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The effect of dietary L-carnitine supplementation on egg production, egg weight, and hatching traits of broiler breeder hen from 32 to 36 weeks of age

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ABSTRACT

The impacts of supplemental L-carnitine in broiler breeder hen diets were evaluated. 400 hens were obtained from (Ross-308) broiler breeder strain at 32 weeks of age. All hens were collected from the same breeder flock and weighed on a balance with 10 g precision. At 32 weeks of age, hens based on a completely randomized design were divided into 5 treatments with 4 replicates per treatment and 20 hens and 2 roosters per replicate. 400 broiler breeder hen were fed the same basal diet that was supplementation with 0 (control), 200, 300, 400, and 500 mg L-carnitine/kg of diet. Egg samples were analyzed for egg weight, egg production and hatching traits in newly-hatched chickens. The results of the study indicate that, dietary L-carnitine supplementation didn't show any significant effect on egg production, weight of eggs and hatchability of broiler breeder hens from 32 to 36 weeks of age. Weight of newly-hatched chickens was significantly higher when supplemental L-carnitine in broiler breeder hen diets from 32 to 36 weeks of age were received 400 and 500 mg than control group. These data clearly indicate a potential important impact on weight of newly-hatched chickens by increasing dietary L-carnitine nutrition of a broiler breeder hen.

Key words: L-carnitine, egg production, egg weight, hatching traits, broiler breeder hen.

INTRODUCTION

L-carnitine is a water-soluble quaternary amine 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 [1]. Under circumstances of increased metabolism, when the demand for energy escalates, L-carnitine availability could become a limiting factor for β-oxidation of fatty acids. L-carnitine also possesses antioxidant properties. Chick embryonic tissues contain high levels of polyunsaturated fatty acids, an essential component of the phospholipid content in cell membranes [2, 3]. Polyunsaturated fatty acids are susceptible to lipid peroxidation caused by free radicals, which are produced by mitochondria because of the high metabolic rate of rapidly developing embryos

[4]. Moreover, L-carnitine may work as an antioxidant to scavenge free radicals [5, 6, 7]. Thus, the presence of L-carnitine in the fertile egg may decrease embryonic mortality by reducing oxidative stress during the hatch process, thereby increasing hatch rate. Moreover, all nutrients needed for embryogenesis are provided by the hen by the time the fertile egg is laid [8]. If nutritional deficiencies occur during the formation of the egg, it can have significant repercussions on the developing embryo [9]. Hen diets are composed mainly of corn and soy, which contain low levels of L-carnitine [10]. Therefore, eggs contain little or no L-carnitine [11]. Also, the chick embryo may have limited capability to synthesize L-carnitine during incubation [12]. Gamma-butyrobetaine, an intermediate substance required for L-carnitine biosynthesis, is limited in embryos and young animals due to the low activity of γ-butyrobetaine hydroxylase [13, 14]. Low levels of L-carnitine synthesis may make supplementation of L-carnitine beneficial to chick embryos. As an example, hatchability of eggs from broiler breeder hens consuming diets supplemented with 50 or 100 mg of L-carnitine for 3 wk as compared with controls increased from 83 to 87% and from 82.4 to 85.3%, respectively.

The primary objective of this research is to evaluate the impact of increased levels of dietary L-carnitine on egg production, egg weight, and hatching traits of broiler breeder hen from 32 to 36 weeks of age.

MATERIALS AND METHODS

Broiler breeder, 32-week-old were used in this experiment. 400 hens were obtained from (Ross-308) broiler breeder strain. All hens were collected from the same breeder flock and weighed on a balance with 10 g precision. At 32 weeks of age, hens based on a completely randomized design were divided into 5 treatments with 4 replicates per treatment and 20 hens and 2 roosters per replicate. Five experimental diets were formulated, by adding four levels of supplemental L-carnitine (200, 300, 400 and 500 mg/kg) to a basal diet and used from 32 to 36 weeks of age. Hens were dieted from 32 to 36 weeks of age and provided with a standard broiler breeder ration (National Research Council, 1994) (table 1) [15]. Each treatment group and hen was identified by the neck tag and recorded. All hens and treatments were randomly assigned to 1 of 20 pens. Each pen was bedded with soft pine wood shavings and equipped with automatic drinkers, and manual self-feeders. Food and water were available ad libitum. The lighting schedule was maintained at 17 hours of daylight and 7 hours of darkness throughout the studies. Supplemental L-carnitine was supplied by synthetic 98% feed quality L-carnitine from Merck® Co. All animal experimentation was conducted in accordance with the regulations of Islamic Azad University, Animal Ethics Committee. Egg samples were analyzed for egg weight, egg production and hatching traits in newly-hatched chicks. Upon hatch, the hatchability and weight of newly-hatched chickens were measured. The Weight of newly-hatched chickens was determined by weighing all chicks hatched one by one. Hatchability was calculated by considering the ratio of chickens hatched to the live chicken's embryo after the treatment and expressed as a percentage of fertilized eggs. Results were analysed by ANOVA using the GLM procedure of SAS software (SAS institute, 2001) [16]. Differences between treatments were compared by the Duncan's multiple range tests following ANOVA, and values were considered statistically different at $P < 0.05$ [17]. When data were percentages they were transformed by arc sin square root.

RESULTS AND DISCUSSION

Dietary L-carnitine supplementation didn't show any significant effect on egg production, weight of eggs and hatchability of broiler breeder hens from 32 to 36 weeks of age. Zhai et al. [18] reported that hens consuming L-carnitine throughout their life cycle had egg production and egg

weight similar to control hens. Also, Zhai et al. [19] demonstrate that *in ovo* injection of L-carnitine in a 0.05 to 10 µmol/egg dose range into fertile eggs at 17 or 18 d of incubation did not affect hatchability, which used Single Comb White Leghorns. Rabie et al. [20] reported that supplementation of 50, 100, or 500 ppm of dietary L-carnitine did not affect egg production and egg weight during the late laying period from 65 to 73 wk in a Hungarian brown hybrid line. Celik et al. [21] stated that egg weight was not affected by supplementation of 50 ppm of L-carnitine in the drinking water of 47-wk-old laying hens for 8 wk. Moreover, Yalcin et al. [22] found that the addition of L-carnitine to laying quail diets did not affect egg production, but did increase egg weight. Because the rates of lipid metabolism vary between egg-type strains of poultry [23], embryos in these 3 types (Leghorn breeder eggs, broiler breeder eggs, laying quail eggs) of poultry may differ in their response to supplemental L-carnitine.

Based on the results of present study, the supplemental L-carnitine in broiler breeder hen diets can be an effective tool to increase the weight of newly-hatched chickens. In other experiment, when L-carnitine was supplemented in broiler breeder hen diets at a dose of 50 mg/kg, a significant improvement in BW gain of the progeny chicks resulted [24, 25]

Table1. Ingredient percentages and calculated analysis of broiler breeder hen diet

Item	Diet
Ingredient (%)	
Corn	58.23
Wheat	10
Soybean meal(44% CP)	19.81
Dicalcium phosphate	1.95
Oyster sell-ground	8.77
Salt	0.52
Vitamin premix[1]	0.3
Trace mineral premix[2]	0.3
DL-Met	0.12
Calculated analysis	
ME (kcal/kg)	2672
CP (%)	14.95
Ca (%)	3
Available P (%)	0.45
Met (%)	0.36
Met + cystine (%)	0.59
Lys (%)	0.68

[1]*Vitamin premix provided the following per kilogram of diet: vitamin A, 11,013 IU; vitamin D3, 3,525 IU; vitamin E, 33 IU; vitamin K, 2.75 mg; riboflavin, 7.7 mg; pantothenic acid, 17.6 mg; niacin, 55.1 mg; choline, 478 mg; vitamin B12, 0.028 mg; pyridoxine, 5.0 mg; thiamine, 2.2 mg; folic acid, 1.1 mg; biotin, 0.22 mg.*

[2]*Trace mineral premix provided the following per kilogram of diet: manganese, 64 mg; zinc, 75 mg; iron, 40 mg; copper, 10 mg; iodine, 1.85 mg; and selenium, 0.3 mg.*

Yolk lipids provide essential energy to growing embryos. In fact, approximately 90% of the total energy requirement of the developing embryo is derived from fatty acid oxidation of yolk lipids [26]. Chick embryos show a high requirement for L-carnitine, yet contain low levels of L-carnitine, the injection of L-carnitine into the yolk sac would lead to circulation to fat storage areas such as the yolk sac to facilitate catabolism of fatty acids for energy. An increased efficiency in fatty acid oxidation may, likewise, reduce the dependency of the embryo upon gluconeogenesis, thereby sparing muscle tissue protein in the posthatch chick. This could subsequently lead to an increase in muscle yield during grow-out. Because skeletal muscle is a major site for fatty acid oxidation [27], the effects of exogenous L-carnitine on lipid utilization may become most evident in various muscle groups. In the present study, dietary L-carnitine supplementation had significantly increased the weight of newly-hatched chickens. This result

generally agrees with our hypothesis that exogenous nutrition provision can substitute for amino acids from the pectoral for glucose glucogenonesis; i.e. exogenous nutrient supply increases protein deposition.

Table 2. The effect of supplemental L-carnitine on egg production, egg weight of broiler breeder hen

Levels of L-carnitine added (mg/kg)	Egg production (g)	Egg weight (g)
Control	83.5	60.6
200 mg	86.0	58.1
300 mg	82.0	59.6
400 mg	85.0	61.0
500mg	82.7	61.7
P-Value	0.56	0.23
SEM	0.25	0.12

Table 3. The effect of supplemental L-carnitine on hatchability, weight of newly-hatched chickens of broiler breeder hen

Levels of L-carnitine added (mg/kg)	Hatchability (%)	Weight of newly-hatched chickens (g)
Control	83.75	40.16[b]
200 mg	81.50	39.51[b]
300 mg	84.75	40.04[b]
400 mg	81.00	41.68[a]
500mg	82.75	41.33[a]
P-Value	0.67	0.002
SEM	2.01	0.35

Different letters (a, b, c, d or e) show significant difference.

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REFERENCES

[1] J. Bremer. *Physiol. Review*. **1983**, 63, 1420, 1480.
[2] R.C. Noble, M. Cocchi. *Prog. Lipid Res*., **1990**, 29, 107, 140.
[3] B.K. Speake, A.M. Murray, R.C. Noble. *Prog. Lipid Res.*, **1998**, 37, 1, 32.
[4] P.F. Sural, *Br. Poult. Sci.*, **1999**, 40, 397–405.
[5] A. Agarwal, S.A. Prabakaran, T.M. Said. *J. Androl.*, **2005**, 26, 654, 660.
[6] A. Agarwal, T.M. Said. *Reprod. Biomed. Online*, **2004**, 8, 376, 384.
[7] E. Vicari, A.E. Calogero. *Hum. Reprod*., **2001**, 16, 2338, 2342.
[8] M.T. Kidd, C.D. Mcdaniel, E.D. Peebles, S.J. Barber, A. Corzo, S.L. Bravton, J.C. Woodworth. *Br. Poult. Sci*., **2005**, 46, 91–103.
[9] E.T. Moran. *Poult. Sci*., **2007**, 86, 1043–1049.
[10] J. Buyse, G.P. Janssens, E. Decuypere. *Br. Poult. Sci.*, **2001**, 42, 230-241.
[11] P. Chiodi, B. Ciani, S. Kentroti, F. Maccari, A. Vernadakis, L. Angelucci, M.T. Ramacci. *Int. J. Biochem*., **1994**, 26, 711, 720.
[12] E.R. Casillas, R.W. Newburghl. *Biochim. Biophys. Acta.*, **1969**, 184, 566, 577.
[13] P.R. Borum. *Annu. Rev. Nutr*., **1983**, 3, 233, 259.
[14] C.J. Rebouche. *FASEB J*., **1992**, 6, 3379–3386.
[15] National Research Council,. Nutrients requirements of poultry. Ninth revised edition, National academy press .Washington, D.C. **1994**.

[16] SAS Institute, SAS User's Guide. Version 8 ed. SAS Inst. Inc., Cary, NC. **2001**.
[17] J.W. Duncan, Multiples range and multiple F tests. *Biometrics*, **1955**, 11, 1.
[18] W. Zhai, S.L. Neuman, M.A. Latour, P.Y. Hester. *Poult. Sci*., **2008**, 87, 1171, 1181.
[19] W. Zhai, S.L. Neuman, M.A. Latour, P.Y. Hester. *Poult. Sci*., **2008**, 87, 569, 572.
[20] M.H. Rabie, M. Szilagyi, T. Gippert. *Br. J. Nutr*. **1997**, 78, 615, 623.
[21] L.B. Celik, A. Tekeli, O. Ozturkcan. *J. Anim. Physiol. Anim. Nutr*. (Berl.) **2004**, 88, 229, 233.
[22] S. Yalcin, A. Ergun, H. Erol, S. Yalcin, B. Ozsoy. *Acta Vet. Hung*. **2005**, 53, 361, 370.
[23] M. Sato, T. Tachibana, M. Furuse. *Comp. Biochem. Physiol.*, **2006**, 143, 382, 388.
[24] M.H. Rabie, M. Szilagyi, *Br. J. Nutr*., **1998**, 80, 391-400.
[25] M.H. Rabie, M. Szilagyi, T. Gippert. *Acta Biol. Hung*., **1997**, 48, 221-239.
[26] R.C. Noble, M. Cocohi. *Prog. Lipid Res.*, **1990**, 29, 107–140.
[27] K.C. Klasing Lipids; Pages 171–200 in Comparative Avian Nutrition. CAB International, New York, NY., **1998**.