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RESEARCH OPINIONS IN ANIMAL & VETERINARY SCIENCES

Impact of different levels of L-carnitine on carcass characteristics and some serum parameters in female broiler chickens at 10 days of age

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Abstract

A research was conducted to explore the effects of various levels of L-Carnitine in diet on carcass characteristics and some serum parameters in female broiler chickens. A total of 480 one-day old female broiler chicken (Ross 308) were randomly allocated to 4 dietary treatments (6 replicates with 20 birds in each) in a completely randomized design. Treatments included were control and the addition of various levels of L-Carnitine at level of 100, 200 and 300 mg/kg in diets. The results showed that 300 mg/kg L-Carnitine in diet decreased live body weight, carcass, thigh, and intestinal weight ($P<0.05$). However, all dietary treatments decreased breast weight compared to control diet ($P<0.05$). In addition, no significant difference was observed in carcass yield and relative organ weights. The serum triglyceride decreased significantly in treated groups. Aspartate aminotransferase (AST), alanine aminotransferase (ALT) and albumin increased significantly ($P<0.05$) in group fed 300 mg/kg L-carnitine. In conclusion, the addition of L-Carnitine in diets had no positive effects on carcass traits in first 10 days of age.

Keywords: Broiler; carcass; L-carnitine; serum

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Introduction

The broiler chicken industry is a main source of animal protein and accumulation of fat of broiler chickens body is one of the major concerns in chicken industry (Mersmann, 2002). L-Carnitine (β-hydroxyγ-trimethyl amino butyrate) is a water-soluble quaternary amino acid that exists naturally in micro-organisms, plants, and animals and is required for the long chain fatty acid transfer from cytoplasm to mitochondrial matrix for subsequent β-oxidation and energy production (Bremer, 1983; Harpaz, 2005). Broilers can synthesize L-carnitine de novo via lysine and methionine metabolism. In addition, dietary meals derived from animal origin are higher in L-Carnitine than those of vegetable meals (Kidd et al., 2009). Therefore, broiler diets which are mainly based on vegetable may have deficiency in L-Carnitine. Several reports on broilers and pigs have demonstrated that growth performance can be improved by feeding supplementary dietary L-Carnitine (Weeden et al., 1991; Lettner et al., 1992). However, inconsistency exists in results of broiler research with L-Carnitine.

Dietary addition of 25 (Xu et al., 2003) or 50 (Rabie et al., 1997; Rabie and Szilagyi, 1998) ppm L-Carnitine have been shown to decrease abdominal fat pads in comparison to broilers fed diets without L-Carnitine. However, other demonstrated that the inclusion of different levels of L-Carnitine (50, 100, 160, and 200 ppm) in diets had no effects on fat pad deposition in broilers (Cartwright, 1986; Lien and Horng 2001). Broiler research studies with L-Carnitine differ in terms of carcass composition and serum blood parameters (Cartwright 1986, Rabie et al., 1997, Rabie and Szilagyi, 1998). There are limited studies about the effects of L-Carnitine supplementation of broiler diets

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in early age on carcass yield and serum lipids. Therefore, the present study was carried out to determine the effects of various levels of L-Carnitine on carcass characteristics and some serum parameters in broiler chickens at 10 days of age.

Materials and Methods

Birds and diets

A total of 240 one-day-old female broiler chicken (Ross 308) were randomly assigned to 4 treatments (3 replicates with 20 birds in each replicate). Treatments include control or the addition of various levels of L-Carnitine at 100, 200, and 300 mg/kg in diets. Diets and water were offered *ad libitum* throughout the experiment. Lighting schedule was 23 h light and 1 h dark. The temperature was gradually reduced from initially 32°C by decreasing 3°C in each week. Table 1 showed diets composition and formulation from 1 to 10 days of age based on NRC (1994) recommendation.

Carcass characteristics

On 10 day of age, 2 birds from each replicate were randomly selected and sacrificed to measure carcass and organs weights. Carcass weight, breast, thighs and visceral weight were measured.

Blood parameters assay

Two birds from each replicate were randomly selected and blood samples were taken from wing vein at 10 day of age. Serum samples were taken and glucose (GLU), albumin (AL), cholesterol (CHO), triglyceride (TG), low density lipoprotein (LDL), high density lipoprotein (HDL), aspartate aminotransferase (AST), and alanine aminotransferase (ALT) were measured using the specific kits (ShimiZist, Tehran, 2012).

Statistical analysis

A completely randomized design was employed to data analysis. One-way analysis of variance was performed using the GLM procedure of SAS software (SAS, 2004). Duncan's multiple range test was used to means comparison ($P<0.05$).

Results and Discussion

Carcass yield and relative organelle weights

The effects of various levels of L-Carnitine inclusion in diets on carcass characteristics and relative organ weights of broiler chickens at 10 days of age are shown in Table 2. The results showed that the inclusion of 300 mg/kg L-Carnitine in diets decreased live body weight, carcass, thigh, and intestine weights ($P<0.05$). However, all dietary treatments decreased breast weight ($P<0.05$). No significant difference was observed in corrected traits of carcass characteristics and relative organelle weights among dietary treatments. Studies on the effects of L-Carnitine addition in diets on carcass characteristics and relative organ weights of broiler chickens are scarce. The results of present study indicated that with increasing level of L-Carnitine in diets, the carcass characteristics relative organ weights (g) decreased. When the results were expressed as percentage of live body weight, the statistical difference between dietary treatments disappeared. In this regard, it was reported that supplementary L-Carnitine did not influence carcass characteristics in poultry (Rabie and Szilagyi, 1998; Lien and Horng, 2001; Arslan et al., 2003) which is in agreement with the findings of current study.

Table 1: Diet formulation and calculated chemical composition 1 to 10 day of age[1]

Ingredients	Percentage
Corn grain	49.40
Soybean meal	42.9
Soybean oil	3.62
Dicalcium phosphate	1.94
Limestone	1.31
Salt	0.34
DL-methionoine	0.10
L-lysine	0.05
Vitamin permix[2]	0.25
Mineral permix[3]	0.25
Calculated analysis	
ME (kcal/kg)	3010
Crude protein	23
Calcium	1.04
Available P	0.51
Methionine	0.50
Lysine	1.23

[1]L-Carnitine was added to the basal diet (control) at 100, 200, and 300 mg/kg in diets, respectively to make the respective dietary treatments; [2]Supplied the following per kilogram of diet: Vitamin A (retinyl acetate), 8,000 IU; vitamin D3 (cholecalciferol), 3,000 IU ; vitamin E (DL-alpha-tocopheryl acetate), 25 IU ; K3, 40 mg; vitamin B12 (cyanocobalamin), 0.02 mg; biotin, 0.1 mg; folacin (folic acid), 1 mg; niacin (nicotinic acid), 50 mg; pantothenic acid, 15 mg; pyridoxine (pyridoxine_HCl), 4 mg; riboflavin, 10 mg; and thiamin, 3 mg (thiamin mononitrate); [3]Supplied the following per kilogram of diet: 10 mg of copper ($CuSO_4$); 1.0 mg of iodine Ca (IO_3); 80 mg of iron ($FeSO_4H_2O$); 100 mg of manganese ($MnSO_4H_2O$); 0.15mg of selenium ($NaSeO_3$); 80 mg of zinc ($ZnSO_4H_2O$); and 0.5 mg of cobalt ($CoSO_4$).

Blood parameters

The effects of different diets on serum parameters of broiler chicken at 10 days of age are illustrated in Table 4. The lowest serum TG concentrations was observed by inclusion of 200 and 300 mg/kg L-Carnitine in diets ($P<0.05$). No significant difference was observed in CHO, LDL, and HDL concentrations by dietary treatments. The L-Carnitine supplementation has long been known to ameliorate lipid metabolism in

Table 2: The effects of diets on carcass characteristics of broiler chicken at day 10 of age (g)

L-Carnitine	LBW[1]	Carcass	Breast	Thigh	Liver	Intestine	Gizzard	PV[2]	Heart
0 mg/kg (control)	157.98[a]	77.04[ab]	24.20[a]	26.53[a]	6.86	17.53[a]	10.71	1.74	1.26
100 mg/kg	152.06[ab]	72.38[a]	19.91[b]	22.35[a]	5.98	15.40[ab]	9.95	1.67	1.08
200 mg/kg	150.15[ab]	71.63[a]	19.24[b]	22.74[a]	6.15	17.27[a]	10.82	1.67	1.10
300 mg/kg	147.97[b]	72.90[b]	18.50[b]	23.83[b]	6.21	14.56[b]	10.19	1.84	1.08
SEM	1.70	2.09	0.05	0.29	0.42	0.64	0.50	0.18	0.07
P value	0.03	0.04	0.03	0.04	0.49	0.04	0.57	0.89	0.33

[abc]Means in columns with different superscripts were significantly different (P<0.05). SEM, Standard Means of Errors; [1]Live Body weight; [2]Proventriculus

Table 3: The effects of diets on carcass characteristics of broiler chicken at day 10 of age (%)

L-Carnitine	LBW[1] (g)	Carcass	Breast	Thigh	Liver	Intestine	Gizzard	PV[2]	Heart
0 mg/kg (control)	157.98	48.93	32.38	33.89	8.92	23.61	13.97	2.24	1.63
100 mg/kg	152.06	48.48	27.18	30.10	8.41	21.27	14.01	2.29	1.52
200 mg/kg	150.15	47.77	26.83	31.89	8.65	24.14	15.26	2.35	1.54
300 mg/kg	147.97	49.58	25.32	32.69	8.49	20.04	14.00	2.51	1.49
SEM	7.772	2.84	2.94	1.97	0.49	1.78	0.74	0.19	0.10
P value	0.821	0.97	0.37	0.59	0.89	0.34	0.55	0.76	0.78

[abc]Means in columns with different superscripts were significantly different (P<0.05). SEM, Standard Means of Errors; [1]Live body weight; [2]Proventriculus

Table 4: The effects of diets on some blood parameters (mg/dl) of broiler chicken at day 10 of age

L-Carnitine	TG[1]	CHO[2]	LDL[3]	HDL[4]	AST[5]	ALT[6]	AL[7]	GLU[8]
0 mg/kg (control)	171[a]	164	64	65	310[c]	7[c]	1.95[b]	229
100 mg/kg	156[b]	180	80	69	315[ab]	15[ab]	2.0[b]	227
200 mg/kg	92[c]	166	74	73	329[ab]	16[ab]	2.1[ab]	251
300 mg/kg	88[c]	183	91	75	357[a]	17[a]	2.2[a]	218
SEM	9.68	14.98	9.32	5.11	6.54	0.012	0.05	22
P value	0.03	0.74	0.31	0.57	0.04	0.04	0.04	0.74

[abc]Means in columns with different superscripts were significantly differ (P<0.05). SEM, Standard Means of Errors; [1]TG=Triglyceride; [2]CHO=Cholesterol; [3]LDL=Low density lipoprotein; [4]HDL=High density lipoprotein; [5]AST=aspartate aminotransferase; [6]ALT=Alanine aminotransferase; [7]AL=Albumin; [8]GLU=Glucose

patients with type IV hyperlipoproteinemia (Maebashi et al., 1978). With L- Carnitine treatment, the levels of triacylglycerol and total CHO in aged rats reduced comparison to those of young rats (Tanaka et al., 2004). It was also shown that administration of L-Carnitine in rats decreased plasma triacylglycerol, CHO, phospholipids, nonesterified fatty acid and very-low-density lipoproteins (VLDL) concentrations (Maccari et al., 1987). It is possible that supplemental L-Carnitine may increase the rate of fatty acid transportation in broilers, and hence reduce serum nonesterified fatty acid and triacylglycerol contents (Lien and Horng, 2001). The L-Carnitine in the diet of chickens decreases the triaclyglyerol content of sera and liver and abdominal fat percentage, which is related to L-Carnitine promotion of β-oxidization of free fatty acids (Wang et al., 2003). The inclusion L-Carnitine in diets increased activity of lipase and decreased activity of lipoprotein lipase, thereby leading to a higher concentration of fatty acid in serum by accelerating hydrolysis of TG to glycerol and fatty acid, while reducing the concentration of TG in sera (Zhang et al., 2010). It is demonstrated that the supplementation of 50, 75, or 100 mg/kg L-Carnitine in diets decreased the total activity of lipoprotein lipase (Xu et al., 2003), which catalyzes the conversion of TG to glycerol and fatty acids. With the decrease of its activity, lipoprotein lipase increases hydrolysis of VLDL, which has been suggested to play a major role in regulating the deposition of fat in animal body (Griffin and Whitehead, 1982). Thus, the results of the experiment implicated that L-Carnitine modulated serum lipid parameters and deposition of fat in peripheral broiler tissues. These observations are in agreement with another study (Arslan et al., 2003). No significant decrease in lipid fractions (CHO, LDL, and HDL) was probably the result of β-oxidation of long chain fatty acids with the support of additional L-Carnitine.

The highest serum AST and ALT were obtained by inclusion of 300 mg/kg L-Carnitine in diets (P<0.05). Adversely, the highest serum AL concentration was found by the inclusion of 300 mg/kg L-Carnitine in diets (P<0.05). The liver is the primary site for fatty acid synthesis in poultry. Activities of ALT and AST in serum are usually considered as an important index for understanding the liver health. When it works healthy, the activity of these two enzymes in serum will reduce. The results indicated that the activities of ALT and AST increased as the result of introducing L-Carnitine levels into the diets showing negative effect on liver

health. No significant difference was observed in serum glucose concentration. Serum glucose significantly decreased in L–Carnitine supplementation in broiler chicken diet (ManoochehriArdekani et al., 2012). Since L-Carnitine increases fatty acid oxidation, it is possible that carnitine may have sparing effect on the blood glucose.

Conclusions

In conclusion, L-Carnitine administration had no positive effects on carcass traits. At the level of 300 mg/kg diet could alleviated serum triglycerides and increased albumin concentrations.

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