Plant Archives Vol. 19 No. 2, 2019 pp. 4409-4414 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

EFFECTS OF DIETARY L-CARNITINE TO DIETS WITH DIFFERENT FAT SOURCES ON PRODUCTIVE PERFORMANCE OF BROILER

Othman M. Farhan[1], B.H. Mousa[2]* and Adel A. AlHamdani[2]

[1]Ministry of Agriculture, Department of Agriculture, Al-Anbar, Iraq.
[2]Department of Animal Production, College of Agriculture, University of Anbar, Iraq.

Abstract

The study was conducted to investigate the effect of adding two levels of Carnitine (L-Carnitine) to diets differs with fat sources (vegetable or animal) on productive performance of broilers. A total of 288 broiler chickens (Ross308) were used in the study, randomly distributed to eight treatments with three replicates per treatment (12 chicks/replicate). The experimental treatments were involved T1: diet with sunflower oil (free of carnitine), T2: diet with animal fat (free of carnitine), T3: dietincluded sunflower oil with 100 mg carnitine/kg feed, T4: diet included sunflower oil with 300 mg carnitine/kg feed, T5: diet included animal fat with 100 mg carnitine/kg feed, T6: dietincluded animal fat with 300 mg carnitine/kg feed, T7: diet included a mixture of animal fat and sunflower oil with 100mg carnitine/kg feed, T8: diet included a mixture of animal fat and sunflower oil with 300mg carnitine/kg feed. The obtained results showed that there were no significant differences were detected between different treatments in productive performance traits at the age of 42 days, which included live body weight, body weight gain, feed consumption and feed conversion ratio.

Key word: Carnitine, Productive Performance, Fat Source, Broiler.

Introduction

The optimal formation of broilers diets is the cornerstone for obtaining healthy and economical production, so researchers were interested in the composition of diets and nutritional supplementation to achieve highest productive performance of birds. The huge development in the poultry industry was accompanied by increased attention to nutrition which showed some problems. The protein sources are the most expensive in the preparation of diet. Moreover, causes some environmental problems as a result of ammonia and increased the possibility of environmental pollution caused some diseases and metabolic problems such as Ascites and increased abdominal fat, which is a problem facing the poultry industry. On the other hand, the application of laws banning the use of antibiotics as stimulants for growth in poultry diets in 2006 because of their harmful impact on the health of poultry and their meat led to search for alternatives to antibiotics for use as feed additives that have no harmful effects on birds or consumer health (Mountzouris *et al.,* 2010; Michalczuk *et al.,* 2012).

Carnitine (L-carnitine) has gained attention as a potential feed supplement to improve poultry production and also has multiple properties to lipid oxidation for produce energy to increase physical performance. Carnitine is a quaternary amine (β-hydroxy-trimethylaminobutyrate) easily soluble in water (McDowell, 2000) and biologically manufactures inside the body from the basic amino acids lysine and methionine (Rebouche, 1992). Vitamin C, vitamin B6, nicotinic acid and folic acid and carnitine played a role as cofactors in energy metabolism and transfers of poly unsaturated fatty acids to the cell membrane of mitochondria and oxidation of these PUFA's to produce energy (Reouche, 1992; Arsalan, 2006). Carnitine is not essential because of cellular biosynthesis, but under a special conditions it becomes essential, such as in young animals where carnitine production is limited, low carnitine content, stress, high production performance, and diets with high-fat content (Parsaeimehr *et al.,* 2012). In addition, Carnitine

***Author for correspondence :** E-mail : baraahameed99@gmail.com

acts as an antioxidant by removing the high levels of the acyl group from the cells that increase the produce of reactive oxygen species ROS in mitochondria (Agarwal and Said, 2004; Agarwal *et al.,* 2005). It also removes the free radicals responsible for lipid peroxidation (Rebouche, 1992) and protects other antioxidants such as ascorbic acid, vitamin E, and antioxidants from peroxidase (Super Oxide Dismutase, Catalase and glutathione peroxidase) (Gomez-Amores *et al.,* 2007). Thus, the purpose of the current study was to investigate the role of L-Carnitine with different sources from fat (animal, vegetable) in the production performance of broilers.

Materials and Methods

In this study, two hundred and eighty eight one-day-old Ross 308 broiler with initial weight 38.5gm were randomly distributed to 8 treatments with 3 replicates per treatment (12 chick/replicate). Chicks were rearedat the poultry fields - college of Agriculture/University of Anbar in Ramadi. The experimental period was 42 days for the period from 27th Sep. to 7th of Nov., 2018. Chicks were fed ad libitum during the experiment period on protein and energy-balanced diets and for two stages (starter and finisher diets). The starter diet was fed from 1 day to 21 days and consisted of 22.5% crud protein and 3139 (kcal/kg feed) metabolic energy then the birds were fed on finisher diet from the age of 22 days to 42 days, which included 19.16% crude protein and 3287 (kcal/kg feed) metabolic energy (Table 1). Carnitine was provided by English company (VERO UNIVERSAL). The experimental treatments were T1: diet with sunflower oil (free of carnitine), T2: dietwith animal fat (free of carnitine), T3: diet included sunflower oil with 100 mg carnitine /kg feed, T4: diet included sunflower oil with 300mg carnitine/kg feed, T5: diet included animal fat with 100mg carnitine/kg feed, T6: diet included animal fat with 300mg carnitine/kg feed, T7: diet included a mixture of animal fat and sunflower oil with 100mg carnitine/kg feed, T8: diet included a mixture of animal fat and sunflower oil with 300mg carnitine/kg feed. All the chicks were individually and weekly weighed per replicate at the end of each week during the experimental period and the averages of live body weight (g), body weight gain (g), feed consumption (g/bird) and feed conversion coefficient (gm feed/gm body weight gain) were calculated. The results of the study were analyzed using Complete Randomized Design (CRD) to investigate the effect of different treatments in the studied traits as well as the Duncan Multivariate test (Duncan, 1955) was used to examine the differences between the averages at the mean level of 0.05 and 0.01 by using the Analysis Statistical System (SAS).

Table 1: Ingredient and the Chemical composition calculated of experimental diets.

Ingredients	Starter	Finisher
Corn	50.7	30
Wheat	6	35.26
Soybeans (48%)	32.3	22
[1]Protein concentrate %	5	5
Vegetable oil or animal fat	4	6
Limestone 1.1	1.22	
[2]Dicalcium phosphate	0.53	0.17
DL-methionine	0.16	0.14
L-lysine	0.11	0.11
Salt	0.1	0.1
Total	100	100
[3]Chemical analysis,Calculated		
Crude protein %	22.5	19.16
Metabolizable energy kcal/kg	3139	3287
Protein: energy ratio	139.51	171.55
Ether extract6.65	8.49	
Crude fiber 2.67	2.69	
Methionine + cysteine	1.03	0.90
Lysine	1.38	1.12
Calcium	0.90	0.84
Available phosphorus	0.59	1.65

[1]: The imported protein center from the Dutch company Wafi and the container used 40% crude protein, 2107 kcal energy represented/kg feed, 5% calcium, methionine 3.7%, methionine + cysteine 4.12%, lysine 3.85%, free phosphorus 4.68% calcium 5.6% tryptophan 0.42 %, Threonine 1.70%, sodium 2.50% and chloride 4.20%, [2]: Contains 24% calcium and 18% phosphorus, [3] by chemical composition according to the analysis of feed material contained in NRC (1994).

Results and discussion

The results showed in table 2. A significant increase ($P<0.05$) in body weight at first week in T4 (diet included sunflower oil with 300mg carnitine/kg feed) as compared to T1 (diet with sunflower oil and free of carnitine), T2 (diet with animal fat and free of carnitine) and T6 respectively, while no significant differences were observed between T3 (dietincluded sunflower oil with 100 mg carnitine/kg feed), T4 (diet included sunflower oil with 300mg carnitine/kg feed), T5 (diet included animal fat with 100mg carnitine/kg feed), T7 (diet included a mixture of animal fat and sunflower oil with 100mg carnitine/kg feed) and T8 (diet included a mixture of animal fat and sunflower oil with 300 mg carnitine/kg feed). In the second week, a significant difference ($P <0.05$) in the body weight for treatment T8 compared

with treatments except T2, T3 and T4 was detected. Additionally, T8 was significantly higher (P <0.05) than T2 and T4 during the third week. The results of fourth week showed a significant difference (P<0.05) for T3 and T8 compared to T5 and T6. No significant differences were observed between T1, T2, T4 and T7. Moreover, no significant differences between all the experimental at fifth and sixth week. The results showed that the addition of carnitine had a significant effect on body weight during fourth weeks of the experiment period. The improvement in the body weight can be attributed to the role of transfers long chain fatty acids across the mitochondrial membrane and to control its oxidation and biochemical impact on metabolic energy (Arsalan, 2006). Carnitine plays a role in improving the utilization of dietary nitrogen, directly through the availability of amino acids (methionine and lysine). Also, carnitine was derived to complete protein synthesis and other cellular functions, or indirectly by improving the balance of essential and non-essential amino acids in the cell (Abdel-Ezeem *et al.,* 2014). These results were consistent with Corduk *et al.,* (2007). Furthermore, no significant differences were observed in the body weight of broilers when adding carnitine 100mg/kg with low, medium and high energy diets. Moreover, the obtained result in agreement with the results of Murali *et al.,* (2015) who demonstrated that the addition of carnitine at 900mg/kg to broiler diets with 5% animal fat content had no effect on production performance. However, the results of the study disagreement with results of researchers Michalczuk *et al.,* (2012); Jalali *et al.,* (2015); Taklimi *et al.,* (2015), who indicated significant differences in body weight when adding carnitine to broiler diets.

Data in table 3. shows the effect of the experimental treatments on the average of body weight gain of broiler. There were no significant differences between all the

Table 2: Effect of adding L-Carnitine with different sources of fat on live body weight (gm) of broiler[1].

Weeks	Treatments								SEM*	*P*-value
	T1	T2	T3	T4	T5	T6	T7	T8		
1	136b	140b	143ab	152a	142ab	135b	142ab	145ab	19.3	0.0154
2	354cd	382ab	372abc	378abc	335d	345d	361bcd	391a	51.7	0.0001
3	799bcd	840ab	820bc	843ab	763d	785cd	827bc	883a	93.5	0.0001
4	1347abc	1383abc	1434a	1405ab	1321bc	1311c	1397ab	1418a	156	0.0129
5	2005	2032	2074	2026	1950	1947	2030	2082	210	N.S**
6	2712	2746	2833	2707	2634	2547	2704	2702	349	N.S

T1: diet with sunflower oil (free of carnitine), T2: diet with animal fat (free of carnitine), T3: diet included sunflower oil with 100 mg carnitine /kg feed, T4: diet included sunflower oil with 300 mg carnitine /kg feed, T5: diet included animal fat with 100 mg carnitine /kg feed, T6: diet included animal fat with 300 mg carnitine /kg feed, T7: diet included a mixture of animal fat and sunflower oil with 100 mg carnitine /kg feed , T8: diet included a mixture of animal fat and sunflower oil with 300 mg carnitine /kg feed.,

1 Data represent mean values of 3 replicates per treatment. * SEM: Standard Error of Means. ** N.S: Non Significant.

a–d: Means in the same row with different superscripts differ (P<0.05).

Table 3: Effect of adding L-Carnitine with different sources of fat on live body weight gain (gm) of broiler[1].

Weeks	Treatments								SEM*	*P*-value
	T1	T2	T3	T4	T5	T6	T7	T8		
1	98.1	102	104	112	103	97.3	104	106	7.66	N.S**
2	217bcd	241ab	229abc	227abc	193d	209cd	218abcd	246a	15.1	0.0119
3	445	456	452	466	427	440	464	493	32.1	N.S
4	548	545	609	561	558	530	568	538	41.5	N.S
5	657	647	639	620	627	629	631	660	39.6	N.S
6	707	710	758	681	684	667	667	627	67.5	N.S
1-42	2674	2703	2794	2670	2596	2576	2654	2673	110	N.S

T1: diet with sunflower oil (free of carnitine), T2: diet with animal fat (free of carnitine), T3: diet included sunflower oil with 100 mg carnitine /kg feed, T4: diet included sunflower oil with 300 mg carnitine /kg feed, T5: diet included animal fat with 100 mg carnitine /kg feed, T6: diet included animal fat with 300 mg carnitine /kg feed, T7: diet included a mixture of animal fat and sunflower oil with 100 mg carnitine /kg feed , T8: diet included a mixture of animal fat and sunflower oil with 300 mg carnitine /kg feed.,

1 Data represent mean values of 3 replicates per treatment. * SEM: Standard Error of Means. ** N.S: Non Significant.

a–d: Means in the same row with different superscripts differ (P<0.05).

experimental treatments during the six weeks except the second week, chicks fed diet included combination animal fat and sunflower oil with 300mg carnitine/kg feed (T8) was higher than T1, T5 and T6. No significant differences were observed intreatments T2, T3, T4 and T7. Moreover, the accumulative body weight gain from 1 to 42 days, no significant differences between treatments and this finding was in agreement with the results of Corduk *et al.,* (2007); Murali *et al.,* (2015), who found that there were no significant differences in body weight gain of broilerfed diets with carnitine. However, some studies indicated that adding carnitine to broiler diets resulted a significant increasment in body weight gain. Celik *et al.,* 2003 demonstrated that body weight gain was significantly increased by the addition of carnitine (50 mg/Lt.) or with niacin (50mg/L) to drinking water. The results were disagreement with findings of Parasaeimehr *et al.,* (2012); Ardekani *et al.,* (2013); Jalali *et al.,* (2015), who indicated significant differences in body weight gain of broiler.

Table 4 showed the effect of the experimental treatments on the weekly and accumulative of feed consumption rate of broilers. There were no significant differences between the experimental treatments in the weekly and accumulative feed consumption rate during the six weeks period. The researchers differed on the effect of adding carnitine to broiler diets on feed consumption. Xu *et al.,* (2003) reported that using carnitine with (0, 25, 75, 100 mg/kg) did not affect on average of feed consumption in broiler. The results of Corduk *et al.,* (2007) showed no significant differences in feed consumption of broiler with adding 100mg/kg of

Table 4: Effect of addingL-Carnitine with different sources of fat on feed consumption (gm/bird) of broiler[1].

Weeks	Treatments								SEM*	*P*-value
	T1	T2	T3	T4	T5	T6	T7	T8		
1	120	131	122	128	129	119	127	127	6.25	N.S**
2	376	407	387	404	396	365	378	417	26.5	N.S
3	557	589	558	532	610	525	556	611	37.5	N.S
4	763	818	812	785	862	783	788	805	57.7	N.S
5	1063	1200	1135	1122	1000	1043	1075	1108	138	N.S
6	1214	1183	1301	1154	1209	1186	1214	1169	88.4	N.S
1-42 days	4076	4284	4292	4076	4203	3992	4119	4218	185	N.S

T1: diet with sunflower oil (free of carnitine), T2: diet with animal fat (free of carnitine), T3: diet included sunflower oil with 100 mg carnitine /kg feed, T4: diet included sunflower oil with 300 mg carnitine /kg feed, T5: diet included animal fat with 100 mg carnitine /kg feed, T6: diet included animal fat with 300 mg carnitine /kg feed, T7: diet included a mixture of animal fat and sunflower oil with 100 mg carnitine /kg feed , T8: diet included a mixture of animal fat and sunflower oil with 300 mg carnitine /kg feed.,

1 Data represent mean values of 3 replicates per treatment. * SEM: Standard Error of Means. ** N.S: Non Significant.

a–d: Means in the same row with different superscripts differ (P<0.05).

Table 5: Effect of addingL-Carnitine with different sources of fat on feed conversion coefficient (gm feed/gm of body weight gain) of broiler[1].

Weeks	Treatments								SEM*	*P*-value
	T1	T2	T3	T4	T5	T6	T7	T8		
1	1.23	1.30	1.17	1.14	1.25	1.22	1.22	1.19	0.075	N.S**
2	1.73b	1.68b	1.68b	1.78b	2.05a	1.74b	1.72b	1.69b	0.113	0.0168
3	1.25bc	1.29b	1.23bc	1.14c	1.43a	1.19bc	1.20bc	1.24bc	0.073	0.0081
4	1.39bcd	1.50ab	1.33d	1.39bcd	1.54a	1.47abc	1.38cd	1.50abc	0.060	0.0062
5	1.62	1.84	1.76	1.81	1.59	1.66	1.70	1.67	0.195	N.S
6	1.71	1.69	1.71	1.69	1.76	1.78	1.83	1.88	0.171	N.S
1-42 days	1.52	1.58	1.53	1.52	1.61	1.55	1.55	1.57	0.044	N.S

T1: diet with sunflower oil (free of carnitine), T2: diet with animal fat (free of carnitine), T3: diet included sunflower oil with 100 mg carnitine /kg feed, T4: diet included sunflower oil with 300 mg carnitine /kg feed, T5: diet included animal fat with 100 mg carnitine /kg feed, T6: diet included animal fat with 300 mg carnitine /kg feed, T7: diet included a mixture of animal fat and sunflower oil with 100 mg carnitine /kg feed , T8: diet included a mixture of animal fat and sunflower oil with 300 mg carnitine /kg feed.,

1 Data represent mean values of 3 replicates per treatment. * SEM: Standard Error of Means. ** N.S: Non Significant.

a–d: Means in the same row with different superscripts differ (P<0.05).

carnitine to diet with different levels of metabolizable energy (low, medium, and high) and compared it with diet free of carnitine. Murali *et al.,* (2015) demonstrated that adding carnitine at 900mg/kg feed to broiler diet with 5% of animal fat showed no significant differences in feed consumption rate. Also, Oladele *et al.,* (2011) noted that addition 60 ppm of carnitine to broiler diet had no effects on feed consumption rate and these results were in line with our results of the present study. On the other hand, Taklimi *et al.,* (2015) reported adding carnitine to drinking water of broiler (Ross 308) showed a significant difference ($P<0.05$) in feed consumption rate at 21 day of age.

As shown in table 5. Results of adding carnitine to multiple sources of fats. At the first week, no significant differences between treatments were recorded, while in the second week there were a significant decrease ($P<0.05$) in T5 (diet included animal fat with 100 mg carnitine/kg feed), which recorded worst value of feed conversion coefficient compared to the other experimental treatments which did not indicate significant differences between them. In the third week, T4 (diet included sunflower oil with 300mg carnitine/kg feed) was significantly improved ($P <0.05$) than T2 diet with animal fat (free of carnitine) and T5 (diet included animal fat with 100mg carnitine/kg feed), respectively, with no significant differences between T4 and T1 diet with sunflower (free of carnitine), T3 (diet included sunflower oil with 100mg carnitine/kg feed), T6 (diet included animal fat with 300mg carnitine/kg feed), T7 (diet included a mixture of animal fat and sunflower oil with 100mg carnitine/kg feed) and T8 (diet included a mixture of animal fat and sunflower oil with 300mg carnitine/kg feed) respectively. The results of the statistical analysis did not show significant differences at fifth and sixth week between all treatments. The accumulative feed conversion coefficient (1-42 days) showed no significant differences. This result was consistent with Xu *et al.,* (2003) who revealed that adding carnitine at 0, 25, 75, and 100mg/kg to diet of broiler males did not had any effects on feed conversion efficiency as compared with control. The results of our study were also agreed by Corduk *et al.,* (2007); Murali *et al.,* (2015). In contrast, Sayed *et al.,* (2001) found that addition of carnitine at 50 mg/kg to broiler diet containing 2 and 4% of the sunflower oil resulted a significant improvement in feed conversion coefficient (gm feed/gm body weight gain) compared to control treatment. Furthermore, the obtained result did not agree with the results of Parsaeimehr *et al.,* (2012), who found that there was a significant improvement in feed conversion coefficient of birds fed diets supplemented with 300mg/kg of carnitine with animal fat by 5%. Our finding also did not agree with Jalali *et al.,* (2015) who demonstrated that addition of 120mg/kg of carnitine with soybean oil resulted significant improvement ($P <0.05$) in feed conversion coefficient compared with other experimental treatments.

In conclusion, the addition of carnitine (L-carnitine) to diets with different sources of fat (vegetable, animal) did not improve the productive performance of broiler at the age of 42 days but an improvement in body weight and feed conversion ratio during the first weeks of study.

References

Abdel-Ezeem, N.A., M.Sh. Abdo, M. Madkour and I. El-Wardany. (2014). Physiological and histological responses of broiler Chicks to *in vovo* injection with folic acid or L-Carnitine during embryogenesis. *Global Veterinaria*, **13(4):** 544-551.

Agarwal, A. and T.M. Said (2004). Carnitines and male infertility. *Reproductive Biomedicine Online*, **8:** 376-384.

Agarwal, A., S.A. Prabakaran and T.M. Said (2005). Prevention of oxidative stress injury to sperm. *Journal of Anthology*, **26:** 654-660.

Ardekani, H.M., M. Shevazad, M. Chamani, M. Aminafsha and E.D. Arani (2013). The effect of L-Carnitine and low crude protein supplemented with crystalline essential amino acids diets on broiler chickens. *Annals of Biological Research*, **3(2):** 1085-1093.

Arsalan, C. (2006). L-Carnitine and its use as a feed additive in poultry feeding a review. *Revue Med. Vet.*, **157(3):** 134-142.

Celik, L., O. Ozturkcan, T.C. Inal, N. Canacankatan and L. Kayrin (2003). Effects of L-Carnitine and niacin supplied by drinking water on fattening performance, carcass quality and plasma L-Carnitine concentration of broiler chicks. *Arch. Anim. Nutr.,* **57:** 127- 136.

Corduk, M., N. Ceylan and F. Ildiz (2007). Effects of dietary energy density and L-Carnitine supplementation on growth performance, carcass traits and blood parameters of broiler chickens. *South African Journal of Animal Sci.,* **37(2):** 65-73.

Duncan, D.B. (1955). Multiple Rang and Multiple F-test. *Biometrics*, **11:** 4-42.

Gomez-Amores, L., A. Mate, J.L. Miguel-Carrasco, L. Jime´nez, A. Jos, A.M. Camea´n, E. Revilla, C. Santa-Mary´a, and C.M. Va´zquez (2007). L-Carnitine attenuates oxidative stress in hypertensive rats. *J. Nutr. Biochem.,* **18:** 533–540.

Jalali, S.M.A., R. Rabiei and F. Kheiri (2015). Effects of dietary soybean and sunflower oils with and without L-Carnitine supplementation on growth performance and blood biochemical parameters of broiler chicks. *Arch. Anim. Breed.*, **58:** 387–394.

Michalczuk , M., M. Lukasiewicz and J. Niemiec (2012). Effect of L-Carnitine on performance and dressing percentage of broiler chickens. *Animal Science,* No. **51:** 89–99.

Mountzouris, K.C., P. Tsirtisikos and I. Palamidi (2010). Effects of probiotic inclusion levels in broiler nutrition on growth performance, nutrient digestibility, plasma immunoglobunis and cecalmicroflora composition. *Poult. Sci. V.,* **89:** 58-67.

Murali, P., S.K. George, K. Ally and M.T. Dipu (2015). Effect of L-Carnitine supplementation on growth performance, nutrient utilization, and nitrogen balance of broilers fed with animal fat, *Veterinary World*, **8(4):** 482-486.

Oladele, O.A., F. Adeboye, S. Richard and H. Zainob (2011). Growth response, carcass yield and serum biochemistry of broiler chickens fed with supplemental L-Carnitine in feed or drinking water. *J. Poult. Sci.,* **48:** 223-228.

Parsaeimehr, K., P. Farhoomand and R. Najafi (2012). The effects of L-Carnitine with animal fat on performance, carcass characteristics and some blood parameters of broiler chickens. *Annals of Biological Research*, **3(7):** 3663-3666.

Rebouche, C.J. (1992). Carnitine functions and requirements during the life cycle. *Faseb J.,* **6:** 3379-3386.

SAS. (2012). Statistical Analysis System, Users Guide. Statistical. Version 9.1th ed. ASA. Inc. Cary. N.C. USA.

Sayed, A.N., H.K. Shoeib and H.A. Abdel-Raheem (2001). Effect of dietary L-Carnitine on the performance of broiler chickens fed on different levels of fat. *Assiut Vet. Med. J.*, **45:** 37-47 (Abstract).

Taklimi, S.M., Kh. Ghazvinian and M.R. Kasgari (2015). Effect of L-Carnitine on performance and carcass quality of broiler chickens. *Academia Journal of Scientific Research*, **3(3):** 50-54.

Xu, Z.R., M.Q. Wang, H.X. Mao, X.A. Zhan and C.H. Hu (2003). Effects of L-Carnitine on growth performance, carcass composition and metabolism of lipids in male broilers. *Poult. Sci.*, **82:** 408–413.