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Impact of Dietary L-Carnitine as a Feed Additive on Performance, Carcass Characteristics and Blood Biochemical Measurements of Broiler

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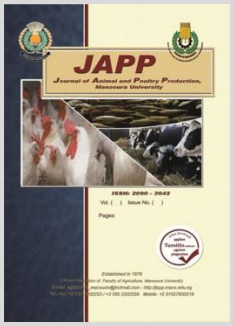

ABSTRACT

The present paper pointed to investigate the effects of L-carnitine on broiler performance, carcass traits and some blood biochemical measurements. A total of 120 Ross chicks provided from hatchery, distributed randomly into four groups (30 chicks each) 3 replicates / each (10 chicks each). The 1st was control group and received basal diet, 2nd, 3rd and 4th groups fed basal diet containing 0.25, 0.5 and 0.75 g of L-carnitine per kg diet. Results showed that body weight (BW) at 42 days old and daily body weight gain (DBWG) through 21-42 and 1-42 days old showed promoting impact of checks received 0.25, 0.5 and 0.75 g L-carnitine /Kg diet than control group. Feed intake (FI) and feed conversion ratio (FCR) reducing significantly (P<0.05) compared with control group during stage 21-42 days of age. Comparative weights of carcass, dressing, giblets and liver were increased (P<0.05 and 0.01) by adding L-carnitine levels into broiler chicks diet compared with the control. The highest values of most mentioned relative weight were recorded with chicks group fed on diet containing 0.75 g L-carnitine /Kg diet confront with the control. Blood plasma Total protein enhanced (P<0.05) by L-carnitine addition, total cholesterol (TC), triglyceride (TG), low density lipoprotein (LDL) and glucose values decreased significantly (P<0.01 or 0.05) in groups fed diet plus various levels of L-carnitine than control group .From the above results, can be concluded that L-carnitine had low role of promoting broiler performance, while it improved carcass characteristics and blood biochemical estimations specially lipid profile.

***Keywords*:** Broiler; growth performance; carcass characteristics; blood estimations.

INTRODUCTION

In the recent year's poultry industry suffer of many problems and there were direction to improve meat productions of chickens to exclude human health risk is highly worthy. Many agents such as genetics and nutrition participate to enhance the capability of broilers fattening. Nutrition research interested to improving carcass characteristics by using natural feed additives such as L-carnitine or β-hydroxy-γ-trimethylaminobutyrate is a quadrilateral amine. L-carnitine molecular weight is 161.2 Dalton, this compound is easily hydro soluble McDoWell (1989). L-carnitine, has major role of the transporting fatty acids of long-chain to express inside mitochondrial integument for energy metabolism and β-oxidation (Borum, 1983). Xu, *et al*. (2003) indicated thatL-carnitine associate to reducing storage long-chain fatty acids in adipose tissue by expedite fatty acid oxidation and increase alimentation of carnitine for metabolism. Breast muscle content of fat, yield of leg and breast meat were increased significant in broiler fed diet inclusion L-carnitine with 50 mg/kg Rabie and Szilagyi (1998). L-carnitine has activity in fatty acid metabolic so body weight gain and yield breast meat were enhanced while, feed conversion ratioand depositions of abdominal fat were improved in broiler fed diet incorporation with L-carnitine (Daskiranand Teeter (2001). (Rebouche, 1992; Heo *et al*., 2001) notify that L-carnitine has anti-oxydant activity, beside enhances long round fatty acids' metabolism midst mitochondrial integument. It can be produced by the animal organism from lysine and methionine. Xu *et al*. (2003) observed that broiler performance did not affect by fed on diet containing (25 mg/kg diet) of L-carnitine. This paper aimed to study L-carnitine effects on the broiler growth performance, carcass characteristics and estimations of blood biochemical of Ross chicks.

MATERIALS AND METHODS

Experimental design

The present work was carried out in the farm of Poultry and Animal Production Departments, Faculty of Agriculture, Zagazig University, Zagazig, Egypt.

A total of 120 Ross chicks provided from commercial hatchery. Chicks were distributed into four different groups (30 chicks each) 3 replicates each (in each replicate 10 chicks). The 1st received basal diet and avail control group, 2nd, 3rd and 4th groups fed on basal diet plus 0.25, 0.5 and 0.75 g L-carnitine / kg diet. The basal diet was prepared to provide broiler chicks requirements during 1-42 days of age as awarded by NRC (1994). The structure and chemical composition of the basal diets (starter and finisher) are presented in Table 1.

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Table 1. Composition and calculated analysis of the experimental basal diets.

Ingredients	Starter (1-21 day)	Finisher (21-42 day)
Yellow corn	58.54	62.20
Soybean meal(48%)	34.9	27.25
Corn gluten meal	2	3.5
Limeston	1.7	1.975
Dicalcium phosphate	1.5	1.7
Sodium chloride	0.2	0.3
DL-Met	0.24	0.15
L-Lys_HCl	0.22	0.125
Oil	0.4	2.5
Broiler vitamin-mineral premix*	0.3	0.3
Total	100	100
Calculated analysis **		
DM%	87.6	86.02
Crude protein (CP%)	23.04	20.41
Metabolic energy(k cal/kg)	2932	3097
Crude fiber (CF%)	2.42	2.36
Ether extract (EE%)	3.43	4.35
Ca	1.19	1.11
Available phosphorus	0.49	0.44
Lys	1.28	1.00
Met + cys	0.96	0.78

*** Broiler vitamin premixProvided the following per 1.5 kg : vitamin A, 12000,000 IU; vitamin D3, 3000,000 IU; vitamin E, 40000 mg; vitamin K, 3000 mg; pantothenic acid, 12000 mg; B1 2000 mg, B2 6000 mg; B6 5000 mg, B12 20 mg, niacin, 45000 mg; biotin, 75 mg and folaic acid 2000 mg.**

Mineral premixProvided the following per 1.5 kg :I 1000 mg; Mn, 100,000 mg; Cu 10,000 mg; Zn 60,000 mg, Se 200 mg; Fe 30,000 mg; choline 260000mg, Cobalt 100mg.

**** Calculated according to NRC(1994)**

Body weight:

Birds of all groups were individually weighed after arriving from hatchery to the farm (initial weight) and individual weight were gained at 21and 42 days.Mean of bird's body weight (BW) was intent in every group feed intake (IF) was recorded and after that calculated (DBWG) and (FCR) were calculated.

Blood measurements:

At the finish of the experiment before slaughter, 3 broiler chicks selected randomly of each group were fasted up to 12h. Blood swabs were cooled from the wing vein using a sterile syringe into tubes containing EDTA to obtain plasma to determine blood biochemical components. Blood samples were centrifugation the at 3000 xg for 15 minutes to obtained the plasma then stored at -20 C° for determining the concentrations of total protein according to Armstrong and Carr (1964). Albumin concentration was measured calorimetrically awarding to Wise (1965). Globulin concentration was calculated by discount albumin content from the total proteins content. Triglycerides (TG), total cholesterol (TC) were determined according to (Allain *et al*., 1974), high density lipoprotein (HDL) determined as described by (Myers *et al*., 1994) and low density lipoprotein (LDL) estimated according to (Friedewald *et al*., 1972),

Carcass traits:

Birds were weighted individually and slaughtered by neck cut and allowed to bleed. The abdominal fat, spleen, heart, gizzard, and liver were removed and weighed then calculated the relative weight to live BW.

Statistical Analysis

SAS package program (2004) used to analyze data statically according to completely randomized design. Differences through experiential groups were detached by Duncan's various range test (Duncan, 1955).

RESULTS AND DISCUSSION

Results

Performance:

Result of body weight (BW) at 42 days old and daily body weight gain (DBWG) through 21-42 and 1-42 days old showed promoting impact of checks fed diet plus 0.25, 0.5 and 0.75 g L-carnitine /Kg diet matched with control chicks. While, the result of initial BW and at 21 days old was not affected significantly due to L-carnitine supplementation (Table 2).

Table 2. Growth performance of broiler chicks as affected by different levels of L-carnitine.

	L-carnitine levels (g/kg diet)				
	0	0.25	0.5	0.75	sig
live body weight ,g, at (day)					
1	41.60 ±0.24	41.43 ±0.40	40.42 ±0.51	41.43 ±0.51	NS
21	706.43 ± 4.31	726.87 ±6.65	736.54 ±8.20	751.82 ± 5.89	NS
42	1932.90 ± 5.57^{b}	2061.16 ± 5.06^{ab}	2104.59 ± 10.11^{a}	2130.36 ± 4.91^{a}	**
Daily B weight Gain ,g, at (day)					
1- 21	31.68 ± 4.24	32.64 ± 6.49	33.15 ± 8.41	33.83 ± 5.88	NS
22- 42	61.51 ± 8.34^{b}	63.27 ± 7.48^{b}	65.14 ± 6.91^{a}	65.89 ± 10.21^{a}	**
1- 42	47.11 ± 5.64^{b}	46.81 ± 5.14^{b}	49.14 ± 10.18^{a}	49.74 ± 4.85^{a}	*
Daily Feed Intake,g, at (day)					
1- 21	56.36 ± 1.43	54.69 ± 2.11	57.72 ± 3.22	52.81 ± 3.27	NS
22- 42	118.21 ±2.08^{a}	113.28 ± 2.51^{a}	103.44 ±2.92^{b}	107.61 ± 2.57^{b}	*
1 - 42	84.75 ± 3.01	81..99 ± 2.56	77.07 ± 2.01	79.81 ± 3.11	NS
Feed conversion ratio at (day)					
1- 21	1.78 ± 0.14	1.66 ± 0.17	1.74 ± 0.04	1.56 ± 0.02	NS
22- 42	1.92 ± 0.09^{a}	1.79 ± 0.04^{ab}	1.58 ± 0.06^{b}	1.63 ± 0.03^{b}	*
1- 42	1.79 ± 0.03	1.75 ± 0.05	1.56 ± 0.07	1.60 ± 0.06	NS

Means within the same row with different common superscripts differ significantly.

*** = (P < 0.05), **=(P<0.01) and NS =not significant.**

It could be noticed that BW at 42 days old and DBWG during overall experimental period (1-42 days old) were enhanced significantly (P<0.05 or 0.01) with growing grade of L-carnitine addition (0.5 to 0.75 g /kg diet) compared with control. Mostly, the elevated BW and DBWG were recorded for birds having 0.75 g L-carnitine /Kg diet as compared with groups treated with (0.25 and 0.5 g L-carnitine /Kg diet) and control group.

Our results harmony with the observation obtained by Taklimi *et al*., (2015) illustrated that BWG improve significantly (P<0.05) in chicks fed diet enriched with L-carnitine thannon treated group. Also findings obtained by

Xu *et al*. (2003) who indicated that broiler chickens fed diet containedL-carnitine increased insulin concentration which leads to stimulating broiler chick's growth. Abouzed *et al*., (2019) and Hrncar *et al*., (2015) showed that enhanced (P<0.05) of broiler chickens live body weight in chick groups fed diet inclusion L-carnitine when comparison with control group, the same trend obtained by Nouboukpo *et al*., (2010) who added L-carnitine to drinking water of broiler chickens, found that live body weight was higher in treated groups after 7 days of beginning experiment compared with control. Previous studies byRabie and Szilagyi (1998) and Buyse *et al*. (2001) showed that body weight of broiler chicks at the end of fattening period affected by L-carnitine without significant.

Results in Table 2 show that (FI) and (FCR) insignificantly affected by L-carnitine supplementation to broiler diet during experimental period except stage 22- 42 days old broiler fed on diet plus grads of L-carnitine significantly (P<0.05) effected on FI and FCR. Whereas, feed consumption reduced (P<0.05) combative by untreated birds, the lowest FI occur in group fed on diet contained 0.75 g L-carnitine /kg diet. It worth to note that addition L-carnitine in broiler chicks diet improved FCR significantly during stage 22-42 days old of experimental period as matched with control group as presented in Table 2. The improve in FCR was associated with increasing addition of L-carnitine in broiler chick diets to provide level 0.25, 0.5 and 0.75 g / kg diet. It could be noticed that chickens fed diet plus 0.75 g L-carnitine /Kg diet recorded the best value of feed conversion ratio while, chicks fed un supplemented diet recorded the poorest value of feed conversion ratio.

Our results supported by Parsaeimehr *et al*. (2012) added (300 ppm) of L-carnitine to broiler diets contain 5% animal fat improved FCR and (DBWG). Also,Abouzed *et al* (2019) observed that FI was decreased significantly in broiler treated by L-carnitine than control one and feed conversion significantly improved for treatment groups. On contrast, the observations of Buyse *et al*. (2001) and Rezaei *et al*. (2007), who showed that L-carnitine added to diet chickens didn't effected on feed conversion. The same trend obtained by Jalali *et al* (2015) showed that growth performance of broiler chicks didn't affected by diet inclusion L-carnitine also, another previous studies of (Corduk *et al*., 2007; Lien and Horng, 2001; Xu *et al*., 2003; Kheiri *et al*., 2011) reported that broiler chicks fed diet containing L-carnitine did not effect on broiler growth, FI and FCR. Sadeghzadeh *et al*., (2014) and Jalali *et al* (2015) found that the reaction of chicks and quail fed on diet containingL-carnitine probably regarding to dietary structure, especially grads lysine and methionine (primary substances of biosynthesis L-carnitine).

Carcass traits:

The effect of diet containing L-carnitine on carcass traits of broiler chicks presented in Table 3. It was observed the comparative weights of carcass, dressing, giblets and liver were affected (P<0.05 and 0.01) by adding L-carnitine levels into broiler chicks diet. It is worth to note that, the highest record values of most mentioned relative weight were recorded with group fed on diet inclusion 0.75 g L-carnitine /Kg diet comparing with the control. While, abdominal fat, heart and gizzard relative weights insignificantly affected.

Our finding confirmed with those found by Daskiran and Teeter (2001) and Zhang *et al*. (2010) who illustrated that broiler diet plus L-carnitine lead to insignificantly increased carcass yield. Xu *et al*., (2003) and Hrncar *et al*., (2015) showed a reduction of abdominal fat when chicks fed on diet contained L-carnitine. Analogous trend was stated by Kaminska (2003) and Wang *et al*. (2003) observed significantly decreased of fat content in group chickens fed diet plus L-carnitine. On contrast the observations were found by CelikandOzturkcan (2003),Celik *et al*., (2003) and Kidd *et al*. (2009) who found that carcass yield didn't affected by L-carnitine added to broiler diet. Buyse *et al*. (2001) reported that mean weight of heart and liver increased insignificantly of broiler chickens fed diet plus L-carnitine.The same trend observed byHrncar *et al* (2015) who revealed that heart, liver and gizzard comparative weights of broiler chickens slightly affected by L-carnitine added to its diet.

Table 3. Relative weight of organs, hind quarter and breast muscle of carcass traits as affected by different level of L-carnitine.

	L-carnitine levels (g/kg diet)				
	0	**0.25**	**0.5**	**0.75**	**sig**
Carcass %	63.48 ±0.34^{b}	62.01 ±0.41^{b}	67.83 ±0.29^{a}	65.54 ±0.76^{a}	*
Dressing%	69.97 ±0.31^{bc}	69.16 ±0.36^{c}	74.25 ±0.51^{a}	72.87 ±0.91^{ab}	*
Giblets %	6.49 ±0.23^{b}	7.15±0.16^{a}	6.42 ±0.31^{b}	7.33 ±0.09^{a}	**
Abdominal fat %	2,98± 0.43	3.01 ± 0.51	2.78 ±0.63	2.35±0.38	NS
Liver %	2.73 ±0.04^{b}	3,35± 0.22^{a}	2.72± 0.11^{b}	3.27 ±0.27^{a}	**
Heart %	0.61 ±0.06	0.53± 0.01	0.57 ± 0.04	0.62 ±0.09	NS
Gizzard %	3.15 ±0.22	3.27± 0.02	3.13± 0.01	3.44 ±0.31	NS

Means within the same row with different common superscripts differ
NS = not significant * = (P < 0.05) ** = (P<0.01)

Blood measurements:

The effect of L-carnitine on blood plasma total protein and its fractions are presented in Table 4. Data indicated that total protein enhanced (P<0.05) by L-carnitine addition while, albumen and globulin insignificantly increased. The data indicated that, the highest value of total protein concentration (4.36 g /dl) occur in group fed diet plus 0.75 g L-carnitine /kg than control group.

Jalali *et al*., (2010) indicated that the enhancing serum protein in birds fed diet contained L-carnitine probably regarding to its protein modest action and decrease utilize the amino acid portent for biosynthesis L-carnitine such as lysine and methionine. Parizadian *et al*. (2011) indicated that serum albumin and globulin concentrations increased in quails fed diet inclusion L-carnitine than control group.

Our results showed TC and TG values were decreased (P<0.01) in broiler groups fed on diet inclusion various levels of L-carnitine than control group, also LDL and glucose concentrations significantly (P<0.05) reduced in every treatment groups than birds of the control (Table 4). HDL insignificantly affected by L-carnitine added to broiler diet. Our results agreed with those obtained by Parizadian *et al*. (2011) who illustrated that feeding quails on diet plus L-carnitine significantly had less triglycerides in the blood comparison to untreated group. Abouzed *et al*., (2019) reported that glucose, serum cholesterol, total proteins insignificantly change in chicken treated with L-carnitine relative to the control chicken. Jalali *et al*., (2015) reported that broiler fed diet contained L-carnitine increased the action of carnitine acetyltransferase and enhanced carrying of acetyl-CoA (coenzyme A) to the cytosol from the mitochondria. Acetyl-CoA is the exporter of all the carbon atoms in cholesterol. Lien and horng (2001) reported that broiler chicks fed on diet contained L-carnitine increased the activity of L-carnitinepalmitoeiltransferase enzyme. The authors added that β- oxidation of lipids lead to decrease production of VLDL in liver and carnitine palmitoeil transferase enzyme had necessary role this step. Jalali *et al* (2015) indicated that broiler fed diet inclusion carnitine would assist on fatty acid oxidation and reduce esterification response and storage of triacylglycerol in the fatty tissue. Xu *et al*., (2003) observed that hens fed on diets plus (250 mg / kg diet) L-carnitine lead to reducing triglyceride values in the serum due to β- oxidation of fatty acids increasing inside mitochondria membrane. Jalali *et al* (2015) reported that after eating triglyceride values of plasma were reduced whereas; the dietary fats riddance from bloodstreams to tissues was enlarged.

From the above results, can be concluded that L-carnitine had low role of promoting broiler performance, while it improved carcass characteristics and blood biochemical estimations specially lipid profile.

Table 4. Total protein and its fractions and lipid profile parameters as affected by different levels of L-carintein.

	L-carintein levels (g/kg diet)				
	0	**0.25**	**0.5**	**0.75**	**sig**
T. Protein g/dl	3.50 ± 0.11^{b}	4.08 ± 0.07^{a}	4.05 ± 0.02^{a}	4.36 ± 0.16^{a}	*
ALB (g/dl)[1]	2.01 ± 0.13	2.26 ± 0.18	2.34 ± 0.11	2.52 ± 0.07	NS
Glub (g/dl)[2]	1.49 ± 0.24	1.81 ± 0.16	1.71 ± 0.22	1.84 ± 0.09	NS
T. Cholesterol mg/dl	221.32 ± 8.35^{a}	194.53 ± 7.92^{ab}	171.09 ± 8.23^{b}	169.82 ± 6.89^{b}	**
Tri-glysrides mg/dl	232.35 ± 8.92^{a}	213.86 ± 6.84^{ab}	186.12 ± 5.92^{b}	203.27 ± 7.51^{b}	**
HDL (mg/dl)[3]	93.75 ± 5.72	87.94 ± 5.51	79.88 ± 2.12	80.67 ± 1.99	NS
LDL (mg/ dl)[4]	65.11 ± 12.31^{a}	62.79 ± 9.25^{a}	53.86 ± 7.34^{ab}	42.78 ± 8.41^{b}	*
Glucose (mg/ dl)	128.29 ± 6.24^{a}	110.63 ± 4.68^{ab}	100.09 ± 3.98^{b}	91.72 ± 4.01^{b}	*

Means within the same row with different common superscripts differ significantly.
***= (P < 0.05),**= (P<0.01) and NS = not significant.**
1= Albumin" 2= Globulin " 3= High-density lipoprotein " 4= low density lipoprotein

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تأثير اضافة ال-كرنتين للعليقة على اداء النمو وصفات الذبيحة والقياسات البيوكيميائية لبدارى التسمين

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يهدف هذا البحث الى دراسة تأثير اضافة ال-كرنتين على اداء بدارى التسمين وصفات الذبيحة وبعض القياسات البيوكيميائية للدم٠ اجمالى عدد ١٢٠ كتكوت روس تم احضارهم من معمل التفريخ قسمت عشوائيا الى اربع مجموعات مختلفة بكل منها ٣٠ كتكوت وقسمت كل مجموعة الى ثلاث مكررات بكل منها ١٠ كتاكيت٠ لمجموعة الاولى كانت مجموعة مقارنة وتغذت على العليقة الاساسية بينما المجموعات الثانية والثالثة والرابعة تغذت على العليقة الاساسية مضاف لها ٠,٢٥ و ٠,٥ و ٠,٧٥ جرام ال-كرنتين لكل كجم من العليقة٠ النتائج اوضحت تحسن فى وزن الجسم عند عمر ٤٢ يوم والزيادة اليومية فى وزن الجسم خلال ٢١- ٤٢ يوم تحسنوا فى الكتاكيت التى تغذت على ٠,٢٥ و ٠,٥ و ٠,٧٥ جرام ال-كرنتين لكل كجم من العليقة مقارنة بمجموعة المقارنة٠ وانخفض العلف المستهلك معنويا فى المجاميع التى غذيت على ال-كرنتين فى الفترة من ٢١الى ٤٢ يوم وكان اقل قيمة للعلف المستهلك كان فى المجموعة التى تغذت على ٠,٧٥ جرام ال- كرنتين مقارنة بمجموعة الكنترول ٠ كذلك اضافة ال-كرنتين الى عليقة بدراى التسمين ادى الى تحسن معدل التحويل الغذائى معنويا خلال الفترة ٢٢- ٤٢ يوم مقارنة بمجموعة المقارنة٠ بينما متوسط وزن الجسم عند ٢١ يوم من العمر لم يتاثر معنويا فى المجموعات التى اضيف ال-كرنتين الى علائقها مقارنة بالكنترول٠ الوزن النسبى للذبيحة واللحم الكلى والاحشاء الماكولة زاد معنويا بإضافة ال-كرنتين الى علائق بدارى التسمين مقارنة بمجموعة المقارنة٠ الوزن النسبى للكبد زاد معنويا عندما تغذت الكتاكيت على عليقة مضاف لها ال-كرنتين٠ ومن الجدير بالذكر ان اعلى قيم للوزن النسبى لمعظم الصفات تم تسجيلة فى البدارى التى تغذت على عليقة محتوية على ٠,٧٥ جرام ال-كرنتين لكل كجم عليقة ٠تركيزالبروتين الكلى زاد معنويا باضافة ال-كرنتين بينما قيم الالبيومين والجلوبيولين زادت بصورة غير معنوية٠الكوليسترول الكلى والجليسيريدات الثلاثية انخفضت معنويا فى المجموعات التى تغذت على مستويات مختلفة من ال-كرنتين عن مجموعة المقارنة و كذلك الكوليستيرول منخفض الكثافة والجلوكوز انخفضت قيمهم معنويا فى المجموعات التى تغذت على عليقة محتوية على ال-كرنتين عن مجموعة المقارنة٠ من النتائج السابقة يمكن التوصية بان ال-كرنتين له دور ضعيف فى دفع النمو لبدارى التسمين بينما ادى الى تحسن صفات الذبيحة وقياسات الدم البيوكيميائية خاصة صورة الدهون فى الدم.