

VARIATIONS IN EGG PERFORMANCE AND PLASMA CONSTITUENTS AT DIFFERENT AGES OF FEMALES JAPANESE QUAIL

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Abstract: *A total number of one hundred and twelve Japanese quail females at 6 weeks of age were used to determine the variations in egg performance and plasma constituents during different periods of production, and the phenotypic correlations among ages, egg number (EN) ,egg production (EP%) , egg weight (EW) and egg mass (EM) and plasma constituents. At 8, 10, 14, 18, 22, 26 and 30 weeks of age, EN, EP%, EW, EM and plasma constituents (total protein, TP; albumin, Alb; calcium, Ca; Phosphorus, P; total lipids, TL; triglycerides, TG; cholesterol, glucose, aspartate aminotransferase, AST and alanine aminotransferase, ALT) were determined. The results obtained could be summarized as follows: 1- There were high significant differences in EN, EP%, EW and EM at different ages and the highest values were at 14 and 18 wks of age. 2- Highly significant increases were found in plasma constituents (TP, Alb, Ca, P, TL, TG and cholesterol) with age progressive. No significant differences were found in plasma glucose; however, the values of AST and ALT were fluctuated. 3- Highly significant positive phenotypic correlations were found of age and EN with each of TP, Alb, Ca, P, TL, TG and cholesterol. Similarly, highly significant positive phenotypic correlations were found between EP% and each of TP, Alb, Ca, TL, TG, cholesterol and AST. EM had high significant positive phenotypic correlations with Ca, TG, and cholesterol. However, no significant phenotypic correlations were found between EW and plasma constituents. It can be concluded that must use Japanese quail for egg production and meat production due to its superiority. And foundation of highly significant positive phenotypic correlations between egg performance and plasma constituents could be provide new strategy for selecting chickens for improving egg production*

INTRODUCTION

In many countries an increase in demand for foodstuffs of animal origin has been noticed, mostly for eggs and poultry meat, for characterized them with highly nutritive value. Also, the eggs are using as the vehicle of procreation for birds. This prompted the breeders to put more interest in the breeding and keeping of quail, the laying performance of which is relatively high. Over the six months laying period and the total egg production in quails is ten times higher than female's body weight, whereas in chicken such a relation is reached only by the production gathered from 12 months (**Richtrova, 1999**). The synthesis of secondary egg integuments in quail lasts for about 17 hours, *i.e.* much shorter than in chicken. The effect of the so called rapid "egg synthesis" may be seen in laying two eggs during the same 24 hours period by quails (**Rutkowski, 2000**). The quail reaches sexual maturity fast, and metabolic transformations that take place in bird's organism are highly dynamic, this dynamics refers also to the synthesis of the hormone (**Blaszczyk, et al., 2006**). Plasma mineral concentrations during the laying period can influenced by many factors such as laying rate (**Suchy, et al., 2001**) and age of hens (**Cerolini, et al., 1990; Gyenis, et al., 2006 and Pavlik, et al., 2009**). Plasma triglyceride was used as an index of very-low density lipoprotein (VLDL) level, which the primary source of yolk lipid (**Mitchell and Carlisle (1991) and Wallace, 1985**). Also, the cholesterol was the main precursor for the synthesis of steroid hormones. Little informations are available on plasma constituents during laying periods of females Japanese quail .Therefore, the present study aimed to determine the variations in egg performance and plasma constituents of females Japanese quail during different periods of production. and the phenotypic correlations of ages, EN , EP% , EW and EM with plasma constituents.

MATERIALS AND METHODS

The experimental work of the present study was carried out at the Poultry Research Station, Poultry Department, Faculty of Agriculture, Fayoum University from March to August 2009. A total number of one hundred and twelve females of Japanese quail at six weeks of age were used. The birds were marked by wing bands and housed in individual cages . Feed and water were provided *ad libitum* throughout the experimental period. Artificial light was used beside the normal day light to provide 17-hour day photoperiod. Birds were fed on layer diet (19.92% CP, and 2875 kcal ME/kg) as shown in Table (1). Individual body weights were recorded at the beginning and the end (30 weeks of age) of the experiment and being 227.95 ± 2.03 and 264.55 ± 31.57 , respectively. Egg number (EN) and egg

weight (EW) were recorded daily to calculate egg production % (EP% = EN*100/28 day) and egg mass, g/day (EM= (EN*EW)/28).

At 8, 10, 14, 18, 22, 26 and 30 weeks of age, 15 blood samples were collected in heparinized tubes from wing vein of quail in the morning. The blood samples were centrifuged at 3000 rpm for 15 minutes to separate the plasma, and stored at -20°C until the time of determination. Plasma constituents were determined calorimetrically using kits according to **Gornal, et al. (1949)** for TP, **Dumas and Biggs (1971)** for Alb, **Gindler and King (1972)** for Ca, **El-Merzabani, et al. (1977)** for P, **Zollner and Kirsch (1962)** for TL, **Fassati and Prencipe (1982)** for TG, **Allain, et al. (1974)** for cholesterol, **Trinder (1969)** for glucose, **Reitman and Frankel (1957)** for AST and ALT.

Analysis of variance was computed using the General Liner Model (GLM) procedure of statistical analysis system according to **SPSS (1999)**. Significant differences among means were evaluated using Duncan's multiple range test (**Duncan, 1955**).

RESULTS AND DISCUSSION

1- Egg performance

1-1- Egg number (EN)

The means of EN presented in Table (2) indicated that the EN at 14 and 18 Wks of age were higher than the other ages and being 25.93 and 25.11/ birds /28 days, respectively. This may be due to effect of estrogens which increases at the peak of EP (**Hansen, et al., 2003**). Also may be due to the increase in clutch size. And **Bahie El-Deen et al. (2008)** found that the mean EN of quail was being 37.46 during the 45 days after sexual maturity (**Bahie El-Deen et al., 2008**) and it was being 60.84 during the first 90 days of laying (**Bahie El-Deen et al., 2009**).

1-2- Egg production (EP %)

The results in Table (2) of EP% showed that, EP% of quail was continuously high ($\geq 86\%$) up to 30 wks of age and the EP% at 14 wks of age was significantly the highest compared to the other ages, this indicating that the quail reached to the peak (92.20%) at 14 weeks of age, and the lowest value of EP% was at 8 wks of age of 72.55%. These results of EP% indicated that the females quail are considerable to be efficient layers and reaching sexual maturity quickly. However, earlier studies (**Woodard and Abplanalp, 1967**) reported that, EP% of quail decreased after 26 wks of age. **Gildersleeve et al. (1987)** observed that, quail reached to the peak of

egg production at nine wks after the starter of egg production and remained higher than 80% until the 20 wks of age. The mean EP% value of quail was being 83.11 % during the 45 days after sexual maturity (**Bahie El-Deen *et al.*, 2008**) and it was being 67.15 % during the first 90 days of laying (**Bahie El-Deen *et al.*, 2009**).

1-3- Egg weight (EW)

There were high significant increase in EW of quail at 14 and 18 weeks compared to the other ages and the values were being 12.82 and 12.75 g respectively. Whereas, the lowest value of 11.22 g was at eight wks of age as shown in Table (2). However, **Bahie El-Deen *et al.* (2008)** reported that the mean EW value of quail was being 10.96 during the 45 days after sexual maturity, and that trait was being 11.07 g during the first 90 days of laying as found by **Bahie El-Deen *et al.* (2009)**. The differences of egg weight refer to variation in body weight and age of quails were used.

1-4 Egg mass (EM)

Similar trend for EM was observed as that found for EW. The quail at 14 and 18 wks had the highest values of EM ($P \leq 0.01$, 11.85 and 11.45 g) compared with at the other ages. However, the lowest value (8.12 g) was at eight wks of age as shown in Table (2). **Wallace (1985)** reported that estradiol would be expected to play a central role in the determination of EM because this hormone stimulates the avian liver to produce the yolk precursors vitellogenin and very-low density lipoprotein (VLDL), that the primary sources of yolk protein and lipid, respectively. And the synthesis and secretion of egg albumen by the oviduct is also, in part, under estrogenic control (**Christians, and Williams, 1999**). Whereas, **Bahie El-Deen *et al.* (2008)** observed that the mean EM value of quail was being 406.65 g during the 45 days after sexual maturity, and the same trait was 667.74 g during the first 90 days of laying (**Bahie El-Deen *et al.*, 2009**).

2- Plasma constituents

2-1- Plasma total protein and albumin (TP and Alb)

Plasma TP and Alb significantly increased with increasing the age as shown in Figure (1). The highest values were obtained at 26 and 30 wks of age in spite of there were insignificant differences in plasma TP values up to 18 wks of age and up to 22 wks of plasma Alb. The increase of plasma TP and Alb may be due to estrogen secretion at the onset of egg production in laying hens increases serum levels of protein bound calcium (**Urist *et al.*, 1958**). Also, multiple serum proteins, including very low density

lipoprotein (VLDL), vitellogenin and some egg white precursors (such as ovotransferrin, lysozyme and ovomycininhibitor), are present in large quantities in the bloodstream of chickens during the laying period (**Sato and Watanabe, 1976; Ito et al., 2003 and Liou, et al., 2007**). However, **Bahie El-Deen et al. (2009)** observed that TP values decreased with age progressive of Japanese quail.

2-2- Plasma calcium and phosphorus (Ca and P)

Highly significant increases in Ca and P were found with age progressive as shown in Figure (2). The lowest values were at eight and ten wks of age for Ca, and there were insignificant differences in levels of P up to 18 wks of age. Increasing the level of calcium with increasing egg production may be due to steroid hormones which are implicated in regulation of Ca metabolism in laying hens throughout several modes of action as deposition of Ca within the medullary portion of long bones (**Johnson, 1986**) and increases serum levels of protein bound calcium (**Urist et al., 1958**). Also, a considerable increase in plasma Ca levels at the beginning of laying period of hens and subsequent gradual increase was observed by **Cerolini et al. (1990); Gyenis et al. (2006) and Pavlik et al. (2009)**. However, **Pavlik et al. (2009)** reported that, plasma P concentrations were decreased from the 22-75 wks of age.

2-3- Plasma lipid profiles (total lipids (TL), triglycerides (TG) and cholesterol)

Generally, levels of plasma TL and TG of female Japanese quail were highly significant with increasing age. The highest value was at 30 wks of age but, the lowest value at eight wks of age. Also, the highest value of cholesterol was at 30 wks of age as shown in Figures (3,4 and 5). **Blaszczyk et al. (2006)** suggested that no marked changes in mean cholesterol content of plasma Pharaoh quail from 6-10 wks of age. However, **Blaszczyk et al. (2002)** reported that there was circadian rhythm in the blood cholesterol concentration. Also, **Dikmen and Sahan (2007)** found that the mean blood cholesterol levels of broiler breeders were 165.1, 166.5 and 175mg/dl at 28, 45 and 65 wks of age, respectively. Moreover, cholesterol as well as of other blood lipid components may depend on climatic conditions, feeding, animal condition and sexual activity (**Itoh, et al., 1998**).

2-4- Plasma glucose

The results in Figure (6) showed that, no significant differences were found in plasma glucose levels at different ages. Whereas, **Bahie El-Deen et al. (2009)** observed that glucose level of quail significantly

increased at 13 wks of age (peak of EP) compared to at 6 wks of age and at 90 days of egg production.

2-5-Plasma AST and ALT values

There were inconsistent trends in the values of AST and ALT which had fluctuations as shown in Figures (7 and 8). However, **Hillyard *et al.* (1956)** and **Lorentz *et al.* (1983)** reported that estrogen secretion at the onset of egg production in laying hens was drastically increased liver metabolism .

3- Phenotypic correlations

3-1- Phenotypic correlations between age and plasma constituents

There were high significant positive phenotypic correlations between age and each of TP, Alb, Ca, P, TL, TG and cholesterol of the female Japanese quail, however, no significant phenotypic correlations were found among age and each of glucose , AST and ALT as shown in Table (3). The changes in EP are attributable to changing hormone profiles, sensitivity of tissues to hormone action, and diminished ability of the hen to transport calcium at the duodenum **Hansen (2002)**. Also, **Hansen, *et al.* (2003)** found increasing in estrogen receptors α population in kidney of laying hens from 19 wks (0 EP) to 29 wks (peak EP) and interpreted that to the kidney is the primary site at which estrogen sets off the cascade of events leading to Ca uptake by the gut.

3-2- Phenotypic correlations between EN and plasma constituents

EN positively correlated ($P \leq 0.01$) with TP, Alb, Ca, P, TL, TG, Cholesterol and AST as shown in Table (3). And , **Liou, *et al.* (2007)** reported that, although the correlation between serum proteins (apolipoprotein A-I and vitellogenin) and egg numbers is not significant at the time of initial egg production they become significant as egg production increases, similarly, **Kamar *et al.* (1985)** and **Alm El Dein *et al.* (2008)** found that egg number in the first 90 days of production were positively correlated with plasma Ca. These results are disagreement with **Kalamah (1995)** who indicated that there was a significant negative correlation between plasma Ca and egg number. Also, positive correlations ($P \leq 0.05$) were obtained between glucose and egg number at 90 days egg production (**Soliman, 2009**).

3-3- Phenotypic correlations between EP % and plasma constituents

EP% positively correlated ($P \leq 0.01$) with TP, Alb, Ca, TL, TG, Cholesterol and AST as shown in Table (3). These results are in agreement

with **Kamar *et al.* (1985)** that found significant and positive phenotypic correlations between plasma Ca and egg production traits.

3-4- Phenotypic correlations between EW and plasma constituents

The result in Table (3) indicated that there is no phenotypic correlations between EW and the plasma constituents under the study. But, negative correlation was observed between EW and plasma Ca **Alm El Dein *et al.* (2008)**. While, positive correlations ($P \leq 0.05$) were observed between glucose and EW at 13 wks of age (**Soliman, 2009**).

3-5- Phenotypic correlations between EM and plasma constituents

There were positive phenotypic correlations among EM and the plasma Ca, TG and Cholesterol as shown in Table (3). **Similarly, Kamar *et al.* (1985)** and **Alm El Dein *et al.* (2008)** reported that EM in the first 90 days of production were positively correlated with plasma Ca.

Table (1): Composition and chemical analyses of the experimental diets.

Ingredients	Laying diet
Yellow corn, ground	61.28
Soybean meal (44%CP)	22.00
layers concentrates (50% CP)	10.00
Vegetable oil	1.10
Calcium carbonate	5.05
Vit. and Min. premix *	0.30
Sodium chloride	0.20
Di calcium phosphate	---
DL- methionine	0.07
Total	100.00
Calculated analysis**	
CP %	19.92
EE%	3.00
CF%	3.00
Ca%	2.50
Available P %	0.39
Methionine%	0.45
Methionine+Cystine%	0.86
Lysine%	1.00
ME, K cal /kg	2875

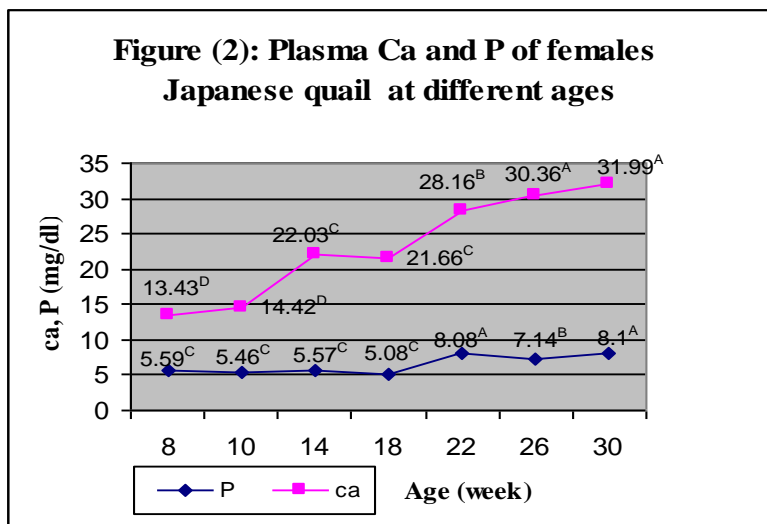
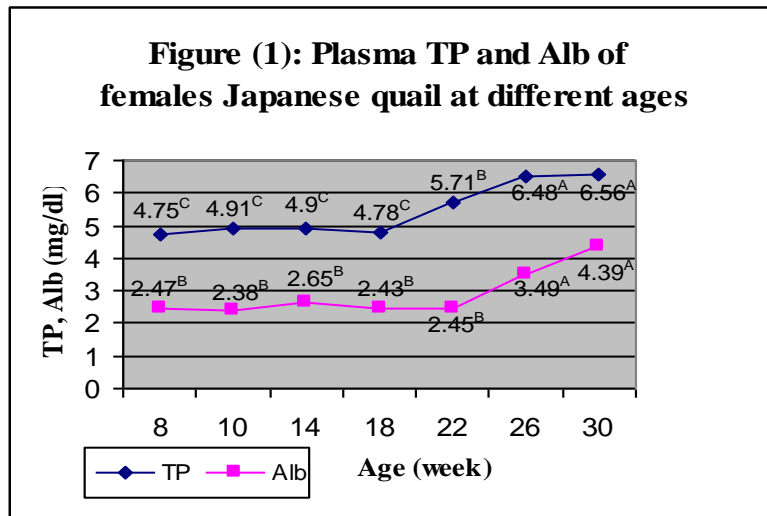
*Each 3.0 Kg of the Vit. and Min. premix manufactured by Amcomix Company, Egypt contains : Vit. A, 12000000 IU Vit. D₃,3000000 IU Vit. E, 20 g Vit. K₃, 1 g Vit. B₁, 1 g Vit. B₂, 5 g Vit. B₆, 1.7 g Vit. B₁₂, 10 mg choline chloride, 450 g biotin, 50 mg folic acid, 1g nicotinic acid , 30 g niacin, 3 g pantothenate acid, 10 g Zn, 50 g Cu, 4 g Fe, 30 g Co, 100 mg Se, 100 mg I, 300 mg Mn, 60 g and completed to 3.0 Kg by calcium carbonate.

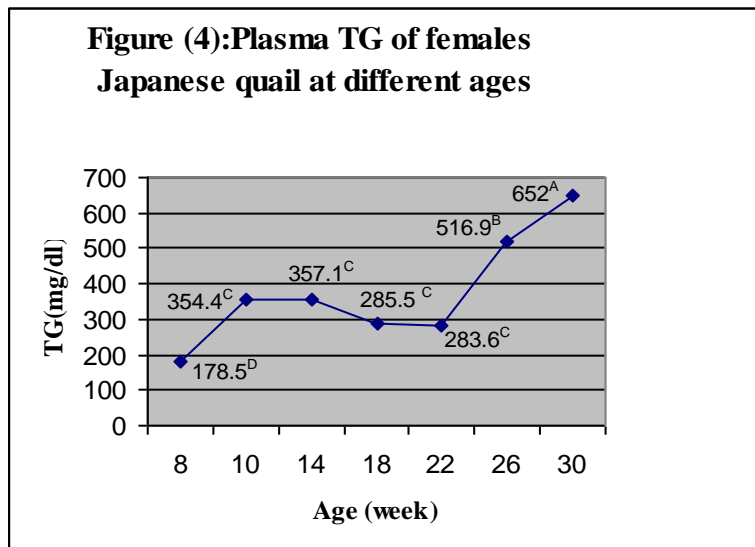
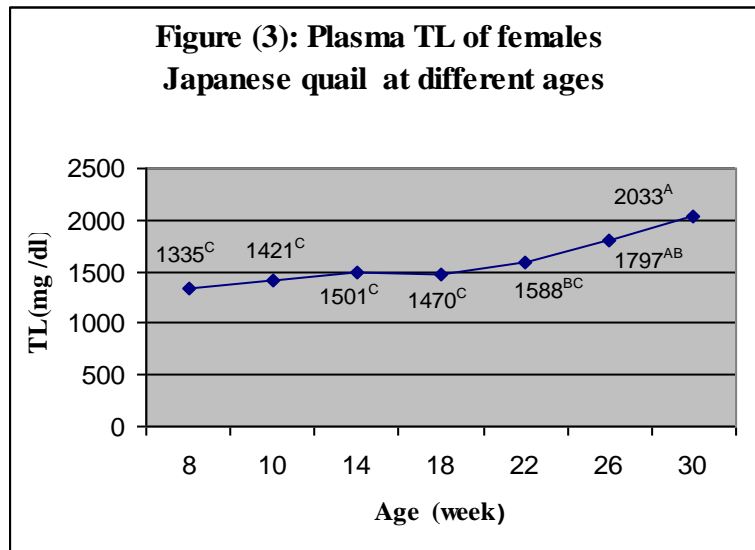
** According to NRC, 1994.

Table (2): Egg performance of the Japanese quail female at different ages (mean±SE).

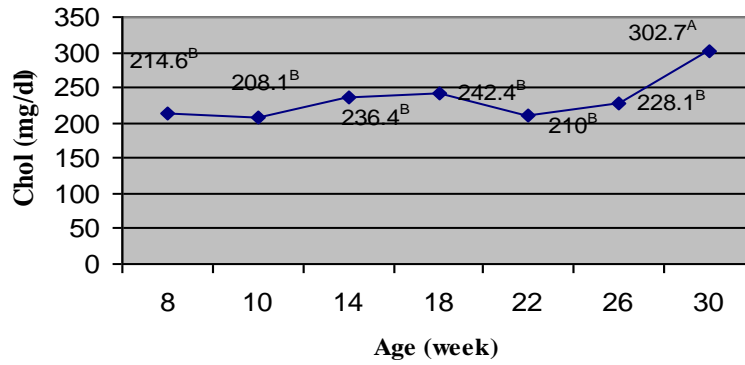
Egg performance				
Age (wk)	Egg number	Egg production (%)	Egg weight (g)	Egg mass (g/bird/day)
8	10.16± 0.22 ^D	72.55± 2.17 ^D	11.22± 0.11 ^C	8.12± 0.25 ^D
10	11.44±0.17 ^C	81.72± 1.18 ^C	12.19± 0.09 ^B	9.96± 0.16 ^C
14	25.93±0.27 ^A	92.20± 0.97 ^A	12.82± 0.10 ^A	11.85± 0.14 ^A
18	25.11± 0.29 ^{AB}	89.67± 1.05 ^{AB}	12.75± 0.10 ^A	11.45± 0.17 ^A
22	24.32± 0.37 ^B	86.86± 1.34 ^B	12.05± 0.10 ^B	10.47± 0.18 ^{BC}
26	24.61± 0.40 ^B	87.88± 1.44 ^B	11.99± 0.10 ^B	10.55± 0.20 ^B
30	24.63± 0.36 ^B	87.97± 1.29 ^B	12.14±.0.11 ^B	10.69± 0.19 ^B
Mean	20.90± 0.29	85.63± 0.58	12.17± 0.04	10.45± 0.08

A,B and C values in the same column within the same item followed by different superscripts are significant at P< 0.01

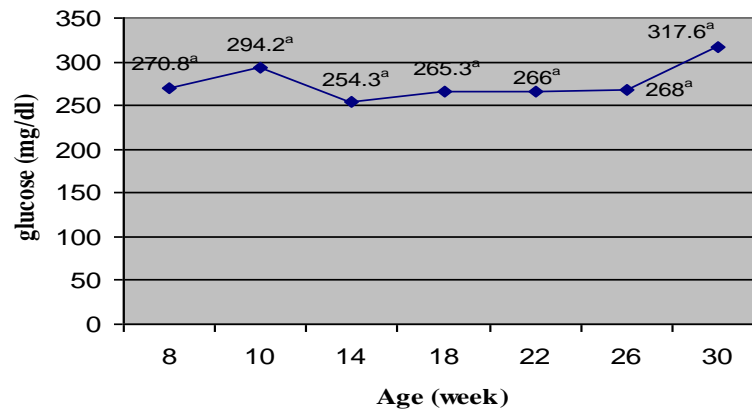




Figure(5): Plasma cholesterol of females Japanese quail at different ages



Figure(6): Plasma glucose of females Japanese quail at different ages



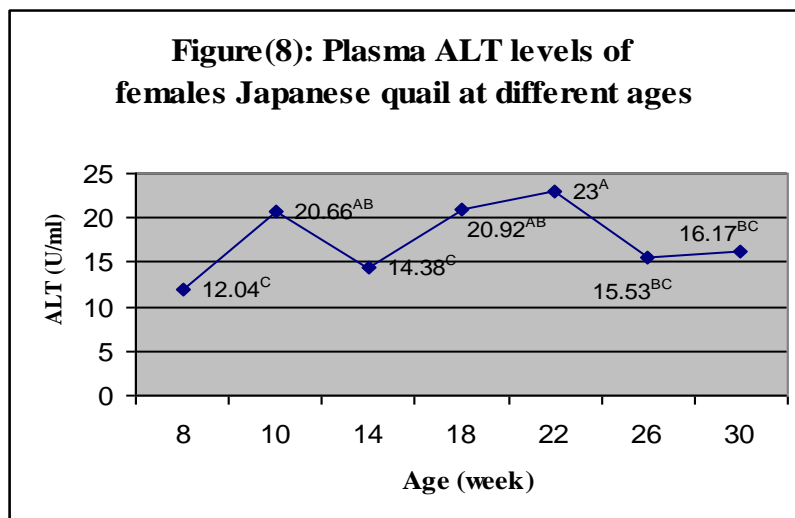
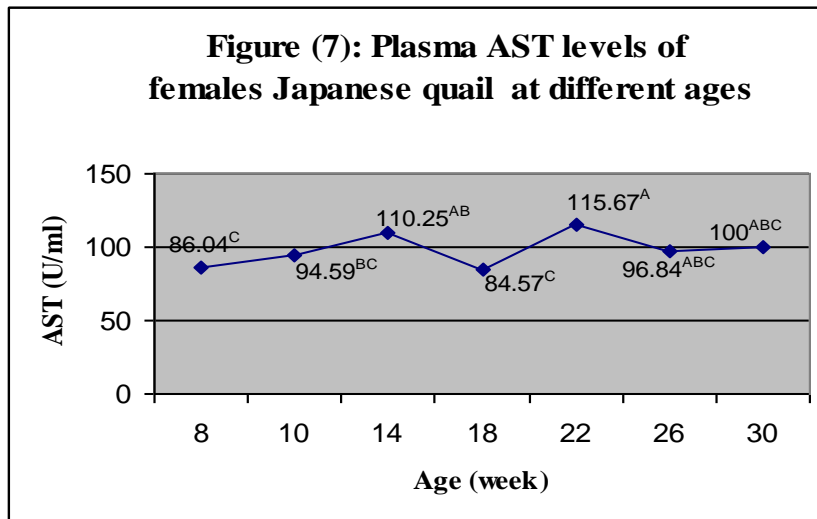


Table (3): Correlation coefficients between age, egg performance and plasma constituents of the Japanese quail female

Items	Age	EN	EP%	EW	EM
TP	0.663**	0.374**	0.249*	-0.103	0.119
Alb	0.765**	0.412**	0.283**	-0.060	0.162
Ca	0.922**	0.790**	0.619**	0.174	0.471**
P	0.617**	0.361**	0.198	-0.156	0.066
TL	0.579**	0.369**	0.290**	0.034	0.200
TG	0.696**	0.404**	0.412**	0.144	0.319**
Cholesterol	0.417**	0.306**	0.249*	0.132	0.217*
Glucose	0.111	-0.072	-0.051	-0.059	-0.060
AST	0.131	0.193	0.202*	0.104	0.169
ALT	0.023	0.040	0.115	0.175	0.136

*significant at $P \leq 0.05$

** significant at $P \leq 0.01$

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الملخص العربي

الاختلافات في الاداء الانتاجي ومكونات البلازما لاناث السمان الياباني البياض عند الاعمار المختلفة

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تم استخدام عدد 112 انثى سمان ياباني عمر 6 اسابيع لتقدير اداء انتاج البيض ومكونات البلازما اثناء الفترات المختلفة من الانتاج و لتقدير الارتباطات المظهرية بين العمر، النسبة المئوية لانتاج البيض، وزن البيضة وكتلة البيضة و مكونات البلازما. كما تم تقدير النسبة المئوية لانتاج البيض، وزن البيضة وكتلة البيضة و مكونات البلازما عند الاعمار 8، 10، 14، 18، 22، 26 و 30 اسبوع ويمكن تلخيص النتائج كما يلي:

- 1- وجدت اختلافات معنوية في عدد البيض، نسبة انتاج البيض، وزن البيضة وكتلة البيضة عند الاعمار المختلفة واعلى القيم كانت عند الاعمار 14 و 18 اسبوع.
- 2- وجدت زيادات معنوية في مكونات البلازما (البروتين الكلي، الاليومين، الكالسيوم، الفسفور، الدهون الكلية، التراي جلسريد والكوليستيرول) مع التقدم في العمر ولكن لم توجد اختلافات معنوية في قيم الجلوكوز، في حين ان قيم انزيمات الكبد لم تكن محددة الاتجاه.
- 3- وجدت ارتباطات مظهرية معنوية للعمر وعدد البيض مع كلا من البروتين الكلي، الاليومين، الكالسيوم، الفسفور، الدهون الكلية، التراي جلسريد والكوليستيرول.
- 4- ايضا هناك ارتباطات مظهرية معنوية بين نسبة انتاج البيض وكلا من البروتين الكلي، الاليومين، الكالسيوم، الدهون الكلية، التراي جلسريد والكوليستيرول.
- 5- كتلة البيضة كان لها ارتباط مظهري معنوي مع كل من الكالسيوم، التراي جلسريد والكوليستيرول. بينما لم يكن هناك ارتباطات مظهرية معنوية بين وزن البيضة ومكونات البلازما.

ويمكن التوصية: بضرورة الاعتماد على السمان الياباني لانتاج البيض و اللحم لتفوقه الانتاجي. ونتجة وجود ارتباطات مظهرية معنوي موجبة بين مكونات البلازما وصفات انتاج البيض لذلك يمكن الاعتماد عليها في ايجاد طرق انتخابية جديدة لتحسين انتاج البيض.