

EFFICACY OF OVERDOSING OF VITAMIN C SUPPLEMENTATION ON GROWTH PERFORMANCE, EUROPE PRODUCTION EFFICIENCY FACTOR (EPEF), CARCASS TRAITS AND SOME BLOOD CONSTITUENTS OF JAPANESE QUAIL

Moustafa M. Metwally¹ and M.A. Metwally²

¹*Agricultural Research Center, Animal Production Research Institute, Giza, Egypt.*

²*Dept. of Poultry Production, Faculty of Agriculture, Assiut University, Assiut, Egypt.*

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SUMMARY

The present study was designed to investigate the efficacy of overdose of vitamin C supplementation on growth performance, Europe production efficiency factor (EPEF), carcass traits and some blood constituents of Japanese quail in one way analysis of variance experiment lasted 49 days of age. Two hundred and twenty five of one day old Japanese quail chicks were used. The chicks were distributed into 5 treatments of 3 replicates of 15 birds each. Five levels of vitamin C (0, 65, 130, 260 and 520mg/kg diet) were used. The body weight and feed intake were recorded weekly and consequently, body weight gain and feed conversion ratio were calculated. At the end of the experiment, three birds from each group were slaughtered to evaluate carcass parts. Blood serum samples were obtained from chicks at 49 day of age after being centrifuged to measure total protein, cholesterol, glucose, calcium, phosphorus and GPT. The results at 49 days of age, showed that the Japanese quail chicks fed 130 mg of vitamin C/kg were significantly ($P < 0.05$) the best and recorded better values for body weight, body weight gain and feed conversion ratio compared to control and the other treatments.. No significant ($P > 0.05$) effects due to vitamin C supplementation were noticed on dressed%, EPEF, and some blood serum parameters measured, although, there were slight improvements in chicks fed 130 mg/kg feed. It was recommended that feed formulation during starter and grower periods, it should be supplemented at least by 130 mg/kg of vitamin C to achieve good performance and health of Japanese quail.

Keywords: *Quail, vitamin C, overdose, performance, carcass and serum.*

INTRODUCTION

The shortage of animal protein intake among the ever increasing human population in the third world countries has long been recognized and remains one of the greatest issues of concern today (Omikhoje *et al.*, 2008). Developing Countries including Egypt are deficient in animal protein security with the per capita consumption put at lower than 10.0 g/per day as against the minimum daily intake of 35 g recommended by Food and Agricultural Organization to be the minimum requirement for the growth and development of the body (Esobhawan *et al.*, 2008). One way of increasing protein supply is to improve poultry production as well as increase the production of other small livestock species with short generation intervals. Among these is the Japanese quail (*Coturnix Coturnix Japonica*). Generally quail occupy a small but special segment of the Egyptian poultry industry. These birds are raised as source of specialty egg and meat. Japanese quail have the advantage of rapid growth rate, small size, good reproductive potential, short life cycle, low feed requirements, good meat taste, better laying ability and shorter time of hatching as compared with the different species of poultry (Roshdy *et al.*, 2010 and Siyadati *et al.*, 2011).

Vitamin C, also called ascorbic acid, is presented as a natural antioxidant that can be used to reduce the oxidative stress imposed by heat stress. Supplementation of ascorbic acid at 250 mg/kg feed has been reported to improve feed intake, body weight gain and feed efficiency, and to enhance immune response and antioxidant status of broiler chickens (Khan *et al.*, 2012). Abidin and Khatoon (2013) reported that vitamin C ameliorates production and immunity problems induced by heat stress such as suppressing immunity, lowering feed consumption, impairing body weight gain, inducing oxidative stress, increasing rectal temperature and increasing mortality in birds.

Although poultry can synthesize vitamin C, synthesis is inadequate under stressful conditions such as low or high environmental temperature, high humidity, high egg production rate and parasite infestation (Sykes, 1978; McDowell, 1989). Such conditions, particularly in poultry, lead to generation of cytotoxic free radicals damaging the cells and cell membranes, increased protein catabolism, decreased protein biosynthesis and depletion of vitamin C. Vitamin C and E supplementations are reported to be beneficial in alleviating some of the heat stress related physiological responses and improving thermotolerance through their antioxidant effects (Sahin and Kucuk, 2001; Sahin *et al.*, 2006). Sahin *et al.* (2003) showed that dietary supplementation of vitamin C and E, particularly as a combination, improved the performance, and antioxidant status of laying Japanese quails exposed to heat stress. Chee *et al.* (2005) observed that vitamin C and vitamin E had got effect on egg shell quality of broiler breeder reared under heat stress conditions.

McKee *et al.* (1997) reported that ascorbic acid supplementation has the ability to influence body energy stores in favor of improving productivity when feed restriction lead to a reduction in the energy consumption of broilers.

Vitamin C with other vitamins such as vitamin E play a major role as antioxidants in biological systems and act individually or synergistically such that vitamin E explicates its antioxidant function in lipid phases whereas vitamin C in aqueous compartments by reacting with peroxy radicals and by restoring the antioxidant properties of vitamin E (Cotelle *et al.*, 2003). Studies on poultry have reported that dietary supplementation with vitamin C, alone can improve growth performance (Sahin and Kucuk 2001; Ajakaiye *et al.* 2010).

Al-Ghamdi (2008) suggested that the alteration in plasma vitamin C level can be used as a heat stress indicator in broiler chickens. He found a significant reduction in plasma ascorbic acid in broilers exposed to 40°C for three hours a day for ten days starting from day 22 of age. Sahin *et al.* (2009) recommended a combination of vitamins C and E supplementation (500 mg of each 1kg of diet) to the diet of quail to improve egg production and heat shock protein synthesis during heat stress.

Therefore, the objective of the present study was to investigate the efficacy of overdosing of vitamin C supplementation as a good management practice in Japanese quail nutrition to promote growth performance, Europe production efficiency factor (EPEF), carcass criteria and some blood constituents of Japanese quail.

MATERIALS AND METHODS

The present study was carried out at the Poultry Research Farm of Department of Poultry Production in Assiut University. The objective of the present study was to investigate the efficacy of overdosing of vitamin C supplementation as a good management practice in Japanese quail nutrition to promote growth performance, Europe production efficiency factor (EPEF), carcass criteria and some blood constituents of Japanese quail.

Housing and experimental design:

A total number of (two hundred and twenty five, one day old Japanese quail chicks were used in this experiment. The chicks were distributed into 5 treatments of 3 replicates (15 birds each). Experimental diets based on corn - soybean meal diets and contain 24% and 20% crude protein during starter and grower periods, respectively according to NRC 1994, recommendation. The ingredient composition and chemical analysis of the experimental diets used in the starting and growing period are presented in Table 1. Samples of the experimental diets were analyzed according to AOAC (1990). The experimental design was as follows:

Treatment 1: Chicks were fed basal diet without vitamin C supplementation (control).

Treatment 2: Chicks were fed basal diet supplemented with 65mg vitamin C/kg feed.

Treatment 3: Chicks were fed basal diet supplemented with 130 mg vitamin C/kg feed.

Treatment 4: Chicks were fed basal diet supplemented with 260 mg vitamin C/kg feed.

Treatment 5: Chicks were fed basal diet supplemented with 520 mg vitamin C/kg feed.

The experimental chicks were housed in galvanized batteries composed of three tiers, equipped with cages, having the dimensions of (75 cm length, 50 cm width and 45 cm height) and placed in a semi closed house. Chicks were raised under adequate and similar managerial, nutritional and hygienic conditions.

Table (1): Composition and analysis of the experimental basal diets.

Ingredient	Starter %	Grower,%
Corn, Grains	53.00	62.0
Soybean Meal (44%)	36.20	30.2
Vegetable oil	1.00	1.0
Corn gluten Meal (60%)	6.40	3.4
Di calcium phosphate	2.05	2.05
Vit . Min. Premix*	0.30	0.30
Limestone	0.45	0.45
Na Cl	0.30	0.3
DL-Methionine	0.15	0.15
L-Lysine HCl	0.15	0.15
TOTAL	100	100
<i>Determined¹ and calculated² composition</i>		
<i>Nutrient_determined analysis</i>		
Dry matter	85.82	87.8
Crude protein ¹	23.92	20.15
Ether extract ¹	3.51	3.2
Crude fiber ¹	4.02	4.0
<i>Nutrient calculated analysis</i>		
Dry matter ²	86.6	85.9
ME (kcal/kg) ²	2920	2857
Crude protein ²	24.79	20.85
Ether extract ²	3.46	3.5
Crude fiber ²	3.86	3.9
Calcium ²	0.86	0.9
Available phosphorus ²	0.53	0.47
Lysine ²	1.29	1.4
Methionine ²	0.59	0.51
Total phosphorus ²	0.8	0.83

* Vitamins and minerals mixture provide per kilogram of diet: Vitamin A (as all-trans-retinyl acetate); 12000 IU; Vitamin E (all rac- α -tocopheryl acetate); 10 IU; k₃ 3mg; Vit.D₃, 2200 ICU; riboflavin, 10 mg; Ca pantothenate, 10 mg; niacin, 20 mg; Choline chloride, 500 mg; Vitamin B₁₂, 10 μ g; Vitamin B₆, 1.5 mg; Thiamine (as thiamine mononitrate); 2.2 mg; Folic acid, 1 mg; D-biotin, 50 μ g. Trace mineral (milligrams per kilogram of diet) Mn, 55; Zn, 50; Fe, 30; Cu, 10; Se, 0.1 and Ethoxyquin 3mg.

Chicks were kept during the first three days of age to a lighting period of 23 hr/day, which was gradually decreased by 1hr/day to reach 12L:12D hours/day during the rest of the growing period.

Body weight was recorded at one day old and each week per each replicate till 7 week.. Also, feed consumed was recorded each week till the last of the experiment. Body weight gain and feed conversion were calculated during the period from 0-7, 0-14, 0-21, 0-28, 0-35, 0-42 and 0-49 days of age. Mortality was recorded daily. In the last of the experiment, three chicks from each replicate (total 45 chicks) were taken to slaughter to measure carcass parts, complete bleeding, scalding and plucking, the edible organs (heart, liver), breast, thigh, weighed and estimated as percentage of the live body weight. The dressing percentage was estimated by dividing the weight of the carcass giblets on the pre-slaughter body weight of birds.

Relative weight = (organ weight/Live body weight) X 100.

Criteria studied:

Body weight development, body weight gain and feed intake of quail birds in different treatments were weekly recorded. Body weight gain and feed conversion ratio (FCR) were calculated according to McDonald *et al.* (1987) and North (1981), respectively.

Depend on the calculations of FI, BWG, FCR and mortality, the European Production Efficiency Factor (EPEF) and European Broiler Index (EBI) were used to evaluate the growing performance of broilers as suggested by Marcu *et al.* (2013). EPEF and EBI were calculated according to the following formula:

TWG (Total weight gain) = Body weight (g) at the end —Body weight (g) at start;

ADG (Average daily gain, g/chick/day) = TWG/ days of growth period.

FCR (kg feed/kg gain) = Cumulative feed intake (kg) /Total Weight gain (kg);

Viability, % = 100 - mortality, %

EPEF= Viability (%) x BW (kg)*100/Age (d) x FCR (Feed / kg gain)

EBI = Viability (%) x ADG (g/chick/day)*100 /FCR (kg feed/kg gain) x 10

Blood samples:

At the end of the experimental period, blood samples were taken using 3 birds from each replicate. The blood samples were left to drop on the side of the tube to prevent destruction of RBC's. Each blood sample was left to coagulate at room temperature. Separation of serum was carried out by centrifugation of coagulated blood at 3000 rpm for 10 min. The clear serum was transferred carefully to clean and dry vials and kept in deep freezer until analysis for determination of serum glucose, total protein, calcium, phosphorus, total cholesterol and GPT using commercial kits obtained from Biodiagnostic Co.

Statistical analysis:

Data obtained were statistically analyzed by using ANOVA in one way experiment and General linear Model (GLM) procedure of SAS software (2009). Duncan's multiple range tests (1955), was used to determine the difference among means, Significant difference were considered to exist when (P<0.05).

The mathematical model used was:

$$Y_{ik} = \mu + T_i + e_{ik}$$

Where: Y_{ik} is any observation by vit D3, μ =the population mean. T_i = Treatment effect (i=1, 2, ...5)
 e_{ik} =Experimental random error.

RESULTS AND DISCUSSION

Body Weight (BW):

Results in (Table 2) showed that there were no significant (P>0.05) differences in body weight between treatments when compared to control at 7, 14, 28, 35 and 42 days of age .At 21 and 49 days of age, the highest body weight values were achieved in treatment 2, in which chicks were fed 130 mg vitamin C/kg feed. Body weight of chicks in such treatment was higher by about 12 and 8.8% than control. The obtained results were in agreement with Ramadan *et al.*,(2019) who reported that the best performance was observed in birds supplemented with 200 mg/kg vitamin C. Jain *et al.*, (2019) mentioned that increased body weight, were observed in the supplemental groups as compared with control especially at higher levels of supplementation. The authors concluded that there was a beneficial effect of vitamin C supplementation in the diet of broilers on body weight, of broilers. Studies on poultry have reported that dietary supplementation with vitamins C, alone, can improve growth performance (Sahin and Kucuk 2001; Ajakaiye *et al.* 2010)

On the other hand, results of Ipek *et al.*(2007) mentioned that the highest body weight was demonstrated in quail on 500 mg of Vitamin C/kg feed and Durrani *et al.* (2008) found when giving Aloe extract 10 ml/liter to broilers in drinking water resulted in better body weight.

Vathana *et al.* (2002) reported that during the first three weeks, no difference in body weight among different treatments was detected ($p>0.05$). However, a significant difference in body weight among groups was observed from the 3rd to the 6th weeks. Birds in group received 40mg/bird/day of vitamin C were the heaviest .The same results had been recorded by Edrise *et al* (1986). Similarly Lohakare *et al.* (2005) have also evaluated the efficacy of supplemental ascorbic acid on the performance of broiler chickens and reported significantly higher body weight in the supplemental groups at higher levels as compared with control. Rajput *et al* (2009) have also recorded increased live body weight in broiler birds supplemented with vitamin C at level of 500mg/kg of feed in comparison to control birds. They added that the control registered significantly less mean body weight of broilers than the treatments, indicating thereby a significant beneficial effect of using vitamin C in the diet of broilers. The differences in the mean body weight of broilers among other treatments were non-significant, being at par. This indicates that all treatments irrespective of level of vitamin C in diet were more or less equally beneficial. Other researchers found that vitamin C supplementation at level of 150 or 300 mg/kg feed didn't achieve any significant ($P>0.05$) effect on body weight (Knoca *et al.*, 2009).

Table (2): Efficacy of overdosing of vitamin C supplementation on body weight of Japanese quail (g).

Period	Treatment				
	T0	T 1	T 2	T 3	T 4
1 day old	8.5± 0.06	9.2± 0	7.8± 0.4	8.4±0	8.6±0
7 day	20.9±0.9	21.3±1.5	19.5±0.56	20.4±0.93	21±0.86
14 day	44±2.7	44.8±0.9	44.4±1.24	43.2±1.61	45.4±2.03
21 day	68 ^b ±1.39	72.1 ^{ab} ±2.75	76.2 ^a ±0.92	68.7 ^b ±1.7	69.2 ^b ±2.1
28 day	120.2±1.6	127.2±5	124±4	115±7	127.2±4.3
35 day	145.2±10	149.3 ±2.4	144.7±7.8	134.3±7.9	145.9±10.3
44 day	158.3±10	172.7±1.4	163.3±6.7	163.5±2.7	176.7±9.8
49 day	201.9 ^b ±4.6	214.4 ^{ab} ±0.5	219.7 ^a ±6.5	200.7 ^b ±3.8	216.6 ^{ab} ±7.5

a, b, means in the same rows with different superscripts are significantly different $p<0.05$. T0= control diet, T1=(65 mg of Vit. C/kg feed), T2=(130 mg of Vit. C/kg feed), T3=(260 mg of Vit. C/kg feed), T4=(520 mg of Vit. C/kg feed).

Body weight gain:

Results in (Table 3) indicate that no significant ($P>0.05$) in body weight gain were obtained between treatment when compared to control during the periods from 0- 7, 0-14, 0- 28, 0-35 and 0-42 days of age .However, during the periods from 0- 21 and 0-49 days of age, the results showed showed that the highest body weight gain values were achieved in treatment 2, in which chicks were fed 130 mg vitamin C/kg feed. Body weight gain of chicks in treatment 2 was higher than control treatment by about 14.9 and 9.56%, respectively. The obtained results were in agreement with Jain *et al.*, (2019) who mentioned that increased, body weight gain were observed in the supplemental groups as compared with control especially at higher levels of supplementation. The authors concluded that there was a beneficial effect of vitamin C supplementation in broilers diets on body weight gain. Supplementation of ascorbic acid at 250 mg/kg feed has been reported to improve body weight gain and to enhance immune response and antioxidant status of broiler chickens (Khan *et al.*, 2012).

In particular, vitamin C promotes performance associated with the suppressed-stress responses as indicated by lowering the plasma corticosterone level and adrenocorticotrophic hormone (Lin *et al.* 2006; Ahmadu *et al.* 2016). Nevertheless, it has been suggested that vitamin C effectiveness on poultry performance expresses only in environmental stress condition whereas, it is not detectable under normal temperature condition (Newman and Leeson 1999; Saki *et al.* 2010).The higher body weight gains have been reported by Mans and Larbier (1986) by supplementation of diet with vitamin C with lower stocking density. Ipek *et al.* (2007) reported that the highest body weight gain was demonstrated in quail on 500 mg of Vitamin C/kg feed.

Table (3): Efficacy of overdosing of vitamin C supplementation on body weight gain of Japanese quail (g).

Period	Treatment				
	T0	T 1	T 2	T 3	T 4
0-7 day	12.4±0.87	12.1±1.5	11.7±0.94	12.02±0.9	12.7±0.86
0 -14 day	35.5±2.7	35.6±0.91	36.6±1.2	34.8±1.6	36.8±2.03
0-21 day	59.5 ^b ±1.3	62.9 ^{ab} ±2.8	68.4 ^a ±1.3	60.3 ^b ±1.7	60.6 ^b ±2.1
0-28 day	111.7±1.9	118±4.9	116.2±3.1	106.6±6.9	118.6±4.3
0-35 day	136.7±10.4	140.1±2.4	136.9±7.4	125.9±7.9	137.3±10.3
0-44 day	149.8±10.1	163.5±1.4	155.5±5.3	155.1±2.7	168.2±9.8
0-49 day	193.4 ^b ±4.5	205.2 ^{ab} ±0.6	211.9 ^a ±6.2	192.3 ^b ±3.8	208 ^{ab} ±7.5

a,b, means in the same rows with different superscripts are significantly different p<0.05). T0= control diet, T1=(65 mg of Vit. C/kg feed),T2=(130 mg of Vit. C/kg feed), T3=(260 mg of Vitt. C/kg feed),T4=(520 mg of Vit.. C/kg feed).

On the other hand, Tuleun *et al.*, (2011) found that there were no significant differences in mean daily weight gain, between treatments and the control group (vitamin C free diet). Vitamin C supplementation at level of 150 or 300 mg/kg feed didn't achieve any significant (P>0.05) effect on body weight gain (Knoca *et al.*, 2009).

Feed consumption (FC):

Results in (Table 4) showed that, there are no significant (P>0.05) in feed consumption between treatment when compared to control during the periods from 0- 7, 0-14, 0-35, 0-42 and 0-49 days of age .However, during the periods from 0- 21 and 0-28 days of age, the results showed significant differences as that the highest feed consumed values were achieved in chicks were fed 520 mg vitamin C/kg feed. Feed consumed in treatment 4 in which chicks were fed 520 mg/kg feed was higher than control by about 5.65 and 4.76%, respectively. The obtained results were in agreement with Jain *et al.*, (2019) who mentioned that increased feed intake were observed in vitamin C supplemental groups as compared with control especially at higher levels of supplementation. This indicate the beneficial effect of vitamin C supplementation in the diet of broilers on feed intake of broilers. Supplementation of ascorbic acid at 250 mg/kg feed has been reported to improve body weight gain and to enhance immune response and antioxidant status of broiler chickens (Khan *et al.*, 2012). Ipek *et al.* (2007) reported that the highest feed intake was demonstrated in quail on 500 mg of Vitamin C/kg feed.

Table (4): Efficacy of overdosing of vitamin C supplementation on feed consumption of Japanese quail at different periods (g).

Period	Treatment				
	T0	T 1	T 2	T 3	T 4
0-7 day	22.2±0	22.2±0	22.2±0	22.2±0	22.2±0
0 -14 day	104.7±1.2	104 ±1.2	105.3±1.8	103.1±2.02	104.7±1.7
0-21 day	153.9 ^{ab} ±27	149. 2 ^b ± 2	151.1 ^b ±1.1	158.2 ^{ab} ±2.9	162.6 ^a ±4
0-28 day	273.1 ^{ab} ±2.	268.5 ^b ±4.7	274.9 ^{ab} ±3.3	276.9 ^{ab} ±5.4	286.1 ^a ±6
0-35 day	436.8±2.1	431.8± 5.4	441.7±7.1	443.6±7.7	453.6±10
0-44 day	633.2±2.2	637.9 ±4.5	642.2±12	653.8±7.9	655±14.9
0-49 day	830.8±2.3	845.6± 7.4	845.1±16.8	870.9±2.7	857.4±20

a,b, means in the same rows with different superscripts are significantly different p<0.05). T0= control diet, T1=(65 mg of Vit. C/kg feed),T2=(130 mg of Vit. C/kg feed), T3=(260 mg of Vitt. C/kg feed),T4=(520 mg of Vit.. C/kg feed).

Feed conversion ratio (FCR):

Results in (Table 5) showed that, there are no significant (P>0.05) effect on feed conversion ratio between treatment when compared to control during the periods from 0- 7, 0-14, 0-35 and 0-42 days of

age .However, during the periods from 0- 21, 0-28 and 0-49 days of age, the results showed the presence of significant difference that, the best feed conversion ratio values were achieved in chicks fed 130 mg vitamin C/kg feed and was better by 9-3% than control treatment. The obtained results confirmed those of Khan *et al.*, (2012) who stated FCR can be improved by supplementation of ascorbic acid at 250 mg/kg feed and to enhance immune response and antioxidant status of broiler chickens. Ipek *et al.* (2007) reported that the best feed conversion ratio was demonstrated in quail on 500 mg of Vitamin C/kg feed.

On the other hand, The obtained results are in disagreement with Jain *et al.*, (2019) who concluded that vitamin C is not essential for improvement of FCR or the performance of broilers. However, Tuleun *et al.*, (2011) found that there were no significant differences in mean feed conversion ratio, between treatments and the control group (AA free diet)

Ascorbic acid can be considered as one of the most potent naturally occurring antioxidants because it works by reacting with aqueous peroxy radicals and by restoring the antioxidant properties of vitamin E (Cotella *et al.*, 2003). AA has been suggested to act synergistically with tocopherol to regenerate the tocopheryl radicals. AA may scavenge peroxy radical and inhibit cytotoxicity induced by oxidants. In addition, AA can reduce or prevent H₂O₂-induced lipid peroxidation and the formation of OH-deoxyguanosine (Yena *et al.*, 2002). Such effect of vitamin C can be reflected positively on growth and feed utilization.

Table (5): Efficacy of overdosing of vitamin C supplementation on feed conversion ratio of Japanese quail (g feed/g gain).

Period	Treatment				
	T0	T 1	T 2	T 3	T 4
0-7	1.8±0.1	1.9±0.23	1.9±0.17	1.9±0.15	1.8±0.12
0 -14	2.9±0.19	2.9±0.11	2.9±0.14	2.9±0.1	2.9±0.19
0-21	2.6 ^{ab} ±.04	2.4 ^{bc} ±0.14	2.2 ^c ±0.05	2.6 ^{ab} ±0.1	2.7 ^a ±0.03
0-28	2.4 ^{ab} ±0.01	2.3 ^b ±0.12	2.4 ^{ab} ±0.1	2.6 ^a ±0.13	2.4 ^{ab} ±0.03
0-35	3.2±0.21	3.1±0.1	3.3±0.22	3.5±0.17	3.3±0.17
0-42	4.3±0.26	3.9±0.03	4.1±0.18	4.2±0.11	3.9±0.13
0-49	4.3 ^{ab} ±0.11	4.12 ^b ±0.03	3.9 ^b ±0.18	4.5 ^a ±0.07	4.13 ^b ±0.12

a,b, means in the same rows with different superscripts are significantly different p<0.05). T0= control diet, T1=(65 mg of Vit. C/kg feed),T2=(130 mg of Vit. C/kg feed), T3=(260 mg of Vitt. C/kg feed),T4=(520 mg of Vit.. C/kg feed).

European production efficiency factor (EPEF) and European broiler index (EBI).

Date presented in Table (6), showed the Europe Production efficiency Factor (EPEF) and Europe Broiler Index (EPI) values of Japanese quail during the period from one day old to 49 days of age. The results of EPEF and EPI showed that the overdose of vitamin C supplementation didn't achieve the highest performance values of EPEF and EPI (10.7) and (1026.6) compared to the other doses of vitamin C and control chicks, respectively. However, the highest values of both EPEF and EPI were achieved by chicks fed 130 mg/kg of vitamin C. The values were 11.49 and 1107.6, respectively compared with the control.

If for instance a very low density is used during the grow-out period, the daily gain and with it the EBI will most likely go up, but the profit per square meter will go down, and the last one is economically of more interest.

If a low density, cheap feed is used, the daily growth and feed conversion might be negatively influenced, and with it the EBI, but the net profit per kg of meat might go up.

Carcass criteria:

The results of carcass traits as affected by vitamin C levels are presented in (Table 7).The results showed that there were no (P>0.05) significant differences due to vitamin C overdose on carcass weight, dressed%, blood weight, blood%, breast weight, breast%, thigh weight, thigh%, heart weight, heart%, liver weight and liver%. The obtained results are in agreement with that reported by Konca *et al.*, (2009) who found that dietary vitamin C supplementation did not improve carcass parts and edible

Table (6): Effect of treatments on European Production Efficiency Factor and European Broiler Index of Japanese quail.

T	R	Bw0	BW-49day(g)	BW-49day(kg)	T WG	ADG	FCR	Viability, %	EPEF	EBI
0	1	8.5	201.9 ^b	0.2019	193.4	3.95	4.3 ^{ab}	100	9.58	918.6 ^b
1	1	9.2	214.4 ^{ab}	0.2144	205.2	4.18	4.12 ^b	100	10.62	1014.5 ^a
2	1	7.8	219.7 ^a	0.2197	211.9	4.32	3.9 ^b	100	11.49	1107.6 ^a
3	1	8.4	200.7 ^b	0.2007	192.3	3.92	4.5 ^a	100	9.10	871.1 ^b
4	1	8.6	216.6 ^{ab}	0.2166	208	4.24	4.13 ^b	100	10.70	1026.6 ^a

EPEF= Europe Production efficiency Factor. EBI= Europe Broiler Index.
 Bw0=Body weight at one day old. TWG (Total weight gain, g). ADG=average daily gain during 49 days of age. Viability=100-%mortality

Table (7): Efficacy of different dietary levels of vitamin C on carcass traits.

Item	Treatment				
	T0	T 1	T 2	T 3	T 4
Live_BW,g	241.7±6.7	241.7±9.8	251.7±7.3	246.1±2	252.8±8.2
After bleed,g	235±6.6	234.4±9.3	245±7.3	238.3±2.5	245.6±7.7
BloodW,g	6.7±0.7	7.2±0.6	6.7±3.3	7.8±0.6	7.2±0.6
CarcassW,g	179.4±5.5	175±5.4	184.4±2	173.3±3.5	177.2±7.7
_carcass,%	74.3±1.9	72.5±0.7	73.4±1.8	70.4±0.8	70.1±0.8
_blood,%	2.8±0.4	2.9±0.2	2.7±0.1	3.2±0.2	2.9±0.1
BreastW,g	94.25±2.6	94.3±3.8	98.2±2.8	95.9±0.8	98.6±3.2
Breast_,%	39±2.9	39±2.9	39±2.9	39±0	39±4.1
ThighW,g	58±1.6	58±2.3	60.4±1.7	59.1±0.5	60.7±1.9
Thigh_,%	24±1.5	24±0	24±2.1	24±0	24±0
HeartW,g	2.4±0.1	2.4±0.1	2.5±0.1	2.5±0.02	2.5±0.1
Heart,_%	1±4.5	1±0	1±4.5	1±0	1±4.5
LiverW,g	7.3±0.2	7.3±0.3	7.6±0.2	7.4±0.1	7.6±0.2
Liver_,%	3±1.8	3±0	3±2.6	3±0	3±0

a,b, means in the same rows with different superscripts are significantly different $p < 0.05$. T0= control diet, T1=(65 mg of Vit. C/kg feed), T2=(130 mg of Vit. C/kg feed), T3=(260 mg of Vit. C/kg feed), T4=(520 mg of Vit. C/kg feed).

organs and abdominal fat yields. The current results are in agreement with Fletcher and Cason (1991) and Celik and Ozturkcan (2003), who found that ascorbic acid supplementation have no effect on carcass and abdominal fat. However, some studies suggested that dietary ascorbic acid supplementation increased carcass (Kutlu, 2001; Sahin *et al.*, 2003; Lohakare *et al.*, 2005), breast (Lohakare *et al.*, 2005), liver, heart, spleen and empty gizzard weight (Sahin *et al.*, 2003) and decreased abdominal fat pad (Kutlu, 2001; Sahin *et al.*, 2003).

Blood serum constituents:

The results of blood parameters biochemical constituents as affected by overdosing of vitamin C supplementation are presented in (Table 8). There were no significant ($P > 0.05$) differences due to vitamin C levels on the measured blood serum parameters. Some of the obtained results agree with several author such as Clegg *et al.* (1976) and McKee *et al.* (1997) who reported that dietary vitamin C supplementation did not affect blood cholesterol and plasma triglyceride (McKee *et al.*, 1997) in broilers and albumin, creatine and glucose (Seyrek *et al.*, 2004) in quails. On the contrary these findings the reduction of blood cholesterol (Kutlu and Forbes, 1993; Sahin *et al.*, 2003), triglyceride (Clegg *et al.*, 1976) and glucose (Kutlu and Forbes, 1993; Sahin *et al.*, 2003) concentrations by feeding ASA have been demonstrated in broilers and quails (Gursu *et al.*, 2004; Sahin *et al.*, 2002).

Table (8): Efficacy of overdosing of vitamin C supplementation on blood serum constituents of Japanese quail.

Item	Treatments				
	T0	T 1	T 2	T 3	T 4
SGOT (AST) (U/ml)	21.1 ^{ab} ±1.3	18.9 ^b ±0.8	41.6 ^a ±2.3	26.8 ^{ab} ±3.3	19.3 ^b ±1.3
SGPT (ALT)(U/ml)	14.5 ^b ±4	17.1 ^b ±2.4	20.4 ^a ±1.3	16.9 ^b ±1.1	15.0 ^b ±1.3
Total Protein (g/dl)	6.6 ^a ±0.2	1.3 ^{ab} ±0.4	3.6 ^b ±0.1	2.5 ^{ab} ±0.2	3.2 ^b ±0.3
Cholesterol (mg/dl)	199.0 ^b ±4.5	175.4 ^b ±7.3	347.8 ^a ±9.3	77.5 ^c ±4.3	121.6 ^b ±6.2
Glucose (mg/dl)	326.0±7.3	478.3±9.3	412.8±11	372.3±8	422.7±13
T. Calcium,%	11.5 ±0.3	13.5±0.6	10.7±0.4	11.8±0.2	10.7±0.3
T.Phosphorus,%	6.2 ^a ±0.2	6.2 ^a ±0.3	4.3 ^b ±0.4	6.1 ^a ±0.2	6.5 ^a ±0.3

a, b, means in the same rows with different superscripts are significantly different p<0.05).

T0= control diet, T1=(65 mg of Vit. C/kg feed), T2=(130 mg of Vit. C/kg feed), T3=(260 mg of Vit. C/kg feed), T4=(520 mg of Vit. C/kg feed).

Also, *sahin et al. (2003)* reported that dietary ASA supplementation increased serum protein in broilers. In the current study, dietary vitamin C supplementation caused a quadratic change in the AST and a linear and quadratic decrease in the serum ALT levels ($p<0.05$). The ALT catalyzes the transfer of an amino group from alanine to α -ketoglutarate, the products of this reversible transamination reaction being pyruvate and glutamate. It is used as a liver function test and elevated levels monitored liver malfunction (*Murray et al., 1990*). On the contrary to those results, *Sahin et al. (2002)* and *Gursu et al. (2004)* reported that dietary ASA did not affect serum ALT and AST levels in quails.

Current findings showed that feeding vitamin C at supra-nutritional levels can't be a good management practice in Japanese quail nutrition to promote growth performance traits under thermoneutral environmental conditions.

It has been suggested that vitamin C effectiveness on poultry performance expresses only in environmental stress condition whereas is not detectable under normal temperature conditions (*Newman and Leeson 1999; Saki et al. 2010*). Oxidative lesions, leading to conformational modifications of proteins, could induce pancreatic enzyme inhibition and/or dietary protein resistance to digestion (*Ahmadu et al. 2016*). Consequently, antioxidants, such as vitamin E and/or C, could contribute in preserving the proteins from oxidative denaturation improving digestibility of nutrients and their metabolic utilisation (*Panda et al. 2008; Ahmadu et al. 2016*). As already observed in previous study (*Sigolo et al. 2018*), under thermoneutral condition, vitamin C added at high doses (520 mg/kg) to quail diet seem to help in promoting a general animals' welfare which results in raised growth. Vitamin C is required for the proper development and function of many parts of the body. It also plays an important role in maintaining proper immune function. Vitamin C supplementation to non-stressed broilers at the first 21 days of life positively modulate the production performance.

Elagib-Hind and Omer (2012) reported that BW was improved by the low and moderate levels (150 and 350 mg/kg) of V.C compared with the higher level. Also, *SabahElkheir et al. (2008)* observed that V.C supplementation at higher doses (500 mg and 750 mg/kg) resulted in lower final weight and weight gain. Previous studies reported that V.C supplementation increased body gain (*Sahin and Kucuk, 2001*). On the other hand, others found that broiler feed intake was not affected by the V.C supplementation (*Blaha and Kroesna, 1997; Jaffar and Blaha, 1996*).

In general, results obtained suggested that additional vitamin C in quail diets had some beneficial effect on some of examined parameters such as crude fat of meat, colour of thigh in broiler chicks, but most of parameters did not influenced by the dietary vitamin C supplementation. However, there were a number of fundamental differences among reports, including the basal diets, genetic stocks used and environmental conditions of the experiments. Further experiments should need to be conducted to determine whether the effect of vitamin C at different conditions in quail.

In conclusion, although vitamin C added to quail diet recorded better findings compared to control, however, the overdose level of vitamin C are recommended particularly under stressful conditions.

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تأثير الجرعات العالية من اضافة فيتامين C علي معدل اداء النمو ومعامل كفاءة الانتاج الاوربي وصفات الذبيحة وبعض مكونات الدم في السمان الياباني

مصطفى محمد متولى¹ و محمد متولى احمد²

¹مركز البحوث الزراعية-معهد بحوث الانتاج الحيواني -الجيزة- مصر.

²قسم انتاج الدواجن - كلية الزراعة - جامعة اسيوط - اسيوط- مصر.

صممت التجربة لدراسة فاعلية الجرعات العالية من فيتامين C المضاف على معدل النمو ، ومقاييس الذبيحة وبعض مكونات الدم في السمان الياباني في تجربة احصائية احادية العامل واستمرت التجربة لمدة 49 يوماً .. تم استخدام مانتين وخمسة وعشرين كتكوت من كتاكيت السمان الياباني. وزعت الكتاكيت على 5 معاملات لكل منها 3 مكررات كل منها 15 طائرا. تم استخدام خمسة مستويات من فيتامين C المضاف (0 ، 65 ، 130 ، 260 ، و 520مجم / كجم عليقة). تم تسجيل وزن الجسم وكمية العلف المستهلكة أسبوعياً وبالتالي تم حساب زيادة وزن الجسم ونسبة التحويل الغذائي.وفي نهاية التجربة تم ذبح ثلاثة طيور من كل مجموعة لتقييم أجزاء الذبيحة. وتم الحصول على عينات سيرم الدم من الكتاكيت عند عمر 49 يوم وبعد الطرد المركزي واخذ سيرم الدم تم قياس البروتين الكلي والكوليسترول والجلوكوز والكالسيوم والفوسفور و ال GPT.

أظهرت النتائج أنه عند عمر 49 يوم ، ان طيور السمان التي تغذت على 130 مجم فيتامين C/كجم عليقة حققت معنوياً ($P < 0.05$) أعلى وزن للجسم و اعلى زيادة في وزن الجسم وكذلك افضل نسبة تحويل غذائي. وان اضافة فيتامين C لم يؤثر معنوياً على % للذبيحة وبعض مكونات الدم التي تم قياسها وان كان يوجد تحسن طفيف غير معنوي..

نوصي بأن يتم اضافة فيتامين C بمعدل 130 مجم / كجم عليقة نظرا لما حققه من معدل نمو عالى وكذلك تحسن غير معنوي لبعض صفات الذبيحة للسمان الياباني.