Effects of Dietary L-Carnitine (Carniking®) Supplementation on Overall Performance and Carcass Characteristics of Seven-Week-Old Broiler Chickens

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Story in Brief

This study was conducted to evaluate the effects of six dietary L-carnitine inclusion levels on performance, carcass characteristics, and body composition of 7-wk-old broiler chickens. Two-thousand-one-hundred day-old Cobb x Cobb male broiler chickens were received from a commercial hatchery and reared in floor pens under optimum growth conditions until 49 d of age. Upon their arrival, they were randomly distributed into 60 floor pens in a randomized block design (10 pen/trt, 35 birds/pen). L-carnitine levels used in this experiment were control, 40, 80, 120, 160, and 200 ppm. No significant L-carnitine effect was noted on overall feed efficiency, body weight, carcass characteristics, and body composition of broilers at d 49. However, regardless of the inclusion level, dietary L-carnitine improved survivability and as dietary L-carnitine level increased, broiler survivability rate also increased. Increasing survivability with dietary L-carnitine supplementation increased overall live yield without affecting overall performance. In conclusion, this study demonstrated that L-carnitine has the potential to improve the least-cost broiler production.

Key Words: L-carnitine, Carniking®, Broiler Performance, Survivability, Carcass Characteristics

Introduction

High dietary fat consumption, particularly saturated fat, has been associated with the incidence of cardiovascular diseases, diabetes, and colon and breast cancers increasing consumer demand for lean tissue (Jensen, 1982). Nutritionally, people eat poultry meat for its high content of high-quality protein and its low fat content. Therefore, the aim of today's broiler market is to produce a lean animal in as few days as possible with highest benefits to both customers and producers. Enhanced genetic capacity of poultry made it necessary to feed these animals differently from their ancestors to reach the highest genetic potential, and changes in diet formulation are required to meet the nutrient requirements.

Carnitine is a quaternary amine (β-hydroxy γ-trimethylaminobutyrate), which is easily soluble in water and found in two stereo isomeric forms, D- and L-carnitine (McDowell, 1989). The most important and well known function of carnitine is the transport of long-chain fatty acids into the mitochondrial matrix for β-oxidation by the fatty acid oxidation complex (Borum, 1983). It is synthesized in the animals from two essential amino acids, lysine and methionine (Borum, 1983; Feller and Rudman, 1988).

For years, a carnitine requirement was not considered due to endogenous biosynthesis. However, studies show that it becomes an essential nutrient under certain circumstances, such as limited carnitine biosynthesis in young animals, diets high in fat content, and diets low in carnitine. Exciting multiple species data with swine (Bohles et al., 1983; Bohles et al, 1984; Theo et al.,

1993), ruminant (LaCount et al., 1995; Hill et al., 1995), and fish (Bilinski and Jonas, 1970; Santulli and D'Amelio, 1986) have demonstrated the efficiency of L-carnitine to repartition nutrients away from fat deposition and towards muscle accretion. The intent of this research was to evaluate the best carnitine dose applicable to broiler diets.

Materials and Methods

Two-thousand-one-hundred day-old Cobb x Cobb male broilers were received from a commercial hatchery and randomly distributed into 60 floor pens (Figure 1) in a randomized block design. Sixty floor pens were divided into 10 blocks and 6 dietary L-carnitine treatments were randomly assigned into these blocks. Broiler chicks were raised on wood shavings litter. Feed and water were available for ad libitum consumption throughout the experiment period (Figure 2). Twenty-four-hour continuous lighting was provided during the study.

Figure 1. A floor pen

Figure 2. A closer look

L-carnitine levels used in this experiment were 0 (control), 40, 80, 120, 160, and 200 ppm. Birds were fed corn-soy based starter (d 0 to19), grower (d 20 to 35), and finisher (d 36 to 49) diets. Diets were formulated to meet NRC (1994) requirements (Table 1).

Table 1. Composition of the starter, grower, and finisher diets

Ingredients, %	Starter	Grower	Finisher
Corn, ground	49.63	58.84	65.45
SBM, dehulled (47.5 % CP)	41.37	33.56	28.21
Soybean oil	5.34	4.62	3.62
Dicalcium phosphate	1.80	1.27	1.02
Limestone	.98	.93	.92
Salt	.25	.24	.29
Vitamin mix[a]	.20	.20	.20
DL Methionine	.22	.10	.06
Trace mineral mix[b]	.10	.10	.10
Coban®	.05	.05	.05
Selenium mix	.05	.05	.05
Ethoxyquin®	.02	.02	.02
Calculated analysis			
Energy (kcal ME/kg)	3185	3200	3200
Crude protein, %	24	21	19

[a]Vitamin mix is supplied in the following per kg of diet: Vitamin A, 17500 IU; Cholecalciferol, 5000 IU; Vitamin E, 25 IU; Vitamin B_{12}, 0.03 mg; Riboflavin, 15 mg; Niacin, 75 mg; D-panthotenic acid, 25 mg; Choline, 705.5 mg; Menadione, 5 mg; Folic acid, 1.5 mg; Pyridoxine, 6.25 mg; Thiamine, 3.03 mg; D-biotin, 0.127 mg.

[b]Trace mineral mix is supplied in the following per kg of diet: Manganese, 120 mg; Zinc, 100 mg; Copper, 10 mg; Iodine, 2.5 mg; Calcium, 135 mg, Iron, 75 mg; Selenium, 0.15 mg.

Feed consumption (d 0 to 49) and initial (d 0) and final body weights (d 49) were recorded on a group basis. At d 49, four birds from each floor pen were randomly selected and processed for carcass characteristics. Estimated carcass fat values were obtained by the predictive equations using carcass specific gravity data (Wiernusz et al., 1994).

The data were analyzed using ordinary least squares (PROC GLM, SAS Institute, Cary, NC). The model included L-carnitine dose as main effect. Mean separation was accomplished using Least Significant Difference.

Results and Discussion

Dietary L-carnitine effects on final body weight, feed efficiency, and survivability of 7-wk-old broilers are presented in Table 2. No significant carnitine effect was noted on final body weight or feed efficiency (P>.05). Overall performance data did not differ from the findings of Cartwright (1986) and Barker and Sell (1994). However, L-carnitine had a positive impact on survivability (P=.0521). Survivability rate was increased with increasing dietary L-carnitine

levels, but the efficiency in survivability decreased with increasing L-carnitine levels. When carbohydrate and lipid sources are present together, fatty acids are used in preference to glucose in heart tissue and the rate of fatty acid β oxidation in heart is dependent on available exogenous fatty acids, the rate of acetyl-CoA oxidation by the citric acid cycle, and utilization of energy by the tissue (Neely and Morgan, 1974). Therefore, improved survivability could be attributed to more efficient utilization of fatty acids in heart muscle in the presence of dietary L-carnitine supplementation.

Table 2. Effect of L-carnitine (Carniking®) on body weight, feed efficiency (F/G), and survivability of 7-wk-old broilers

L-carnitine (ppm)[a]	Body weight (g)	Feed efficiency (F/G)	Survivability (%)
0 (Control)	2625	2.06	90.3
40	2613	2.138	93.8
80	2645	2.122	94.5
120	2584	2.132	95.3
160	2580	2.10	96.3
200	2633	2.11	96.3
Pooled SEM	24.2	.030	1.46
Probability	.3329	.1663	.0521

[a]Carniking is recommended for the manufacture of dry feed and has 48.5 to 52.0% L-carnitine potency.

Effects of L-carnitine on carcass characteristics and carcass fat percentage of 7-wk-old broilers are displayed in Table 3. There was a numerical increase in dressing percentage with L-carnitine supplementation. No significant L-carnitine effect (P≥.1) was observed on dressing percentage, breast yield, abdominal fat pad, and/or carcass fat.

Table 3. Effect of L-carnitine (Carniking®) on certain carcass characteristics and carcass fat percentage of 7-wk-old broilers

L-carnitine (ppm)[a]	Dressing percentage (%)	Breast yield (%)	Abdominal fat pad (g)	Carcass fat (% of body wt)
0 (Control)	73.2	20.1	28.09	11.97
40	73.4	20.1	28.14	12.35
80	73.8	19.6	27.22	12.19
120	74.1	19.9	26.98	12.06
160	73.5	20.1	26.14	12.36
200	74.2	19.7	28.03	12.07
Pooled SEM	.034	.23	1.2	.34
Probability	.7856	.2165	.4998	.9297

[a]Carniking is recommended for the manufacture of dry feed and has 48.5 to 52.0% L-carnitine potency.

Implications

Dietary L-carnitine supplementation tends to improve total meat output per amount of feed consumed by improving survivability. Also, dietary L-carnitine supplementation may have a

beneficial effect on broiler nutrition status, presumably due to its sparing effect on its precursors lysine and methionine.

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