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EFFECT OF ALBUMIN AND YOLK DENSITY ON SOME EGG CHARACTERISTICS OF JAPANESE QUAIL (*COTURNIX JAPONICA*)

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Abstract:
This study was conducted in the laboratories of the animal production department of the college of agriculture/university of Kirkuk for the period from 6/5/2020 to 28/5/2020 using 250 Japanese quail eggs were collected immediately after delivery and conducted thoughtful tests. The aim of this study is to find out the effect of albumen density and yolk density about some of the internal and external qualities of Japanese's quail eggs just like (egg weight, egg height, width, shape indicator, shell thickness, shell weight, albumen and yolk weight, albumen volume, yolk volume and knowledge of the coefficient of genetic association between the characteristics taken in Japanese quail eggs. The results obtained showed that there were many differences in attributes that meant that there was a significant high effect of yolk density and albumen density on the volume of the yolks and the volume of albumen respectively, while there was no significant high effect of those traits of the rest of the qualitative qualities of eggs, and the genetics were arranged from moderate quality to high values. High coefficient genetic correlation indicates the ability to use the egg albumen density and yolk density indicator to improve some external and internal egg quality and the results indicate albumen density and yolk density that can support embryo development and successful hatching. It also suggests that selection would be effective in improving certain egg quality characteristics.

Keywords: external and internal characters of eggs, Density of yolk and albumen, Japanese quail.

Introduction:
Eggs contain many important nutrients that are why eggs are produced all over the world. Egg quality traits are of utmost importance in layer breeding programs due to their effect on profitability in the egg production industry and on the production of quality chicks (Blanco et al., 2014). The quality of the eggs is determined by It embraces multiple characteristics such as hygiene, freshness, egg shape and mass to consumers, volume, Packaging Factor, Egg Weight, shell thickness, Yolk and albumen Index, and chemicals elements (Narushin was founded in 1997). The volume of egg yolk and egg white is heavy eggs compared to lighter eggs, but the proportions may vary according to species of hen. Hereditary coefficient of Yolk weight is low in chicken (0.12–0.15) (M u i r, Aguri, 2003) and a mostly 0.11 in quail Daikwo et al., (2013). The technical

value of the egg yolk is given in addition to weight and percentage (Redvinka et al. 2008). The ovoid indicator was defined, as the ratio of the width to the length of the egg (Narushin, 2005). Egg shape index is an important factor in the determination of egg quality. Moreover, unusually long eggs look bad and do not look good either. It does not fit very well in egg cans and is more likely to break during transportation than eggs Normal format (Sarica and Erensayin, 2009). The external quality of eggs for breeding also has a direct impact on the rates of hatching and embryonic development, and it is noted that eggs with an oval shape hatch in a greater proportion than abnormal eggs (Duman and Şekeroğlu, 2017) The quality of the egg consists of many sides associated with the cerebral shell, slippery, yellow and can be divided into external and internal quality. The internal quality depends on the quality of the yolk and its presence it is from bloodstains and flesh. The quality characteristics of all eggs were affected by several factors, such as age and genotype of bird (Shaker, et al., 2017), nutrition, breeding system type, Ovulation time (Shaker, et al., 2019) and storage period (Ahmadi and Rahimi, 2014: Tabidi, 2011). The internal and external egg scale was considered one of the most vital and important factors in completing the hatching process of poultry eggs , such us, Quail, because the physiological state plays a very important role in the development and growth of the embryo inside the egg, and it is believed that the weight of the egg and the qualities of the egg shell, including thickness and fracture strength, are egg Shape index , the yolk weight, the albumen weight, and the dimensions of the yolk and albumen, as the breakdown of any of them leads to the deterioration of the supported physiological functions to provide an ideal environment for the integration of embryos in the egg. (Narushin and Romanov, 2002).

Materials and methods:

This experiment was conducted in the laboratories of the animal production department of the college of agriculture/university of Kirkuk for the period from 6/5/2020 to 28/5/2020. Where 250 fertilized eggs were collected from a Japanese quail breeding field when the flock was (50 to 55) days old with a sex ratio of 2 females: 1 male, Was bred in cages with dimensions of 24 × 45 × 30 cm, feed and water were provided to the birds in the form of Free (*Lipitum* Add,) and fed on a diet with a protein level of 24.0% and a representative energy of 2900 kcal/kg. The eggs were collected at 8pm o'clock at evening, immediately after collection, the weight of the whole egg was taken using an electronic scale with a sensitivity of (0.001) grams. As for the external egg dimensions (length and breadth), they were taken by an electronic Vernier with an accuracy of (0.01) millimeter. The egg shape index was calculated by the equation below:

Egg shape index = (breadth / length) * 100

After breaking the egg, the yolk was weighed, and the shell with the membranes was washed with water and left to dry at room temperature for 24 hours to calculate its weight. And by subtracting the weight of the yolk and the shell with the combined membranes from the total weight

of the egg, the weight of albumin was obtained, as in the equation below: according to the method described in the United States Department of Agriculture (USDA) Egg Grading Manual (2000).

Albumin weight = (Yolk weight + egg shell with membrane weight) – Total egg weight

As for the volume of each of the albumen and yolks, one cubic millimeter was taken using a micropipette to know its weight. To count it, extract the volume of the total yolk and the total white using the two equations below:

Total albumin volume = ($1m^3$ of albumin * albumin total weight) / weight of $1m^3$ of albumin
Total yolk volume = ($1m^3$ of yolk * yolk total weight) / weight of $1m^3$ of yolk

After obtaining the weight and volume of both the yolk and the white, the density of both was calculated using the equation below:

Albumin density = albumin weight / albumin volume
Yolk density = yolk weight / yolk volume

Statistical analysis

The obtained results were analyzed statistically using the SPSS v. 18 statistical package. The significance of differences between Japanese quail groups regarding egg quality traits was verified by one-way ANOVA and statistical differences were established at the level of $p \leq 0.05$ and $p<0.01$.

Result and discussion:

1. Effects of yolk density on Internal and External Egg Characteristics:

   The result of the impact of Yolk density of external and internal egg characteristics was shown in table (1). The volume of the yolk was high (p>0.05) due to the density of the yolk of the quail eggs. Therefore, its recording had high value1. 69 0.26 within >1.400 and the lowest value 1. 37 0.03 in >1.500, There are no significant differences between all traits studied at the three grades, or the interference effect was absent, as the results showed. That different may be due to relationship between yolk density and yolk volume in the egg of quail, which describe as a highly significant positive correlation between the internal and external egg quality traits Godson Aryee et al., (2020). But it's clear from the result that all of egg weight, egg length, egg breadth, shell thickness, egg shape index, yolk weight, albumin weight and shell weight were not significantly influenced by the yolk density, From this, it was concluded that there is a weak relationship between the density of yolk and those characteristics that were studied and these result disagree with (Monira et al., 2003) who reported in their study there was a highly significant positive correlation between yolk mass (volume ,density) and some egg characters specially egg weight and

they explained that Since the yolk occupies almost an area of the egg so it's become heavier. There are a lot of factors effect on qualitative internal and external qualities of eggs, including nutritional and environmental effects (Kavtarashvili, 2021, Godson Aryee et al., 2020, Wijedasa et al., 2020, El-Tarabany, 2015, Hegab and Hanaf, 2019, Sari et al., 2012) Environmental conditions and nutrition will affect the volume of an egg. Any of these can change the mass and/or the volume of the egg.

Table 1: represents the effect of yolk density on some internal and external egg traits in Japanese quails

Table 1:					
Traits	> 1.400	1.400 – 1.500	1.500 <	P-value	Sig.
Egg weight (gm.)	7.351±0.07 a	7.162±0.09 a	7.248±0.11 a	1.321	0.268
Egg length (mm.)	29.97±0.12 a	29.69±0.16 a	29.67±0.23 a	1.231	0.294
Egg breadth (mm.)	23.91±0.07 a	23.92±0.20 a	23.80±0.13 a	0.154	0.858
Shell thickness (mm.)	0.22±0.002 a	0.21±0.003 a	0.21±0.005 a	1.728	0.180
Egg Shape Index (%)	79.86±0.23 a	80.61±0.55 a	80.34±0.48 a	1.182	0.308
Yolk weight (gm.)	2.28±0.03 a	2.23±0.41 a	2.18±0.05 a	1.063	0.347
Albumin weight (gm.)	4.44±0.04 a	4.32±0.05 a	4.44±0.06 a	1.567	0.211
Shell weight (gm.)	0.62±0.006 a	0.60±0.007 a	0.61±0.010 a	2.287	0.104
Yolk volume (ml.)	1.69±0.26 a	1.54±0.02 b	1.37±0.03 c	23.695	0.000
Albumin volume (ml.)	3.45±0.03 a	3.37±0.04 a	3.46±0.05 a	1.123	0.327
Means with different superscript in the same raw differs significantly (P<0.01)					

2. Effect of albumen density on internal and external egg characteristics:

Table (2) presents the effect of albumen density on egg quality traits of Japanese quail. No significant effect (P>0.05) was found of albumen density on egg weight, egg length, egg breadth, shell thickness, and egg shape index. Also it's no different found between three groups of albumen density (>1.200,1.200-1.300,1.300<) on that characters, while there was a significant effect (P<0.05) of the white density on the white volume. The results show significant differences between the values of the white volume at the three grade of the white density. Where the highest recorded value was (3.60±0.12) at a white density > 1.200, and the lowest value was (3.25) reached at a white density 1.300<. The results indicated that there is an overlapping effect between the albumen volume and the albumen density at a value (<1.200-1.300 of 3.50). This effect may be due to the existence of a strong correlation between the volume of the white and the density of the white, which was derived from that mathematical equation. So it is natural that the density has a clear parameter because of the term density depends mainly on the dimensions of the white height and diameter, both of which represent the mass. Therefore, if the density is low, then it indicates a high volume, because the relationship between the two is an inverse relationship, as explained earlier in the mathematical equation.

Table 2: Represents the effect of albumin density on some internal and external egg traits in Japanese quails

Traits	> 1.200	1.200 – 1.300	1.300 <	P-value	Sig.
Egg weight (gm.)	7.02±0.21 a	7.32±0.58 a	7.19±0.10	1.009	0.366
Egg length (mm.)	29.11±0.37 a	29.96±0.10 a	29.62±0.18 a	2.116	0.122
Egg breadth (mm.)	23.62±0.26 a	23.96±0.10 a	23.75±0.10 a	0.917	0.401
Shell thickness (mm.)	0.21±0.014 a	0.22±0.002 a	0.22±0.003 a	0.412	0.663
Egg Shape Index (%)	81.15±0.96 a	80.05±0.29 a	80.32±0.31 a	0.385	0.681
Yolk weight (gm.)	2.19±0.07 a	2.26±0.02 a	2.22±0.05 a	0.322	0.725
Albumin weight (gm.)	4.23±0.15 a	4.43±0.03 a	4.36±0.05 a	1.064	0.347
Shell weight (gm.)	0.59±0.013 a	0.62±0.005 a	0.60±0.007 a	2.115	0.123
Yolk volume (ml.)	1.58±0.79 a	1.60±0.02 a	1.59±0.04 a	0.062	0.940
Albumin volume (ml.)	3.60±0.12 a	3.50±0.03 ab	3.25±0.04 b	11.629	0.000
Means with different superscript in the same raw differs significantly (P<0.01)					

3. Effect of interference between egg white density and yolk density with internal and external egg qualities:

Table 3 shows the correlation between the density of the yolk and albumen in some of the internal and external traits of Japanese quail eggs. The results indicated that there was a very strong effect (p<0.01) for these factors on some of the characteristics investigated. It was observed that there was a high positive correlation (P<0.01) of egg weight and egg width, while there was no significant correlation (P>0.05) between shell thickness and weight, length and width of eggs. The result also indicated a strong significant correlation (P<0.01) between egg shape index and egg weight, length and breadth. Aggregated data recorded a high significant correlation (P<0.01) between the weight of the yolk and the egg weight, egg length and breadth. Statistical analysis of the data showed there was a negative significant correlation (P<0.05) between the yolk weight and the egg shape index. Moreover an insignificant negative correlation (P>0.05) has been observed between the yolk weight and the egg shell thickness. There was a high significant positive correlation (P<0.05) between the albumin weight and egg weight egg length and breadth and yolk weight. But the correlation was negative and insignificant (P>0.05) between the albumin weight,, eggshell thickness, and egg shape index. In addition, several researchers (Abanikannda et al., 2007; ÇiÇek-Rathert et al., 2011; Olawumi and Ogunlade, 2008) provide a correlation between egg breadth, length, and shape index. Furthermore, Alkan et al. (2010) demonstrated a significant negative correlation between egg shape index and shell thickness. This study reported there were a negative significant coefficient (P>0.05) between the eggshell weight, and the coefficient of egg shape index. Which is agreed with the results of Yilmaz et al. (2011). The relationship between the egg shape index and the egg traits shows a positive correlation (TeceK- Rathert et al., 2011) therefore this study found a correlation between yolk and albumin density with some of internal and external egg traits of the Japanese quail, and declare the effect of genetic interference between

them and this agree with what theses researches found Duman et al., (2016), who described the relationship between egg weight ,egg shape index ,albumin and yolk characters with each other.

The correlation between the yolk volume and the egg weight, its length and width, weight of the yolk, the weight of the albumen and weight of the shell was negative, while the results did not record a marked significant correlation between the volume of the yolk and the weight of the shell. The same table also displayed a significant positive correlation with ($P < 0.01$) for egg volume, weight, the weight, length and width and width of the yolk. These results are consistent with the results of the researchers ' study (Hegab and Hanafy, 2019) who conducted the correlation between egg Weight and eggshell thickness was significant and positively correlated with egg weight and eggshell weight, yolk diameter, and yolk weight . The results of the experiment observed a high significant correlation between yolk density and yolk volume and there was no significant correlation ($P>0.05$) of yolk volume, egg albumen volume, and egg albumen weight and egg width. The results presented an insignificant negative correlation ($P>0.05$) between the density of the yolk, the weight of the egg, the length of the egg, the thickness of the shell, the weight of the yolk and the weight of the shell. The high negative correlation coefficient was noticed between the density of egg albumen and the volume of egg albumen although there was a significant negative correlation ($P>0.05$) between the density of egg albumen and the weight and length of the egg and the weight of the albumen.

Table 3: Represents the correlation of the internal and external egg traits in Japanese quails.

Traits												
	EW	EL	EB	ST	ESI	YW	AW	SW	YV	AV	YD	AD
EW	1											
EL	0.847***	1										
EB	0.722***	0.585***	1									
ST	0.001 N.S	0.006 N.S	0.006 N.S	1								
ESI	-0.123*	-0.460***	0.449***	-0.007 N.S	1							
YW	0.858***	0.728***	0.605***	-0.026 N.S	-0.116*	1						
AW	0.899***	0.756***	0.664***	-0.044 N.S	-0.091 N.S	0.554***	1					

SW	0.587***	0.534***	0.404***	0.426***	-0.143**	0.481***	0.449***	1				
YV	0.799***	0.688***	0.550***	0.009$^{N.S}$	-0.134*	0.938***	0.508***	0.465***	1			
AV	0.861***	0.734***	0.642***	-0.054$^{N.S}$	-0.093 N.S	0.533***	0.955***	0.439***	0.485***	1		
YD	-0.002 N.S	-0.032 N.S	0.031 N.S	-0.087$^{N.S}$	0.070 N.S	-0.023$^{N.S}$	0.022$^{N.S}$	-0.048 N.S	-0.361***	0.032$^{N.S}$	1	
AD	-0.107*	-0.132*	-0.091 N.S	0.028$^{N.S}$	0.048 N.S	-0.077$^{N.S}$	-0.106*	-0.087 N.S	-.059$^{N.S}$	-0.392***	-0.039$^{N.S}$	1

EW= egg weight; EL= egg length; EB= egg breadth; ST= Shell thickness; ESI= egg shape index; YW= yolk weight; AW= albumin weight; SW= shell weight; YV= yolk volume; AV= albumin volume; YD= yolk density; AD= albumin density.

Conclusion:

According to the data obtained from this study, it is now possible to improve the measurement or characterization of the shape indices of quail eggs in the future.

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