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Research Article

Repeatability Estimates of Egg Number and Egg Weight under Various Production Periods in three Lines of Local Quail

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Abstract | The current study was aimed to estimate the repeatability of egg weight and egg number characteristics of varieties (desert, brown and white) of local quail at 5, 7, 9, 11 and 13 weeks and overall age of the quail. For this reason, 60 birds (15 males and 45 females) were selected from each variety. The egg numbers and egg weight were summarized on weekly basis for five weeks. The total number of eggs collected for each age was 30 and 150 for the total number of each variety at five different age periods. The results showed that the repeatability estimates for the number of eggs per week was ranged 0.084-0.88 on the desert variety. The repeatability estimates for egg numbers for the five weeks taken together were totally the same among varieties. The repeatability estimates for egg weight at 5 and 13 weeks were generally low in the three varieties of quail and ranged 0.075-0.91. The overall repeatability estimate of egg weight traits highest in desert varieties (0.087) with the least estimate obtained of white varieties (0.081). The results of this study general increase in weight and number of eggs repeatability with different production periods reveals that the less the number records are required to satisfactorily characterize the inherent producing ability for the traits as laying age progressed of each local quail varieties.

Keywords | Repeatability, Egg production, Age, Lines, Local quail

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INTRODUCTION

Quail is one of the poultry species, which has assumed worldwide importance as a laboratory animal due to its extensive use in studies for growth, selection and breeding. Different varieties of quail are nowadays bred in Kurdistan region in Iraq as supply the local markets with testy types of meat and egg particularly for the rural poor (Ahmed and Al-Barzinji, 2020). Quail is popular bird model in numerous fields of research because of its small body size, easily handled, and large number of quails can be reared in limited space. Short generation interval which make it possible to propagate many generations in a year (3-4 generation per year), resistance to many common avian disease and high egg production it has been considered as an excellent laboratory experimental bird, less feed and easy maintenance (Vali et al., 2006; Akpa et al., 2008). Early sexual maturity the females start to lay eggs at six weeks of age, but their full production usually begins at the age of 50 days (about 7 weeks). Females are very prolific because they averagely lay 300 eggs during their entire reproductive period which generally lasts 10-12 months (Kayang et al., 2004; Chełmońska et al., 2008; Alkan et al., 2010). The production of egg is regarded as one of the most performance parameters of laying birds. Despite effective roles of additive genetics on egg production, other factors including age at sexual maturity, bird weight, its nutrition, management and environmental systems might also affect egg production of quail (Daikwo et al., 2014).

Breeding and genetic experimentation must be carried out continuously through genetic parameters such as estimation of heritability and repeatability for egg production traits in different strains and/ or breeds were many researchers pointed out that due to differences, there are many variations in these estimates of the genetic composition, especially improved commercial breeds, to select the best performance of important economic traits by focusing and enhancing the performance of genes that control these traits (Khalil et al., 2013; Chen et al., 1993; John-Jaja et al., 2016).

Repeatability measures the degree of association between records of the same animal, and is characterized by being expressed more than once in an animal's life (Falconer, 1989), which indicates that repeatability estimates are beneficial in the context of quantitative genetics because they are designed set the upper limits of the levels of genetic variation. The advantage of this for breeding programmes is the increases in the proportion of additive genetic variation and improves the selection response (Udeh, 2010). The low repeatability evaluates reported for egg production parameters were attributed to the huge non genetic factors, Falconer (1989), who believes that the improvements of these traits are desirable that due to their economic importance. This can be achieved by improving the genetic and non-genetic factors that affect egg production. Egg production differs from one period to another, so determine repeatability estimates will guide breeders to design appropriate breeding programs to improve egg production (Udeh, 2010). Therefore, the purpose of this study was to determine the repeatability estimates of the egg number and egg weight characteristics of the three varieties at different periods of production in local quails.

MATERIALS AND METHODS

Location of study

This study was conducted at Grdarasha Research Centre, Animal Resources department, College of Agricultural Engineering Sciences, Salahaddin University-Erbil, Iraq.

Collection of data

Thirty (30) freshly laid eggs were randomly selected weekly for fife (5) different ages in three varieties, namely desert (n=150), brown (n=150), and white, (n=150) birds, to determine number and weight of egg. Altogether, 450 eggs were assessed during weeks 5, 7, 9, 11 and 13 of age to the estimate repeatability. The quails were reared in battery cages system according to varieties with sex ratio (1:3). So, there were 135 females. Throughout the experiment, the birds were fed a diet containing 2900 kcal of metabolic energy / kg and 20% crude protein, and had free access to food and water. Daily records of egg number were summarized on weekly and individual basis. The collection of eggs was twice a day at 10.00 am and 6.00 pm, respectively was marked according to cage number and used a digital scale to measure the weight of each egg laid. The data obtained with respect to each trait within varieties.

Statistical analysis

Using the following model described by Becker (1984), a one-way analysis of variance was performed on the data collected for each trait within lines.

$$Yij= \mu + \alpha i + eij$$

Where:
Yij= the record of the i^{th} egg laid by the j^{th} hen; μ= Overall mean; αi=Random effect of the i^{th} birds; eij= Random error related to the dependent variable.

The variance components were estimated by PROC VARCOMP (Procedure Variance Components) of SAS (2004) using Restricted Maximum Likelihood (REML) method. Repeatability coefficient was determination by using the following formula (Becker, 1984).

$$R = \frac{\delta^2 B}{\delta^2 B + \delta^2 E}$$

$$\delta^2 E = MSE$$

$$\delta^2 B = \frac{MS_B - MS_E}{K}$$

R= Repeatability; MSB= Mean square between individuals; MSE= Mean square within individuals; K=Number of record per bird; δ^2B= Variance component of the bird= estimation of all the genetic variances and the portion of specific environmental variance of each bird; δ^2E= Variance component (error)= the differences among measurements within the individual bird.

The standard error (S.E.) of the estimates in this study is given by Becker (1984) expressed as:

$$S.E.(R) = \sqrt{\frac{2(1-R)^2[1+(K-1)R]^2}{k(k-1)(N-1)}}$$

Where;
K= Number of records per bird; R= Repeatability; N= Number of eggs.

RESULTS AND DISCUSSION

The repeatability and variance components estimates at weeks 7, 8, 9, 10, 11, 12 and 13 laying periods of the three local varieties of quail are presented in Table 1. The calculate repeatability vary from one week to another in the three lines probably because of the variability of the environmental factors effecting egg production. In desert and brown varieties, the repeatability estimates decreased from week 7 to week 13. It was highest in week 7 and lowest in week 13. In white variety, the repeatability estimates decreased from week 11 to 13, peaked in week 7 and 9 but decreased in week 13. The repeatability estimates for egg numbers at the different laying periods were higher in white variety than desert and brown varieties. The decreased estimations may be due to progress of age Udoh et al. (2020) reported similar results, and they determined that the repeatability of traits decreased as the laying period progressed. This may be due to the attributed influence of age and environmental factors (Falconer, 1989) and the different species of birds involved. These authors report that they were performed in pullets or layers and not in quail birds. These results were found to be higher than those previously reported by Goto et al. (2015) using Onagadori and White Leghorn breeds to estimate egg weight values of 0.47 and 0.42, respectively. Blanco et al. (2014) recorded 0.75 and 0.71 repeatability for egg weight at 67–70 weeks of age employing white eggs of Lohmann selected leghorn and brown eggs of Lohmann Brown respectively. Udeh (2010) showed that the Black Olympia breed had a low repeatability 0.44 for egg weight at 40 weeks of age.

Table 2 showed the components of variance and repeatability estimates for egg weight in three varieties of local quail at weeks 7, 8, 9, 10, 11, 12 and 13 laying periods. The repeatability estimates for egg weights were generally high in three varieties at different ages and ranged from 0.075-0.081. The highest repeatability was estimates in week 9 were 0.091, 0.089 and 0.085 while, lowest were 0.084, 0.079 and 0.075 in week 5 respectively of three varieties. Similar opinion had been expressed by Akpa et al. (2008) who indicated that the egg weight repeatability increased as progressed the laying period. Wilhelmson (1975) stated that the repeatability estimates for quail egg characteristics were 0.46 to 0.58 while, Sooncharenying and Edwards (1989) observed repeatability coefficient of 0.80 for egg weight in quails. Udoh et al. (2020) showed higher repeatability (0.76) of egg weight in quail. However, Okonkwo and Ibe (1994); Ibe (1984) reported similar studies in other commercial chicken pullets they indicated repeatability coefficient values for egg weight characteristics were different from 22 to 30 weeks, and also noted repeatability was declining in these traits with increasing laying age. Similar opinion had been expressed by Akpa et al. (2008) indicated that the repeatability of the egg weight increased as laying period progressed. Wilhelmson (1975) who expressed that the repeatability estimates egg traits of quails to be 0.46 to 0.58 while, Sooncharenying and Edwards (1989) observed repeatability coefficient of 0.80 for egg weight in quails. Udoh et al. (2020) showed higher repeatability (0.76) of egg weight in quail. But similar studies in other commercial chicken pullets were reported by Okonkwo and Ibe (1994); Ibe (1984) who indicated varying repeatability coefficient values for egg weight traits at 22 to 30 weeks and also noted a declining repeatability in the traits with increasing age in lay. Repeatability estimates for egg weight was similar to the values reported by Akinokun and Dettmers (1977) for Nigerian local chickens, although lower estimations were obtained by Udeh (2010).

The result in Table 3 reveals the repeatability and variance components of egg number and weight traits in three local varieties of quail in the total period. The repeatability estimates of these traits were generally high in desert, brown and white. Egg number (EN) estimations totally higher and similar among three varieties were ranged 0.087-0.08.

Table 1: Variance components and repeatability of egg number in three lines of local quails.

Lines	Desert				Brown				White			
Ages (weeks)	d^2 w	d^2 E	R	S.E	d^2 w	d^2 E	R	S.E	d^2 w	d^2 E	R	S.E
5	0.594	6.165	0.088	0.0412	0.255	2.265	0.087	0.0450	0.379	3.845	0.089	0.0402
7	0.732	7.370	0.090	0.0415	0.150	1.525	0.089	0.0475	0.371	3.730	0.090	0.0405
9	0.543	5.530	0.089	0.0433	0.239	2.475	0.088	0.0452	0. 198	2.005	0.090	0.0397
11	0.201	2.100	0.087	0.0410	0.272	2.93	0.085	0.0447	0.368	3.885	0.087	0.0398
13	0.525	5.670	0.084	0.0405	0.167	1.830	0.084	0.0445	0.367	3.950	0.085	0.0391

Note: d^2E= Variance between birds; d^2w= Variance within birds; R= Repeatability; S.E= Standard error of repeatability.

Table 2: Variance components and repeatability of egg weight in three lines of local quails.

Lines	Desert				Brown				White			
Ages (weeks)	d^2 w	d^2 E	R	S.E	d^2 w	d^2 E	R	S.E	d^2 w	d^2 E	R	S.E
5	0.339	3.660	0.084	0.0433	0.227	2.630	0.079	0.0427	0.16	2.025	0.075	0.0402
7	0.217	2.199	0.089	0.0445	0.280	3.010	0.085	0.0436	0.123	1.513	0.082	0.0412
9	0.252	2.527	0.091	0.0457	0.213	2.368	0.089	0.0440	0.134	1.444	0.085	0.0439
11	0.245	2.781	0.088	0.0452	0.157	1.643	0.087	0.0430	0.160	1.770	0.083	0.0428
13	0.172	1.863	0.084	0.0434	0.127	1.557	0.082	0.0425	0.180	2.034	0.081	0.0422

Note: d^2E= Variance between birds; d^2w= Variance within birds; R= Repeatability; S.E= Standard error of repeatability.

Table 3: Overall mean of variance components and repeatability of egg number and weight traits in three lines of quail.

Lines	Desert				Brown				White			
Traits	d^2 w	d^2 E	R	S.E	d^2 w	d^2 E	R	S.E	d^2 w	d^2 E	R	S.E
EN	0.519	5.367	0.088	0.0415	0.2166	2.205	0.087	0.0454	0.371	3.483	0.088	0.0397
EWT	0.245	2.606	0.087	0.0444	0.2008	2.242	0.084	0.0432	0.151	1.757	0.081	0.0421

Note: d^2E= Variance between birds; d^2w= Variance within birds; R= Repeatability; S.E= Standard error of repeatability; EN= Egg number; EWT= Egg weight.

While egg weight of the desert variety (0.087) was higher than that of the brown (0.084) and white (0.081) varieties, egg weight (EWT) estimations ranged from 0.94 to 0.99 was higher than the estimations previously reported by Udeh (2010); Udoh et al. (2020). Blanco et al. (2014) used white Lohmann eggs and recorded repeatability estimations for egg weights 0.75 and 0.71 of selected Leghom and brown eggs of Lohmann Brown respectively. Similar opinion had been reported by Oyedepo et al. (2007); Bennerwitz et al. 2007 were showed that the repeatability estimates for egg numbers and egg weights in chicken were low.

CONCLUSIONS AND RECOMMENDATIONS

According to the results of this study, the three varieties of local quail have relatively high repeatability estimates for the number of eggs and of the egg weight characteristics. Therefore, it was recommended that the repeatability increased of the traits according to progressed the laying period; good performance and significant genetic gain will occur throughout the egg production period. Egg weight should be used as the key determinant of local quail repeatability estimates since fewer records were needed to adequately characterize the bird's inherent producing ability.

NOVELTY STATEMENT

There is no study on repeatability between line of local quails.

Conflict of interest

The authors have declared no conflict of interest.

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