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GENETIC AND NON-GENETIC PARAMETERS FOR EGG PRODUCTION TRAITS OF TWO IRAQI LOCAL CHICKS

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Abstract

Five hundred and twenty fertile eggs of two local lines were hatched. The resulted chicks were bred and considered as parents (G0). During maturity, 60 females and 10 males of each line were distributed randomly into ten families. Eggs were collected during the peak of production for each generation to produce chicks of the next generation (G1 and G2). Weight and number of eggs were recorded daily and accordingly, the egg mass was calculated. GLM within SAS program was used to analyze the effect of genetic groups and generations on the studied traits. REML method was used to estimate the genetic parameters and repeatabilities. The overall mean of egg weight, daily egg production, and daily egg mass were 48.15 g, 46.84% and 22.59 g, respectively. Effects of genetic group and generation on egg weight were highly significant. Differences between the two lines and the generations in their egg production and egg mass were not significant. Estimates of heritability for egg weight, egg production and egg mass were 0.29, 0.39 and 0.33, respectively, and on the same order, their repeatabilities were 0.47, 0.40, and 0.36. Higher genetic (0.67) and phenotypic (0.49) correlations were recorded between egg weight and egg mass; while, the correlations between egg weight and egg production were negative and being -0.40 and -0.17 on the same order. It can be concluded that the black line will be suitable for egg purposes. Fixed effects need to be adjusted in order to estimate allowable genetic parameters. Genetic gain of birds by generation on the basis of egg weight will be effective for both lines.

***Keywords*:** Iraqi Local Chicks, Egg traits, Genetic Parameters, Repeatability

Introduction

Indigenous chickens constitute about 80% of the local flocks in Africa and Asia, and could form the basis for genetic improvement and diversification to produce breeds adapted to the local environment (Hoffmann, 2005); on the contrary, about 50% of the chicken breeds are classified as being at risk. Regardless of their low growth rates and egg production, indigenous chickens are more resistant to various diseases and can survive under poor nutritional and environmental conditions (Minga *et al*., 2004).

Genetic estimates including heritability, genetic and phenotypic correlations and repeatability of egg production traits in different breeds and/or strains were cited by many investigators who found that there were a lot of variations in these estimates according to the differences of the genetic make-up (El-Labban *et al*., 1991; Poggenpoel *et al*., 1996; Khalil *et al*., 2004; Nurgiartiningsih *et al*., 2004 and Chen *et al*., 2007). In the great majority of single trait selection experiments, positive genetic progress for the trait selected, egg number or rate egg production, was presented; while, in a few cases, genetic progress was absent or negative (Fairfull and Gowe, 1990).

The aim of this study was to analyze genetic and non-genetic factors affecting egg production traits of two Iraqi local chickens (white and black) and to estimate the genetic parameters using an accurate method to be able to improve their productivity by breeding beside the suitable management.

Materials and Methods

Five hundred and twenty fertile eggs of two local lines (White and Black) taken from Agriculture Research Center-Ministry of Agriculture-Baghdad were hatched on the date 9 Sept. 2016. The resulted chicks were bred at the field of Agricultural College, University of Salahaddin, Erbil, Iraq, and considered as parents (G0). During maturity, 60 females and 10 males of each line were distributed randomly into ten families; each family contains one male and six females. Eggs resulted from each family belonging to each line were collected during the peak of production (23-24 week) for each generation to produce chicks of the next generation (G1 and G2). The experiment continued for the period from 9 Jan. 2017 until 25 August 2018. Weight and number of eggs were recorded daily and accordingly, the egg mass production was calculated starting with their maturity (producing 5% of eggs in the flock) (Singh, 1990) and continued until 42 weeks of their age. The chicks were fed according to Isa brown guide (Hendrix Company, 2010) and bred in a clean well-ventilated hall and belonged to ordinary management. All chicks were given Newcastle vaccines, antibiotics, minerals and vitamins as needed.

General Linear Model (GLM) within the statistical program SAS (2005) was used to analyze the studied traits including egg weight, egg number and egg mass during 24 weeks of production. The model includes the effect of genetic groups and generations for the traits. Scheffe's test within the SAS (2005) was conducted to distinguish the significant differences between the least square means of the levels of each factor. Restricted Maximum Likelihood-REML (Patterson and Thompson, 1971) method was used to estimate the variance component of random effects. The mixed model includes the effect of sire as well as the above-fixed effects. Variance-covariance (VCV) matrices were built from random effects (sire and error) and tested for positive definiteness in order to develop reliable estimates and VCV used for genetic parameters should be within the allowable range (Hayes and Hill, 1981). Repeatabilities for egg weight, egg number and egg mass were also estimated.

Results and Discussion

The overall mean of egg weight, daily egg production and daily egg mass were 48.15±0.26 g, 46.84±0.86 % and 22.59±0.40 g, respectively (Table 1).

Egg Weight: It appears from Table (1) that the black chickens (L2) excelled white chicks (L1) in their egg weight (49.18 vs. 47.12 g) and the differences between the two genetic groups were highly significant ($p<0.01$) (Table 2). Earlier study used several lines of the indigenous chickens bred by selection in Kurdistan region; northern Iraq found that genetic lines have a significant effect on egg weight at different ages (Hermiz *et al*., 2012; Shaker *et al*., 2016 and Abdullah and Shaker, 2018). Also, several researchers revealed the significant differences in egg weight at different ages using pure or cross breeds, strains or lines (Javed *et al*., 2003; El-Labban *et al*., 2011; Al-Rubaiee, 2012; Khawaja *et al*., 2012 and 2013; Oke *et al*., 2014; and Jaja *et al*., 2017). The effect of generation on egg weight was highly significant (Table 2) where the egg weight of the 2nd generation excelled those of the parents (G0) and the 1st generation by 2.94 and 0.93 g, respectively (Table 1). The significant effect of generation on egg weight of different breeds/strains was also noticed by Vivian (2011 and 2012) and Abdel-Ghany et al. (2014) who revealed that egg weight increased with each succeeding generation.

Table 1 : Least Square Means ± S.E. for the factors affecting egg weight, daily egg production and mass:

Factors	No	Egg weight (g)	Daily egg production (%)	Daily egg mass (g)
		Means± S.E.	Means± S.E.	Means± S.E.
Overall mean	360	48.15±0.26	46.84±0.86	22.59±0.40
Genetic Group:				
Local White (L1)	180	47.12 ± 0.36 b	47.82 ± 1.21 a	22.61 ± 0.59 a
Local Black (L2)	180	49.18 ± 0.38 a	45.88 ± 1.23 a	22.57 ± 0.56 a
Generation:				
Parents	120	46.50 ± 0.43 b	48.35 ± 1.48 a	22.50 ± 0.69 a
1st Generation	120	48.51 ± 0.44 a	46.67 ± 1.46 a	22.75 ± 0.69 a
2nd Generation	120	49.44 ± 0.44 a	45.53 ± 1.49 a	22.53 ± 0.67 a

Means having different letters within each factor/column differ significantly ($P<0.05$) according to Scheffe's test.

Table 2 : Mean squares and test of significance for factors affecting egg weight, daily egg production and mass:

Factors	d.f.	Egg weight	Daily egg production	Daily egg mass
		Mean squares	Mean squares	Mean squares
Genetic Group	1	381.309 **	0.034	0.171
Generation	2	270.143 **	0.024	2.194
Residual	356	23.166	0.027	57.76

** $P<0.01$

Daily egg production and Daily egg mass: The results of this study did not reveal any significant differences between the two lines in their daily egg production and daily egg mass. However, the white chickens have a mathematically higher daily egg production and Daily egg mass than black chickens (47.82 vs. 45.88), (22.61 vs. 22.57) respectively (Tables 1 and 2). These results could be explained by the fact that the egg weights of black chickens were higher than those produced by white chickens. Earlier studies investigated the differences between pure breeds/strains of chicks and their crosses in their daily egg production and daily egg mass and reported that it was significant at different periods of ages (El-Labban *et al*., 2011 and Khawaja *et al*., 2013). The Mathematical differences between daily egg number and daily egg mass of chickens belonging to different generations were not statistically significant (Tables 1 and 2). These results indicated that increasing egg weight will decrease egg number after two generations which could be due to negative genetic and phenotypic correlations between these two traits (Table 3). However, the results reported by Vivian (2011) and Abdel-Ghany *et al*. (2014) stated that the egg number and egg mass were increased significantly in the second generation compared with the base (parent) and the first generation.

Heritability Estimates: Estimates of heritability for egg weight, daily egg production and daily egg mass are presented in Table (3) and were 0.29, 0.39 and 0.33, respectively. These findings indicated that the heredity of these traits represents 29 %, 39% and 33%; while, the rest could be controlled by the environment. Earlier studies mentioned that heritability estimates of egg production traits using different methods of estimating the variance components were mostly moderate to high (Liljedahl *et al*., 1984; Francesch *et al*., 1997; Oni *et al*., 2000; Nurgiartiningsih *et al*., 2004; Adebambo *et al*., 2006; Paleja *et al*., 2008; Begli *et al*., 2010; Dana *et al*., 2011; El-Labban *et al*., 2011; Vivian, 2011; Foleng *et al*., 2012; Shadparvar and Enayati, 2012; Vivian, 2012; Abdel-Ghany *et al*., 2014; Rath *et al*., 2015 and Jaja *et al*., 2017), and hence the selection of heavier individuals in a population should result in genetic improvement of the trait.

Repeatability Estimates: Repeatability estimates obtained in this study were 0.47, 0.40, and 0.36 for egg weight, daily egg production and daily egg mass, respectively (Table 3). These estimates were higher than that reported earlier by Toye *et al*. (2012) in Black Hacro and Lohman Brown layers chicken and lower than those found by Jaja *et al*. (2017) in Bovan Neva Black. Therefore, when the estimates were high, culling poor performers on the basis of a single record will be effective in improving flock performance and could be used to predict the successive records required to maximize the prediction of performance capacity of an individual (Ibe, 1995).

Genetic (r_g) and Phenotypic (r_p) Correlations among egg weight, daily egg production and daily egg mass were listed in Table (3). Higher genetic (0.67) and phenotypic (0.49) correlations were recorded between egg weight and daily egg mass; while, the correlations between egg weight and daily egg production were negative and being -0.40 and -0.17 on the same order. Also, earlier researchers noticed that the genetic and phenotypic correlations between egg weight and egg number were negative (Shebl *et al*., 1991; El-Wardany *et al*., 1992; Salah *et al*., 2006 and Vivian, 2011), which suggest that increasing the egg weight will decrease the egg number. Regarding the positive genetic and phenotypic correlations egg mass with each of egg weight and egg production were also estimated by El-Labban *et al.* (2011) and Foleng *et al*. (2012). Therefore, the genetic improvement for one trait could result in improvement for the other trait as correlated response and Pleiotropic action of the gene can be implicated here (Adebambo *et al*., 2006).

Table 3 : The genetic parameters for egg weight, daily egg production and mass:

	Egg weight	**Daily egg production**	**Daily egg mass**
Egg weight	0.29	-0.40	0.67
Daily egg production	-0.17	0.39	0.54
Daily egg mass	0.49	0.42	0.33
Repeatability	0.47	0.40	0.36

The values on, above, and below the diagonal are estimates of heritability, genetic and phenotypic correlations among traits, respectively.

Conclusion

It can be concluded that the black line will be suitable for egg purposes. Fixed effects need to be adjusted in order to estimate allowable genetic parameters. The genetic gain of birds by generation on the basis of egg weight will be effective for both lines. Positive and high estimates of genetic parameters indicate that selection on the basis of one trait will improve other traits.

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