relationship between the traits (Yakubu et al., 2009; Udeh and Ogbu 2011; Dorji et al., 2012). Therefore, the objective of this study was to examine the relationship among the internal egg traits in four genetic lines of Kurdish local chickens with a view of identifying those components that define egg conformation. These could be used as selection criteria for improving egg quality and production in the local chicken.

MATERIALS AND METHODS

Experiment was carried out in the animal production dept., agricultural research center in Sulaimani, ministry of Agriculture and water resources in Kurdistan government region-Iraq. Four genetic lines namely Black (B), Black with brown neck (BBN), white with shank feather (WSF), and white with non-feathering shank (WNFS) were used. A total of 299 fertilized eggs were collected when hens were at 62-65 weeks age-old, comprising 82 eggs collected from B, 103 eggs from BBN, 24 eggs from WSF, and 92 eggs from WNFS. The four genetic lines and the flock management were described faithfully by (Shaker et al., 2016; Shaker and Aziz, 2017). Eggs were weighted in gram (g) immediately after collection by using electronic balance (0.01 g) sensitivity. Yolk, albumin, and shell weight were measured for each egg in each genetic line.

After breaking the egg, yolk was separated from albumin and weighted, eggshell of break eggs were washed with water and dried at room temperature for 24 hours following this procedure, eggshell weighted (with membrane) was measured. Finally, albumin was weighted by excluded yolk and shell weight from the total egg weight.

Means, standard errors and coefficients of variation of egg weight and internal egg traits were calculated using descriptive statistics of SPSS/PASW. Pearson's coefficients of correlation (r) among egg weight and the internal egg traits were estimated. From the correlation matrix, data were generated for the principal component factor analysis. Anti-image correlations, Kaiser-Meyer-Olkin measures of sampling adequacy rotation component matrix, and Bartlett's Test of Spherity were computed to test the validity of the factor analysis of the data sets (Jolliffe, 2002). The appropriateness of the factor analysis was further tested using communalities that represent the amount of the variable that is accounted for by the component (Wuensch, 2005).

RESULTS AND DISCUSSION

Means, standard errors and coefficient of variation for egg weight and internal traits in four genetic lines of Kurdish local chicken were present in table 1. Significant differences were observed in egg weight and all internal traits ($p<0.01$). The significantly highest egg weights were observed for WNFS and BBN (62.64±0.44, 61.44±0.32) respectively, while the lowest significant weights were recorded for B and WSF (59.16±0.59, 57.85±0.93) respectively. Several investigators have compared the egg according to the hen physical appearances. (Adomako, et al., 2013) found that the hen with brown father laid egg bigger than white color hen, and the white color laid bigger than the black color hen. Also (Shaker et al., 2016) found that egg weight in WSF higher then WNFS and B, and the lowest line was BBN, furthermore (Abdulla et al., 2016) found Superiority egg weight in BBN and both white genetic lines upon the B, and (Shaker and Aziz, 2017) who studied the relationship between appearance of shank feather and internal egg traits by using same genetic lines that egg weight and their components were significantly differed between WSF and WNFS. Generally the results support our finding that these genetic lines differ genetically in egg weight and internal traits due to the genetic components. The coefficients of variation (C.V.) for egg weight were 5.44, 6.68, 7.92, and 9.06 for BBN, WNSF, WSF, and B respectively. For albumin weight were 6.97, 8.27, 10.62, and 12.58 for BBN, WNFS, WSF, and B respectively. For Yolk weight were 7.57, 8.69, 9.72, and 10.35 for BBN, WSF, WNFS, and B respectively. And for shell weight the C.V. were 13.44, 13.75, 14.61, and 15.29 for BBN, WNFS, B, and WSF respectively. Consequently the results indicate that BBN line less variability then the three lines in all the traits.

Table 2 presents the Eigen values, percentage of the total variance and communalities of the egg components of the four genetic lines of Kurdish local chicken. The communalities for the four genetic lines ranged 0.723 – 0.956, 0.694 – 0.958, 0.737 – 0.918, and 0.567 – 0.863 in B, BBN, WSF, and WNFS respectively. The values of communalities computed for the four genetic lines of chickens confirm that PCA was appropriate for the data set. Additionally the significant of the correlation metrics tested with Bartlett's test of Spherity for egg internal traits of $X^2= 23.318$, $p<0.001$; X2= 20.202, $p< 0.001$; X2= 7.883, $p<0.05$; and X2= 9.551, $p<0.05$, for B, BBN, WSF, WNFS respectively, provided enough support for application of principal components analysis on the data set.

Two principal components were extracted from (B) with Eigen values of 1.562 for the first principal component (PC1), and 0.919 for the second principal component (PC2), and together accounted for 82.71% of the total variance. In (BBN), the two principal components were extracted with Eigen values of 1.457 for PC1 and 0.956 for PC2 and together accounted for 80.45 % of the total variance. (WSF) two principal components were extracted with Eigen value 1.645 for PC1 and 0.878 PC2 and together accounted 84.09% of the total variance. And in (WNFS) two principal components were extracted with Eigen value 1.356 for PC1 and 0.936 for PC2 and together accounted 76.40% of the total variance. Generally in the four genetic lines of chicken, PC1 had the largest share of the total variance and traits for five genotypes found that albumin trait are the most effective parameter of egg.

Pearson's coefficients of correlation between egg weight and internal egg components for the four genetic lines are given in table 3. The correlation coefficients ranged from 0.091 to 0.900, 0.054 to 0.822, 0.123 to 0.898, and 0.064 to 0.845 in B, BBN, WSF, and WNFS respectively. Relationship between egg weight and all internal components were positive. The positive relationship between egg weight and the internal components showed that internal

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correlated highly with albumin weight. (Sarica et al., 2012) that used principal component analysis to study the internal

components could be predicted from egg weight. A similar observed was reported by (Abdulla et al., 2016; Shaker & Aziz, 2017).

CONCLUSION

It was concluded that egg weight and their component significantly differences among the groups due to the differences in genotypes, and BBN line has less variability comparing with the other three lines. These finds could be used to improve egg quality and for selection criteria

Table (1): Means, standard errors and coefficient of variation for egg components of the four genetic lines.

Traits	B n = 82		BBN n = 103		WSF n = 24		WNFS n = 119		P-value
	Mean	C.V.	Mean	C.V.	Mean	C.V.	Mean	C.V.	
Egg weight	59.16±0.59^{b}	9.06	61.44±0.32^{a}	5.44	57.85±0.93^{b}	7.92	62.64±0.44^{a}	6.68	0.000
Albumin weight	35.32±0.49^{a}	12.58	36.07±0.25^{a}	6.97	33.62±0.72^{b}	10.62	36.34±0.31^{a}	8.27	0.000
Yolk weight	18.58±0.21^{c}	10.35	19.75±0.14^{b}	7.57	19.20±0.34^{bc}	8.69	20.52±0.20^{a}	9.72	0.002
Shell weight	5.24±0.847^{b}	14.61	5.60±0.74^{a}	13.44	5.02±0.15^{b}	15.29	5.77±0.08^{a}	13.75	0.000

a-c indicate significant differences between genotype ($p<0.05$). B= black; BBN= black with brown neck; WSF= white shank feather; WNFS= white non-feathering shank

Table (2): Eigen values and percentage of total variance and communalities of the egg components in four genetic lines.

Traits	B			BBN			WSF			WNFS		
	PC1	PC2	Com.	PC1	PC2	Com.	PC1	PC2	Com.	PC1	PC2	Com.
Albumin weight	.893	-.077	.956	.867	-.103	.958	.931	-.032	.868	.631	-.646	.750
Yolk weight	.786	.324	.803	.787	.271	.762	.690	.511	.918	.782	-.021	.567
Shell weight	.082	.974	.723	.063	.977	.694	.054	.957	.737	.589	.720	.863
Eigenvalue	1.562	.919		1.457	.956		1.645	.878		1.356	.936	
% of total variance	52.06	30.65		48.58	31.87		54.82	29.27		45.20	31.20	

PC= principal component; Com= communalities; B= black; BBN= black with brown neck; WSF= white shank feather; WNFS= white non-feathering shank

Table (3): Correlation coefficient of egg weight and their components.

Traits	Egg weight	Albumin weight	Yolk weight	Shell weight
Black (B)				
Egg weight	1.000			
Albumin weight	0.498**	1.000		
Yolk weight	0.900**	0.091 NS	1.000	
Shell weight	0.525**	0.445**	0.269*	1.000
Black with brown neck (BBN)				
Egg weight	1.000			
Albumin weight	0.575**	1.000		
Yolk weight	0.822**	0.054 NS	1.000	
Shell weight	0.549**	0.384**	0.201*	1.000
White with shank feather (WSF)				
Egg weight	1.000			
Albumin weight	0.524**	1.000		
Yolk weight	0.898**	0.123 NS	1.000	
Shell weight	0.649**	0.379 NS	0.439*	1.000
White with non-feathering shank (WNFS)				
Egg weight	1.000			
Albumin weight	0.845**	1.000		
Yolk weight	0.690**	0.239*	1.000	
Shell weight	0.339**	0.064 NS.	0.217*	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; B= black; BBN= black with brown neck; WSF= white shank feather; WNFS= white non-feathering shank

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الملخص العربى

تحليل المكونات الرئيسية لمواصفات البيضة الداخلية في اربع مجاميع وراثية من الدجاج المحلي

شاناز مصطفى عبد الله ، احمد سامي شاكر
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أجريت هذه الدراسة في مركز البحوث الزراعية في محافظة السليمانية التابع لوزارة الزراعة و الموارد المائية لحكومة اقليم كوردستان العراق لمعرفة العلاقة بين وزن البيض ومكوناته في أربعة خطوط وراثية من الدجاج المحلي الكوردي. تم جمع 299 بيضة من أربعة خطوط وراثية. بعد الجمع ، تم وزن وزن البيض ، وزن الصفار ، وزن الألبيومين ووزن القشرة إلى أقرب (0.01.غرام). تم استخراج اثنين من المكونات الرئيسية (PC1 & PC2) للدجاج باللون الأسود والأسود والعنق البني والدجاج الابيض ذو ريش عرقوب، و الأبيض من غير ريش العرقوب ، والتي كانت (82.71 ، 80.45 ، 84.09 ، و 76.40) على التوالي ، من التباين الكلي. لوحظت فروق معنوية بين الخطوط الوراثية الأربعة (أسود ، أسود مع رقبة بنية ، أبيض مع ريش ساق ، والابيض من غير ريش الساق).
وجد ان وزن البيضة يرتبط بدرجة عالية (P <0.001) مع صفار البيض (بمعدل ارتباط r2 = .0.009 و 0.822 و 0.898 و 0.690على التوالى و مع وزن الألبيومين البيض (بمعدل ارتباط r2 = 0.498 و 0.575و 0.542و 0.845 على التوالى ومع وزن القشرة (بمعدل أرتباط r2 = 0.525 و 0.549 و 0.649 و 0.339 على التوالى.
تم استنتاج أن وزن البيض ومكوناتهم تختلف بشكل كبير بين المجموعات بسبب الاختلافات في التراكيب الوراثية. يمكن استخدام هذه الاكتشافات لتحسين جودة البيض ولمعايير الانتخاب.