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PRODUCTIVE AND REPRODUCTIVE RESPONSES OF BREEDER JAPANESE QUAILS TO DIFFERENT DIETARY CRUDE PROTEIN AND L-VALINE LEVELS

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ABSTRACT: The outcomes of dietary crude protein levels (CP; 18 and 20%) and L-valine (Val.; 0, 0.1 and 0.2%) supplementation on the productive/reproductive performance, egg quality and some blood parameters of breeder Japanese quails were evaluated from 14 to 28 weeks of age. One hundred forty-four birds were individually weighed and randomly distributed into six treatment groups with eight replicates each of two females and one male. Body weight, egg weight and percentages of fertility, hatchability and total embryonic mortality were not influenced by treatments. However, significant interactions due to CP and Val. levels on egg production percentage, egg mass, chick weight and egg quality traits were obtained. Quails fed 18% CP + 0.2% Val. diets had better feed and valine intake, FCR, shell thickness and yolk index. Sexual libido, foam production, sperm concentration and motility percentage and methylene blue reaction time (MBRT) did not differ due to treatments while cloacal gland area and semen ejaculate volume of male quail were significantly improved by 18% CP level. No differences between treatments were observed for blood urea and albumin concentrations of male and female. In contrast, total protein and Superoxide dismutase (SOD) concentrations increased significantly in response to Val. levels and were also enhanced differently in the blood of male and female. Superoxide dismutase concentration in the plasma of male was not influenced by treatments while plasma female's SOD was significantly elevated due to 18 % CP + 0.2 % Val. diet. The results indicated that dietary 18% CP with 0.2% L-valine was suitable for breeder quails at 14-28 weeks of age.

Key Words: Quails - Protein – Amino acids - Egg measurements - Reproductive traits

INTRODUCTION

The adequacy of protein and amino acids are essential in poultry diets for maximizing productive and reproductive performance, minimizing feeding cost and alleviating ammonia emission. Diet formulation for Japanese quail is based on NRC nutrient requirements, which are different depending on the age of bird and purpose of production; however, these are not ideal for all climatic conditions of different countries. According to NRC (1994) crude protein (CP) level recommended for Japanese quails during the laying period is 20% CP. Nowadays, essential amino acids can be incorporated into poultry diets to decrease the dietary CP level while still meeting the bird's needs. Kaur et al. (2007) reported that 18.5% CP with 2900 kcal ME/kg of the diet was adequate for laying quail during 6-18 weeks of age. Moreover, supplementation of 100% essential amino acids improved egg production, egg weight, feed conversion efficiency and shell thickness. Also, Alagawany et al. (2014) found that productive performances of laying Japanese quail were not significantly affected by feeding a 16% CP diet supplemented with crystalline amino acids level equivalent to 20% CP. Besides, feeding on low-CP diets had many beneficial effects such as lowering diet price which represents more than 70% of the total production costs and decreasing N excretion in feces, thus reducing the N emission to the environment. However, no difference in egg weight was observed when isoleucine supplemented to laying Japanese quail diet containing 16% or 20% CP (Santos et al., 2016).

Valine may potentially be one of the limiting amino acids in a corn-soybean meal based diets for laying hens after Meth., Lys., Trp., and Thr. (Bregendahl and Roberts, 2008). Harms and Russell (2001) reported an improvement in commercial layers performance by adding Val. to a corn-soybean meal diet containing supplemental Meth., Lys., Trp., Ile. and Thr. It was reported that laying Japanese quail required CP slightly higher than 16% with 0.83% Val. in their diet (Allen and Young, 1980). Dietary 1.36% Val. reduced feed consumption and daily egg mass by 5 to 10 %, respectively, and decreased body weight in laying hens (Peganova and Eder, 2002). However, supplementation of 4 g Val./kg of diets (containing 16.2% CP) was tolerated and could be effectively fed to laying hens without detrimental effects on laying performance or immunity functions (Azzam et al., 2015).

Contradictory results have been obtained on low-protein diets and essential amino acid supplementation to laying Japanese quails. Therefore, this study was carried out to evaluate the effects of crude protein and valine levels on productive and reproductive performance, egg quality and some blood parameters of breeder quails from 14 to 28 weeks of age.

MATERIALS AND METHODS

Birds, management and experimental diets:

This study was carried out at the Poultry Farm, Department of Animal Production, Faculty of Agriculture, Suez Canal University, Ismailia, Egypt. One hundred forty-four of male and female Japanese quails (14 wks of age), close in body weight (♀, 264.21±2.95; ♂, 238±2.63g) and egg production rate (82.00±1.94%), were individually weighed and randomly assigned to six treatments. Each dietary treatment was replicated eight times, two females and one male each (24 birds/treatment). Each replicate was represented by one wire-battery cage and equipped with a nipple drinker and trough feeder. A light schedule of 16 hr of light: 8 hr dark was provided daily. Birds were supplied with feed and water *ad-libitum* during the experimental period (14 to 28 weeks of age). After acclimatization of two weeks, data were collected from 16 to 26 weeks of age. At the 26th week of age, the female of each treatment was removed into another battery cages and the reproductive measurements of male were collected. The experiment was performed according to the institutional guidelines on animal use.

Two levels of crude protein (CP; 18 and 20%) and three levels of L-valine (Val.; 0, 0.1 and 0.2 % of diet), over the NRC (1994) Japanese quail requirements, were used to form six dietary treatments. Corn-soybean meal diets were formulated to be isocaloric and provided in mash form. Amino acids chemical analyses were performed using high performance Amino Acid Analyzer Biochrom 30 (Biochrom Ltd, United Kingdom). Diets were formulated to meet the recommended nutrient requirements of NRC (1994). The composition and chemical analyses (calculated and determined; AOAC, 1990) of diets are shown in Table 1.

Productive performance measurements: Individual body weight was recorded at the beginning and at the end of the study to estimate body weight change. Eggs were collected daily and individually weighed to the nearest 0.01 g. At the end of the experiment, the feed left in each feed trough was weighed. Feed intake (FI; g/h/d), Val. intake (Val.I; g/h/d), egg production rate (EP; %), average egg weight (AEW; g/h), average egg mass (AEM; g/h/d) and feed conversion (FCR; g feed/g egg mass) were assessed.

Egg quality traits:

Eggs were taken from each replicate during three consecutive days, every two weeks, for egg quality evaluation. Egg weight, length and width were determined. Each egg was carefully broken out onto a flat surface to determine the internal components. Percentages of yolk, albumen and shell weights relative to egg weight were calculated. Shell thickness (µm) without shell membrane was measured at equator point by a micrometer. Egg shape index, yolk index and internal quality units (IQU) were calculated according to Tumova and Gous (2012), Kul and Seker (2004) and Card and Nesheim (1972), respectively.

Incubation measurements:

Eggs were collected daily, weighed and stored till incubation. Every four days, labeled eggs were placed in an automatic incubator at 37.6°C and 65% relative humidity. At day 15, eggs from each replicate were packed in a suitable container and transferred to a hatchery at a temperature of 37.3°C and 70% relative humidity. The hatched chicks per replicate were counted and weighed to calculate the chick weight percentage [CW % = (chick weight/egg weight) ×100] for each group. The infertile eggs and embryonic mortality were estimated via the un-hatched eggs. The embryonic mortality was classified into three groups, early embryonic mortality (EEM; 1-7 days), late embryonic mortality (LEM; 8-15 days) and pipped dead embryo (PDE) according to Yakimenko et al. (2002). Fertility percentage [F % = (number of fertile eggs/ number of total eggs) ×100] and Hatchability percentage [H % =

(number of hatched chicks/ number of fertile eggs) ×100] were calculated.

Sexual libido and semen evaluation:

After one week of female removal, sexual behavior and semen samples were evaluated. The cloacal gland height and width were measured by using a caliper to calculate the cloacal gland area (CGA, mm^2) for each male (Biswas et al., 2007). The foam produced by the cloacal gland was collected three times every 15 min and immediately weighed using an electronic analytical balance to calculate foam production (FP; mg) for each male. Time of sexual libido (SL) was estimated, as far as response time in second, according to Hanafy and Khalil (2015). The semen samples were gathered by micropipette. Semen ejaculate volume (EV; µl), sperm motility (SM %), sperm concentration (SC; $\times 10^6$/ml) and methylene blue reaction time (MBRT) in each ejaculate were assessed immediately after collection (Hanafy and Khalil, 2015).

Blood parameters:

A blood sample was collected from jugular vein of each bird in a heparinized tube at the end of experiment. Collected blood was immediately centrifuged at 3000 rpm for 20 min and plasma was separated and stored at -20°C for further analysis. Total protein (g/dl), albumin (g/dl) and blood urea (g/dl) were performed using commercial colorimetric kits. Superoxide dismutase (SOD; U/ml) was estimated according to Nishikimi et al. (1972).

Statistical analysis:

The experiment was designed and statistically analyzed as a 2×3 factorial arrangement of two CP levels and three Val. levels based on a completely randomized design. A statistical analysis was performed using SAS (2004) to assess the main effects of CP and Val. levels and their interaction. Means comparisons were performed using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Productive performance:

Data in Table 2 showed no significant difference in the productive performance of laying quails when dietary CP was reduced from 20 to 18%. Laying quails requires higher CP content in their diets as compared with laying hens. The dietary level of 20% CP and 2900 kcal ME/kg are suggested by NRC (1994). Recent studies concluded that meeting amino acids needs with maintaining a minimum CP had no negative effect on the productive performance of laying Japanese quails (Kaur et al., 2007; Alagawany et al., 2014; Santos et al., 2016). Dietary 20% CP with/out Val. supplementation in laying quails insignificantly improved EP (%) and FCR but not AEW or AEM (Table 2). This might be due to the antagonism effect between Val. and the other branched-chain amino acids (leucine and isoleucine) in the diet (NRC, 1994). Valine requirement for the breeding period of Japanese quails is estimated based on values obtained for other ages or species (NRC, 1994) and was predicted to be 0.92% with 20% CP of diet. However, the amino acid requirements of modern quails might be higher (Mehri et al., 2016) than those reported by NRC (1994). Martinez et al. (2017) concluded that 1.96 g Val./kg diet provided the highest response on egg production, followed by feed intake and egg weight; verifying that Val. was the first limiting amino acids in the diet. Dietary 18% CP + 0.1 or 0.2% Val. diets increased EP (%), AEM and improved the FCR with significant ($P \leq 0.05$) effect of 0.2% Val. diet in comparison with 18% CP + 0% Val. diet (Table 2). Accordingly, laying Japanese quails could perform well on 18% CP diet supplemented with Meth., Lys. and Thr. as recommended by NRC (1994) plus 0.2% L-valine. This data also revealed that valine was considered a limiting amino acid in corn-soybean diets when CP was reduced by 2%. Similarly, 16% CP laying quail diets supplemented with isoleucine (Santos et al., 2016) or individual Thr., Trp. and Val. or their mixture (Alagawany et al., 2014) was suitable for better performance, egg quality, lower feeding cost and significant reduction of nitrogen excretion compared to control (20% CP) diet.

In contrast with the data presented here, Abdel-Mageed et al. (2009) indicated that the productive performance of laying Japanese quail was negatively affected when dietary CP reduced by 2%; however the addition of 0.2% Thr. improved the productive performance. On the other hand, significant decline in EP rate, egg number, AEM, AEW and FCR when laying quail fed 17% CP diet supplemented with/out SAA and Thr. in comparison with 20 % CP diet (Zeweil et al., 2016). In layer hens, valine at 0.85 and 0.93% of diet (Attia and Abd Elhalim, 2008) or supplementation of L-valine (0, 0.1, 0.2, 0.3 and 0.4%) to the diet (Azzam et al., 2015) did not affect egg production, egg mass, egg weight and FCR. Supplementation of high concentrations of L-valine was tolerated and had no detrimental effects on laying performance or immune function (Azzam et al., 2015). The contradictory results between studies might be due to the age of birds, the variation of nutrient levels in the diets and/or the rearing conditions.

Egg quality and incubation measurements:

Egg quality traits were not affected by reducing dietary CP except for increased ($P \leq 0.002$) egg shape index and reduced ($P \leq 0.008$) shell thickness with 20% CP diet compared to 18% CP (Table 3). Valine supplementation (0, 0.1 and 0.2%) had no effect on egg quality traits except for egg shape and yolk index. In agreement with the present results, Abdel Azeem (2011) and Santos et al. (2016) reported no significant effects of CP levels (14 to 20%) in the diets on percentages of albumen and egg yolk of Japanese quail. Moreover, Abdel-Mageed et al. (2009) found that higher protein levels in the diets increased egg yolk and reduced albumen percentages in eggs of laying quails. Lelis et al. (2014) stated no influence of extra Val. supplementation on yolk, albumen, or egg shell percentages. In the same way, the present results concluded that CP levels or Val. supplementation had no effect on calcium deposition, and the intake of protein and Val. were sufficient for normal internal egg quality. Egg quality was significantly affected due to Val. supplementation to 18 or 20% CP diets of laying quail. The highest shell thickness ($P \leq 0.05$), yolk index ($P \leq 0.03$) and albumen (%) ($P \leq 0.001$) was reported with 18% CP + 0.2% Val. diet. However, the present data divergent with those of Azzam et al. (2011) and (2015) who found that egg quality was not affected by a low-CP diet supplemented with Thr. or Val., respectively. Conversely, feeding quails 20 or 18% CP diets supplemented with ASS + Thr. (over the NRC recommendation) increased egg shape index, shell thickness and shell percentage (Abdel-Mageed et al., 2009). Alagawany et al. (2014) stated that egg shell and yolk (%) were decreased when quail fed a low-CP (16%) diet supplemented with Thr., Trp. and Val. or their mixture. The lowest albumen (%) and highest yolk (%) and shape index values were detected with 20% CP + 0.2% Val. diets (Table 3). It is well known that formation of egg components especially albumen, almost the entire protein in the egg, required high levels of CP and AAs in the blood of laying birds. Hence, diets formulated based on CP must contain adequate AAs with no excess or deficiency. Valine is critical not only for synthesis of the selective novel protein but also for the collapsed protein stability (Zhang et al., 2017). In the same direction, Peganova and Eder (2002) and Lima et al. (2016) verified the relationship between increasing of valine requirements in birds and its priority to synthesize egg and feather protein. Japanese quails in this study were adult birds thus there is no need for AAs to maintain the slight increase in adipose tissue. Collectively, most of the protein and Val. intake was required for maintenance and semen or egg production of male or female quails, respectively.

In the present study, the experimental diets had no significant effects on fertility, hatchability and total embryonic mortality percentages (Table 4). However, numerical improvements in H (%) were obtained with the supplementation of Val. to 18% CP diet. These results were partially consistent with breeder quails that fed low-CP diet supplemented with extra Val. had the highest values of semen and egg quality. Also, increasing egg weight resulted in a linear increase in chick weight. Similar results were observed after feeding 20% CP or 18% CP diets supplemented with ASS + additional Thr. over NRC diet in Japanese quail (Abdel-Mageed et al., 2009). Although no significant differences were observed with egg weight, supplementing the 18% CP diet with Val. tended to increase chick weight and chick weight percent and decrease early embryonic mortality in comparison with other treatments. However, this difference in CW (%) and EEM (%) might be attributed to egg quality and egg size since egg composition and volume are limiting factors to the embryo development (Luquetti et al., 2004).

Sexual libido and semen evaluation:

Feeding costs and nutrient requirements of male quail could not be excluded due to the high (one male: two females) sex ratio which is needed for increasing reproductive performance of breeder quails (Khalil et al., 2011). Reports about the effect of dietary CP and L-Val. supplementation on semen quality and sexual activity of male quail were unreachable.

As presented in Table 5, there were no significant differences related to the effect of CP, Val. or their interaction on the reproductive parameters of male quail, except for cloacal gland area (CGA) and semen ejaculate volume (EV). The diet of 18% CP + 0.1% Val. revealed the highest ($P \leq 0.05$) EV in comparison to those obtained by 20% CP + 0.1 or 0.2% Val. diets. The largest size of the CG (dependent testosterone sexual organ) was associated with 18% CP diet followed by 18% CP + 0.2% valine. The clarification for the increase in the semen ejaculate volume that supplementation of L-valine to quail diet enhanced the synthesis of the seminal plasma of spermatozoa. Present results also clear a high correlation between CGA, testicular size (data not shown) and semen quality for detecting the sexual activity of male quails during the breeding program (Biswas et al., 2007; Hanafy & Khalil, 2015). However, SM, MBRT and SC were numerically improved by feeding low-CP diet supplemented with Val. but there was no significant difference. This is consistent with that dietary Thr. supplementation to low-CP diets increased the F% and H% in breeder quails (Abdel-Mageed et al., 2009). The positive effect of Val. on egg fertility may not be directly related to the volume of ejaculated semen but rather to a possible improvement in the motility and viability of quail sperm.

Blood parameters:

In the present results, plasma constituents of male and female quails were differently responded to the treatment's effect. The total protein concentration of female quail increased ($P \leq 0.05$) by Val. supplementation to 20% CP diet and the maximum was obtained by 20% CP + 0.2% Val. diet in comparison with those fed 20% CP + 0.0% Val. diet (Table 6). These results are comparable with those of Alagawany et al. (2014) who reported that dietary 16% CP + 0.1% Val. decreased total protein level in the blood of laying quail. Also, Alagawany et al. (2011) and Zeweil et al. (2011) indicated that plasma total protein increased by increasing dietary protein in laying hens. In contrast, plasma protein concentrations of male quails were affected ($P \leq 0.001$) by CP levels and their interaction with Val. (Table 7). The highest concentration of total protein was recorded with 18% CP + 0.2% Val. diet. However, albumin concentrations in the blood of male and female quails were not affected by reducing CP level and Val. supplementation. These results are in contrary with those of Azzam et al. (2015) who found that serum albumin concentration of laying hen increased significantly in response to Val. (from 0 to 4 g/kg diet) supplementation.

As shown in Tables 6 and 7, the lowest blood urea was detected in breeder quails fed low-CP diet supplemented with valine. Consistent with dietary protein; the blood urea level of female (Table 6) was three times higher than that of male (Table 7) quail. These results might be attributed to more consuming feed, high metabolic rate and more nitrogen excretion in laying females. In the same context, the reduction of dietary protein level from 24 to 20% reduced the nitrogen excretion by 28% during the laying period of quails (Minoguchi et al., 2001). Moreover, broilers fed amino acid-supplemented diets had higher protein utilization and lower nitrogen excretion (DeSchepper and DeGroote, 1995).

Nutrition is an essential factor that plays a crucial role in normal enzyme activity (Mézes, et al., 2003). It has been reported that trace elements, vitamins, or amino acids supplementation to animal diet stimulate antioxidant enzymes. Superoxide dismutase, an antioxidant enzyme, destroys the free radical superoxide by converting it to hydrogen peroxide and molecular oxygen (Benov and Fridovich, 1998). In the present study, plasma SOD concentration of female quail (but not of male) was significantly ($P \leq 0.001$) elevated in response to CP level and Val. supplementation (Tables 6 and 7). The highest level of SOD was observed by 0.1 and 0.2% Val. with 18% CP diet, which may result in a superior antioxidative status. Similar results have been obtained in both serum and liver of laying hens after L- threonine supplementation at 0.2% (Azzam et al., 2012). In line with the present results, Dong et al. (2012) reported that serum SOD increased significantly by 0.4 g L-tryptophan/kg diet. In contrast, supplementation of 4 g L-Val./kg diet did not influence serum concentrations of SOD and total antioxidative capacity or liver concentrations of these antioxidant enzymes in laying hens (Azzam et al., 2015). This contrary between studies on antioxidant activities might be implied to the kind and/or the level of amino acids supplementation and the physiological status of animals.

Based on the obtained results, it could be concluded that through a supply of ideal diet, the dietary protein requirements for breeder quails could be reduced by 2% during 14 to 28 weeks of age. Supplementation of low protein diet (18%) with extra Val. at 0.2% over NRC (1994) recommendations gave better productive and reproductive performance and was comparable to those achieved with birds fed the high-protein diet (20% CP).

Table (1): Formulation and chemical analysis (calculated and determined) of the experimental diets

Ingredients %	**Diet 1 (20% CP)**	**Diet 2 (18% CP)**
Yellow corn	54.88	61.42
Soybean meal (44%)	35.00	29.00
Dicalcium phosphate	1.15	1.20
Limestone	5.70	5.70
*Vitamin and mineral premix	0.30	0.30
Salt	0.30	0.30
Vegetable oil	2.60	1.80
DL-Methionine	0.07	0.12
L-Lysine HCl	0	0.08
L-threonine	0	0.08
Total	100	100
Calculated analysis %		
ME (Kcal/kg)	2871.7	2880.9
Crude protein	20.06	17.98
Methionine+Cystine	0.716	0.712
Lysine	1.084	1.020
Threonine	0.761	0.757
Valine	0.944	0.846
Isoleucine	0.845	0.747
Leucine	1.735	1.597
Calcium	2.53	2.53
Phosphorus, available	0.35	0.35
Determined analysis %		
Dry matter	90.96	90.24
Crude protein	19.63	17.49
Methionine+Cystine	0.764	0.760
Lysine	1.087	1.019
Threonine	0.791	0.783
Valine	0.993	0.883
Isoleucine	0.963	0.861
Leucine	1.789	1.589
Ether extract	4.49	4.73
Crude fiber	3.66	3.58
Ash	10.37	10.91

*Supplied per kg of diet: vitamin A (retinol acetate), 36000 IU; vitamin D_3 (cholecalciferol), 7500 IU; vitamin E (α-tocopheryl acetate), 60 mg; vitamin K_3 (Menadione), 9.0 mg; Thiamine, 3.0 mg; Riboflavin, 15.0 mg; Pyridoxine, 7.5 mg; Cyanocobalamin, 0.045 mg; Pantothenic acid, 30 mg; Niacin, 90 mg, Folic acid, 3.0 mg;

Table (2): Productive performance of laying quail as affected by dietary crude protein (CP), L-valine (Val.) levels and their interaction (Mean±SE)

Items	%	[1]FBW & CBW (g)	[2]EP (%)	[3]AEW (g)	[4]AEM (g)	[5]FI (g/h/d)	[6]Val I(g/h/d)	[7]FCR
Main effect								
CP	**18**	273.1 ± 6.6 (+10.2)	80.86 ± 2.13	12.74 ± 0.21	10.32 ± 0.32	30.94 ± 0.52	0.302^{b} ± 0.007	3.05 ± 0.11
	20	273.9 ± 4.4 (+8.3)	83.22 ± 1.78	12.36 ± 0.21	10.29 ± 0.29	29.71 ± 0.60	0.323^{a} ± 0.008	2.94 ± 0.12
P-value		0.932	0.425	0.299	0.937	0.160	0.007	0.557
Val.	**0.0**	273.1 ± 7.6 (+8.9)	78.97 ± 2.90	12.68 ± 0.29	10.02 ± 0.44	31.51^{a} ± 0.57	0.295^{b} ± 0.006	3.24^{a} ± 0.16
	0.1	272.2 ± 5.66 (+10.4)	82.14 ± 2.23	12.39 ± 0.26	10.17 ± 0.27	28.25^{b} ± 0.69	0.295^{b} ± 0.008	2.80^{b} ± 0.10
	0.2	275.2 ± 6.4 (+8.5)	85.44 ± 1.48	12.56 ± 0.23	10.74 ± 0.30	30.66^{a} ± 0.62	0.349^{a} ± 0.008	2.88^{ab} ± 0.10
P-value		0.959	0.140	0.737	0.277	0.005	0.000	0.021
Interaction effect (CP × Val.)								
CP, 18	**0.0**	269.4 ±11.5 (+9.9)	75.24^{b} ± 3.68	12.77 ± 0.47	9.60^{b} ± 0.55	31.92^{a} ± 0.95	0.282^{b} ± 0.008	3.39^{a} ± 0.18
	0.1	274.0±12.0 (+15.5)	79.67^{ab} ± 3.89	12.50 ± 0.32	9.89^{ab} ± 0.39	28.95^{bc} ± 0.89	0.284^{b} ± 0.009	2.95^{ab} ± 0.16
	0.2	276.1 ± 12.1 (+5.5)	88.46^{a} ± 1.03	12.93 ± 0.28	11.45^{a} ± 0.32	31.24^{ab} ± 0.50	0.338^{a} ± 0.006	2.74^{b} ± 0.09
CP, 20	**0.0**	276.3 ± 10.6 (+7.6)	82.69^{ab} ± 4.30	12.59 ± 0.38	10.45^{ab} ± 0.69	31.0^{abc} ± 0.65	0.309^{b} ± 0.007	3.10^{ab} ± 0.27
	0.1	271.1 ± 6.1 (+5.9)	84.62^{ab} ± 2.10	12.28 ± 0.43	10.37^{ab} ± 0.37	27.75^{c} ± 1.02	0.303^{b} ± 0.011	2.69^{b} ± 0.13
	0.2	274.2 ± 5.5 (+11.5)	82.42^{ab} ± 2.32	12.20 ± 0.33	10.04^{ab} ± 0.33	30.09^{b} ± 1.15	0.359^{a} ± 0.014	3.02^{ab} ± 0.16
P-value		0.857	0.050	0.727	0.050	0.019	0.000	0.041

[1]Female Final Body Weight & Body Weight Change; [2]Egg Production; [3]Average Egg Weight; [4]Average Egg Mass; [5]Feed Intake; [6]Valine Intake; [7]Feed Conversion Ratio. [a,b,c] Means within column not sharing a common superscript differ significantly ($P \leq 0.05$)

Table (3): Egg quality traits of laying quail as affected by dietary crude protein (CP), L-valine (Val.) levels and their interaction (Mean±SE)

Items	%	Yolk (%)	Albumen (%)	Egg Shell (%)	Shell Thickness(μm)	Shape Index	Yolk Index	*IQU
Main effect								
CP	**18**	31.8± 0.22	59.1 ± 0.22	9.2 ± 0.06	21.20^{a} ± 0.20	77.7^{b} ± 0.29	38.9 ± 0.43	90.0 ± 0.53
	20	31.9 ± 0.29	58.8 ± 0.30	9.3 ± 0.07	20.41^{b} ± 0.19	78.8^{a} ± 0.26	38.3 ± 0.40	89.9 ± 0.80
P-value		0.930	0.739	0.136	0.008	0.002	0.421	0.924
Val.	**0.0**	32.1 ± 0.37	58.8 ± 0.36	9.2 ± 0.07	20.69 ± 0.25	79.4^{a} ± 0.27	38.5^{ab} ± 0.48	90.1 ± 1.13
	0.1	31.8 ± 0.29	59.0 ± 0.30	9.2 ± 0.09	20.64 ± 0.24	76.7^{b} ± 0.25	37.5^{b} ± 0.54	90.2 ± 0.48
	0.2	31.8 ± 0.29	59.0 ± 0.30	9.3 ± 0.08	21.08 ± 0.24	78.8^{a} ± 0.40	39.8^{a} ± 0.46	89.6 ± 0.86
P-value		0.756	0.824	0.527	0.423	0.000	0.007	0.857
Interaction effect (CP × Val.)								
CP, 18	**0.0**	32.4^{ab} ± 0.55	58.6^{ab} ± 0.53	9.0 ± 0.11	20.97^{ab} ± 0.43	79.3^{a} ± 0.41	38.3^{ab} ± 0.92	91.0 ± 0.70
	0.1	32.3^{ab} ± 0.31	58.5^{ab} ± 0.31	9.2 ± 0.08	21.17^{a} ± 0.29	76.7^{b} ± 0.33	38.1^{ab} ± 0.67	90.3 ± 0.64
	0.2	31.1^{b} ± 0.32	59.7^{a} ± 0.32	9.2 ± 0.12	21.35^{a} ± 0.34	77.3^{b} ± 0.62	40.0^{a} ± 0.65	88.9 ± 1.15
CP, 20	**0.0**	31.8^{ab} ± 0.50	59.0^{ab} ± 0.50	9.3 ± 0.10	20.48^{ab} ± 0.28	79.5^{a} ± 0.36	38.6^{ab} ± 0.53	89.4 ± 1.93
	0.1	31.2^{b} ± 0.48	59.6^{a} ± 0.52	9.2 ± 0.16	20.04^{b} ± 0.38	76.6^{b} ± 0.37	37.0^{b} ± 0.82	90.2 ± 0.70
	0.2	32.7^{a} ± 0.50	57.8^{b} ± 0.52	9.4 ± 0.08	20.71^{ab} ± 0.32	80.4^{a} ± 0.37	39.5^{a} ± 0.65	90.4 ± 1.29
P-value		0.003	0.001	0.389	0.050	0.000	0.031	0.445

*Internal Quality Unit ^{a,b} Means within column not sharing a common superscript differ significantly ($P \leq 0.05$).

Table (4): Incubation parameters of laying quail as affected by dietary crude protein (CP), L-valine (Val.) levels and their interaction (Mean±SE)

Items	%	[1]F (%)	[2]H (%)	[3]CW (g)	[4]CW (%)	[5]EEM (%)	[6]LEM (%)	[7]PDE (%)	[8]TEM (%)
Main effect									
CP	**18**	89.9 ± 2.35	81.1 ± 2.60	8.70^{a} ± 0.13	69.40^{a} ± 0.83	8.68 ± 2.12	7.10 ± 1.52	3.17 ± 1.00	18.95 ± 2.60
	20	90.0 ± 1.69	80.0 ± 1.37	8.15^{b} ± 0.17	65.82^{b} ± 0.82	6.66 ± 1.61	8.38 ± 1.29	4.95 ± 1.09	19.99 ± 1.28
P-value		0.920	0.659	0.011	0.004	0.574	0.658	0.422	0.786
Val.	**0.0**	91.5 ± 1.76	80.2 ± 2.13	8.51 ± 0.21	67.57 ± 1.13	10.23 ± 2.45	6.35 ± 1.52	3.18 ± 1.27	19.76 ± 2.13
	0.1	90.5 ± 2.29	80.9 ± 3.59	8.30 ± 0.23	67.24 ± 1.35	5.07 ± 1.17	9.01 ± 2.15	5.04 ± 1.38	19.12 ± 3.59
	0.2	87.6 ± 3.38	80.6 ± 1.74	8.48 ± 0.14	68.11 ± 0.86	6.84 ± 2.57	8.33 ± 1.50	4.19 ± 1.22	19.38 ± 1.47
P-value		0.553	0.981	0.630	0.780	0.130	0.423	0.573	0.951
Interaction effect (CP × Val.)									
CP, 18	**0.0**	92.7 ± 2.08	79.0 ± 4.52	8.70^{ab} ± 0.27	69.11^{a} ± 1.21	16.23 ± 3.39^{a}	2.89 ± 0.97	1.91 ± 1.21	21.02 ± 4.52
	0.1	88.8 ± 3.35	81.6 ± 6.89	8.62^{ab} ± 0.23	69.63^{a} ± 1.81	4.47 ± 2.36^{b}	9.51 ± 3.66	4.40 ± 2.34	18.37± 6.89
	0.2	87.6 ± 6.42	82.9 ±0.85	8.79^{a} ± 0.17	69.47^{a} ± 1.40	3.84 ± 1.90^{b}	9.75 ± 2.09	3.47 ± 1.83	17.06 ± 0.85
CP, 20	**0.0**	90.2 ± 2.91	81.3 ± 1.39	8.32^{ab} ± 0.32	66.03^{ab} ± 1.81	5.09 ± 2.14^{b}	9.32 ± 2.17	4.27 ± 2.12	18.68 ± 1.39
	0.1	92.3 ± 3.22	80.1 ± 3.17	7.93^{b} ± 0.39	64.50^{b} ± 1.57	5.68 ± 0.59^{b}	8.52 ± 2.70	5.68 ± 1.70	19.88 ± 3.17
	0.2	87.6 ± 2.85	78.2 ± 3.14	8.17^{ab} ± 0.16	66.75^{ab} ± 0.80	9.84 ± 4.64^{ab}	6.91 ± 2.17	4.91 ± 1.84	21.69 ± 2.76
P-value		0.706	0.615	0.050	0.050	0.011	0.118	0.843	0.724

[1]Fertility; [2]Hatchability; [3]Chick Weight; [4]Chick Weight (%); [5]Early Embryonic Mortality; [6]Late Embryonic Mortality; [7]Pipped Dead Embryo; [8]Total Embryonic Mortality. ^{a,b} Means within column not sharing a common superscript differ significantly ($P \leq 0.05$).

Table (5): Sexual libido, cloacal gland area, foam production and semen quality of male quail as affected by dietary crude protein (CP), L-valine (Val.) levels and their interaction (Mean±SE)

Items	%	[1]SL (Sc.)	[2]CGA (mm^2)	[3]FP (mg/M)	[4]EV (µl)	[5]SC ($\times10^6$/ml)	[6]SM (%)	[7]MBRT (Sc.)
Main effect								
CP	**18**	5.50 ± 0.88	559.4[a] ± 19.00	37.39 ± 3.40	18.65[a] ± 1.29	22.53 ± 2.51	78.40 ± 2.95	2.25 ± 0.51
	20	8.05 ± 1.78	487.8[b] ± 13.42	36.00 ± 3.87	14.64[b] ± 0.81	20.58 ± 2.53	75.23 ± 0.81	2.94 ± 0.52
P-value		0.150	0.007	0.810	0.021	0.594	0.459	0.284
Val.	**0.0**	5.81 ± 1.23	529.33 ± 20.99	35.63 ± 4.08	17.31 ± 1.29	23.06 ± 3.54	74.50 ± 4.13	2.20 ± 0.55
	0.1	5.85 ± 1.22	506.35 ± 25.13	40.00 ± 4.67	16.92 ± 1.39	19.38 ± 3.22	79.23 ± 3.37	2.53 ± 0.85
	0.2	9.08 ± 2.69	525.40 ± 20.28	35.00 ± 4.66	15.23 ± 1.52	21.10 ± 2.30	77.00 ± 2.57	3.13 ± 0.56
P-value		0.273	0.827	0.666	0.273	0.799	0.657	0.492
Interaction effect (CP × Val.)								
CP, 18	**0.0**	5.63 ± 1.55	580.53[a] ± 30.26	31.25 ± 4.41	19.00[ab] ± 1.92	22.80 ± 3.91	73.38 ± 6.03	1.93 ± 0.33
	0.1	5.20 ± 2.08	535.54[ab] ± 55.42	38.75 ± 6.39	20.80[a] ± 2.42	21.25 ± 7.65	79.20 ± 6.02	1.79 ± 1.14
	0.2	5.57 ± 1.33	552.30[ab] ± 20.57	42.86 ± 6.80	16.71[ab] ± 2.48	22.93 ± 4.00	77.86 ± 3.60	3.57 ± 0.91
CP, 20	**0.0**	6.00 ± 2.02	478.13[b] ± 14.93	40.00 ± 6.81	15.63[ab] ± 1.64	23.23 ± 5.43	70.63 ± 5.70	3.13 ± 0.85
	0.1	6.25 ± 1.60	488.11[ab] ± 23.20	42.00 ± 7.35	14.50[b] ± 1.07	18.44 ± 3.55	79.25 ± 4.33	3.03 ± 1.24
	0.2	13.17 ± 5.38	498.50[ab] ± 33.44	27.14 ± 5.22	13.50[b] ± 1.52	18.90 ± 1.68	76.00 ± 3.97	2.52 ± 0.46
P-value		0.270	0.050	0.417	0.050	0.948	0.725	0.168

[1]Sexual Libido; [2]Cloacal Gland Area; [3]Foam Production; [4]Ejaculate Volume; [5]Sperm Concentration; [6] Sperm Motility; [7]Methylene Blue Reaction Time [a,b] Means within column not sharing a common superscript differ significantly ($P \leq 0.05$)

Table (6): Plasma total protein, albumin, urea and superoxide dismutase (SOD) enzyme of female quail as affected by dietary crude protein (CP), L-valine (Val.) levels and their interaction (Mean±SE)

Items	%	Females			
		Total Protein (g/dl)	**Albumin (g/dl)**	**SOD (U/ml)**	**Blood Urea (g/dl)**
Main effect					
CP	**18**	5.93± 0.28	3.17 ± 0.11	$271.88^{a} \pm 4.86$	13.33 ± 0.70
	20	5.51 ± 0.26	2.96 ± 0.30	$192.50^{b} \pm 6.02$	14.36 ± 0.62
P-value		0.617	0.529	0.000	0.953
Val.	**0.0**	5.39 ± 0.31	3.26 ± 0.30	$201.25^{c} \pm 18.69$	14.39 ± 0.94
	0.1	5.69 ± 0.15	2.76 ± 0.30	$237.50^{b} \pm 14.76$	13.44 ± 0.77
	0.2	6.23 ± 0.54	3.16 ± 0.17	$252.50^{a} \pm 12.59$	13.54 ± 0.86
P-value		0.233	0.518	0.000	0.576
Interaction effect (CP × Val.)					
CP, 18	**0.0**	$6.10^{ab} \pm 0.23$	3.12 ± 0.23	$246.88^{b} \pm 3.13$	13.35 ± 1.26
	0.1	$5.71^{ab} \pm 0.22$	3.15 ± 0.12	$281.25^{a} \pm 4.42$	13.54 ± 1.34
	0.2	$5.97^{ab} \pm 0.85$	3.23 ± 0.26	$272.92^{a} \pm 2.08$	13.03 ± 1.44
CP, 20	**0.0**	$4.88^{b} \pm 0.41$	3.36 ± 0.50	$170.83^{e} \pm 2.08$	15.43 ± 1.33
	0.1	$5.67^{ab} \pm 0.21$	2.44 ± 0.53	$193.75^{d} \pm 1.98$	13.32 ± 0.77
	0.2	$6.65^{a} \pm 0.37$	3.03 ± 0.15	$221.88^{c} \pm 3.13$	14.30 ± 0.33
P-value		0.050	0.496	0.000	0.670

[a,b,c,d] Means within column not sharing a common superscript differ significantly ($P \leq 0.05$).

Table (7): Plasma total protein, albumin, urea and superoxide dismutase (SOD) enzyme of male quail as affected by dietary crude protein (CP), L-valine (Val.) levels and their interaction (Mean±SE)

Items	%	Males			
		Total Protein (g/dl)	Albumin (g/dl)	SOD (U/ml)	Blood Urea (g/dl)
CP	18	3.83[a] ± 0.18	1.49 ± 0.11	178.57 ± 12.63	5.30 ± 0.21
	20	3.04[b] ± 0.13	1.59 ± 0.09	171.43 ± 19.23	5.82 ± 0.41
P-value		0.001	0.432	0.599	0.372
Val.	0.0	3.40 ± 0.20	1.61 ± 0.12	191.33 ± 19.76	5.79 ± 0.77
	0.1	3.31 ± 0.23	1.53 ± 0.14	171.43 ± 26.25	5.43 ± 0.27
	0.2	3.50 ± 0.24	1.48 ± 0.10	160.71 ± 16.53	5.58 ± 0.32
P-value		0.905	0.761	0.571	0.939
Interaction effect (CP × Val.)					
CP, 18	0.0	3.72[ab] ± 0.28	1.60 ± 0.18	178.57 ± 17.86	5.35 ± 0.11
	0.1	3.71[ab] ± 0.42	1.45 ± 0.24	196.43 ± 35.72	5.27 ± 0.26
	0.2	4.05[a] ± 0.29	1.38 ± 0.17	160.71 ± 0.00	5.30 ± 0.52
CP, 20	0.0	3.12[b] ± 0.26	1.61 ± 0.17	200.90 ± 33.71	6.01 ± 1.20
	0.1	3.03[b] ± 0.23	1.59 ± 0.17	133.93 ± 26.79	5.60 ± 0.50
	0.2	2.94[b] ± 0.20	1.58 ± 0.11	160.72 ± 30.93	5.87 ± 0.39
P-value		0.036	0.961	0.673	0.944

[a,b] Means within column not sharing a common superscript differ significantly ($P \leq 0.05$)

REFERENCES

Abdel Azeem, F., 2011. Influence of qualitative feed restriction on reproductive performance of Japanese quail hens. Egypt. Poult. Sci., 31:883-897.

Abdel-Mageed, M. A. A.; Shabaan, S. A. M. and El-Bahy, N. M. A., 2009. Effect of threonine supplementation on Japanese quail fed various levels of protein and sulfur amino acids. 2. Laying period. Egypt. Poult. Sci., 29:805-819.

Alagawany, M.; Abd El-Hack, M. E.; Laudadio, V. and Tufarelli, V., 2014. Effect of low-protein diets with crystalline amino acid supplementation on egg production, blood parameters and nitrogen balance in laying Japanese quails. Avian Biol. Res., 7:235-243.

Alagawany, M.; El-Hindawy, M. M.; Ali, A. A. and Soliman, M. M., 2011. Protein and total sulfur amino acids relationship effect on performance and some blood parameters of laying hens. Egypt. J. Nutrition and Feeds, 14, 477-487.

Allen, N. K. and Young, R. J., 1980. Studies on the amino acid and protein requirements of laying Japanese quail (Coturnix coturnix japonica). Poult. Sci., 59:2029-2037.

Association of Official Analytical Chemist, AOAC, 1990. Official methods of analysis association. 15th Ed., Washington DC., USA.

Attia, F. A. M. and Abd Elhalim, H. S., 2008. The effect of dietary total sulfur amino acids, lysine, valine and threonine supplementation levels on laying hen performance and egg quality measurements. Egypt. Poult. Sci., 28:103-124.

Azzam, M. M. M.; Dong, X. Y.; Dai, L. and Zou, X. T., 2015. Effect of excess dietary L-valine on laying hen performance, egg quality, serum free amino acids, immune function and antioxidant enzyme activity. Br. Poult. Sci., 56:1-7.

Azzam, M. M. M.; Dong, X. Y; Xie, P.; Wang, C. and Zou, X. T., 2011. The effect of supplemental L-threonine on laying performance, serum free amino acids, and immune function of laying hens under high-temperature and high-humidity environmental climates. J. Appl. Poult. Res., 20:361-370.

Azzam, M. M. M.; Dong, X. Y.; Xie, P. and Zou, X. T., 2012. Influence of L-threonine supplementation on goblet cell numbers, histological structure and antioxidant enzyme activities of laying hens reared in a hot and humid climate. Br. Poult. Sci., 53:640–645.

Benov, L. and Fridovich, I., 1998. Growth in iron-enriched medium partially compensates E. coli for the lack of Mn and Fe SOD. J. Biol. Chem., 273:10313–10316.

Biswas, A.; Mohan, J.; Sastry, K. V. H. and Tyagi, J. S., 2007. Effect of dietary vitamin E on the cloacal gland, foam and semen characteristics of male Japanese quail. Theriogenology, 67, 59–263.

Bregendahl, K. and Roberts, S., 2008. The ideal amino acid profile for laying hens. Iowa State University Animal Industry Report.

Card, L. E. and Nesheim, M. C., 1972. Poultry production. 11th Ed. Lea and Febiger, Philadelphia, PA.

DeSchepper, K. and DeGroote, G., 1995. Effect of dietary protein, essential and non-essential amino acids on the performance and carcass composition of broiler chickens. Br. Poult. Sci., 36:229-245.

Dong, X. Y.; Azzam, M. M.; Rao, W.; Yu, D. Y. and Zou, X. T., 2012. Evaluating the impact of excess dietary tryptophan on laying performance and immune function of laying hens reared under hot and humid summer conditions. Br. Poult. Sci., 53:491–496.

Duncan, D. B., 1955. Multiple range and multiple F- test. Biometrics, 11:1-42.

Hanafy, A. M. and Khalil, H. A., 2015. Influence of chronic dexamethasone administration on reproductive parameters and semen traits in male of Japanese quail. Asian J. Poult. Sci., 9:223-232.

Harms, R. H. and Russell, G. B., 2001. Evaluation of valine requirement of the commercial layer using a corn-soybean meal basal diet. Poult. Sci., 80:215-218.

Kaur, S.; Mandal, A. B.; Singh, K. B.; Kadam, M. M. and Elangovan, A. V., 2007. Response of laying Japanese quails to graded levels of essential amino acids profile with reduced dietary protein. J. Sci. Food Agri., 87:751-759.

Khalil, H. A.; Hanafy, A. M.; Roshdy, M. and Mady M. E., 2011. Effect of photoperiods and sex ratio on productive and reproductive performance of Japanese quail. Egypt. J. Anim. Prod., 48:295-309.

Kul, S. and Seker, I., 2004. Phenotypic correlations between some external and internal egg quality traits in the Japanese quail (Coturnix coturnix japonica). Int. J. Poult. Sci., 3:400-405.

Lelis, G. R.; Albino, L. F. T.; Tavernari, F. C.; Calderano, A. A.; Rostagno, H. S.; Barros,V. R. S. M. and Maia, R. C., 2014. Digestible valine-to-digestible lysine ratios in brown commercial layer diets. J. Appl. Poult. Res., 23:683-690.

Lima, M. B. de; Sakomura, N. K.; Dorigam, J. C. P; da Silva, E. P.; Ferreira, N. T. and Fernandes, J. B. K., 2016. Maintenance valine, isoleucine, and tryptophan requirements for poultry. Poult. Sci., 95:842–850.

Luquetti, B. C; Gonzales, E.; Bruno, L. D. G.; Furlan, R. L. and Macari, M., 2004. Egg traits and physiological neonatal chick parameters from broiler breeder at different ages. Brazilian J.Poult. Sci., 6:13-17.

Martinez, K. M.; Sakomura, N.; da Silva, E.; Suzuki, R. M.; Reis, M. and Ferreira, N., 2017. Efficiency of utilization of valine in Japanese quails. Poult. Sci., 96 (E-Suppl. 1), 406P.

Mehri, M.; Ghazaghi, M.; Bagherzadeh-Kasmani, F. and Rokouei, M., 2016. A simple estimation of ideal profile of essential amino acids and metabolizable energy for growing Japanese quail. J Anim Physiol Anim Nutr, 100:680-685.

Mézes, M.; Erdélyi, M.; Shaaban, G.; Vir, G.; Balogh, K. and Wéber, M., 2003. Genetics of glutathione peroxidase. Acta Biologica Szegediensis, 47:135-138.

Minoguchi, N.; Ohguchi, H.; Yamamoto, R. and Hanaki, Y., 2001. Low protein diets for Japanese quail and the reduction in nitrogen excretion. Research bulletin of the Aichi-ken Agricultural Research Center, 33, 319–324.

National Research Council, NRC, 1994. Nutrient Requirements of Poultry. 9th Revised Ed., National Academy of

Sciences Press, Washington, DC., USA.

Nishikimi, M.; Roa, N. A. and Yogi, K., 1972. The occurrence of superoxide anion in the reaction of reduced phenazine methosulfate and molecular oxygen. Biochem. Biophys. Res. Commun., 46:849-854.

Peganova, S. and Eder, K., 2002. Studies on requirement and excess of valine in laying hens. Archiv für Geflügelkunde, 66:241-250.

Santos, G. C. dos; Garcia, E. A.; Filho, J. A. V.; Molino, A. B. de; Pelicia, K. and Berto, D. A. 2016. Performance of Japanese quails fed diets with low-protein and isoleucine. Acta Scientiarum, Animal Sciences, 38:219-225.

SAS Institute Inc., 2004. SAS/STAT 9.13 User's Guide. SAS Inst. Inc., Cary, NC., USA.

Tumova, E. and Gous, R. M., 2012. Interaction of hen production type, age and temperature on laying pattern and egg quality. Poult. Sci., 91:1269-1275.

Yakimenko, I.; Besulin, V. and Testik, A., 2002. The effects of low intensity red laser irradiation on hatching eggs in chicken and quail. Int. J. Poult. Sci., 1:6-8.

Zeweil, H. S.; Abdalah, A. A.; Ahmed, M. H. and Ahmed, M. R. S., 2011. Effect of different levels of protein and Met on performance of baheij laying hens and environmental pollution. Egypt. Poult. Sci., 31:621-639.

Zeweil, H. S.; Zahran, S. M.; Ahmed, M. H.; Dosoky, W. M. and Mekael, R., 2016. Effect of threonine supplementation on laying quail fed different levels of protein and sulfur amino acids on productive performance, serum biochemistry, cellular immunity and reduction in environmental pollution. Egypt. Poult. Sci., 36:251-1267.

Zhang, S.; Zeng, X.; Ren, M.; Mao, X. and Qiao, S., 2017. Novel metabolic and physiological functions of branched chain amino acids: a review. J. Anim. Sci. Biotechnol., 8:10

Quails - Protein – Amino acids - Egg measurements - Reproductive traits

الملخص العربى

تأثر الأداء الانتاجى والتناسلى للسمان اليابانى المستخدم بغرض التربية بالمستويات المختلفة من البروتين والفالين في الغذاء

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أجريت هذة الدراسة بغرض التعرف على تأثير التغذية على علائق تحتوى على مستويين من البروتين (18 و 20%) مضاف إليها ثلاث مستويات (0، 0.1 و 0.2%) من الحامض الأمينى فالين وتأثير ذلك على الأداء الإنتاجي والتناسلى ومواصفات جودة البيضة وبعض مكونات بلازما الدم فى السمان اليابانى المربى بغرض إنتاج بيض التفريخ. اجرى البحث على مائة وأربعة وأربعون من طيور السمان عمر 14 أسبوع تم وزنها و قسمت الى 6 مجموعات تحتوى كل منها على ثمانية مكررات وبكل مكررة ذكر واحد وعدد 2 من الإناث. تم تربية الطيور فى بطاريات من السلك و استمرت التجربة لمدة 14 أسبوع (14- 28). أظهرت النتائج انه لا يوجد تأثير للمعاملات على وزن الجسم، وزن البيض والنسبة المئوية للخصوبة والفقس و النفوق الجنينى. وعلى العكس من ذلك، كان هناك تأثير معنوى للمعاملات على معدل إنتاج البيض، كتلة البيض، وزن الكتاكيت الفاقسة وكذلك جودة البيض. أظهرت الطيور التى تم تغذيتها على بروتين خام 18% مضافا إليه فالين بنسبة 0.2% أعلى معدل تحويل غذائي ، أفضل معدل استهلاك للعليقة /للفالين على سمك للقشرة و دليل للصفار. وبالرغم من عدم وجود اختلاف بين الذكور فى بعض الصفات كالرغبة الجنسية، كمية الفوم المنتج من غدة فوق المجمع وتركيز الحيوانات المنوية وحركة الحيوانات المنوية فى القذفة وكذلك اختبار الميثلين الأزرق، فقد حدث تحسن معنوى فى مساحة غدة فوق المجمع وفى حجم قذفة السائل المنوى نتيجة التغذية على بروتين 18% المدعم بالفالين. إضافة مستويات الفالين للعلائق أظهرت زيادة معنوية فى بعض مكونات بلازما الدم مثل البروتين الكلى والأنزيم المضاد للتأكسد – والتى اختلف أدائها طبقاً للجنس- ولكن لم تؤثر معنوياً على تركيز الألبيومين أو يوريا الدم. التركيز المعنوى للأنزيم المضاد للتأكسد تم تقديره فى بلازما الأمهات المغذاة على أقل مستوى بروتين وأعلى مستوى من الفالين ولم يكن لأى من مستويات البروتين أو الفالين تأثير كافى لزيادة تركيز الإنزيم فى بلازما الذكور. هذة النتائج يمكن إجمالها فى أن العليقة التي تحتوى على 18% بروتين ومدعمة بـ 0.2% فالين تعتبر ملائمة للحصول على أفضل الخصائص الإنتاجية والتناسلية عند تغذية سمان التربية من عمر 14 حتى 28 اسبوع.