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RESPONSE OF GROWING JAPANESE QUAIL TO DIFFERENT LEVELS OF PROTEIN WITH OR WITHOUT VITAMIN E AND SELENIUM SUPPLEMENTATION

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ABSTRACT

A total of 300 unsexed one-day-old Japanese quail chicks (Coturnix coturnix japonica) were used in a 3x2 factorial arrangement. Quail chicks were randomly divided into three treatment groups (100 chicks/ group) that received three dietary protein levels (20, 22 and 24 % CP). Each quail group was randomly divided Into two sub-groups (50 chicks each). The first sub-group of each group received diet without any supplementation, while the second sub-group was given diets supplemented with Vitamin E (VE) 200 IU and Selenium (Se) 0.5 mg/kg diet. The experimental diets were formulated isofibrous and isocaloric (2900 kcal ME/kg).

The main results obtained could be summarized as follows:

- Live body weight and body weight gain were improved with the medium protein level (22%) followed by high protein (24%) and the low protein level (20%) during the whole experimental period.
- Feed intake during the whole experimental period recorded significantly ($P<0.05$) increased with decreasing dietary crude protein level. In contrast, protein intake recorded significantly decrease ($P< 0.05$) with decreasing CP level.
- Feed conversion ratio revealed significantly ($P<0.05$) improved with medium protein level in the diet.
- Efficiency of protein utilization was improved with low protein level 20% in the diet.
- Morality rate recorded non-significant difference among experimental groups of protein level.
- Dietary protein level had insignificant effect on carcass traits.
- Digestibility coefficients and the nutritive values expressed as DCP, TDN % and ME kcal/kg were significantly varied ($P<0.05$) among different protein levels.
- Economical efficiency percentage recorded higher values with 22% protein level.
- Regardless of protein level, results showed that supplementing diet with VE and Se affected of body weight, body weight gain, feed conversion ratio and morality rate were significantly ($P<0.05$) improved, but feed consumption was significantly increased ($P<0.05$), while efficiency of protein utilization improved as compared to unsupplemented diets.
- Carcass traits were improved clearly when quail fed a diet contain 22 % level of protein supplemented with VE and Se.
- Digestibility coefficients and the nutritive values expressed as DCP, TDN % and ME kcal/kg were significantly improved ($P<0.05$) with VE and Se as compared to unsupplemented diets.
- Economical efficiency percentage recorded the higher values when supplementing diet with VE and Se.
- Interaction between dietary protein level, VE and Se supplementation indicated that the presence of supplemented with any level of dietary protein resulted in improvements in the obtained values of live body weight and body weight gain, feed conversion, carcass traits, digestibility trials and economical efficiency comparably with the unsupplemented diets during the experimental period.

- The higher value of economical efficiency was obtained by using 22% CP with Supplemented VE and Se compared to other treatments.

From the previous results, it could be concluded that moderate protein level 22 % in diet supplemented with Vitamin E and Selenium (200 IU VE and 0.5 mg Se /kg diet) improve the growth performance of growing Japanese quail and the economic efficiency.

Keywords: Quail, protein level, vitamin E and selenium, growth performance, carcass traits, digestion trials and economical efficiency.

INTRODUCTION

Feeding costs of poultry production is usually considered the most expensive item, specially, dietary protein which is considered one of the most expensive nutrients in poultry nutrition. Hence it is to be expected that great effect will be made to reduce its level without lowering the birds performance. Among the most important attempts made to minimize the feeding cost, during the growing period, Murakami *et al.*(1993) found that 20 % CP level resulted in best performance, while Boztepe and Ozturk (1993) recommended a 22% crude protein for growing japanese quail, The NRC (1994) suggests a protein requirement of 24 for Japanese quail in the growing period.

Supplementing low protein diets with growth promoters may be an alternative way to cut feed cost down to the minimal levels. From this point of view, vitamin E and Selenium that play an important role in this respect can be used.

Vitamin E has been reported as an excellent biological chain breaking antioxidant that protects cells and tissue from lipid preoxidative damage induced by free radicals (Halliwell and Gutteridge, 1989 and Yu, 1994). Schultz (1989) suggested that vitamin E and selenium appears to stimulate immune responses when fed levels more than the requirement. Marsh *et al.* (1981) stated that nutritional deficiencies in vitamin E and / or selenium caused impaired immune function.

Selenium is a trace mineral that is part of an antioxidant enzyme called glutathione peroxides. It is also necessary for normal growth and proper utilization of the trace element, iodine, for normal thyroid function. Primary selenium uses, supports the antioxidant effects of vitamin E and glutathione peroxides, and secondary uses, normal growth and thyroid function.

One of the chief functions of both selenium and vitamin E is their antioxidant function. They serve to protect the integrity of cell walls from the harmful and destructive effects of free radicals, which are produced during energy metabolism. This is crucial for the proper functioning of healthy epithelial tissue, such as the reproductive tract. Selenium and vitamin E are also very important in the functioning of the immune system and promotes healthy growth and fertility.

Desai and Scott (1965), Thompson and Scott (1970) suggested that selenium may conserve vitamin E by controlling its retention or preventing its destruction in the tissues. The mixture of vitamin E and selenium significantly reduced both mortality and the effects of disease on body weight gain, due to the metabolic relationships between vitamin E and selenium (Cook, 1991).

Shamberger (1983) found that adding vitamin E and/or selenium has a direct effect on pituitary gland and gonads activity. They protect these glands against the oxidizing agents, which cause devaluation, necrosis and or interfere with lipid transport by modifying the cell membrane permeability (Damron et al., 1981).

In addition, Selenium is required by the chicks for the normal transit function of methionine to cystine (Bunk and Combs, 1981). The toxic level of sodium selenate in immature chicken diets was 10 mg/kg (Ort and Latshew,1978).

The experiment study aimed to find out the response of growing japanese quail to different levels of protein with or without vitamin E and selenium supplementation.

MATERIALS AND METHODS

The present work was carried out at Maryiout Experimental Research Station (South West of Alexandria), which belongs to the Desert Research Center.

A total of 300 unsexed one-day-old Japanese quail chicks (Coturnix coturnix japonica) were used in a 3x2 factorial arrangement. Quail chicks were randomly divided into three treatment groups (100 chicks/group) that received three dietary protein levels (20, 22 and 24 % CP). Each quail group was randomly divided into two sub-groups (50 chicks/ sub-groups).

The first sub-group of each group received diet without any supplementation, while the second sub-group was given diets supplemented with a mixture of 200 IU vitamin E (VE) and 0.5 mg selenium (Se) /kg diet according to Abaza (2002). The source of supplemented selenium was sodium selenite (Na_2-SeO_3), while vitamin E was α-tocopherol acetate.

The highest level of protein 24 % was formulated to meet the nutrient requirements of growing Japanese quail chicks according to NRC (1994). Experimental quail chicks were kept under similar managerial, hygienic and environmental conditions. The chicks were housed in metallic cages at hatch up to 42 days of age. All diets were isocaloric (2900 kcal ME/kg) and isofibrous. The experimental diets (Table 1) were fed in mash form. Feed and water were offered *ad-libitum*. Chemical analysis of the experimental diets and dried excreta were assayed using methods of A.O.A.C (1990).

Live body weight and feed intake were determined weekly. Body weight gain, feed conversion ratio (g feed/g gain), protein intake (g/d) and efficiency of protein utilization (g gain/ g protein intake) were calculated. The mortality was recorded daily.

Finally, 60 quail (10/ sub-groups) were sacrificed to study carcass traits. The assigned birds were deprived of feed for 12 hours, after which birds were individually weighed, slaughtered to complete bleeding, feather was removed. The organs and the intestine were removed and weighed. Weights of dressing and giblets were expressed relative to live body weight of birds.

Table (1): Composition and proximate chemical analysis of the experimental diets

Ingredient, %	Level of protein		
	20%	22%	24%
Yellow corn	62.57	59.49	56.00
Soybean meal (44% CP)	6.00	10.65	11.30
Concentrate (52% CP)*	10.00	10.00	10.00
Corn gluten meal (60% CP)	8.40	9.20	11.84
Wheat bran	11.52	9.20	9.53
Dicalcium phosphate	0.51	0.48	0.44
Vit. and Min. premix**	0.30	0.30	0.30
L- lysine	0.39	0.39	0.38
Dl- methionine	0.31	0.30	0.21
Total	100	100	100
Proximate chemical analysis %			
Crude protein	20.12	22.01	24.11
Crude fiber	3.36	3.39	3.45
Ether extract	3.66	3.54	3.68
Calculated values:			
Metabolizable energy (kcal/kg)***	2900	2900	2900
Calcium %	0.85	0.86	0.86
Available phosphorus %	0.30	0.30	0.30
Methionine %	0.51	0.52	0.52
Lysine %	1.30	1.30	1.30
Methionine +Cysteine %	0.74	0.75	0.75
Selenium (mg/kg)	0.24	0.23	0.25
Price /kg diet (LE)****	1.410	1.450	1.510

* Protein concentrate contain: 52% Crude protein, 2.03% Crude fiber, 6.17% Ether extract, ME 2080 (Kcal/Kg), 1.50 % Methionine, 2.00% Methionine and Cystine, 3.0 % Lysine, 7.00% Calcium, 2.93 % Avalailable Phosphorus and 2.5 % Nacl.

** Each 3 kg Vitamins and minerals premix contains (per ton of feed), Vit. A 12000000 IU, Vit. D_3 2000000 IU, Vit.E l0g, Vit.K_3 1000 mg, Vit. B_1 1000 mg, Vit. B_2 5g, Vit. B_6 1.5g, Vit. B_{12} 10 mg, Pantothenic acid 10g, Niacin 30g, Folic acid 1g, Biotin 50 mg, Iron 30g, Manganese 60g, Choline chlorite 10g, Iodine 300 mg, Copper 4g, Zinc 50g and Selenium 100 mg.

***Calculated according to *NRC* of poultry (1994).

****Calculated according to price of feed ingredient at the same time of the experiment (2006).

At the end of the experimental feeding period, digestion trials were conducted using 30 adult quail males (five quail from each sub-groups) to determine the digestibility coefficients and the nutritive values of the experimental diets. Males were housed individually in metabolic cages.

The digestibility trials extended for 9 days of them 5 days as a preliminary period followed by 4 days as collection period. The individual live body weights were recorded during the main collection period to determine any loss or gain in the live body weights. During the main period, excreta were collected daily and weighed dried at 60°C bulked finally ground and stored for chemical analysis. The faecal nitrogen was determined according to Jakobsen *et al.*(1960). Urinary organic matter was calculated according to

Abou-Raya and Galal (1971). The digestion coefficients % of organic matter (OM), crude protein (CP), crude fiber (CF), ether extract (EE) and nitrogen free extract (NFE) of the experimental diets were estimated.

The nutritive values expressed as digestible crude protein (DCP), total digestible nutrients (TDN) were calculated. Metabolizable energy (ME) was calculated as 4.2 kcal per gram TDN as suggested by Titus (1961).

Economical efficiency of feed was calculated from the input / output analysis according to the costs of the experimental diets and selling price of one kg quail.

Data were statistically analyzed according to SAS (1996), a factorial design (3x2) according to the treatment was carried out using the following model:

$$Y_{ijk} = \mu + P_i + S_j + PS_{ij} + e_{ijk}$$

Where:

Y_{ijk} = Represented observation.

μ = Overall mean.

P_i = Effect of protein level (i = 20,22 and 24%).

S_j = effect of VE and Se (with or without).

PS_{ij} = interaction between crude protein level and VE and Se.

e_{ij} = Random error.

Duncan's New Multiple Range Test (Duncan, 1955) separated differences among treatment means.

RESULTS AND DISCUSSION

Live body weight and body weight gain

Live body weight and body weight gain of growing quail as affected by dietary protein level, vitamin E (VE) and selenium (Se) supplementation and their interaction during growing period are summarized in Table (2).

The effect of dietary protein levels on final live body weight and body weight gain during the whole experimental period varied significantly ($P<0.05$) between the experimental groups.

It is worthy noting that live body weight was improved with medium protein level (22%) followed by high protein (24%) and low protein level (20%) during the whole experimental period.

Moreover, feeding quail on 22 % CP resulted in 3.00 and 1.09% more body weight gain than that of 20 and 24% CP, respectively.

These results are in agreement with Minoguchi *et al.*(2001) who indicated that it is possible to reduce the CP level to 22% in Japanese quail during the growing period. Abdel-Azeem *et al.*(2001) who found that growing Japanese quail fed on a 22 % crude protein diet was improved body weight gain as compared to 24 % crude protein. Zeweil (1996) found that live body weight and body weight gain were improved significantly with protein level (22%) as compared to 24 % CP. Also, Boztepe and Ozturk (1993) recommended a 22% crude protein for growing japanese quail.

Table (2). Live body weight and body weight gain ($\bar{X}$ ±SE) of growing Japanese quail as affected by dietary protein level, VE and Se supplementation and their interaction

Treatments		Live body weight (g)			Body weight gain (g)/bird /period		
Protein level	VE and Se	Initial	3 weeks	6 weeks	0-3 weeks	3-6 weeks	0-6 weeks
20	-	8.15±4.09	82.57±5.08^{b}	187.50±7.01^{b}	74.42±2.20^{b}	104.94±2.04^{b}	179.36±2.06^{b}
22	-	8.09±3.81	86.01±4.99^{a}	192.84±5.03^{a}	77.92±2.24^{a}	106.84±1.95^{a}	184.76±2.11^{a}
24	-	8.07±3.24	86.70±5.62^{a}	190.99±5.07^{a}	78.63±2.03^{a}	104.29±2.01^{b}	182.92±2.05^{ab}
Sig.		n.s	*	*	*	*	*
-	S0	8.12±5.05	83.14±5.52^{b}	182.52±6.51^{b}	75.02±1.91^{b}	99.38±2.64^{b}	174.40±2.30^{b}
-	S1	8.08±4.22	87.05±4.09^{a}	198.37±5.85^{a}	78.96±1.07^{a}	111.32±2.99^{a}	190.29±2.61^{a}
Sig.		n.s	*	*	*	*	*
Interaction							
20	S0	8.20±5.55	80.00±4.99^{b}	180.89±8.35^{b}	71.80±2.21^{b}	100.89±2.56^{b}	172.69±2.21^{b}
20	S1	8.09±6.03	85.13±5.01^{a}	194.11±6.01^{a}	77.04±2.09^{ab}	108.98±2.33^{ab}	186.02±2.01^{ab}
22	S0	8.06±5.99	84.01±6.02^{b}	184.55±9.05^{b}	75.95±2.02^{b}	100.54±2.09^{b}	176.49±2.20^{ab}
22	S1	8.11±6.01	88.00±5.82^{a}	201.13±7.21^{a}	79.89±1.90^{a}	113.13±2.01^{a}	193.02±2.17^{a}
24	S0	8.10±4.62	85.40±7.20^{a}	182.11±7.51^{b}	77.30±1.07^{ab}	96.71±1.76^{b}	174.01±2.04^{b}
24	S1	8.04±5.01	88.01±6.99^{a}	199.87±6.65^{a}	79.96±1.88^{a}	111.86±1.98^{a}	191.83±2.01^{a}
Sig.		n.s	*	*	*	*	*

^{a,b}. means in each column within each item, bearing the same superscripts are not significantly different ($P<0.05$).
n.s= not significant.
S0= diet without Vitamin E and selenium.
S1= diet with Vitamin E and selenium.

Regardless of protein level, results showed that supplementing diet with VE and Se affected live body weight and body weight gain were significantly (P<0.05) increased in the period from 0-6 weeks of age as compared to unsupplemented diets (Table 2).

It is worthy noting that feeding quail on VE and Se supplemented diets resulted in 9.11% higher in body weight gain than that of unsupplemented diets.

Interaction between dietary protein levels, VE and Se supplementation indicated that the presence of supplemented with any level of dietary protein resulted in improvements (P<0.05) in the obtained values of live body weight, body weight gain,

However, the better improvement was obtained by using the medium protein level (22%) followed by high protein (24%) and low protein level (20%) during the whole experimental period (6 weeks of age).

Feed intake and feed conversion ratio

Feed intake (g) during the whole experimental period recorded an increase (P< 0.05) with the decrease of CP levels as shown in Table (3).

It is worthy noting that feeding quail on 20 % CP resulted in 2.65 and 4.79 % increase in feed intake than that of 22 and 24% CP, respectively.

Regarding the amount of feed intake (g/period) by the experimental quail, it is observed that feed intake increased with decreasing CP levels.

These results are in agreement with those of Ali *et al.* (2000) who found that growing Japanese quail fed on a 22 % crude protein diet significantly (P< 0.05) consumed more feed compared to 24 % crude protein. Shalan-Hedaia (1993) and Mohammed (1990) who found that increasing level of protein in the quail grower diets caused a decrease in the amount of feed consumption. Aggoor *et al.*(1997) found that feed intake in the broiler diets significantly (P<0.05) decreased with increasing protein levels.

Irrespective of protein level, results of feed intake during the whole experimental period recorded an increase (P<0.05) with the supplemented of VE and Se as compared to unsupplemented (Table 3).

Feed conversion ratio revealed a significant difference (P<0.05) among the experimental groups. On the basis of the present data, it seems that quail received diets with 24 and 22 % CP had the best feed conversion ratio, while the worst values were for the 20% CP. The improvement observed in Feed conversion ratio may result from the increased body weight gain as a result of CP levels in the diets (Table 3).

These results agreed with those of obtained by Shalan-Hedaia (1993) who found that increased protein content in the quail diet gradually improved feed conversion ratio and decreased feed intake. Pettersson et al.(1990) who showed that the high protein level resulted improved feed conversion ratio than the low protein diet fed to broiler.

Regardless of protein level, it appears that quail fed of supplemented VE and Se diets showed significantly (P<0.05) improved feed conversion ratio compared to unsupplemented.

Table (3). Feed intake and feed conversion ratio ($\overline{X}$ ±SE) of growing japanese quail as affected by dietary protein level, VE and Se supplementation and their interaction

Treatments		Feed intake (g)/ bird /period			Feed conversion ratio (g feed/g gain)		
Protein level	VE and Se	0-3 weeks	3-6 weeks	0-6 weeks	0-3 weeks	3-6 weeks	0-6 weeks
20	-	276.22±2.02^{a}	450.00±2.11^{a}	726.22±2.22^{a}	3.80±0.04^{a}	4.29±0.09^{a}	4.05±0.08^{a}
22	-	265.45±1.53^{b}	436.86±2.99^{b}	705.81±1.57^{b}	3.40±0.02^{b}	4.10±0.07^{ab}	3.82±0.10^{b}
24	-	263.00±1.02^{b}	436.11±2.00^{b}	699.11±2.06^{b}	3.35±0.01^{b}	4.21±0.03^{a}	3.83±0.07^{b}
Sig.		*	*	*	*	*	*
-	S0	263.20±1.23^{b}	438.03±3.03^{b}	700.9±2.23^{b}	3.51±0.02	4.41±0.08^{a}	4.02±0.09^{a}
-	S1	273.21±1.06^{a}	445.64±2.99^{a}	718.85±2.04^{a}	3.46±0.04	4.01±0.06^{b}	3.78±0.05^{b}
Sig.		*	*	*	n.s	*	*
Interaction							
20	S0	272.10±2.11^{a}	443.50±1.40^{ab}	715.60±3.01^{ab}	3.95±0.09^{a}	4.40±0.10^{a}	4.14±0.11^{a}
20	S1	280.34±2.02^{a}	456.50±1.09^{a}	736.84±2.80^{a}	3.64±0.02^{ab}	4.19±0.04^{ab}	3.96±0.09^{a}
22	S0	260.80±1.30^{b}	437.71±1.01^{b}	697.51±2.51^{b}	3.43±0.03^{b}	4.35±0.11^{a}	3.95±0.03^{a}
22	S1	270.10±1.21^{a}	441.00±1.30^{b}	710.10±2.20^{b}	3.38±0.01^{b}	3.90±0.03^{b}	3.68±0.08^{b}
24	S0	256.80±1.11^{b}	432.80±1.50^{b}	689.60±1.95^{b}	3.32±0.09^{b}	4.48±0.10^{a}	3.96±0.02^{a}
24	S1	269.20±1.03^{ab}	439.42±1.44^{b}	708.62±2.01^{b}	3.37±0.06^{b}	3.93±0.08^{b}	3.69±0.10^{b}
Sig.		*	*	*	*	*	*

^{a,b}. means in each column within each item, bearing the same superscripts are not significantly different ($P<0.05$).
S0= diet without Vitamin E and selenium.
S1= diet with Vitamin E and selenium.

The reduction observed in feed conversion ratio may result from the decreased body weight gain as a result of unsupplemented in the diet. It appears that, quail fed with VE and Se improved feed conversion ratio by 7.64 % compared to unsupplemented.

This improvement could be attributed to the biological functions of VE such as its role in enzymatic oxidation reduction, nucleic acids metabolism and in promoting the activity of oxidized substances such as carotenoids (Kennedy *et al.*,1992 ; Hossain and Sergio,1995).

Interaction between dietary protein levels, VE and Se supplementation indicated that the presence of supplemented with any level of dietary protein resulted in improvements ($P<0.05$) in the obtained values of feed conversion ratio comparably with the unsupplemented diets during the experimental periods (Table 3).

Protein intake and efficiency of protein utilization

Results of protein intake (g) during the experimental period was significantly ($P<0.05$) different among experimental groups. It is clear that protein intake increased by 24% CP during the whole experimental period (Table 4). Level of 24 % CP recorded the highest values followed by 22%, while 20% recorded the lowest values. This may be due to that the protein intake was increase with increased percentage of protein level in diets.

Regardless of protein level results cleared that protein intake (g) during the whole experimental period recorded an increase ($P<0.05$) with the supplemented of VE and Se compared to unsupplemented diets (Table 4).

Efficiency of protein utilization (g weight gain / g protein intake) during the whole experimental period was improved with low protein level (16%) followed by medium protein (22%) and high protein level (24%) during the whole experimental period. These results are in agreement with those of Zeweil (1996) found that protein utilization efficiency improved significantly ($P<0.01$) by decreasing protein level of quail diet. Aggoor *et al.*(1997) who found that protein intake increased with increasing protein level, while protein efficiency ratio decreased with increasing protein level.

Irrespective of protein level, results of protein efficiency utilization during the whole experimental period improved ($P<0.05$) with the supplemented of VE and Se compared to unsupplemented diets as shown in Table (4).

Interaction between dietary protein levels and VE and Se supplementation indicated that the presence of supplemented with any level of dietary protein resulted in improvements ($P<0.05$) in the obtained values of protein intake (g) and efficiency of protein utilization comparably with the unsupplemented diets during the experimental periods (Table 4).

Mortality rate%

In contrast to the level of protein in the diet, results on mortality rate % recorded a non significant difference among experimental groups (Table 4). Quail fed low protein level recorded the lowest values, while the level of 24% recorded the highest ones. Vohra and Roudybush (1971), Johri and Vohra (1977) and Mohammed (1990) found that the mortality rate during growing period of Japanese quail did not significantly influence by dietary protein levels.

Table (4). Protein intake, efficiency and mortality rate ($\overline{X}$ ±SE) of protein utilization of growing japanese quail as affected by dietary protein level, VE and Se supplementation and their interaction

Treatments		Protein intake (g))/ bird /period			Efficiency of protein utilization			Mortality %
Protein level	VE and Se	0-3 weeks	3-6 weeks	0-6 weeks	0-3 weeks	3-6 weeks	0-6 weeks	0-6 weeks
20	-	55.58±1.20^{b}	90.54±1.23^{b}	141.62±156^{b}	1.32±1.01	1.31±1.01	1.27±0.34	3.46±0.09
22	-	58.43±0.98^{ab}	96.70±1.23^{ab}	154.48±1.99^{ab}	1.34±0.94	1.12±0.98	1.20±1.09	3.56±0.17
24	-	63.41±1.01^{a}	105.15±1.12^{a}	168.56±2.02^{a}	1.24±0.82	1.11±0.95	1.09±1.02	3.95±1.14
Sig.		*	*	*	n.s	n.s	n.s	n.s
-	S0	58.02±1.09^{b}	96.64±0.81^{b}	154.49±1.07^{b}	1.28±0.84	1.15±0.95	1.14±1.06	4.10±1.14^{a}
-	S1	60.25±0.04^{a}	98.28±1.03^{a}	157.70±0.46^{a}	1.31±1.10	1.20±1.11	1.20±1.10	3.19±1.05^{b}
Sig.		*	*	*	n.s	n.s	n.s	*
Interaction								
20	S0	54.75±1.10^{b}	89.23±1.11^{b}	143.98±2.01^{b}	1.26±0.87	1.31±1.01	1.20±1.12	3.80±1.02^{ab}
20	S1	56.40±1.22^{a}	91.85±1.03^{b}	148.25±1.09^{b}	1.37±1.01	1.30±1.09	1.25±1.32	3.11±0.95^{b}
22	S0	57.40±1.40^{a}	96.34±1.12^{ab}	153.22±1.32^{b}	1.33±0.79	1.06±1.10	1.15±1.21	3.88±1.20^{a}
22	S1	59.45±1.20^{a}	97.06±2.02^{a}	156.29±1.03^{ab}	1.34±0.94	1.17±0.99	1.24±1.40	3.24±1.08^{b}
24	S0	61.91±1.23^{a}	104.35±1.32^{a}	166.26±1.32^{a}	1.24±0.99	1.07±1.11	1.05±1.20	4.62±1.26^{a}
24	S1	64.90±1.05^{a}	105.94±1.09^{a}	168.56±1.13^{a}	1.23±0.87	1.14±1.03	1.14±1.01	3.23±1.08^{b}
Sig.		*	*	*	n.s	n.s	n.s	*

^{a,b}. means in each column within each item, bearing the same superscripts are not significantly different (P<0.05).
n.s= not significant.
S0= diet without Vitamin E and selenium.
S1= diet with Vitamin E and selenium.

Regardless of protein level, results showed that supplementing diet with VE and Se decreased mortality rate significantly (P<0.05) in the period from 0-6 weeks of age as compared to unsupplemented diets. This result may be due to the increase in immunity response of quail chicks with the addition of VE and Se. The mixture of vitamin E and selenium significantly reduced both mortality and enhance body weight gain. Due to the metabolic relationships between vitamin E and selenium (Cook, 1991). Salwa *et al* (2004) reported that dietary VE and Se supplementation caused an increase in the values of antibody and reducing mortality. Moreover, Franchini *et al.* (1995) indicated that the main role of VE is the activation disease resistance of birds.

Interaction between dietary protein levels, VE and Se supplementation indicated that the presence of supplemented with any level of dietary protein resulted in improvements (P<0.05) in the percentage of mortality rate.

Carcass traits

Data of carcass traits are presented in Table (5). There were insignificant differences in all carcass traits studied between different levels of protein.

It was noticed that the dressing percentages were decreased insignificantly when protein level decreased, this may be due to the decrease in live body weight. Mahapatra *et al.*(1984) and Lee *et al.*(1990) reported similar results, different protein levels had no significant difference on eviscerated carcass weight.

The edible giblets ranged from about 6.08 to 6.14 %, which did not differ statistically among the experimental groups and these results indicated that edible giblets decrease with increased in protein levels.

Similar results were obtained by Zeweil *et al.*(1993) and Zeweil (1996) found that total edible parts were decrease with increased protein level for quail diets and protein level had insignificant effect on viscera and giblets percentages.

El-Ghamry *et al.* (2002) and Abd El-Hady and Abd El-Ghany (2003) who found that there were no significant differences in carcass characteristics due to dietary protein level. Shalan-Hedaia (1993) who reported that, carcass, liver, gizzard, heart, giblets, feather and blood percentages were insignificantly affected by different protein level.

Regardless of protein levels, using VE and Se as feed supplementation in diet resulted in improved dressing and edible giblets percentage.

Interaction between dietary protein levels, VE and Se supplementation resulted in improvements in the obtained values of dressing and edible giblets percentage with any levels of dietary protein.

Digestibility and nutritive values of the experimental diets

The effect of dietary protein level on digestion coefficients % and nutritive values of the experimental diets are shown in Table (6). The digestibility of CP, CF, EE and NFE % showed significant differences (P<0.05) among experimental diets with increases in protein level, this may

Table (5): Carcass traits ($\bar{X}$±SE) of growing japanese quail as affected by dietary protein level, VE and Se supplementation and their interaction

Treatments		Live body weight (g)	Dressing%	Liver%	Gizzard%	Heart%	Edible giblets %
Protein level	VE and Se						
20	-	197.70±2.22	72.37±1.51	2.66±0.81	2.65±0.54	0.83±0.80	6.14±1.05
22	-	204.15±2.51	72.72±0.99	2.70±0.92	2.56±0.51	0.82±0.59	6.08±0.99
24	-	198.13±2.35	73.08±2.01	2.84±1.01	2.43±0.32	0.82±0.72	6.08±1.01
Sig.		n.s	n.s	n.s	n.s	n.s	n.s
-	S0	195.55±1.99[b]	72.16±1.21	2.67±0.99	2.53±0.61	0.81±0.94	6.04±0.99
-	S1	204.44±2.05[a]	73.28±1.50	2.79±1.03	2.57±0.75	0.83±1.02	6.15±1.04
Sig.		*	n.s	n.s	n.s	n.s	n.s
Interaction							
20	S0	194.20±2.02[b]	71.82±1.60	2.61±1.02	2.57±1.01	0.82±1.07	6.10±1.12
20	S1	201.20±2.54[ab]	72.92±1.57	2.71±1.51	2.73±1.11	0.83±1.03	6.17±1.14
22	S0	200.30±3.46[ab]	72.11±1.52	2.59±1.13	2.60±1.02	0.81±1.00	6.00±1.05
22	S1	208.00±3.01[a]	73.33±1.42	2.80±1.52	2.52±1.50	0.83±1.10	6.15±1.04
24	S0	192.14±3.51[b]	72.56±1.70	2.80±1.16	2.41±0.99	0.81±1.02	6.02±1.02
24	S1	204.11±2.98[a]	73.60±1.95	2.87±1.42	2.45±0.85	0.83±1.01	6.14±1.12
Sig.		*	n.s	n.s	n.s	n.s	n.s

[a,b]. means in each column within each item, bearing the same superscripts are not significantly different ($P<0.05$).
Sig.= Significant. n.s= not significant.
S0 = diet without Vitamin E and selenium.
S1 = diet with Vitamin E and selenium.
Edible giblets=heart, empty gizzard and liver.

Table (6). Digestion coefficients and nutritive values ($\overline{X}$ ±SE) of the experimental diets as affected by dietary protein level, VE and Se supplementation and their interaction

Treatments		Digestion coefficients%				Nutritive values		
Protein level	VE and Se	Crude protein (CP)	Crude fiber (CF)	Ether extract (EE)	Nitrogen free extract (NFE)	Digestible crude protein (DCP)	Total digestible nutrients (TDN)	Metabolizable energy (ME)
20	-	82.99±2.19^{a}	26.68±1.45^{a}	89.22±1.45^{a}	87.63±2.43^{a}	16.60±1.65^{b}	63.40±1.21^{b}	2663±12.21^{b}
22	-	82.53±2.01^{ab}	26.31±1.36^{a}	88.17±2.25^{ab}	87.02±2.22^{a}	18.06±1.62^{a}	65.13±1.03^{a}	2735±13.36^{ab}
24	-	81.33±2.30^{b}	24.51±1.52^{b}	87.08±1.25^{b}	85.75±2.61^{b}	19.61±1.12^{a}	66.87±1.11^{a}	2809±10.81^{a}
Sig.		*	*	*	*	*	*	*
-	S0	81.19±1.25^{b}	25.26±3.01^{b}	87.46±2.32^{b}	86.07±2.12^{b}	17.85±1.21^{b}	64.58±2.01^{b}	2713±15.0^{b}
-	S1	82.87±2.01^{a}	26.40±2.06^{a}	88.84±2.01^{a}	87.53±2.00^{a}	18.32±1.07^{a}	65.75±1.33^{a}	2762±13.6^{a}
Sig.		*	*	*	*	*	*	*
Interaction								
20	S0	81.61±2.36^{ab}	26.34±2.33^{a}	88.72±2.51^{a}	87.17±1.44^{ab}	16.42±1.12^{b}	62.96±1.41^{b}	2644±14.02^{b}
20	S1	83.39±2.01^{a}	27.01±2.51^{a}	89.71±2.16^{a}	88.09±2.06^{a}	16.78±1.09^{b}	63.83±1.35^{b}	2681±12.99^{b}
22	S0	81.10±3.05^{b}	25.93±2.90^{ab}	87.64±2.56^{ab}	86.03±2.51^{b}	17.85±1.01^{ab}	64.42±1.10^{ab}	2706±13.56^{ab}
22	S1	83.01±2.89^{a}	26.69±3.02^{a}	88.69±3.01^{a}	88.01±2.24^{a}	18.26±1.45^{a}	65.84±1.02^{a}	2765±10.10^{ab}
24	S0	80.00±2.01^{b}	23.11±3.01^{b}	86.03±2.32^{b}	85.71±2.03^{b}	19.29±1.01^{a}	66.37±1.20^{a}	2788±12.09^{a}
24	S1	82.69±2.71^{a}	23.51±2.61^{b}	88.12±2.25^{a}	86.49±2.12^{b}	19.93±1.58^{a}	67.57±1.25^{a}	2839±11.51^{a}
Sig.		*	*	*	*	*	*	*

a,b. means in each column within each item, bearing the same superscripts are not significantly different (P<0.05).
S0= diet without Vitamin E and selenium.
S1= diet with Vitamin E and selenium.

be due to the dietary protein level increases the amount of uric acid increases, consequently the digestion coefficients decreases. Yamazaki *et al.* (1996) showed that the excretion of nitrogen increased as protein level increased. Mitchell (1942) found that when protein intake exceeds the efficiency of protein requirement, its utilization decreases rapidly, since protein can be not stored in body to any appreciable extent

It is of great importance to note that the results of the digestion trials were coincided generally with growth performance and feed conversion ratio.

Nutritive values expressed as DCP, TDN % and ME (kcal/kg) of the experimental diets were gradually increased (P<0.05) with the increasing of CP level in the diet. These results are in agreement with those of Aggoor *et al.*(1997), Ghazalah *et al.*(1988) and Attia (1986) who found that increasing protein level decreased digestibility of CP and CF%. Hassanein (2004) who found that increasing protein levels decreased digestibility of DM, OM, CP, CF% and nutritive values in quail diets.

Regardless of protein level results, using VE and Se as feed supplementation in diet recorded the improved on digestion coefficients % and nutritive values comparably with the unsupplemented diets.

In generally, the results showed that improvement of digestibility coefficients of nutrients and nutritive values significantly (P<0.05) increased with supplemented of VE and Se compared to unsupplemented diets as shown in Table (6).

It is of great importance to note that the results of the digestion trial were coincided generally with the positive response in performance and feed utilization of quail birds with supplemented of VE and Se.

Selenium may affect metabolism and performance because it is essential for the synthesis of active thyroid hormones. Thyroid hormones increased metabolic rate (Hadley, 1984). Ferit *et al.* (2003) found that dietary VE and Se inclusions resulted in a greater (P<0.01) serum concentration of triiodothyronine (T3), thyroxine (T4), thyroid stimulating hormone (TSH), Ca, P and K, while urea, cholesterol and Na were decreased (P<0.01).

Furthermore, the improvement of performance as a result of adding growth promoter may be due to reducing bacterial utilization of essential nutrients, allowing increased synthesis of vitamins and growth factors, improving the absorption of nutrients by reducing the thickness of intestinal epithelium, reducing intestinal mucosa epithelial cell turnover and reducing intestinal motility (Prescott and Baggot, 1993).

From these results, it can be concluded that when VE and Se supplementation on the diets indicated improvement digestibility and nutritive values.

Economical Efficiency

Feeding cost and feed conversion ratio are the most important factors involved in the achievement of maximum efficiency of meat production. The effects of different treatments on economic efficiency are shown in Table (7).

Results indicated that dietary protein level of 22 % recorded the best of economical efficiency are calculated in table 6.

A higher economical efficiency percentage was recorded with 22% CP (116.65) diet followed by 20% CP and 24% CP diet (110.21 Vs 107.50), respectively.

Abd El-Hady and Abd El-Ghany (2003) who found that decreasing crude protein level in broiler diets increased economic efficiency, which in accordance of the present results.

Irrespective of protein levels, the best economical efficiency was obtained by quail fed diets supplemented with VE and Se (118.28) as a feed supplementation comparably with the unsupplemented diet.

Table (7): Economical evaluation of growing japanese quail as affected by dietary protein level, VE and Se supplementation and their interaction

Protein level	VE and Se	Feed conversi-on ratio	Cost of Kg feed (L.E)	Feed cost of kg meat (L.E)	Net revenue (L.E)	Economic efficiency
20	-	4.05	1.41	5.711	6.289	110.21
22	-	3.82	1.45	5.539	6.461	116.65
24	-	3.83	1.51	5.756	6.217	107.50
-	S0	4.02	1.45	5.794	6.192	106.61
-	S1	3.78	1.45	5.497	6.503	118.28
Interaction						
20	S0	4.14	1.40	5.808	6.204	107.04
20	S1	3.96	1.41	5.584	6.416	114.90
22	S0	3.95	1.44	5.688	6.312	110.97
22	S1	3.68	1.45	5.336	6.664	124.89
24	S0	3.96	1.50	5.940	6.060	102.02
24	S1	3.69	1.51	5.572	6.428	115.36

Cost of kg feed calculated according to price of feed ingredient at the same time of the experiment (2006).
Selling price of one Kg meat= 12 (L.E).
S0= diet without Vitamin E and selenium.
S1= diet with Vitamin E and selenium.

Interaction between dietary protein levels, VE and Se supplementation resulted in improvements in the obtained values of economical efficiency comparable with the unsupplemented diets during the experimental periods.

Generally, quail fed diets containing 22% CP and supplemented with VE and Se improved the economical efficiency.

In conclusion and application, based on results obtained in the present study, it could be concluded that a protein level of 22 % in the diet supplemented with Vitamin E and Selenium (200 IU VE and 0.5 mg Se /kg diet) improve the growth performance of growing Japanese quail and economic efficiency.

REFERENCES

Abaza, M.(2002).Immune system and some physiological aspects in japanese quail affected by antioxidants Egypt. Poult. Sci., 22 (1):259-276.

Abd El-Hady, S. B. and F. A. Abd El-Ghany (2003). The effect of genotype, dietary protein level and their interaction on chicken performance of two strains. Egypt. Poult. Sci.,23: 153-167.

Abdel-Azeem, F.; Faten A. A. Ibrahim and Nematallah, G. M. Ali (2001). Growth performance and some blood parameters of growing Japanese quail as influenced by dietary different protein levels and microbial probiotic supplementation. Egypt. Poult.Sci.,21:465-489.

Abou-Raya, A.K. and A.G.H. Galal (1971). Evaluation of poultry feeds in digestion trials with reference to some factors involved. Egypt. J. Anim. Prod., 11(1): 207-221.

Aggoor, F.A.M.; N.M. El-Naggar; A.Z Meherz; Y.A. Attia and M.A. Qota (1997). Effect of different dietary protein and energy levels during roaster period on: 1- performance and economic evaluation of broiler chicks. J. Egypt. Poult.Sci., 17(1):81-105.

Ali, A.M.; K.Y. El-Nagmy and M.O. Abd-Alsamea (2000). The effect of dietary protein and yeast culture levels on performance of growing japanese quail. Egypt. Poult. Sci., 20(4);777-787.

A.O.A.C., Association of Official Analytical Chemists (1990). In "*Official Methods of Analysis*", 15th ed. Washington, USA.

Attia, Y.A.(1986). Effect of different dietary protein and energy on producative and reproductive performance of white Leghorn chickens. *M.Sc.,thesis* Fac. Agric. AL-Azaher Univ., Egypt.

Boztepe, S. and A. Ozturk (1993). Effect of diets with different levels of protein on performance of Japanese quail. Hayvancilik Arastirma Dergisi, 3(1): 56-57.

Bunk, M.J.; and G.F. Combs (1981). Evidence for an impairment in the conversion of methionine to cystine in the selenium-deficient chick. Proc. Soc. Exp. Biol. Med., 167 : 87 - 93.

Cook, M.E. (1991). Nutrition and the immune response of the domestic fowl. Crit. Rev. Poult. Biol. 3: 167-190.

Damron. B. L.; H.R. Wilson; R.A. Voitle and R.H. Harms (1981). Selenium supplamentation for the diet of Large White turkey hens. Nutr. Rep .Int., 23 : 245 – 248 .

Desai, I.D. and Scott, M. L. (1965). Archs. Biochem. Biophys. 110: 309-315.

Duncan, D.B. (1955).Multiple range and multiple F-Test. J. Biometrics,11:1-42.

EL-Ghamry, A. A.; G. M. EL-Mallah and A.T. EL-Yamny (2002). The effect of incorporating yeast culture, Nigella sativa seeds and fresh garlic in broiler diets on their performance . Egypt. Poult. Sci., 22: 445-459.

Ferit ,G.M.; N.Sahin and O.Kucuk (2003). Effect of vitamin E selenium on thyrouid status, adrenocoriticotropin hormone and blood serum metabolite and mineral concentrations of Japanese quail reared under heat stress. J. Trace Elements in Experimental Medicine, 16:95-104.

Franchini,A.; S.Bertuzz; C.Tosarelli and G.Manfrola (1995).Vitamin E in Viral inactivated vaccines. Poult. Sci., 74: 666-671.

Ghazalah,A.A.; M.R. El-Abdady; A.I. Labib and N.E. Omar (1988). Effect of different dietary protein and energy levels in three stage system on general performance of broiler chicks. Egypt. Poult.Sci.,8:159-123.

Hadley, M. E. (1984). Pancreatic hormones and metabolic regulation. Thyroid hormones and hormones of males reproductive physiology, In: Endocrinology, pp. 235-263, 292-317, 402-420, Prentica-Hall, Inc., Englewood cliffs, N.J.

Halliwell, B. and J.M.C. Gutteridge (1989). Lipid peroxidation: A radical chain reaction. Pages, 188-218 in: Free radicals in Biology and Medicine. Zend ed. Oxford University Press, New York.

Hassanein, E.A.M.(2004).Some notional studies on quail. *M.Sc.,thesis*,Fac. Agric. zagazig Univ., Egypt.

Hossain, S. M. and L. Sergio (1995). Influence of various levels of vitamin E on reproductive performance of broiler breeder. Poult. Sci.,74 (supplement 1):133

Jakobsen, P.E.; S.G.Kirsten and S.H. Nilsen (1960).Fredjelighed frogmed fierbrae." Digestibility trails with poultry "Bereting fra for sogslabortoriat, Kabenhaven, 56:1-34.

Johri,T.S. and P.Vohra (1977).Protein requriments of *Coturnix Coturnix Japonica* for reproduction using purified diets. Poult. Sci., 56:350-353.

Kennedy,D.G.; D.A. Rice ;D.W.Bruc;E.A.Gsodal and S.G. Mcilroy (1992). Economic effects of increased vitamine E supplementation of broiler diets on commercial broiler production.Br.Poult. Sci.,33:1015-1023.

Lee, S. J.; S. S. Kim; K. H. Lee and C. H. Kwack (1990). Effect of dietary protein level on broiler performance. Research reports of the rural development administration, Livestock, 32: 28-34.

Mahapatra, C. M.; N. K. Pandey and S. S. Verma (1984). Effect of diet, strain and sex on the carcass yield and meat quality of broilers. Indian. Poult. Sci., 19: 236-240.

Marsh, J.A.; R.R. Dietort and R.R. Combs (1981). Influence of dietary selenium and vitamin E on the humoral immune response of the chick. Proc. Exp. Biol. Med., 166, 228-236.

Minoguchi, N.; H.Ohguch;R.Yamamoto and Y.Hanaki (2001).Low protein diets for Japanese quail and the reduction in nitrogen excretion .Research Bullen of the Aichi Ken Agric. Research Center.33:319-324.

Mitchell, B. (1942). Biological methods of measuring the protein values of food. J.Anim.Sci., 2:263-277.

Mohammed, F.A. (1990). Studies on protein requirements of Japanese quail during growing and laying periods. *PhD.Thesis* Fac. Agric. AL-Azhar, Univ.,Egypt.

Murakami, A.E; V.M.B. Moraes; J. Ariki ; O.M. Junqueira and S.N. Kronka (1993). Niveis de proteina energia para codornas japonesas (*Coturnix coturnix japonica*).Revista Brasileira de Zootecnia, 22(4):541-552.

NRC., National Research Council (1994).Nutrient Requirements of Poultry. 9th rev. ed. National Academy of Science. Washington, D.C. USA.

Ort, J.F. and J.D. Latshew (1978). The toxic level of sodium selenite in the diet of laying chickens. J. Nutr. 108:114.

Pettersson, D.; H.Graham and P. Aman (1990). Enzyme supplementation of low or high crude protein concentration diets for broiler chickens. Anim.Prod.51;399-404.

Prescott, J. F. and D. J. Baggot (1993). Antimicrobial therapy in veterinary medicine, 2nd Ed, pp 564-565. Ames, IA: Iowa State University Press.

Salwa S. Siam; K.M. Mansour; E.M.M. El-Anwer and A. A. El-Warith (2004). Laying hens performance, hatchability, immune response and some blood constituents as affected by vitamin E and selenium supplementation under hot condition. Egypt. Poult. Sci., 24 (2): 483-496.

SAS (1996). In" *Statistical analysis system"* User's Guide SAS institute, Inc., Cary, North Carolina. USA.

Schultz, R.D. (1989). The role of vitamin E and selenium in immunity. In Proc. Veterinary Nutrition Symposium, ed. R. Shaver. University of Wisconsin, Medison, p. 42.

Shalan-Hedaia, M.I.(1993).Effect of different levels of protein and calories to protein ratios on Japanese quail production. *M.Sci.Thesis* Fac. Agric. Alexandria Univ., Egypt.

Shamberger, R .J. (1983). Biochemistry of Selenium. Plenum press. New york and London.

Thompson, J.N. and M.L. Scott (1970). Impaired lipid and vitamin E absorption related to atrophy of the pancreas in selenium deficiency chicks. J. Nut. 100: 797-809.

Titus, H.W. (1961).In "The scientific feeding of chickens". Danville, Illinois, USA.

Vohra, P. and T.P. Roudybush (1971). The effect of various levels of dietary protein on the growth and egg production of *Coturnix coturnix japonica.* Poult. Sci., 50:1081-1084.

Yamazaki, M.; A. Murakami; M. Yamazaki and M. Takemsa (1996). Reduction of nitrogen excreted from broiler chicks feeding lowprotein, amino acid supplemented diets. Japanese Poult. Sci., 33:249-255.

Yu, B.P. (1994). Cellular defenses against damage from reactive oxygen species. Physio. Rev., 74: 139-162.

Zeweil, H. S.; N. S. Isshak; S. A. Abd El-Fatah and M. E. Abd El-Aziz (1993). Effects of virginiamycin on performance of Japanese quail fed optimal and sub-optimal proteins. Egypt. Poult. Sci., 13: 612-623.

Zeweil, H. S. (1996). Enzyme supplements to diets of growing Japanese quail. Egypt. Poult. Sci., 16 (3): 535-557.

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استجابة السمان الياباني النامي لمستويات مختلفة من البروتين مع أو بدون إضافة فيتامين هـ والسيلينيوم .

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استخدم في هذا البحث عدد ٣٠٠ كتكوت سمان ياباني من الفقس حتى عمر ٦ أسابيع. استهدفت التجربة دراسة تأثير مستوى البروتين و إضافة فيتامين هـ والسيلينيوم على أداء السمان اليابانى النامى. حيث قسمت كتاكيت السمان عشوائيا في نظام تحليل تباين عاملى (٢x٣) الى ثلاثة مجموعات رئيسية غذيت على نسب متدرجة من البروتين الخام ٢٠، ٢٢ و٢٤% على التوالى . وقسمت كل مجموعة رئيسية إلى تحت مجموعتين بكل منها ٥٠ كتكوت. غذيت تحت المجموعة الأولى على عليقة بدون إضافة (فيتامين هـ وسيلينيوم) , بينما غذيت تحت المجموعة الثانية على عليقة أضيف إليها فيتامين هـ(الفا توكوفيرول) والسيلينيوم(سيلينات الصوديوم) بمعدل ٥٠ مجم فيتامين هـ و ١مجم سيلينيوم. وكانت العلائق المستخدمة متشابهة في الطاقة الممثلة ٢٩٠٠ كيلو كالورى /كيلوجرام والالياف الخام.

يمكن إيجاز أهم النتائج في النقاط التالية:

- سجل كل من وزن الجسم الحي والزيادة فى الوزن الحي تحسنا مع مستوى البروتين ٢٢% بينما سجلت المجموعة الغداة على ٢٠ % بروتين خام اقل القيم خلال الفترة التجريبية.
- لوحظ زيادة استهلاك الغذاء معنوياً (عند مستوى ٥%) وذلك بانخفاض نسبة البروتين, حيث سجلت المعاملة المغذاة على ٢٠ % اكبر القيم استهلاكا للغذاء.
- سجل معدل تحويل الغذاء(جم غذاء مستهلك / جم نمو) افضل القيم معنويا(عند مستوى ٥%) لمستوى بروتين ٢٢ % بينما سجلت نسبة ٢٠ % أسواء القيم.
- – لوحظ زيادة استهلاك البروتين وذلك بزيادة مستوى البروتين فى العليقة, حيث سجلت المعاملة المغذاة على ٢٤ % اكبر القيم أثناء الفترة التجريبية.
- حققت المجموعة المغذاة على ٢٠% بروتين أفضل كفاءة نسبية للبروتين بينما سجلت المجموعة المغذاة على ٢٤% اقل القيم أثناء الفترة التجريبية .
- انخفض معدل النفوق بانخفاض نسبة البروتين فى العليقة.
- أظهرت معاملات الهضم الظاهرية لكلا من البروتين والألياف الخام و معامل هضم مستخلص الأثير انخفاضا معنويا (عند مستوى ٥ %) بزيادة البروتين بينما لم يتأثر معنويا معامل هضم المستخلص الخالي من النتروجين بمستوى البروتين.
- حققت المجموعة المغذاة على ٢٢ % بروتين أفضل عائد صافي للتغذية بالإضافة إلى أعلى قيمة كفاءة اقتصادية .
- لوحظ أن هنالك تأثير إيجابي ومعنوي بإضافة فيتامين هـ والسيلينيوم على وزن الجسم والزيادة في وزن الجسم و معدل التحويل الغذائي , الكفاءة النسبية للبروتين , معدل النفوق و صفات الذبيحة , معاملات الهضم الظاهرية والقيم الغذائية وافضل عائد صافي للتغذية بالإضافة إلى أعلى قيمة كفاءة اقتصادية.وذلك مقارنة بعدم اضافة فيتامين هـ والسيلينيوم.
- لوحظ وجود تأثيرات معنوية راجعة للتداخل بين مستوى البروتين واضافة فيتامين هـ والسيلينيوم وقد كان التحسن واضح باستخدام مستوى البروتين ٢٢ % مع إضافة فيتامين هـ والسيلينيوم.

من الوجهة الغذائية والاقتصادية توصى الدراسة بإمكانية استخدام مستوى بروتين ٢٢ % مع إضافة فيتامين هـ والسيلينيوم حيث كان التأثير إيجابي على معدلات أداء السمان النامى و العائد الاقتصادي.