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

R. K. Mosa, J. M. Jassim and B. A. H. Al-Sereah*
Animal Resources Department, College of Agriculture, University of Basra, Basra, Iraq.

Abstract

Experiment 960 was a non-naturalized chick at 1 day old. The treatments were distributed as follows: 1) Control, 2) Carnitine 100 mg/kg feed with addition of methionine (115, 130, 145 %), 3) Carnitine 200 mg/kg feed with addition of methionine (115, 130, 145 %) and 4) Carnitine 300 mg/kg feed with the addition of methionine (115, 130, 145 %). The results of the study showed that there was a significant superiority (P≤0.05) in the live of body weight at age (2, 4 and 6) weeks and the increase in weight and the amount of feed intake weekly and cumulative for periods (1 - 2, 3 - 4 and 5 - 6) a week in the treatment of adding 300 mg/kg carnitine feed compared with non-addition and other experimental treatments. Also significantly higher (P≤0.05) was the treatment of quail fed on a diet supplemented with 145 % methionine in the same traits and same ages as those fed on standard NRC diets throughout the trial period. A significant effect (P≤0.05) was found to interfere with the addition of 300 mg/kg carnitine and 145 % methionine in these traits throughout the study period. There was a significant improvement (P≤0.05) in the weekly and cumulative feed conversion ratio for periods (1-2, 3-4, 5-6) for a week of birds treated with the addition of 300 mg/kg carnitine throughout the experiment period compared to non-additive treatment and other experimental treatments showed a significant decrease (P≤0.05) in dietary conversion ratio in the addition of methionine by 145 % and for all studied periods compared with those fed on standard NRC diets which gave the best results. Significant effect (P≤0.05) and for all periods in this trait throughout the study period.

Key words: Carnitine, Methionine, Productive traits and Quail.

1. Introduction

The body weight and weight gain are important traits in the poultry industry, which reflect the success of production projects, and the use of carnitine and methionine in bird diets the results of the studies showed that the feeding of Japanese quail birds on carnitine diets had a significant effect (P≤0.05) in the weight of birds fed on diets with carnitine supplemented with (300 mg/kg feed) compared to those fed to the control group at age (22 - 42 days). While no significant effect was achieved in the rate of weight gain of that addition in broiler chicks at the age of (1 - 22 days) (Parsaeimehr *et al*., 2014). In a study conducted by Abdel-Samia *et al*. (2014), the mean weight of the live body was not affected, and the increase in weight gain was increased by the levels

***Corresponding author*: B.A.H. Al-Sereah**
Animal Resource Department, College of Agriculture, University of Basra, Basra, Iraq.
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of added methionine (0.40 and 0.50 %), protein (20 and 22 %) and folic acid (1.7 and 3.4 mg/kg). For a period of 42, the calculation of the amount of feed consumed is an important economic measure in estimating the cost of education, which accounts for about 70 – 60 % of the total cost (Nagy *et al*., 2007). While the feed conversion ratio reflects the extent to which birds benefit from feed and turn it into meat production or egg production. The effect of the use of carnitine and methionine in bird diets has showed many studies of variation in feed intake by birds and improved feed conversion ratio.

2. Materials and Methods

Experimental design

In the experiment, 960 one-day rats and an initial weight of 8.20 g were randomly distributed in 16 treatments with three replicates per treatment, each of which contained 20 chicks until the arrival of birds to the age of 42 days. The transactions were distributed as follows: 1) Control, 2) Carnitine 100 mg/kg feed with the addition of methionine (115, 130, 145 %), 3) Carnitine 200 mg/kg feed with the addition of methionine (115, 130, 145 %) and 4) Carnitine 300 mg/kg feed with the addition of methionine (115, 130, 145 %). Feeding birds during the period 1 - 42 days on a diet grower diet containing 22.26 % crude protein and 3049 kcal/kg of energy represented.

Production traits

Production traits were final body weight, feed intake and weight gain and feed conversion ratio. All traits were measured in this study at 2, 4 and 6 weeks.

Statistical analysis

The data obtained from the experiment were analyzed statistically using the general linear model (GLM) procedure in the statistical software SPSS (2012).

3. Results

The Table - 2 showed a significant effect ($P \leq 0.05$) to add carnitine in the live body weight of quail birds in different treatments. The treatment of birds fed on a diet supplemented with 300 mg/kg carnitine. This table showed a significant effect ($P \leq 0.05$) to add (145 %) methionine to the live body weight of quail birds in different treatments and for all ages. There was a significant effect ($P \leq 0.05$) on the interaction between the addition of carnitine and methionine in the diet to the live weight of the quail birds at ages (2.4 and 6 weeks). The addition treatment (300 mg/kg carnitine and 145 % methionine. The Table - 3 showed that there is a significant superiority ($P \leq 0.05$) in the weight gain of birds in addition to 300 mg/kg carnitine on the other treatments for periods (1 - 2), (3 - 4) and (5 - 6) week and cumulative. The results of the table showed a significant superiority ($P \leq 0.05$) in the mean weight gain of treated birds fed on added diets (145 %) methionine. The table showed a significant effect ($P \leq 0.05$) between the addition of carnitine and methionine in a synergistic manner to the diet on the weight gain rates for periods (1 - 2), (3 - 4) and (5 - 6) weeks and cumulative weight gain. Table - 4 showed a significant effect ($P \leq 0.05$) to add carnitine (300 mg/kg) on feed consumption rates for periods (1 - 2), (3 - 4), (5 - 6) week and cumulative feed intake of (1 - 6) weeks. The table showed a significant superiority ($P \leq 0.05$) for the group of birds added to their methionine (145 %) with the highest feed intake. The addition treatment (300 mg/kg carnitine and 145 % methionine) exceeded the other treatments in the feed intake. Table - 5 indicated a significant effect ($P \leq 0.05$) to add carnitine to dietary conversion ratio rates during periods (1 - 2), (3 - 4) and (5 - 6) weeks and cumulative. The table showed a significant effect ($P \leq 0.05$) on dietary conversion ratio, which showed a significant decrease in this trait in the treatment of birds fed on diets added to methionine (145 %) and for all periods studied. Table - 5 showed a significant effect ($P \leq 0.05$) for the interaction between the addition of carnitine and methionine on the dietary conversion ratio (1 - 2 weeks) (300 mg/kg carnitine) was recorded the best dietary conversion ratio. In the period from (3 - 4) week, the additive treatment, (300 mg/kg carnitine and 130 % methionine) were the best, while in the period from (5 - 6 weeks) the addition treatment (200 mg/kg carnitine and 0 % methionine best rates.

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 1kg 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 IUVit 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; 1.600mg Manganese; 7.000 mg Choline chloride; 320 mg Pantothenic acid and niacin 800 mg.
**Calculated Chemical composition analysis adopted by NRC (1994).

Table - 2: Effect of addition of carnitine and methionine in the body weight of quail (mean ± standard deviation)

Period (week)	Carnitine / Methionine	Control	115 %	130 %	145 %	Mean of Carnitine
Second week	Control	53.68 ± 0.34	54.95 ± 0.24	57.77 ± 0.38	58.32 ± 0.77	^{C} 56.18 ±2.05
	100 mg/kg	58.97 ± 0.10	59.58 ± 0.45	60.91 ± 0.43	60.46 ± 0.28	^{B} 59.98 ±0.84
	200 mg/kg	59.79 ± 0.54	61.68 ± 0.41	61.81 ± 0.66	63.85 ± 0.66	^{B}61.78 ±1.58
	300 mg/kg	62.52 ± 0.20	65.92 ± 0.18	66.07 ± 0.83	67.63 ± 0.45	^{A}65.54 ±1.99
	Mean of methionine	58.74 ^{C}±3.36	60.53 ^{B}±4.14	^{A} 61.64 ±4.14	^{A} 62.56 ±3.71	LSD 2.72**
Fourth week	Control	124.91 ± 1.64	127.72 ± 3.74	129.95 ± 2.18	134.38 ± 0.96	129.24^{D} ± 4.14
	100 mg/kg	131.22 ± 2.70	136.97 ± 2.40	138.86 ± 2.39	143.68 ± 2.27	^{C}137.68 ±5.10
	200 mg/kg	129.87 ± 2.05	145.32 ± 1.75	145.33 ± 2.09	150.18 ± 1.74	142.68 ^{B} ± 8.16
	300 mg/kg	134.15 ± 1.48	150.10 ± 1.51	155.48 ± 1.16	158.09 ± 0.59	^{A}149.46 ±9.76
	Mean of methionine	130.04^{C} ± 3.89	140.03 ^{B} ± 9.15	^{B}142.41 ±9.89	^{A}146.58 ±9.18	** LSD 7.37
Sixth week	Control	203.83 ± 2.55	205.92 ± 1.60	212.98 ±2.57	219.83 ± 2.07	210.64^{C} ± 6.85
	100 mg/kg	206.92 ± 0.57	212.17 ± 3.91	221.85 ± 4.27	226.47 ± 1.63	216.85 ^{C}± 8.46
	200 mg/kg	213.18 ± 1.43	226.50 ± 2.13	226.29 ± 1.04	228.05 ± 1.68	223.51 ^{B} ± 6.42
	300 mg/kg	218.31 ± 1.04	235.61 ± 4.27	232.94 ± 2.42	239.73 ± 2.62	231.65 ^{A} ± 8.77
	Mean of methionine	210.56 ^{C} ± 6.00	220.05 ^{B} ± 12.49	^{B}223.52 ±7.94	^{A}228.52 ±7.69	** LSD 9.68

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

Table - 3: Effect of addition of carnitine and methionine in the weekly and cumulative weight gain rate of quail (mean ± standard deviation)

Period (week)	Carnitine / Methionine	Control	115 %	130 %	145 %	Mean of Carnitine
Week (1-2)	Control	45.48 ± 0.45	46.06± 1.05	49.55 ± 0.49	50.18 ± 1.04	47.82^{D} ± 2.27
	100 mg/kg	50.77 ± 0.01	51.39 ± 0.57	52.4 ± 0.8	52.22 ±0.24	51.60^{C} ± 0.81
	200 mg/kg	51.59± 0.5	53.40 ± 0.26	53.64 ± 0.74	55.66 ± 0.78	53.57^{B} ± 1.59
	300 mg/kg	54.31 ± 0.33	57.82 ± 0.14	57.80 ± 0.89	59.43± 0.33	57.34^{A} ± 2.00
	Mean of methionine	50.54^{C} ± 3.36	52.17^{B} ±4.44	53.35^{A}±3.16	54.37^{A} ±3.72	LSD 2.91**
Week (3-4)	Control	71.23 ± 1.93	72.77 ± 3.5	72.17 ± 1.95	76.05 ± 0.49	^{D} 73.06 ±2.69
	100 mg/kg	72.25 ± 2.66	77.39 ± 1.99	77.95 ± 2.81	83.22 ± 1.99	^{C} 77.70 ±4.54
	200 mg/kg	70.08 ± 1.90	83.74 ± 1.33	83.53 ± 1.44	86.33 ± 1.98	^{B}80.92 ±6.76
	300 mg/kg	71.63 ± 1.50	84.18 ± 1.50	89.41 ± 0.36	90.47 ± 0.95	^{A}83.92 ±7.88
	Mean of methionine	71.30^{D}±1.93	79.52^{C}±5.30	^{B} 80.77 ±6.88	^{A} 84.02 ±5.61	LSD 4.25**
Week (5-6)	Control	78.92 ± 2.17	78.40 ± 4.69	83.04 ± 0.41	85.45 ± 1.39	81.45^{B} ± 3.82
	100 mg/kg	75.70 ± 2.76	75.2 ± 1.84	82.99 ± 6.52	82.80 ± 0.64	^{B}79.17 ±4.99
	200 mg/kg	83.31 ± 2.34	77.85 ± 5.28	80.95 ± 3.12	77.87 ± 1.30	79.99^{B} ± 3.72
	300 mg/kg	84.19 ± 1.62	88.84 ± 0.86	77.45 ± 1.27	81.85 ± 1.99	^{A}83.08 ±4.48
	Mean of methionine	80.53^{C} ± 4.07	80.08^{C} ± 6.28	^{B}81.11 ±3.93	^{A}81.99 ±3.09	** LSD 1.29
Cumulative weight gain (1-6) week	Control	195.63 ± 2.48	197.69 ± 1.54	204.76 ±2.68	211.02 ± 3.45	202.28^{C} ± 6.73
	100 mg/kg	198.72 ± 0.49	203.98 ± 3.98	213.6 ± 4.20	218.24 ± 1.59	208.63^{C}± 8.44
	200 mg/kg	204.98 ± 1.38	218.19 ± 2.04	218.12 ± 0.98	219.79 ± 1.73	215.27^{B} ± 6.39
	300 mg/kg	210.10 ± 0.98	227.51 ± 4.09	224.75 ± 2.54	231.53 ± 2.74	223.47^{A} ± 8.78
	Mean of methionine	202.36^{D} ± 5.99	211.84^{C} ± 12.51	^{B}215.31 ± 7.97	^{A}220.14 ± 7.98	** LSD 9.82

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

Table - 4: Effect of addition of carnitine and methionine in the weekly and cumulative feed intake for quail (mean ± standard deviation)

Period (week)	Carnitine / Methionine	Control	115 %	130 %	145 %	Mean of Carnitine
Week (1-2)	Control	101.28 ± 1.11	104.65± 0.62	106.08 ±2.24	107.72 ± 2.22	104.93^{C} ± 2.87
	100 mg/kg	102.29 ± 3.27	109.42 ± 2.70	109.81 ± 1.63	112.56 ±3.78	108.52^{B} ± 4.69
	200 mg/kg	105.70± 2.56	117.15 ± 2.63	119.89 ± 0.45	123.03 ± 3.27	117.42^{A} ±6.55
	300 mg/kg	105.91 ± 1.48	123.60 ±4.80	125.44 ±3.11	130.29±2.15	120.12^{A} ±10.49
	Mean of methionine	103.81^{D} ± 2.82	113.70^{B} ±8.01	115.30^{B}±8.27	118.40^{A} ±9.54	LSD 4.30**
Week (3-4)	Control	181.00 ± 0.75	185.09 ± 2.25	184.82 ± 4.41	188.64 ± 2.79	^{C} 184.49 ±3.73
	100 mg/kg	181.37 ± 1.77	192.39 ± 1.27	196.02 ± 1.03	200.85 ± 3.99	^{B}192.66 ±7.75
	200 mg/kg	182.12 ± 2.04	198.24 ± 2.84	200.65 ± 5.31	204.68 ± 3.00	^{A}197.72 ±8.68
	300 mg/kg	184.22 ± 2.80	198.70 ± 3.66	204.57 ± 2.74	211.30 ± 1.44	^{A}198.51 ±11.13
	Mean of methionine	182.35^{C}± 2.28	193.60^{B}±6.18	^{B} 196.51 ±8.36	^{A} 201.36 ±8.97	LSD 7.96**
Week (5-6)	Control	274.64 ± 1.04	280.44 ± 0.70	285.49 ± 4.97	296.23 ± 1.28	284.20^{C} ± 8.59
	100 mg/kg	276.94 ± 1.82	290.37 ± 2.16	303.57 ± 3.46	308.55 ± 3.33	^{B}294.86 ±13.06
	200 mg/kg	287.00 ± 0.70	301.13 ± 9.30	311.83 ± 3.20	323.74 ± 2.83	307.64^{A} ±14.21
	300 mg/kg	290.91 ± 8.00	306.02 ± 3.65	316.45 ± 1.09	324.23 ± 1.75	^{A}307.98 ±14.17
	Mean of methionine	282.70^{C} ± 8.54	294.49^{B} ± 11.22	$^{A\,B}$304.34 ± 12.69	^{A}313.18 ± 12.34	N.S
Cumulative feed intake (1-6) week	Control	556.93 ± 0.63	570.18 ±2.13	576.39 ±8.51	592.59 ± 1.42	574.02^{B} ± 13.91
	100 mg/kg	560.60 ± 6.21	592.19 ± 0.93	609.40 ± 3.58	621.95 ± 5.87	596.04^{B}± 24.38
	200 mg/kg	574.83 ± 0.18	616.52 ± 13.31	632.37 ± 7.97	651.44 ± 4.39	622.78^{A} ± 28.24
	300 mg/kg	581.04 ± 9.36	628.32 ± 11.37	646.46 ± 6.11	665.82 ± 2.68	626.61^{A} ± 35.02
	Mean of methionine	568.87^{D} ± 12.20	601.80^{C} ± 24.61	^{B}616.15 ±28.28	^{A}632.95 ± 29.61	** LSD 18.18

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

Table - 5: Effect of addition of carnitine and methionine in the rate of weekly and cumulative feed conversion ratio of quail(mean ± standard deviation)

Period (week)	Carnitine / Methionine	Control	115 %	130 %	145 %	Mean of Carnitine
Week (1-2)	Control	2.23 ± 0.01	2.27± 0.04	2.14 ± 0.07	2-15 ± 0.09	2.20^{A} ± 0.08
	100 mg/kg	2.01 ± 0.07	2.13 ± 0.07	2.10 ± 0.02	2.15 ±0.07	2.10^{C} ± 0.08
	200 mg/kg	2.04± 0.02	2.19 ± 0.06	2.24 ± 0.04	2.21 ± 0.08	2.17^{B} ± 0.09
	300 mg/kg	1.96 ± 0.04	2.14 ± 0.09	2.17 ± 0.08	2.19 ± 0.03	2.12^{C} ± 0.11
	Mean of methionine	2.06^{B} ± 0.11	2.18^{A} ± 0.08	2.16^{A} ±0.07	2.17^{A} ±0.07	LSD 0.04**
Week (3-4)	Control	2.54 ± 0.06	2.54 ± 0.09	2.56 ± 0.06	2,48 ± 0.03	^{A}2.53 ±0.06
	100 mg/kg	2.51 ± 0.08	2.49 ± 0.07	2.52 ± 0.10	2.41 ± 0.07	^{AB}2.48 ±0.08
	200 mg/kg	2.60 ± 0.09	2.37 ± 0.01	2.40 ± 0.06	2.37 ± 0.05	^{BC}2.44 ±0.11
	300 mg/kg	2.58 ± 0.01	2.36 ± 0.05	2.29 ± 0.03	2.34 ± 0.01	^{C} 2.39 ±0.12
	Mean of methionine	2.56^{A} ±0.07	2.44^{B}± 0.10	^{B} 2.44 ± 4.13	^{B} 2.40 ± 0.07	LSD 0.09**
Week (5-6)	Control	3.48 ± 0.09	3.59 ± 0.21	3.44 ± 0.07	3.47 ± 0.07	3.49^{B} ± 0.12
	100 mg/kg	3.66 ± 0.15	3.86 ± 0.09	3.67 ± 0.29	3.73 ± 0.06	^{A}3.73 ±0.17
	200 mg/kg	3.42 ± 0.06	3.89 ± 0.39	3.86 ± 0.18	4.16 ± 0.10	3.83^{A} ± 0.33
	300 mg/kg	3.50 ± 0.04	3.44 ± 0.02	4.09 ± 0.05	3.96 ± 0.12	^{A}3.75 ±0.30
	Mean of methionine	3.52^{C} ± 0.12	3.69^{B} ± 0.27	$^{A B}$3.76 ± 0.29	^{A}3.83 ±0.28	** LSD 0.17
Cumulative feed conversion ratio (1 - 6) week	Control	2.85 ± 0.03	2.89 ± 0.03	2.81 ±0.07	2.81 ± 0.05	2.84 ±0.05
	100 mg/kg	2.82 ± 0.03	2.90 ± 0.06	2.85 ± 0.04	2.85 ± 0.02	2.86±0.05
	200 mg/kg	2.79 ± 0.01	2.82 ±0.04	2.90 ± 0.05	2.96 ± 0.03	2.87 ±0.07
	300 mg/kg	2.79 ± 0.02	2.76 ± 0.08	2.87 ± 0.04	2.87 ± 0.04	2.82 ±0.07
	Mean of methionine	2.81^{C} ± 0.03	2.84^{B} ± 0.08	^{A}2.86 ±0.05	^{A}2.87 ±0.06	** LSD 0.04

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

4. Discussion

The treatment of birds fed on a diet supplemented with 300 mg/kg of carnitine was superior (Table - 2). The reason for the superior treatment of 300 mg/kg carnitine in body weight may be due to the role of carnitine through the rapid transfer of fatty acids to the mitochondria and then their entry into beta oxidation and energy production (Farrokhyan *et al*., 2014). The current results were agreed with Alireza *et al*. (2016) who indicated that the body weight was significantly higher when the carnitine was added to 300 mg / kg feed in broiler chicks. Significant effect (P≤0.05) to add 145 % methionine to the live body weight of quail birds in different treatments and for all ages (Table - 2). This may be due to the fact that the addition of methionine has improved the amino acid balance and thus the speed and increase of protein building in the body by adding the appropriate amount to meet the needs of quail birds of the primary amino acid methionine which led to weight gain rather than the use of traditional

diets (Esteve and Stefan, 2000). This result was agreed with Kadhim and Najmuddin (2015) who found a significant effect of the addition of methionine in broiler diets, which led to increased weight and growth rates.

The Table - 2 showed that the addition treatment (300 mg/kg carnitine and 145 % methionine) is higher than the mean body weight for ages (2.4 and 6 weeks). This can be attributed to the fact that carnitine has the potential to improve the use of nitrogen in the body, either directly through its precursors of methionine and lysine to synthesize protein and other cellular functions, or indirectly by improving the balance of essential and non-essential amino acids (Sarica, 2005). This result was agreed with Saeid *et al*. (2014) who observed a significant increase ($P \leq 0.05$) in the live body weight of broilerin the treatment supplemented with carnitine by 150 mg/kg NRC 115 % of methionine.

The Table - 3 showed that there is a significant superiority ($P \leq 0.05$) in the weight gain of birds in the treatment of addition of 300 mg/kg carnitine for periods (1 - 2), (3 - 4), (5 - 6) weeks and cumulative. The reason for the increase in the rate of increase in weight may be due to the high level of energy and protein in the body, which stimulates the pituitary gland to release growth hormone, which moves from the blood to the liver and then linked to the receptors found on liver cells to stimulate the release of the growth factor similar to the hormone insulin (Thissen *et al*., 1994). The carnitine increases the secretion of the growth factor similar to insulin and stimulates the growth rate, which may be considered a cause of the increase in the weight of the birds (Beccavin *et al*., 2001). These results were agreed with Mozafar and Taklimi (2015), whose results showed a significant increase in the rate of weight gain of birds fed on diets added to the carnitine in broilers. There was a significant increase in the weight gain of birds treated with added diets (145 %) Methionine (Table - 3). The increase in the rate of weight gain of supplementation (145 %) may be due to the fact that the needs of the amino acids in poultry increase linearly with the increase of the raw protein in the fodder mixture (Morris and Abbeb, 1990). This result was agreed with the results obtained by Abdel-Samia *et al*. (2014) with an improvement in the weight gain in the levels of methionine added to the Japanese quail diets for 42 days. In this table, the addition treatment (300 mg/kg carnitine and 145 % methionine) was higher in this trait. The increase in weight gain can be attributed to the synergistic effect of carnitine and methionine in the role of carnitine in the transfer of fatty acids to the mitochondria and thus in the production of energy after entering the beta oxidation (Farrokhyan *et al*., 2014).

In Table - 4, birds fed on diets added to the Carnitine (300 mg/kg feed) were the highest in feed intake. This finding was agreed with the findings of Mozafar and Taklimi (2015), who observed a significant increase in feed intake for broiler during the growth period of 1 - 21 days in birds added to their 400 mg/kg carnitine. Perhaps the reason is that the carnitine improved the shape and consistency of the villi and increase the surface area in the intestine and good absorption process and then increase the efficiency of feed intake. Birds with methionine (145 %) had the highest feed intake (Table - 4). This result was agreed with Kaur and Mandal (2015) who found significant superiority when adding methionine to Japanese quail diets for a period of (0 – 3 and 0 - 5) weeks in feed intake. This may be due to the fact that the addition of amino acid methionine in appropriate quantities in the fodder mix of birds instead of the traditional ones has improved the amino acid balance, which has positively affected the type of feed used, which led to increased feed intake (Ezzedine and Dabdoub, 2007). In this table, the addition treatment (300 mg/kg carnitine and 145 % methionine) exceeded the other treatments in the feed intake.

In Table - 5, the addition of 300 mg/kg carnitine was the best in the feed conversion ratio. Perhaps the reason for improved dietary conversion ratio when adding carnitine is the ability of carnitine to increase the secretion of insulin-like growth factor and stimulate growth rate, which is a cause of moral improvement

(Beccavin *et al*., 2001). The results of this study were consistent with the results of Mozafar and Taklimi (2015), who found a gradual improvement in feed conversion ratio when increasing the level of carnitine in broiler diets. Table - 5 showed a significant effect on feed conversion ratio, which showed a significant decrease in the status of birds fed on methionine (145 %). The lack of improved dietary conversion ratio of methionine supplementation may have been due to an increase in the amount of feed consumed by birds fed on diets added to methionine, which resulted in reduced conversion ratio due to an inverse relationship between the amount of feed consumed and the feed conversion ratio. The results of this study were consistent with that of Yunis (2014), who found no significant improvement in feed conversion ratio when adding methionine to broilers. The highest rates of cumulative feed conversion ratio were found in the addition treatment (300 mg/kg carnitine and 115 % methionine) (Table - 5). Results that showed an improvement in feed conversion ratio probably because of the role of carnitine, which improves the use of nitrogen for the synthesis of protein and other cellular functions or improves the balance between essential and non-essential amino acids (Sarica *et al*., 2005). For methionine, this improvement in feed conversion ratio can be explained by the addition of methionine. Most of the protein in the feed mixtures used is from soybeans. This protein is poor in the essential amino acid methionine (Harry, 1971).

5. References

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