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Research Article

EFFECT OF INDIVIDUAL AND COMBINATION ADDITION OF L – CARNITINE AND DL – METHIONINE TO DIET ON BLOOD PARAMETERS FOR QUAIL (COTURNIX)

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Abstract

In this study, 960 birds from quail was conducted to determine the effects of different levels of L-Carnitine and methionine on quail in a completely randomized experimental design with 16 treatments and 3 replicates in 48 penand contain 20 birds with three levels of L - Carnitine (100, 200 and 300 mg/kg) and three levels of methionine (115, 130 and 145 NRC %) and control group. At 42 d, 2 chickens from each replicate were randomly taken for measurements of Total Protein (TP), Glucose (GLU), Cholesterol (CHOL), Albumin (Alb), Aspartate Aminotransferase (AST), Alanine Aminotransferase (ALT) and Alkaline Phosphatase (ALP). There was a significant superiority ($P \leq 0.05$) in the concentration of total protein, albumin and globulin in male and female quail serum in the addition of 300 mg/kg carnitine alone, 145 % methionine addition and 300 mg/kg carnitine supplementation and 145 % methionine, and the results showed significant superiority ($P \leq 0.05$). In the treatment of non-addition in the concentration of cholesterol in the serum of males and females compared to the treatment of addition of carnitine 300 mg/kg feed. There was a significant superiority ($P \leq 0.05$) in the treatment of non-addition of methionine compared with the treatment of addition of methionine by 145 % in the serum of males, while the opposite occurred in female serum. There was no significant difference between the addition of carnitine and methionine in the concentration of cholesterol, glucose, ALP, AST and ALT in the serum of males and females. We concluded from this study that the addition of carnitine and amino acid methionine individually and synergistically improved some of the physiological traits of male and female quail.

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1. Introduction

In the recent years, another study in feed additive was carried out using L-carnitine in the feeding of poultry (Arslan, 2006). The major metabolic role of L-carnitine appears to be the transport of long-chain fatty acids from cytoplasm into themitochondria for β-oxidation (Borum, 1983). Lien and Horng (2001) reported that the supplementary L-carnitine at the level of 160 mg/kg of diet were significantly lowered serum cholesterol, glucose and AST activity compared to the control group. Thiemel and Jelinek (2004) found that biochemical examination of the samples of blood plasma collected from the experimental layers after the administration of L-

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carnitine at a dose of 30 mg per kg of feeding mixture lower levels of cholesterol, glucose and AST as compared to the control. The bioavailability of L-carnitine varies due to dietary composition but since it can be biosynthesized endogenously from methionine and lysine, these two amino acids are usually the more important limiting amino acids in poultry nutrition. Methionine and lysine are frequently supplemented in the formulated diets. Previous studies showed that methionine supplement during the early stages of chicken growth causes significant improvement in hematocrit, red blood cell count and related parameters (Taraz and Dastar, 2008). The objective of this study was to evaluate the effects of different levels of L-carnitine and DL- methionine on the biochemical parameters of male and female quails.

2. Materials and Methods

The main aim of the present paper was to assess the effect of continuously administered feeding mixture supplemented with L - carnitine and DL - methionine on metabolic profile of blood in quails. Nine hundred sixty one day old unsexed chicks at weight 8.20 g were used in this experiment, the chicks were randomly distributed into sixteen treatments groups. Each group was divided into three replicates with 20 birds per one. Upon the arrival of the birds to the age of 42 days, according to the dietary L - carnitine (L - Carnitine Xtreme 60 ct, Dymatize Nutrition Company, USA) and DL – Methionine (DL - methionine 99 % PO AMNHO - China) supplementation for 6 weeks with three levels of L - Carnitine (100, 200 and 300 mg/kg) and three levels of methionine (115, 130 and 145 NRC %) and control group. Food and water were provided *ad libitum* and the diets were presented in mash form. They were formulated to be isocaloric and isonitrogenous and their composition were determined according to the NRC (1994) and the composition of the basal diet is presented in Table - 1.

The experiment was started with quails aged one day old; the quails were examined regularly after six weeks. The examinations included biochemical tests of blood. Blood samples for biochemical examination were collected from all quails at 8 a.m after six weeks. Blood samples were collected from the wing vein into sterile tubes without anticoagulant and after clotting at room temperature for 4 hours, they were centrifuged at 3000 g for 10 min. Thereafter, sera were carefully harvested and stored at –20 ºC until determination of biochemical parameters. The blood serum of quails was analyzed for the following organic substances; total protein, albumin, globulin, glucose, cholesterol, AST, ALT and ALP. The above mentioned biochemical parameters of blood serum were determined photo metrically by commercially available testing kits (Atlas Medical/UK, Biolab/France Rando/UK, Biomerieux/France). The data obtained from the experiment were analyzed statistically using the general linear model (GLM) procedure in the statistical software SPSS (2012).

Table - 1: Percentage of ingredient and calculated chemical analysis of experimental basal diet

Ingredients	**(%)**	**Calculated Chemical composition****	
Wheat	11.5	Energy (kcal/kg)	3049
Yellow corn	49	Crud Protein (%)	22.262
Soya bean meal (48 %)	31.2	Calcium (%)	0.8
concentration protein *	5.3	Methionine (%)	0.50
Limestone	1.4	Available Phosphorus (%)	0.58
Vegetable oil	1.6		
Total	100		

*Concentration protein (Wafi) each 1 kg of vit. and min. premix (imported from Holland) contains: 40 % Crud protein; 5 % Crud fat; 2.20 % Crud fiber; 4.20 % Calcium; 4.68 % Available phosphorus; 2.50 % sodium; 3.70 % methionine; 3.70 % methionine + cysteine; 4.12 % Lysine; 2107 kcal/kg metabolic energy; 200000 IU Vit A; 80000 IU Vit.D3; 600mg Vit.E; 50 mg Vit.K3; 60 mg Vit B1;140 B2; 80 mg Vit B6; 700 mg Vit.B12; 20 mg Folic acid; 50 mg Biotin; 1.200 mg Zinc; 200 mg Copper; 20 mg Iodine; 1.000 mg Iron; 5 mg Selenium; 1.600 mg Manganese; 7.000 mg Choline chloride; 320 mg Pantothenic acid and niacin 800 mg.
**Calculated Chemical composition analysis adopted by NRC (1994).

3. Results

Total protein concentration and Albumin

The Table - 2 showed a significant effect ($P \leq 0.05$) to add carnitine in the total protein concentration in serum birds. The highest total protein in male and female serum 5.80 and 5.81 g/100 ml blood, respectively was recorded in the supplementation treatment (300 mg/kg carnitine), while the lowest total protein was recorded in serum of males and females 4.28 and 4.24 g/100 ml blood, respectively in the non-addition treatment. Also this table showed a significant effect ($P \leq 0.05$) to add methionine in the total protein concentration in the serum of birds. The highest rate 5.20 and 5.31 g/100 ml in male and female serum respectively was recorded in the treatment of addition 145 % methionine, while the lowest rate 4.63 and 4.57 g/ 100 ml in male and female serum in a non-additive treatment. The analysis of variance indicates a significant overlap ($P \leq 0.05$) for the effect of addition of carnitine and methionine. The males and females fed under the influence of addition (300 mg/kg carnitine and 145 % methionine) recorded the highest rate 6.01 and 5.93 g/100 ml respectively, while the treatment of non-addition of carnitine and methionine was the lowest rate 4.16 and 4.06 g/100 ml for males and females, respectively. Table - 2 showed a significant effect ($P \leq 0.05$) to add carnitine in this trait and recorded the highest rate of albumin concentration in male and female serum under the influence of the addition of 300 mg/kg carnitine 2.67 and 2.64 g/ 100 ml blood respectively, while the lowest rate 1.63 and 1.59 g/100 ml was recorded in the blood of male and female quail fed on diets not added to the carnitine. This table showed a significant effect ($P \leq 0.05$) to add 145 % methionine to albumin concentrationand the highest rate 2.25 and 2.28 g/100 ml in male and female serum, respectively, While the lowest rate 1.87 and 1.83 g/100 ml in the serum of males and females respectively, in the treatment of non-addition. The analysis of variance indicates significant overlap ($P \leq 0.05$) for the effect of addition of carnitine and methionine in albumin level in serum for quail birds, males and females fed under the influence of 300 mg/kg carnitine and 145 % methionine were highest 2.66 and 2.74 g/100 ml in male and female serum, respectively.

Globulin concentration

The Table - 3 showed a significant effect ($P \leq 0.05$) for the addition of carnitine in this trait for males and females, respectively. The added treatment (300 mg/kg feed) was recorded highest rates 3.14 and 3.17 g/100 ml in both male and female serum, respectively while the lowest rate was recorded in non-treatment (2.65 and 2.65 g/100 ml) male and female blood respectively. This table showed a significant effect ($P \leq 0.05$) to add methionine to male and female quail diets on the concentration of serum globulin. The addition of 145 % methionine was highest (2.94 and 3.02 g/100 ml) in male and female serum, respectively, While the non-addition of methionine was the lowest rates with 2.75 and 2.74 g/100 ml serum of male and female respectively. The analysis of variance indicates a significant overlap ($P \leq 0.05$) for the effect of the synergistic addition of carnitine and methionine in the level of male and female serum globulin. Birds fed under 300 mg/kg carnitine and 145 % methionine was highest rates (3.26 and 3.25 g/100 ml) in serum of male and female birds, respectively.

Table - 2: Effect of addition of carnitine and methionine in some biochemical traits in male and female quail serum at age 42 days (mean ± standard deviation)

Period (week)	Carnitine / Methionine	Control	115 %	130 %	145 %	Mean of carnitine
Total protein conc. Male (gm100/ ml)	Control	4.16 ± 0.05	4.20±0.04	4.33±0.18	4.44±0.29	4.28 D ±0.19
	100 mg/kg	4.23 ± 0.28	4.46±0.20	4.65±0.12	4.87±0.08	4.55 C ±0.29
	200 mg/kg	4.69±0.06	4.87±0.08	5.22±0.22	5.48±0.01	5.06 B ±0.34
	300 mg/kg	5.43±0.16	5.80±0.07	5.96±0.06	6.01±0.08	5.80 A ±0.25
	Mean of Methionine	4.63 D ±0.55	4.83 C ±0.64	5.04 B ±0.66	5.2 A ±0.64	LSD 0.43**
Total protein conc. Female (gm100/ ml)	Control	4.06 ± 0.17	4.16 ± 0.05	4.07 ± 0.06	4.69 ±0.06	4.24 D ± 0.28
	100 mg/kg	4.08 ± 0.17	4.12 ± 0.11	4.79 ± 0.23	4.75 ± 0.15	4.43 C ± 0.38
	200 mg/kg	4.65 ± 0.12	4.83 ± 0.42	4.93 ± 0.42	5.88 ± 0.14	5.07 B ± 0.57
	300 mg/kg	5.52 ± 0.18	5.88 ± 0.14	5.91 ± 0.16	5.93 ± 0.09	5.81 A ± 0.22
	Mean of Methionine	4.57 D ±0.64	4.75 C ±0.77	4.93 B ± 0.73	5.31 A ± 0.63	LSD 0.362**
Albumin conc. Male (gm100/ ml)	Control	1.51 ± 0.02	1.56 ± 0.03	1.67 ± 0.17	0.77 ± 0.17	1.63 C ±0.15
	100 mg/kg	1.63 ± 0.20	1.73 ± 0.12	1.87 ± 0.13	2.02 ± 0.15	1.81 C ±0.20
	200 mg/kg	1.87 ± 0.01	2.02 ± 0.01	2.34 ± 0.16	2.48 ± 0.10	2.18 B ±0.26
	300 mg/kg	2.48 ± 0.09	2.69 ± 0.08	2.74 ± 0.02	2.74 ± 0.02	2.67 A ±0.13
	Mean of methionine	1.87 C ±0.40	2.00 B ±0.46	2.16 A ±0.45	2.25 A ±0.41	LSD 0.32**
Albumin conc. Female (gm100/ ml)	Control	1.50 ± 0.09	1.51 ± 0.02	1.49 ± 0.02	1.87 ± 0.01	1.59 D ± 0.17
	100 mg/kg	1.50 ± 0.09	1.58 ± 0.02	2.06 ± 0.17	1.94 ± 0.14	1.77 C ± 0.27
	200 mg/kg	1.82 ± 0.05	2.01 ± 0.36	2.16 ± 0.29	2.66 ± 2.07	2.16 B ± 0.38
	300 mg/kg	2.50 ± 0.09	2.66 ± 0.07	2.74 ± 0.02	2.66 ± 0.09	2.64 A ± 0.11
	Mean of methionine	1.83 D ± 0.43	1.94 C ± 0.51	2.11 B ± 0.48	2.28 A ± 0.40	LSD 0.28**

*Different letters vertically and horizontally mean that there are significant differences at the level ($P \leq 0.05$).
** LSD for the interfering between carnitine and methionine.

Table - 3: Effect of addition of carnitine and methionine in some biochemical traits in male and female quail serum at age 42 days (mean ± standard deviation)

Period (week)	Carnitine / Methionine	Control	115 %	130 %	145 %	Mean of carnitine
Globulin conc. Male (gm100/ ml)	Control	2.60 ± 0.09	2.64±0.03	2.66±0.02	2.67±0.13	2.65 D ±0.06
	100 mg/kg	2.65 ± 0.07	2.73±0.10	2.78±0.04	2.84±0.12	2.74 C ±0.12
	200 mg/kg	2.82±0.07	2.85±0.08	2.88±0.06	3.00±0.10	2.89 B ±0.10
	300 mg/kg	2.95±0.07	3.11±0.02	3.22±0.04	3.26±0.06	3.14 A ±0.13
	Mean of methionine	2.75 C ±0.16	2.83 B ±0.19	2.88 A B ±0.22	2.94 A ±0.25	LSD 0.14**
Globulin conc. Female (gm100/ ml)	Control	2.56 ± 0.10	2.65 ± 0.07	2.58 ± 0.06	2.82 ±0.07	2.65 C ± 0.12
	100 mg/kg	2.56 ± 0.10	2.54 ± 0.09	2.73 ± 0.08	2.81 ± 0.05	2.66 C ± 0.14
	200 mg/kg	2.82 ± 0.08	2.83 ± 0.14	2.77 ± 0.14	3.22 ± 0.11	2.91 B ± 0.21
	300 mg/kg	3.01 ± 0.11	3.22 ± 0.11	3.19 ± 0.09	3.25 ± 0.06	3.17 A ± 0.13
	Mean of methionine	2.74 B ±0.22	2.81 AB ±0.28	2.82 AB ± 0.25	3.02 A ± 0.23	LSD 0.46**

* Different letters vertically and horizontally mean that there are significant differences at the level ($P \leq 0.05$).
** LSD for the interfering between carnitine and methionine.

Cholesterol and Glucose concentration

The Table - 4 showed a significant effect ($P \leq 0.05$) to add carnitine in bird diets. The birds fed on diets not added to the carnitine recorded the highest rates (182.66 and 186.74 mg/100 ml) of male and female blood, respectively. Birds fed on diets added 300 mg/kg carnitine, recorded the lowest rates (158.69 and 161.32 mg/ 100 ml) in male and female blood serum. This table showed a significant effect ($P \leq 0.05$) to add methionine to bird diets. Males fed on diets that did not add methionine had the highest rates of 177.32 mg/100 ml in serum, while males fed on diets added methionine (145 %) had the lowest rates (166.37 mg/100 ml) in serum. For females fed on diets, methionine (145 %) was the highest rates (179.58 mg/100 serum), while females fed on diets with no methionine added the lowest rates (171.93 mg/100) in serum. The analysis of variance (4) showed no significant overlap between the addition of carnitine and methionine in the concentration of cholesterol in the serum of males and females of quail. Table - 4 indicates the effect of addition of carnitine and methionine on the concentration of glucose for the male and female quail blood at age 42 days. The absence of significant effect of the addition of carnitine in the concentration of glucose in male and female serum. The Table 4 showed no significant effect of the addition of methionine on the concentration of glucose in male and female serum. There was significant overlap in the addition of carnitine and methionine in quail diets in the concentration of glucose in male and female serum.

ALP, ALT and AST concentration

The Table - 5 showed no significant effect of adding carnitine and methionine and their overlap in enzyme concentration ALP, ALT and AST concentration in both male and female serum.

Table - 4: Effect of addition of carnitine and methionine in cholesterol and glucose in male and female quail serum at age 42 days (mean ± standard deviation)

Period (week)	Carnitine / Methionine	Control	115 %	130 %	145 %	Mean of carnitine
Cholestrol conc. Male (gm100/ ml)	Control	185.61 ± 1.55	185.33±2.23	181.67±5.49	178.01±1.70	182.66 ^{A} ±4.22
	100 mg/kg	182.06 ± 4.25	174.75±2.43	175.04±1.67	173.21±1.98	176.26 ^{A} ±4.28
	200 mg/kg	175.35±1.70	167.52±6.33	169.60±3.72	164.66±1.98	169.28 ^{B} ±5.27
	300 mg/kg	166.26±4.98	163.86±2.96	156.11±4.04	149.59±1.32	158.69 ^{C} ±7.52
	Mean of methionine	177.32 ^{A} ±8.25	172.86 ^{B} ±9.17	170.60 ^{C} ±10.38	166.37 ^{D} ±11.38	N.S
Cholestrol conc. Female (gm100/ ml)	Control	184.07 ± 4.19	188.21±2.78	190.04±4.08	184.67±0.83	186.74 ^{A} ±3.80
	100 mg/kg	178.70 ± 2.26	185.69±2.06	182.96±2.32	178.62±1.37	181.49 ^{B} ±3.58
	200 mg/kg	173.17±2.64	169.54±3.62	178.82±3.07	169.43±3.71	172.74 ^{C} ±4.87
	300 mg/kg	157.28±2.94	166.49±6.00	166.50±3.20	155.01±1.58	161.32 ^{D} ±6.35
	Mean of methionine	171.93 ^{D} ±11.82	173.30 ^{C} ±10.79	177.48 ^{B} ±10.54	179.58 ^{A} ±9.35	N.S
Glocose conc. Male (gm100/ ml)	Control	175.96 ± 2.07	176.41 ± 5.07	182.88 ± 9.70	180.21 ± 8.84	178.87 ±6.75
	100 mg/kg	176.48 ± 5.52	181.65 ± 7.61	180.80 ± 9.49	178.95 ± 8.46	179.47 ±7.05
	200 mg/kg	180.30 ± 7.06	177.53 ± 2.30	181.38 ± 11.54	174.16 ± 15.48	178.34 ±9.29
	300 mg/kg	178.69 ± 4.39	181.43 ± 8.72	178.54 ± 7.43	180.58 ± 7.69	179.81 ±6.30
	Mean of methionine	177.86 ±4.71	179.26 ±5.99	180.9 ±8.39	178.48 ±9.42	N.S
Glocose conc. Female (gm100/ ml)	Control	176.48 ± 8.43	182.66 ± 10.64	179.14 ± 3.09	176.27 ± 4.95	178.64 ±6.85
	100 mg/kg	178.88 ± 9.95	169.36 ± 4.72	182.68 ± 8.91	178.45 ± 15.76	177.34 ±10.38
	200 mg/kg	184.96 ± 1.98	174.03 ± 7.76	184.63 ± 7.61	179.78 ± 8.55	173.88 ±4.91
	300 mg/kg	178.5 ± 17.88	177.94 ± 2.34	174.74 ± 3.37	176.27 ± 8.36	178.55 ±7.37
	Mean of methionine	178.55 ±7.37	176.14 ±10.98	181.1 ±5.96	176.24 ±8.77	N.S

Table - 5: Effect of addition of carnitine and methionine in ALP concentration in male &female and ALT & AST concentration in male quail serum at age 42 days (mean ± standard deviation)

Period (week)	Carnitine / Methionine	Control	115 %	130 %	145 %	Mean of Carnitine
ALP conc. Male (Unit Armstrong)	Control	12.25 ± 1.43	13.91±0.98	13.38±1.17	13.33±1.19	13.22±1.21
	100 mg/kg	13.04 ± 0.72	13.43±1.49	13.32±0.91	12.99±0.94	13.19±0.92
	200 mg/kg	13.76±1.18	13.36±1.12	12.65±0.38	13.17±1.34	13.23±1.00
	300 mg/kg	12.87±1.05	13.58±0.68	12.70±0.90	13.13±1.54	13.07±0.99
	Mean of methionine	12.98 ±1.11	13.57 ±0.97	13.01±0.84	13.15±1.09	N.S
ALP conc. Female (Unit Armstrong)	Control	12.47 ± 2.07	13.20±0.57	13.37±1.35	12.52±1.04	12.89±1.24
	100 mg/kg	12.73 ± 1.27	13.83±1.12	12.81±0.84	13.46±0.55	13.21±0.97
	200 mg/kg	12.53±1.41	12.56±1.38	12.66±1.20	12.97±1.58	12.68±1.20
	300 mg/kg	12.68±1.15	12.97±1.11	12.92±1.30	13.01±1.29	12.90±1.04
	Mean of methionine	12.60 ±1.30	13.14 ±1.04	12.94±1.05	12.99±1.06	N.S
ALT conc. enzyme in male serum (IU / L)	Control	220.67 ± 4.51	219.67 ± 8.33	223.67 ± 6.51	218.33 ± 7.77	220.58 ±6.26
	100 mg/kg	217.67 ± 6.66	217.33 ± 6.43	219.00 ± 8.54	216.09 ± 8.19	217.50 ±6.50
	200 mg/kg	220.67 ± 12.50	217.33 ± 10.02	215.00 ± 11.00	208.67 ± 9.61	215.42 ±10.32
	300 mg/kg	216.00 ± 10.44	219.67 ± 9.50	218.66 ± 13.43	220.67 ± 9.60	218.75 ±9.44
	Mean of methionine	218.75 ±8.02	218.50 ±7.50	219.08 ±9.28	215.92 ±8.88	N.S
AST Conc. enzyme in male serum (IU / L)	Control	18.30 ± 0.79	17.40 ± 0.65	18.73 ± 0.35	17.80 ± 0.62	18.06 ±0.75
	100 mg/kg	18.53 ± 0.57	18.20 ± 1.06	18.53 ± 0.91	17.87 ± 2.01	18.28 ±1.11
	200 mg/kg	18.14 ± 1.26	18.33 ± 0.95	18.31 ± 1.25	18.60 ± 1.64	18.35 ±1.12
	300 mg/kg	17.93 ± 1.31	18.23 ± 1.77	17.97 ± 0.21	18.57 ± 1.23	18.18 ±1.11
	Mean of methionine	18.23 ±0.91	18.04 ±1.08	18.39 ±0.74	18.21 ±1.31	N.S

*Different letters vertically and horizontally mean that there are significant differences at the level ($P \leq 0.05$).
** LSD for the interfering between carnitine and methionine.

4. Discussion

Table – 2 showed a significant effect ($P \leq 0.05$) to add carnitine in the total protein concentration in serum birds.This finding was agreed with the findings of Al-hyani (2012), which indicated that the total protein concentration tends to highest in the serum of guinea-fowl chickens fed on a diet supplemented with carnitine (300 mg /kg) feed compared to those fed on standard diets. There is a positive correlation between total protein concentration in serum and body weight, which is a good indicatorof body weight gain, and health status of birds (Jatoi *et al*., 2013). This tableshowed a significant effect ($P \leq 0.05$) to add methionine in the total protein concentration in the serum of birds.the result of this study was different with what found Yunus (2014). He pointed out that the use of methionine in quail diets does not play a role in raising the total protein concentration in the serum of birds. The reason for the increase in total protein concentration in this study can be attributed to the increase in essential amino acids consumed by birds as a result of their consumption of feed in larger quantities. This may be due to higher bird weights because of a positive correlation coefficient between live body weight and total serum protein (Krupakaran, 2013). The analysis of variance indicates a significant overlap ($P \leq 0.05$) for the effect of addition of carnitine and methionine.

The increase in total protein values in the serum of fowl-fed birds in diets added to both carnitine and methionine may be due to the higher live weight of these birds. There is a positive correlation coefficient between the two live weight and total protein of the blood serum (Krupakaran, 2013).The table showed a significant effect ($P \leq 0.05$) to add carnitine in this trait and recorded the highest rate of albumin concentration in male and female serumunder the influence of the addition of 300 mg/kg carnitine. This result differed with the results indicated by Tufan *et al*. (2015) who did not notice any significant effect in the albumin concentration in Japanese quail serum when adding carnitine with 150 mg/kg feed. The reason for the high concentration of albumin in the serum in this study may be due to the role of carnitine in raising the concentration of albumin in the serum of birds through its effect on the increase in weight gain and thus increase weight.

The Table - 2 shows a significant effect ($P \leq 0.05$) to add methionine to albumin concentration in male and female serum for quail. The results of this study were agreed with what Mustafa and Saber (2011) who referred to the use of methionine by 5 mg/0.1 ml distilled water led to an increase in the level of albumin in the serum of broiler. Table - 3 showed a significant effect ($P \leq 0.05$) of adding 300 mg/ kg feed carnitine to the level of serum globulin in the blood for male and female quail bird. These results were agreed with the findings of Abdel-Fattah *et al*. (2014), who noted that the use of carnitine in the diets of quail (200 and 400 mg/kg) feed has a role in raising the level of globulin in the serum of these birds. The reason may be due to the beneficial effect of carnitine in balancing essential amino acids as well as the role of carnitine in the production of immunoglobulin, particularly IgG, and thus elevate the level of serum globulin (Sarica *et al*., 2005). This table showed a significant effect ($P \leq 0.05$) to add 145 % methionine to male and female quail diets on the concentration of serum globulin.The results of this study were agreedwith the results obtained by Mustafa and Saber (2011) who found a significant increase in the level of globulin when adding methionine by 5 mg/0.1 ml distilled water in the eggs of the broiler. This may be due to increased numbers of lymphocytes, as lymphocytes are responsible for the manufacture of the protein of the globulin (North, 1984). The analysis of variance indicates a significant overlap ($P \leq 0.05$) for the effect of the synergistic addition of 300 mg/kg carnitine and 145 % methionine. In the (Table - 4) birds fed on diets not added to the carnitine recorded the highest rates, whereas birds fed on diets added 300 mg/kg carnitine, recorded the lowest rates.These results were agreed with the findings of Daraji and Hayani (2012) who pointed out decreased concentration of cholesterol in the blood serum of guinea chicken, which was added to its carnitine by 300 mg/kg feed.

The decrease in serum cholesterol concentration in birds fed on diets supplemented by carnitine can be attributed to the importance of carnitine in the oxidation of fatty acids and energy metabolism (Sigma, 2004). And the addition of carnitine to the diets leads to increased secretions of the pituitary gland of growth hormone and thyroid hormone (Thyroxin) T4 (Buyse *et al*., 2001). In this table, males fed on diets that did not add methionine had the highest rateswhile males fed on diets added methionine (145 %) had the lowest rates. For females fed on diets, methionine (145 %) was the highest rates, whereas females fed on diets with no methionine added the lowest rates. The results of the present study were agreed with the results of Kauomars *et al*. (2011), which found a significant difference in the concentration of cholesterol in the female serum, which added methionine (200 mg/kg feed). The reason for high cholesterol in female serum start phase of the production of eggs at this stage raises the level of cholesterol in blood serum for use in the formation of the contents of the egg, which introduces cholesterol as an important element in the formation.

The analysis of variance (4) showed no significant overlap between the addition of carnitine and methionine in the concentration of cholesterol in the serum of males and females of quail. The results differed with Saeid *et al*. (2014), which indicated a significant difference in the concentration of serum cholesterol in the addition of carnitine (0 mg/kg carnitine and 85 % methionine in female broiler diets), possibly due to different experimental conditions in terms of dose and bird type. In this table, the absence of significant effect of the addition of carnitine in the concentration of glucose in male and female serum. The results of the current study were agreed with the results obtained by Arslan *et al*. (2003), who indicated that the use of carnitine (200 mg/kg) drinking water for ducks had no significant effect on glucose concentration. The results of the present study did not agree with the results obtained by Al-Hayani (2012), which found a significant decrease in serum glucose concentration when adding carnitine by 300 mg/kg feed in guinea fowl diets which was attributed to the use of carnitine in birds diets Increase concentration of insulin-like growth factor (I - factor growth Like - Insulin) I - IGF in blood plasma (Kita *et al*., 2002). The results of the study were agreed with the results obtained by Yunis (2014), which indicated that there was no significant effect of the addition of methionine in Japanese quail diets. Table - 5 showed no significant effect of adding carnitine and methionine and their overlap in enzyme concentration ALP in both male and female serum. The results of this study were agreed with the results obtained by Yalcın *et al*. (2008) who indicated that there was no significant effect of adding carnitine by 200 mg/kg feed in Japanese quail diets. Table - 5 showed the effect of adding carnitine and methionine to the concentration of ALT and AST in the serum of male feces at age 42 days. The table showed no significant effect of addition of carnitine and methionine in the serum ALT and AST concentrations. The results were agreed with Yunis (2014) that adding carnitine and methionine in quail diets did not have a significant effect on the concentration of these two enzymes.

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