Estimating of some specific traits of Japanese quail eggs for different levels of blood hemoglobin

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Abstract. This study was conducted in the field of Japanese quail of the Department of Animal Production at the college of Agriculture - Tikrit University for the period from 2/10/2019 to 7/1/2020, the experiment of electing the hemoglobin level in the blood was conducted, as blood samples were drawn from birds at the age of 14 days and after that they were divided into three groups: Control group with range hemoglobin level (11.33 - 11.67) g / 100ml blood, second group with a high hemoglobin level (above 11.67) g / 100ml blood, and a third group with a low hemoglobin level (less than 11.33) g / 100ml blood, each group divided in to 4 subgroup, and each subgroup contain 12 birds, the sex ratio 3 : 1 was adopted as one male for three females. The aim of the study was to estimate some of the genetic parameters of egg quality traits in quail, depending on the level of blood hemoglobin at early ages and its effect on productive characteristics. The results showed that there were no significant differences for the characteristic value of the egg shape, the yolk index, the egg albumin index, the Haugh unit, the yolk relative weight rate, and the albumin relative weight of the elected groups for the hemoglobin level in the high, control, and low blood levels. Whereas, there were significant differences (p≤0.05) in shell thickness with membranes as the group of high hemoglobin level over the control group and group of low hemoglobin level. The results also indicate the presence of significant differences (p≤0.05) for the ratio of the relative weight of shell with the membranes among groups selected for high level of hemoglobin level in the blood, control and low hemoglobin level in the blood, as the low treatment outperformed the level of hemoglobin recorded high measurement compared with control.

1. Introduction:

The number of eggs produced is the main indicator of the performance of commercial poultry flocks, as it represents about 90% of the income in egg production farms[1]. As a Japanese female quail is laying from 240 - 270 eggs a year, and the egg weight ranges between 10 - 15 grams, where the Japanese quail eggs are distinguished by different colors that tend to blue and eggs and the presence of brown or black spots, also, the eggs of the Japanese quail are distinguished by an increase in the ratio of the yolk to the egg albumin compared to the other birds as well as it is rich in minerals and vitamins essential amino acids such as lysine, serine, aspartic acid, threonine and glycine.

The quality of eggs has an important impact on the consumption of eggs and its products, as the quality of eggs is measured based on the appearance characteristics, including the size of the egg and the thickness of the shell, as well as the internal characteristics, including the quality of eggs and yolk[2], as some researchers considered the specific characteristics of eggs as an important economic characteristic that could be improved through continuous selection[3].

The aim of the study was to estimate the mathematical rates of the specific characteristics of Japanese quail eggs, based on divergent selection of the hemoglobin level.
2. Materials and methods:

This study was conducted in the field of Japanese quail, which is affiliated to the Animal Production Department at the college of Agriculture - Tikrit University for the period from 2/10/2019 to 7/1/2020, the aim of this study was to estimate some of the genetic features of the Japanese quail, depending on the level of blood hemoglobin at early ages and its effect on productive, physiological and biochemical characteristics. Blood samples were drawn from birds at the age of 14 days and were divided into three groups: {control group / with average hemoglobin level (11.33 - 11.67) g / 100 ml blood, treatment group with high hemoglobin level (above 11.67) g / 100 ml blood and treatment group with a low hemoglobin level (less than 11.33) g / 100ml blood}, each group divided in to 4 subgroup, and each subgroup contain 12 birds, a nationality ratio (3:1) was distributed for one male for every three females, where the birds were numbered by placing a ring on their legs, and the birds were fed on their starting diet until the age of (21) days, as shown in Table (1), Then, the birds were transferred to the breeding hall containing three-room cages (local industry) with dimensions (100 x 100 x 50) cm for length, width and height respectively for each room equipped with their own feeders and water intakes. Birds were fed on two types of diets, the first feed, a starter provided for birds from the age of one day up to 35 days with a level of crude protein 22.84% and represented energy 2998 kilocalories / kg and used the second feed as a production feed provided to birds after 35 days and until the end of the experiment with a protein level of 19.56% and represented energy 2753 kcal / kg.

Sixteen eggs were taken from each treatment group for the parents' generation. The specific characteristics of the eggs were measured three times over a period of 51 days. The measurements were made as follows:

**Egg shape index (%):**

The measurements of the length and width of the egg are recorded by the measuring instrument (Vernia) which measures in millimeters. The egg shape index was extracted according to the equation mentioned by [4].

\[
\text{Egg width (mm)}
\]

\[
\text{Egg shape index} = \frac{\text{Egg width (mm)}}{\text{Egg length (mm)}} \times 100
\]

**Egg shells thickness with membranes (mm):**

The thickness of the shell was measured after it was dried with the measuring machine (Vernia) from its pointed and middle end and its wide tip for each egg, according to the equation [4]:

\[
\text{Average shell thickness} = \frac{\text{convex shell thickness (mm)} + \text{pointed shell thickness (mm)} + \text{wide shell thickness (mm)}}{3}
\]

**The internal quality measurements of the egg:**

Each egg was broken on a flat glass surface to measure the egg’s internal characteristics, which include:

**Egg albumin guide:**

Calculate the average egg albumin index from the equation below mentioned by [4]:

\[
\text{Egg albumin height (mm)}
\]

\[
\text{Egg albumin guide} = \frac{\text{Egg albumin height (mm)}}{\text{Egg albumin diameter (mm) } \left(\frac{\text{Egg albumin length} + \text{Egg albumin width}}{2}\right)} \times 100
\]
Yolk guide:

Calculate the mean index of the yolk from the equation mentioned by [4]:

\[
\text{Yolk height (mm)}
\]

\[
\text{Yolk guide} = \frac{\text{Yolk height (mm)}}{\text{Yolk diameter (mm)}} \times 100
\]

Haugh unit:

Haugh's unit was calculated by applying the equation referred to by Haugh (1937) and modified by [5]:

\[
\text{Haugh Unit} = 100 \log (H + 7.57 - 1.7 W^{0.37})
\]

As:

H~is the egg albumin height (mm).

W~The weight of an egg (grams).

Percentage of egg components (%):

After breaking the egg and separating the egg albumin from the yolk, the shell was dried and the yolk and egg and shell weights were recorded (with membranes) where the percentage of the three components was extracted by applying the following equation [4]:

\[
\text{shell weight with membranes (grams)}
\]

\[
\text{Shell percentage (with membranes)} = \frac{\text{shell weight with membranes (grams)}}{\text{Egg weight (grams)}} \times 100
\]

\[
\text{Yolk weight (grams)}
\]

\[
\text{Yolk percentage} = \frac{\text{Yolk weight (grams)}}{\text{Egg weight (grams)}} \times 100
\]

\[
\text{Egg albumin weight (grams)}
\]

\[
\text{Egg albumin percentage} = \frac{\text{Egg albumin weight (grams)}}{\text{Egg weight (grams)}} \times 100
\]

Statistical Analysis:

Data analysis was performed using Completely Randomized Design (CRD) to study the effect of coefficients on the studied traits. The significant differences between the averages were compared using the Duncan Polynomial Test [6] and using the [7] statistical program in the statistical analysis of the data.
3. Results and Discussion:

Table (1) shows that there are no significant differences for the value of the egg shape index of the Japanese quail, which represents the relationship between the diameter and length of the egg. The values of their mean (78.83, 78.70 and 78.41)% for each of the selected groups for the characteristics of high, control and low hemoglobin levels, respectively. These results were agreed with the results of [8], [9], (3), [10], as they did not find any significant differences in the characteristic average evidence of the shape of the egg during their study of the Japanese quail and disagreed with the findings of [11], as he found significant differences between the elected line for high and low body weight and the control line in his study of the Japanese brown quail. The results appear from Table (1) that there were no significant differences for the yolk index rate between the groups selected for the high, control and low hemoglobin level, as the values of their rates reached (37.94, 38.15 and 38.64), respectively.

The results of the experiment agreed with what was obtained by [12], [10], (3), [13], as they did not find any significant differences for this trait in their studies on some of the qualitative qualities of the eggs of the Japanese quail and disagreed with [14], [15] in his study of the Japanese brown quail. As shown in Table (12), there were no significant differences for the level of the egg albumin index, as its average values (9.60, 9.25 and 10.16) were between the groups selected for the high, control and low hemoglobin level, respectively, and this was agreed with the results of [8], [13], [16], as they did not notice any significant differences for the attribute rate of egg albumin index in their studies on Japanese quail. Whereas, the results of this study differed with the results of (3), as they found a significant difference in their study on the Japanese quail, and also differed with what [11] find in his study on the Japanese brown quail, selected for high and low body weight and line of control. The data of Table (1) showed that there were no significant differences in the characteristic of Hue unit rate for the groups selected for the level of high, control and low hemoglobin levels in the blood. The above coefficients indicated that they were under the influence of the same factors, including age, breeding system, temperature, etc. as these results were in agreement with [13], [17]. The increase in the Hue unit rate for the low hemoglobin group compared to the high control groups of the level of hemoglobin may be attributed to the fact that the birds in this group took enough food, which led to an increase in metabolism and consequently the proteins needed to form the egg and improve its quality due to the increased egg content of the responsible adenamycin protein on the gelatinous texture of the egg, which in turn led to an increase in the value of the Hue unit, which is an important measure in expressing the quality of the egg white. These results differed with [10], Ataqi et al. (2019), where they found significant differences in their studies on the Japanese quail. Table (1) shows the presence of significant differences (p<0.05) in the average thickness of the shell with membranes between the groups selected for the level of high and control blood hemoglobin level, as the treatment group of high level of hemoglobin outperformed over the control and treatment groups of low hemoglobin levels, and the level of hemoglobin reached rates (0.27), 0.25 and 0.25 mm, respectively. And the reason for these differences may be due to several factors, including hereditary ones, including the environment, as the environment has the important effect on the thickness of the shell, where the gradual or sudden rise in temperature leads to a decrease in the thickness of the shell and the components of the diet that have an important effect on the thickness of the shell. Also, age has an effect on the thickness of the egg shell. The older the bird ages, the lower the thickness of the egg shell. These results agreed with [17] in their study of Japanese quails and differed with, Yilmaz et al (2011), [10], and [11]. And [14] in their study of the Japanese quail.
Table (1) Effect of selection on blood hemoglobin level on specific egg characteristics {Average ± standard error}

| Group            | Adjectives | Egg shape guide rate | Egg albumin guide rate | Yolk guide rate | The shell thickness of (ml) | Hue unit rate |
|------------------|------------|----------------------|------------------------|-----------------|-----------------------------|--------------|
| High hemoglobin  | 86.41 ± 0.64 A | 0.27 ± 0.004 A | 37.94 ± 0.62 A | 0.27 ± 0.004 A | 86.41 ± 0.64 A |
| Control          | 87.29 ± 0.52 A | 0.25 ± 0.002 B | 38.64 ± 0.90 A | 0.25 ± 0.002 B | 85.77 ± 0.71 A |
| Low hemoglobin   | 78.83 ± 0.66 A | 9.60 ± 0.34 A | 38.15 ± 0.45 A | 10.16 ± 0.27 A | 78.70 ± 0.82 A |

* Different capital letters within one column indicate significant differences (p≤ 0.05) between the averages.

Percentage of egg components:

The results shown in Table (2) indicate the presence of significant differences (p≤0.05) for the average weight ratio of the shell with the membranes between the groups selected for the level of high and control blood hemoglobin level, as a treatment group of low hemoglobin level outperformed over the control and the rates of its values reached (12.50, 12.17 and 13.15%) for high, control, and low level of hemoglobin in the blood, respectively, and the reason for the presence of significant differences may be due to the presence of an influence of genetic factors on the ratio of egg components. These results were agreed with the results of [11], [15] in their studies on some of the qualities of the Japanese quail, and also agreed with [12], as he found significant differences between the groups selected for the age attribute at Sexual maturity early, middle, and late, while the results of this study disagreed with the results of each in their study on two strains of the Japanese quail, white and brown, as they observed that there were no significant differences. The results also disagreed with the results of [9], as he did not find any significant differences for the average weight ratio of the shell weight with the membranes in his study on some of the specific characteristics of Japanese quail eggs. The results also showed in the above table that there were no significant differences between the groups above for the relative weight ratio of egg albumin, where the values of their rates (56.12, 56.46 and 55.70) were respectively, and no significant difference appeared between the above factors for the relative weight ratio of the yolk as it reached its rates (31.37, 31.35 and 31.13) are for the above treatment groups, respectively. These results were in agreement with [13], [14]. As these results differed with the results of [12], [18]) in their studies on some of the specific characteristics of Japanese quail eggs. The improvement in the quality of eggs may also be attributed to the characteristics of the Japanese quail in its ability to resist diseases, which makes its use more than the nutrients available in the feed, which increases the representation and absorption of nutrients, and thus improves the quality of eggs produced for the Japanese quail.

Table (2) effect of selection on blood hemoglobin level on percentages of shell weight with membranes, yolk and egg albumin (%) {rates ± standard error}

| Group            | Adjectives | Average ratio of shell weight with membranes (%) | Egg albumin ratio (%) | Yolk weight ratio (%) |
|------------------|------------|--------------------------------------------------|-----------------------|-----------------------|
| High hemoglobin  | 12.50 ± 0.18 AB | 56.12 ± 0.42 A | 31.37 ± 0.40 A |
| Control          | 12.17 ± 0.20 B | 56.46 ± 0.54 A | 31.35 ± 0.50 A |
| Low hemoglobin   | 13.15 ± 0.44 A | 55.70 ± 0.48 A | 31.13 ± 0.63 A |

* Different capital letters within one column indicate significant differences (p≤ 0.05) between the averages.
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