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EFFECTS OF MATERNAL BODY WEIGHT, SOME BLOOD PARAMETERS AND EGG QUALITY TRAITS ON FERTILITY, HATCHABILITY AND CHICK WEIGHT OF JAPANESE QUAIL

By

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Abstract: *A total number of one hundred and fifty-three females and males of Japanese quail at 14 weeks of age were used with sex ratio 2 female / 1 male to study the effect of maternal body weight, some blood parameters and egg quality traits on fertility% (F%), hatchability% for total and fertile eggs (H/TE % and H/FE %), and chick weight (CW). Birds classified into three groups (light, medium and heavy) according to the body weight at six weeks of age (BW_6), (seventeen replicates of each group) and the averages were 205.9, 229.5 and 250.9 g of females and were 179.8, 194.8 and 205.8 g of males. The results obtained as follows: The eggs weight (EW) and CW increased significantly with increasing the BW_6. The medium group had the highest value of H/TE %. Medium and heavy groups had higher plasma calcium (Ca), total lipids (TL), triglycerides (TG), Red blood cells (RBCs) count than the light group. The heavy female group had the highest significant value of white blood cells (WBCs) count, hemoglobin (Hb), egg surface area (ESA), shell weight / unit surface area (SWUS), egg length (E L), egg width (E WD), albumen weight (Alb W), shell weight (SW) and shell thickness (ST) while it had significant decrease in Haugh unit compared to the other groups. There were significant positive phenotypic correlations between F % and each of plasma Alb, Ca, TL, TG, SWUS, yolk % (Y%) and shell % (S%) and negatively with albumen % (Alb%). The H/TE % positively correlated with each of BW_6, plasma Alb, Ca, TL, TG, RBC's count and yolk diameter (YD), but it correlated negatively with plasma P, glucose, alanine aminotransferase (ALT) and Alb %. The H/FE % correlated positively with each of plasma TP, Ca, RBCs count, WBCs count, Hb %, packed cell volume% (PCV %) and YD and negatively with P, glucose, ALT and yolk index (YI). Significant positive phenotypic correlations were found between CW and each of BW_6, plasma TP, Alb, Ca, TL, TG, aspartate aminotransferase (AST), RBCs count, WBCs count, Hb %, PCV %, EW, ESA, EL, Alb W, SW, SWUS, yolk weight (YW) and ST, but it correlated negatively with plasma P, glucose, ALT and Y%. It can be concluded that the medium and heavy Japanese quail females had some blood parameters and egg quality traits caused improving in each of F%, H/TE%, H/FE% and CW. Therefore, the selection for high body weight or for high some blood parameters may be cause good effects on studied traits.*

Key Words: Maternal Body Weight, Blood Parameters, Egg Quality, Hatchability, Chick Weight, Japanese Quail

INTRODUCTION

Recently, in Egypt and other countries, it has been observed in the poultry breeding that the quails were benefited as much as hens both for their meat and eggs, therefore, commercial quail breeding have became widespread. The uniformity of flock at the beginning and during the laying period is the main factor to increase egg production (Leeson *et al.*, 1997). Also, Yalçin *et al.* (1996) found that hatch weight of Japanese quail increased with increasing the maternal body weight. And the fertility % is affected by factors originating from the hen such as her ability to mate successfully, to store sperm, to ovulate an egg cell and to produce a suitable environment for the formation and development of the embryo (Brillard 2003). Fertility% also depends on hen mate's ability to mate successfully, quantity and quality of semen deposited. The dam that laid the egg was the main source of genetic variation in hatch of fertile eggs, suggesting a huge impact of egg quality traits (Wolc and Olori 2009).

External and internal quality traits of the eggs are significant in the poultry breeding for their influence on the yield features of the future generations, breeding performances, and chicks quality and growth (Altinel *et al.*, 1996). Also, Cavero and Schmutz (2009) reported that selection for better hatchability will be in line with not only improved external egg quality, but also internal egg quality like the proportion of yolk in the analysed lines of White Leghorn, but there was antagonism between high Haugh units and good hatchability. Thickness of eggshell is an indirect index of its strength and the eggshell quality (weight, thickness and structure) is the most essential morphological trait for the normal incubation (Rodriguez-Navarro *et al.*, 2002). Calcium and phosphorous are essential macro minerals with calcium forming a significant component of the shell and phosphorous playing an important role in skeletal calcium deposition and subsequent availability of calcium for egg shell formation during the dark period (Boorman *et al.*, 1989). At the onset of egg production, the flow of TG from liver to peripheral tissues, such as muscle and adipose tissues, is redirected mainly to yolk deposition (Bacon 1994).

Little information was found on the effects of maternal weight, blood parameters and egg quality traits on F%, H/TE %, H/FE % and CW of quail. Therefore, the present study was conducted to fill this gap.

MATERIALS AND METHODS

Birds and husbandry

The experimental work of this study was carried out at the Poultry Research Station, Poultry Department, Faculty of Agriculture, Fayoum University from March to June 2009. A total number of one hundred and fifty-three females and males of Japanese quail at 14 weeks of age were used in this study. Birds were classified into three groups (light, medium and heavy) according to the body weight at six weeks of age, and the averages were 205.91, 229.45and 250.90 g of females and were 179.77, 194.78 and 205.79 g of males, respectively. Birds were marked by wing bands and housed in individual cages with sex ratio 1 male : 2 females (seventeen replicates of each group). Birds were fed on layer diet (19.92% CP, and 2875 kcal ME/kg), and both feed and water were provided *ad libitum* throughout the experimental period. Artificial light was used beside the normal daylight to provide 17-hour day photoperiod.

Sampling and analysis

Six hundred eggs that represented the three groups of female's body weight were collected during 14 weeks of age. Eggs were collected at 5.00 pm every day for week in room at 16-18 °C (the eggs of each female were marked with permanent marker) after that incubated in automatic electrical incubator (El Takamoly Poultry Project) at 99-100 °F and 60-70% relative humidity and turning each two-hour. After 14^{th} day of incubation, eggs of each female put in netting plastic and transferred to the hatcher (turning was stopped, 96- 97°F and 80-90% relative humidity). The F %, H/TE %, H/FE % and CW at hatch were determined. Thereafter, at the same age ninety eggs were collected of the last two days (30 eggs of each group of females body weight) to determine the egg quality traits. EW recorded individually, length and width of eggs were measured using caliper to calculate shape index using the formula of Carter (1968), shape index =

(E WD/EL)*100. Then, eggs were broken on table with a flat glass, yolk diameter measured by caliper, a 3- legged micrometer was used for measuring the height of yolk and albumen. Yolk index was estimated from ratio of yolk height to yolk diameter. Shell thickness was measured in three different parts (sharp. blunt and equatorial) by micrometer after it dried (Tyler 1961). The surface area (cm^2) of each egg was estimated using the formula of Carter (1975a) as $3.9782 \times W^{0.7056}$ where W is egg weight in grams. Shell weight per unit surface area (mg/cm^2) = shell weight (mg) /egg surface area (cm^2) according to Carter (1975b). Haugh unit = 100 x log ($AH + 7.57 - 1.7x\ EW^{0.37}$) where AH, albumin height and EW, egg weight.

At 14 weeks of age, 15 blood samples (five samples of each category) were collected in heparinized tubes from wing vein of quail in the morning. Blood samples divided into two parts, the first part was used to determine the hematological parameters (RBCs, WBCs, PCV and Hb) and the second part was centrifuged at 3000 rpm for 15 minutes to separate 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 and Reitman and Frankel (1957) for AST and ALT.

Analysis data and correlation coefficients were computed according to SPSS (1999). Significant differences among means were evaluated using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Average BW of light, medium and heavy weight groups of Japanese quail females at 6 weeks of age were 205.91, 229.45 and 250.90 g, respectively as shown in Table 1. The EW and CW increased significantly ($P\leq 0.01$) with increasing the BW_6 and being 12.38, 12.98 and 13.52 and 8.50, 9.14 and 9.20 g. respectively. These results are in agreement with those reported by Yalçin *et al.* (1996): Ipek and Dikmen (2007); Cavero and Schmutz (2009): Alkan *et al.* (2010). However, insignificant differences were found in F% among the three groups ($P>0.05$) and the lowest value was 85.50 % for the light group but the highest value was 92.56% for the medium group. Similarly, Ipek *et al.* (2003) observed that the breeder pairs that had the heaviest BW displayed higher fertility rates. Medium and heavy groups had higher H/TE % compared to the light group being 87.99 and 85.18 vs 78.32, respectively. Insignificant increase was shown in H/FE % with increasing the body (Table 1). Also, Coban *et al.* (2008) found that increasing the parent body weight of Japanese quail caused elevation of hatchability %, similarly, Liptói and Hidas (2006); Wolc and Olori (2009) reported that the dam that laid the egg was the main source of genetic variation in H/FE%, suggesting a huge impact of egg quality traits.

Medium and heavy groups had significantly higher plasma Ca, TL and TG than the light group as shown in Table (2). Also, Nestor and Emmerson (1990) and Riczu *et al.* (2004) observed that BW was correlated with total bone density in laying hens and Elaroussi *et al.* (1994) reported that Ca is one of the key elements required for maintenance and egg production. Also, Klasing (1998) showed that most Ca in laying hens is used for shell formation, and it plays a role in fat and carbohydrate metabolism (Singh and Panda, 1996). Similarly, El-Full *et al.* (2006) found that plasma TL of Japanese quail females selected for high BW_6 was higher than females of the randombred control. Likewise, Hassan *et al.* (2008) observed that the BW_6 of Japanese quail positively correlated with each of TL and TG.

There were insignificant differences among the three females body weight groups in each of plasma TP and alb, P, cholesterol, glucose, AST and ALT (Table 2). However, highly significant increases were found in RBCs and WBCs with increasing the body weight of females Japanese quail as shown in Table (2). Also, El-Full *et al.* (2006) observed increasing in WBCs of females selected for high BW_6. The heavy females group had the highest significant value of Hb% compared to other groups, while insignificant increases were observed in PCV % with increasing body weight. Hassan *et al.* (2008) reported that PCV% increased in two lines selected to high growth rate and BW_6 compared to control this may be because the tissues of that lines must be supplied with high values of oxygen to support metabolism.

Results presented in Table (3) showed that there were significant differences in ESA, SWUS, E WD, EL, Alb W, SW, and ST among the females groups, and the highest value was of heavy group compared to medium and light groups. Similar results were reported by Silversides *et al.* (2006) of chicken and by Alkan *et al.* (2010) of Japanese quail. This because BW was correlated with total bone density in laying hens (Nestor and Emmerson 1990; Riczu et *al.* 2004). There was significant decrease in Haugh unit of heavy female group compared to the other groups as shown in Table (3). However, no significant differences were found in SI, YW, Y%, Alb%, S% and YI among the groups. Alkan *et al.* (2010) found decrease in YI of egg high line body weight Japanese quail compared to low line.

Phenotypic correlations

1- Phenotypic correlations among fertility %(F %), hatchability% for total and fertile eggs (H/TE% and H/FE %) and chick weight (CW) and each of body weight, plasma biochemical and hematological parameters of Japanese quail females

There were significant positive phenotypic correlations between F % of egg quail and each of plasma Alb, Ca, TL and TG. Also, H/TE % correlated positively with each of BW_6, plasma Alb, Ca, TL, TG and RBCs count of Japanese quail females, but its correlations were negative and significant with plasma P, glucose and ALT as shown in Table (4). Keshavarz (1994) observed that high plasma P decreases calcium absorption from the gut and calcium from the bone. The H/FE % positively correlated with plasma TP, Ca, RBCs count, WBCs count, Hb % and PCV% and negatively correlated with P, glucose and ALT. High significant ($P \leq 0.01$) positive phenotypic correlations were found between CW of quail and each of BW_6, plasma TP, Alb, Ca, TL, TG, AST, RBCs count, WBCs count, Hb % and PCV%. Also, Wilson (1991) reported that the BW is important after sexual maturity because of high positive correlations were found between BW and EW, EW and CW at hatching. However, CW was correlated positively with each of P, glucose and ALT.

2- Phenotypic correlations among fertility %(F%), hatchability% for total and fertile eggs (H/TE% and H/FE%) and chick weight (CW) and egg quality traits of Japanese quail females

Positive phenotypic correlations were found between F % of egg and SWUS, Y% and S% and negatively with Alb%. There was significant positive phenotypic correlation between H/TE % and YD but it correlated negatively and significantly with Alb % as shown in Table (5). However, H/FE % correlated positively with YD and negatively with YI. Cavero and Schmutz (2009) found positive correlation between the egg shell quality and hatchability, but there was antagonism between high Haugh units and good hatchability (Barnett *et al.*, 2004 ; Cavero and Schmutz, 2009).The quality of the egg which defines the micro-environment of the developing embryo was mostly responsible for the successful hatching of the egg. This implies that egg quality was important in hatchability and can make substantial contribution to the genetic improvement of hatchability (Bennewitz *et al.*, 2007).

High significant ($P \leq 0.01$) positive phenotypic correlations were found between CW and each of EW, ESA, EL Alb W and SW. While, it correlated significantly and positively with SWUS, YW and ST. but it correlated negatively with Y% (Table 5). Also, Altinel *et al.* (1996) said that external and internal quality traits of the eggs are significant in the poultry breeding for their influence on chick's quality and growth. While, Flock *et al.* (2007) observed positive correlation of yolk proportion with hatchability and chick quality. Kul and Seker (2004) reported that positive phenotypic correlation was found between the EW and the SW or ST and the values were being 0.6 and 0.21 respectively. Also, Farooq *et al.* (2001) on egg Fayoumi hens that said the EW is indicator to shell quality. It can be concluded that the medium and heavy females had blood parameters and egg quality traits caused improving in each of F%, H/TE %, H/FE % and CW of the Japanese quail. Therefore, the selection for high body weight or for high some blood parameters may be cause good effects on that traits.

Table (1): Body weight at 6 weeks (BW6), egg weight (EW), chick weight (CW), fertility %(F%) and hatchability % for total and fertile eggs (H/TE % and H/TE %) of Japanese quail females differ in body weight.

Groups	Body weight			SE	Sig
Traits	Light	Medium	Heavy		
BW6 (g)	205.91^{c}	229.45^{b}	250.90^{a}	1.26	***
EW (g)[1]	12.38^{c}	12.98^{b}	13.52^{a}	0.14	**
C W (g)	8.50^{b}	9.14^{a}	9.20^{a}	0.13	**
F%	85.50	92.56	89.19	2.06	NS
H/TE %	78.32^{b}	87.99^{a}	85.18^{ab}	2.54	*
H/FE %	91.74	94.61	96.26	1.89	NS

Means having different superscripts within each effect in the same row are significantly different at $P \leq 0.05$
SE: standard error, Sig: significance, NS: not significant, *: significant at $P \leq 0.05$, **: significant at $P \leq 0.01$, ***: significant at $P \leq 0.001$. [1]EW = Eggs weight that incubated

Table (2): Plasma biochemical and hematological parameters of Japanese quail females differ in body weight.

Groups	Body weight			SE	Sig
Traits	Light	Medium	Heavy		
Total protein, mg/dl	4.75	4.86	5.10	0.20	NS
Albumin, mg/dl	2.53	2.75	2.68	0.14	NS
Calcium, mg/dl	17.46^{b}	24.52^{a}	24.12^{a}	1.84	*
Phosphorus, mg/dl	5.93	5.61	5.18	0.61	NS
Total lipids, mg/dl	1220^{b}	1705^{a}	1579^{a}	42.68	**
Triglycerides, mg/dl	290.00^{b}	410.00^{a}	371.50^{a}	15.43	**
Cholesterol, mg/dl	236.00	225.75	247.50	8.37	NS
Glucose, mg/dl	260.5	254.49	248.05	18.08	NS
AST, U/ml	106.31	105.19	119.25	7.80	NS
ALT, U/ml	16.75	13.88	12.50	1.29	NS
RBCs ($x 10^{6}/mm^{3}$)	4.06^{c}	4.88^{b}	5.12^{a}	0.06	***
WBCs ($x 10^{3}/mm^{3}$)	97.5^{b}	110.00^{b}	135.00^{a}	6.23	**
Hb%	12.60^{b}	13.08^{b}	14.30^{a}	0.40	*
PCV %	44.26	46.4	50.63	1.77	NS

Means having different superscripts within each effect in the same row are significantly different at $P \leq 0.05$
SE: standard error, Sig: significance, NS: not significant, *: significant at $P \leq 0.05$, **: significant at $P \leq 0.01$,
***: significant at $P \leq 0.001$

Table (3): The egg quality traits of Japanese quail females differ in body weight.

Groups	Body weight			SE	Sig
Traits	Light	Medium	Heavy		
Egg weight, g	12.39[b]	12.74[b]	13.33[a]	0.14	***
Surface area, cm2	23.48[b]	23.95[b]	24.73[a]	0.19	***
SWUS, mg/cm2 [1]	46.99[b]	48.18[ab]	49.23[a]	0.66	*
Egg length, cm	3.28[b]	3.31[b]	3.36[a]	0.01	**
Egg width, cm	2.65[ab]	2.62[b]	2.69[a]	0.01	*
Shape index %	80.88	79.21	79.82	0.60	NS
Yolk height, mm	10.30	10.31	10.24	0.16	NS
Yolk diameter, cm	2.59[b]	2.61[b]	2.70[a]	0.03	*
Yolk weight, g	3.82	3.94	3.98	0.07	NS
Yolk %	30.80	30.97	29.80	0.39	NS
Albumin weight, g	7.47[b]	7.64[b]	8.11[a]	0.11	***
Albumin %	60.29	59.97	60.88	0.39	NS
Shell weight, g	1.10[b]	1.15[b]	1.22[a]	0.02	***
Shell %	8.92	9.06	9.15	0.13	NS
Yolk index %	39.88	39.52	38.12	0.68	NS
Haugh unit	84.11[a]	84.03[a]	81.12[b]	0.78	*
Shell thickness, mm	0.216[b]	0.215[b]	0.227[a]	0.003	**

Means having different superscripts within each effect in the same row are significantly different at $P \leq 0.05$
SE: standard error. Sig: significance. NS: not significant. *: significant at $P \leq 0.05$. **: significant at $P \leq 0.01$. ***: significant at $P \leq 0.001$. [1] SWUS: Shell weight per unit surface area

Table (4): Correlation coefficients among fertility % (F%), hatchability % for total and fertile eggs (H/TE% and H/FE %) and chick weight (CW) and each of body weight, plasma biochemical and hematological parameters of Japanese quail females.

Items	F%	Sig	H/TE%	Sig	H/FE %	Sig	CW	Sig
BW_6, g [1]	0.145	NS	0.235	*	0.207	NS	0.413	***
Total protein, mg/dl	0.070	NS	0.198	NS	0.250	*	0.318	**
Albumin, mg/dl	0.289	**	0.345	**	0.194	NS	0.358	**
Calcium, mg/dl	0.255	*	0.340	**	0.231	*	0.385	**
Phosphorus, mg/dl	-0.105	NS	-0.231	*	-0.258	*	-0.343	**
Total lipids, mg/dl	0.282	**	0.346	**	0.202	NS	0.365	**
Triglycerides, mg/dl	0.288	**	0.345	**	0.191	NS	0.355	**
Cholesterol, mg/dl	-0.161	NS	-0.066	NS	0.120	NS	0.058	NS
Glucose, mg/dl	-0.123	NS	-0.247	*	-0.260	*	-0.354	**
AST, U/ml	-0.046	NS	0.076	NS	0.203	NS	0.208	*
ALT, U/ml	-0.180	NS	-0.294	**	-0.260	*	-0.381	**
RBCs (x 10^6/mm^3)	0.204	NS	0.311	**	0.256	*	0.388	**
WBCs (x 10^3/mm^3)	0.075	NS	0.202	NS	0.252	**	0.321	**
Hb%	0.059	NS	0.186	NS	0.247	*	0.308	**
PCV %	0.076	NS	0.203	NS	0.252	*	0.322	**

Sig: significance, NS: not significant. *: significant at $P \leq 0.05$. **: significant at $P \leq 0.01$. ***: significant at $P \leq 0.001$.
BW_6: Body weight at 6 weeks of age. AST: aspartate aminotransferase. ALT: alanine aminotransferase.
RBCs: red blood cells. WBCs: white blood cells. Hb: hemoglobin. PCV: packed cell volume

Table (5): Correlation coefficients between fertility% (F%), hatchability % for total and fertile eggs (H/TE % and H/FE %) and chick weight (CW) and egg quality traits of Japanese quail females.

Items	F%	Sig	H/TE %	Sig	H/FE %	Sig	CW	Sig
Egg weight, g	-0.118	NS	-0.069	NS	0.015	NS	0.750	***
ESA[1]	-0.119	NS	-0.070	NS	0.013	NS	0.751	***
SWUS[2]	0.260	*	0.151	NS	-0.067	NS	0.226	*
Egg length	0.033	NS	0.029	NS	0.081	NS	0.328	**
Egg width	0.002	NS	0.108	NS	0.178	NS	0.195	NS
Shape index	0.025	NS	0.078	NS	0.107	NS	-0.074	NS
Yolk diameter	0.119	NS	0.227	*	0.225	*	0.171	NS
Yolk height	0.180	NS	0.098	NS	0.070	NS	0.145	NS
Yolk index	-0.064	NS	-0.081	NS	-0.218	*	0.006	NS
Yolk weight	0.116	NS	0.170	NS	0.128	NS	0.215	*
Yolk %	0.213	*	0.199	NS	0.048	NS	-0.229	*
Albumen weight	0.167	NS	-0.067	NS	0.107	NS	0.524	***
Albumen %	-0.300	**	-0.239	*	-0.007	NS	0.190	
Shell weight	0.179	NS	0.136	NS	0.008	NS	0.440	***
Shell %	0.274	**	0.141	NS	-0.102	NS	0.088	NS
Haugh unit	-0.082	NS	-0.149	NS	-0.145	NS	-0.202	NS
Shell thickness	-0.071	NS	0.004	NS	0.095	NS	0.218	*

Sig: significance. NS: not significant. *: significant at $P \leq 0.05$. **: significant at $P \leq 0.01$. ***:significant at $P \leq 0.001$. [1] ESA: Surface area of incubated eggs. [2] SWUS: Shell weight per unit surface area

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الملخص العربي

تاثير وزن جسم الام وبعض قياسات الدم وصفات جودة البيضه على الخصوبة والفقس ووزن كتكوت السمان الياباني

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تم استخدام عدد ١٥٣ أنثى ونكر سمان يابانى عند عمر ١٤ اسبوع بنسبة جنسية ٢ أنثى / ١ نكر لدراسة تأثير وزن الجسم وبعض قياسات الدم وصفات جودة البيضه للام على نسبة الخصوبة والفقس منسوبا للبيض الكلي او منسوبا لبيض المخصب ووزن الكتكوت .تم تقسيم الطيور الى ثلاثة مجموعات (خفيفة ، متوسطة وثقيلة) تبعا لوزن الجسم عند عمر ٦ أسابيع وكانت المتوسطات ٢٠٥.٩ ، ٢٢٩.٥و ٢٥٠.٩ للا نات و ١٧٩.٨ ، ١٩٤.٨ و ٢٠٥.٨ للذكور على الترتيب وكانت النتائج كالتالى

زيادة وزن البيضة ووزن الكتكوت معنويا مع زيادة وزن الجسم عند عمر ٦ اسابيع . والمجموعة متوسطة الوزن كان لها اعلى نسبة فقس منسوبا للبيض الكلي و المجموعتين المتوسطة والثقيلة كان لهما أعلى نسبة كالسيوم، دهون كلية وجليسريدات ثلاثية ببلازما الدم واعلى عدد كرات دم حمراء وبيضاء. كان لمجموعة الاناث الثقيلة القيم الاعلى لعدد كرات الدم البيضاء، نسبة الهيموجلوبين ، مساحة سطح البيضة ،وزن قشرة البيضه / وحدة مساحة سطح ، طول وعرض البيضه ، وزن البيومين البيضه، وزن قشرة البيضه و سمك قشرة البيضه بينما كانت هذه المجموعة هي الاقل في وحدة هومقارنة بالمجموعات الاخرى.

وجد ارتباط معنوي موجب بين نسبة الخصوبة وكلا من نسب الالبيومين، الكالسيوم، الدهون الكلية والجليسريدات الثلاثية ببلازما الدم ، وزن قشرة البيضه / وحدة مساحة سطح، نسبة الصفار ونسبة القشرة وسلبيا مع نسبة البيومين البيضه .

نسبة فقس البيض المنسوب للبيض الكلي ارتبطت ايجابيا مع كلا من وزن الجسم عند عمر ستة اسابيع ، ونسب الالبيومين ،الكالسيوم ،الدهون الكلية والجليسريدات الثلاثية ببلازما الدم ، وعدد كرات الدم الحمراء وقطر صفار البيضه وكان الارتباط سلبيا مع نسبة الفوسفور، الجلوكوز و انزيم الالانين امينو ترانسفيريز ببلازما الدم ونسبة البيومين البيضه.

وجد ارتباط معنوي موجب بين نسبة فقس البيض المنسوب للبيض المخصب وكلا من نسب البروتين ،الكالسيوم ببلازما الدم ، وعدد كرات الدم الحمراء والبيضاء ونسبة الهيموجلوبين والمكونات الخلوية وقطر صفار البيضه وكان الارتباط سلبيا مع نسبة الفوسفور، الجلوكوز ، انزيم الالانين امينو ترانسفيريز ببلازما الدم ودليل الصفار.

وجد ارتباط معنوي موجب بين وزن الكتكوت وكلا من وزن الجسم عند عمر ستة اسابيع ، ونسب البروتين ، الالبيومين ،الكالسيوم والدهون الكلية والجليسريدات الثلاثية وانزيم الاسبارتات امينو ترانسفيريز ببلازما الدم ، وعدد كرات الدم الحمراء والبيضاء ،نسبة الهيموجلوبين ، نسبة المكونات الخلوية ،وزن البيضه ،مساحة سطح البيضه، طول البيضه ، وزن البيومين البيضه، وزن قشرة البيضه، وزن قشرة البيضه / وحدة مساحة سطح ، وزن الصفار وسمك قشرة البيضه. في حين كان الارتباط سلبيا مع نسبة الفوسفور ، الجلوكوز، انزيم الالانين امينو ترانسفيريز ببلازما الدم و نسبة صفار البيضه.

نستنتج من ذلك ان اناث السمان الياباني المتوسطة وثقيلة الوزن لها صفات دم وجودة بيض تؤدي إلى تحسن في كلا من نسبة الخصوبة ونسبة الفقس سواء منسوبا إلى عدد البيض الكلي او لعدد البيض المخصب وكذلك تحسن في وزن الكتكوت الناتج. لذلك الانتخاب لوزن الجسم او لبعض مكونات الدم المرتفعة قد يسبب تأثيرات جيدة على الصفات التي تم دراستها.