THE EFFECT OF L-CARNITINE ADDITIONS ON PERFORMANCE AND CARCASS CHARACTERISTICS OF GROWING-FINISHING SWINE[1]

K. Q. Owen, T. L. Weeden, J. L. Nelssen, and R. D. Goodband

Summary

An experiment was conducted to evaluate the efficacy of dietary carnitine on growth performance and carcass characteristics of growing-finishing swine. The trial was designed to investigate the response of pigs fed carnitine from weaning to market vs control pigs receiving no carnitine. In addition, the performance of these pigs was compared to that of pigs fed carnitine only during the starter or finishing phases. The trial was broken down into the following four phases: 1) phase I (0 to 14 d post weaning) 2) phase II (14 to 35 d post weaning) 3) grower (d 35 to 135 lb), and 4) finisher (135 to 230 lb). One hundred and twenty-eight pigs averaging 11.40 lb were used in the first two phases to investigate the effects of added carnitine on the performance of the early weaned pig. This also assisted in finding the proper carnitine administration period to elicit optimum growth performance and carcass characteristics in growing-finishing pigs. During phases I and II, one half of the pigs received a high nutrient density diet (HNDD) containing 1000 and 500 ppm, respectively, of carnitine; the other half received a HNDD with no added carnitine. These HNDD were formulated to contain 1.45% and 1.25% lysine, respectively. Pigs were allotted to pens on the basis of weight and sex, with each pen being randomly assigned to treatment. There was a total of 32 pens each containing four barrows or four gilts per pen. During phase I, pigs consuming the diet with carnitine were more efficient and had slightly higher daily gains. Nevertheless, during phase II, pigs receiving no carnitine had higher daily gains. Over the first 35 d of the trial, pigs offered no carnitine had higher daily gains and daily feed consumptions but were slightly less efficient. After the first two phases, pigs were reallotted within treatments on the basis of weight resulting in one of the following carnitine treatments: 1) feeding carnitine from weaning to market (15 to 230 lbs); (C/C) 2) carnitine during phases I and II only (C/N), 3) carnitine during growing-finishing only (N/C), and 4) no added carnitine (N/N). A total of 95 pigs (three pigs/pen) were used to provide eight replicates/treatment (four replicates/sex). Grower diets contained .85% lysine, and as pigs approached 135 lb, the lysine content was reduced to .75%. Carnitine was supplemented in the growing-finishing diets (N/C and C/C) at 25 ppm. During the growing-finishing phase, there were no difference in performance among treatments. However, a significant increase occurred in longissimus muscle area of pigs receiving carnitine only during the growing-finishing phase as compared to pigs fed no additions of carnitine throughout the trial. This suggests that carnitine supplementation during the growing-finishing phase increases loineye area, but has no effect on growth performance.

(Key Words: L-Carnitine, Growth, Carcass, Starter , G-F.)

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Introduction

Resent research at the University of Georgia has shown that supplementing finishing diets with L-carnitine results in a small reduction in backfat thickness. A similar effect was observed at the Coastal Plains Research Center; however, these results were based on ultrasonic readings with no actual carcass measurements recorded. Resent research at KSU has shown that feeding high levels of carnitine in phase I nursery diets reduced fat accretion through the nursery phase. Limited research has been conducted addressing the effect L-carnitine elicits on carcass composition; however, no data have been collected to determine the subsequent effects of carnitine on performance and carcass characteristics. Therefore, this research was conducted to determine the appropriate dietary carnitine administration period to elicit optimum response of growth performance and carcass composition characteristics of growing-finishing swine.

Procedures

One hundred and twenty eight crossbred pigs, weaned at 21 d of age, and averaging 11.40 lb, were used in a 35 d growth trial. Pigs were allotted to two dietary treatments based upon weight, sex, and ancestory. One-half of the pigs received phase I (d 0-14 postweaning) diets containing 1000 ppm L-carnitine, whereas the other half received no added carnitine. The carnitine level in phase II (d 14 to 35 postweaning) diets was reduced to 500 ppm. There were four pigs per pen with 16 replicate pens per dietary treatment. Pigs were housed in an environmentally controlled nursery in 4 5 ft pens with woven wire flooring. Feed and water were offered on an ad libitum basis.

After the 35-d growth trial, 95 pigs (48 males, 47 females) were reallotted by weight and sex within phases I and II treatment groups. One-half of the pigs receiving carnitine supplementation during phases I and II were kept on diets containing 25 ppm carnitine, whereas the remaining pigs were placed on a basal grower diet without added carnitine. This procedure was also employed with pigs receiving no carnitine supplementation during phases I and II, resulting in four treatments represented in Table 1. The four dietary treatments were randomly assigned within blocks, providing eight replicate pens per treatment (four replicates/sex). Pigs were housed in a fully enclosed, environmentally regulated building with a totally slatted floor. Pig and feed weights were recorded every two weeks.

A total of four basal diets was used during the experiment. All diets (Table 2) were standard corn-soybean meal diets that met or exceeded recommended nutrient requirements. Phase I and II diets were formulated to contain 1.45 and 1.25% lysine, respectively. The grower diet contained .85% lysine, and as pigs approached 135 lb, the lysine content of the diet was reduced to .75%.

As the average pen weight reached 230 lb, 10 pigs/treatment (five pigs/sex) were slaughtered for determination of carcass characteristics.

Results and Discussion

Addition of L-carnitine to the starter diet did not significantly influence ($P > .10$) starter pig performance. However, pigs fed carnitine from d 0 to 14 were 8% more efficient and had 3% higher average daily gains (Table 3). Nevertheless, during phase II (d 14 to 35) and over the 35 d trial, pigs offered diets with no carnitine had 8 and 5% higher average daily gains and consumed 7 and 6% more feed per day, respectively. However, d 0 to 35 data revealed that pigs consuming carnitine were 3% more efficient.

During the grower phase (d 35 to 135 lb), there were no differences ($P > .10$) in performance among any treatment combinations. Similar responses were noted during the finishing phase (135 to 230 lb), but pigs

on the N/N treatment had a tendency to consume more feed per day. Performance from d 35 to 230 lb showed no response to the additions of carnitine during the growing-finishing phase. Feeding high to moderate levels of carnitine in the nursery or low levels in the growing-finishing phase has no subsequent effects on growth performance during the growing-finishing period or over the entire trial.

When pigs were slaughtered at a mean weight of 230 lb, there were no differences in dressing percentages. Average backfat thickness was increased (P=.09, P=.07) in pigs receiving carnitine during the nursery phase (C/N), compared to pigs having no (N/N) or continuous (C/C) carnitine supplementation throughout the trial , respectively. The longissimus muscle area was larger (P=.03) for pigs receiving carnitine additions during the growing-finishing phase (N/C) compared to pigs offered no carnitine (N/N). Also, there was a tendency for pigs receiving added carnitine at some point during the trial to have larger longissimus muscle area than pigs offered no carnitine (N/N). Pigs fed carnitine in the nursery or growing-finishing phase (N/C, C/N, and C/C) had larger livers (P=.09) and smaller hearts (P=.05) than pigs that did not receive carnitine (N/N). Marbling score were inversely related to longissimus muscle area and percent crude protein in the carcass, because marbling scores were highest in pigs that did not receive L-carnitine (N/N). Analysis of carcass samples for fat has not been completed. However, because pigs receiving carnitine only in the growing-finishing phase (N/C) had higher crude protein values (P=.13) and larger loineye areas as compared to pigs receiving no carnitine (N/N), we expect the lipid accretion rates of these pigs on this treatment (N/C) to be lower. The decrease (P=.05) in marbling observed for pigs offered carnitine in the growing-finishing phase (N/C) compared to pigs receiving no carnitine (N/N) supports this assertion.

These data suggest that carnitine may play a larger role in carcass composition than in growth performance. This study shows the need for additional information addressing the action of carnitine as a metabolic modifier. Additionally, more information is needed to determine the optimal feeding level of L-carnitine during the nursery and growing-finishing phases.

Table 1. Carnitine Level (ppm) in Dietary Treatments

Item	Control[a] 15-230 lb	Carnitine[b] 15-50 lb	Carnitine[c] 50-230 lb	Carnitine[d] 15-230 lb
d 0 to 14	0	1,000	0	1,000
d 14 to 35	0	500	0	500
d 35 to 135 lbs	0	0	25	25
135 lbs to 230 lbs	0	0	25	25

[a]No carnitine supplementation throughout trial.
[b]Carnitine supplementation only in phases I and II.
[c]Carnitine supplementation only in growing-finishing phase.
[d]Carnitine supplementation throughout trial.

Table 2. Diet Composition

Ingredient, %	Phase I	Phase II	Grower	Finisher
Corn	33.66	47.00	79.55	79.55
Soybean meal, (44% CP)	18.20	33.10		
Soybean meal, (48.5% CP)			17.66	17.66
Dried skim milk	20.00			
Dried whey	20.00	10.00		
Monocalcium phosphate	1.23	1.85	1.68	1.02
Limestone	.44	.80	.95	.91
Salt	.10	.30	.30	.30
Vitamin premix	.25	.25	.25	.25
Soybean oil	5.00	5.00		
Trace mineral premix	.10	.10	.10	.10
Selenium premix	.05	.05	.05	.05
Copper sulfate	.05	.05	.05	.05
L-Lysine HCl	.22	.10		
DL-Methionine	.10			
Antibiotic[a]	.50	.10	.10	.10
Total	100.0	100.0	100.0	100.0
Calculated Analysis, %				
Protein	20.20	18.96	16.48	15.15
Lysine	1.45	1.25	.85	.75
Ca	.92	.90	.80	.65
P	.82	.80	.70	.55

[a]Anitibiotic was CSP 250: (Sulfathiazole) in phase I, Mecadox: (Carbadox) in phase II and CTC: (Chlortetracycline) in growing-finishing phase.

Table 3. Influence of L-Carnitine on Growth Performance of Nursery Pigs[ab]

Item	Control[c]	Carnitine[d]	CV
d 0 - 14			
ADG, lb	.64	.65	20.3
ADFI, lb	.61	.60	18.1
F/G	1.13	1.04	23.5
d 14 - 35			
ADG, lb	1.03	.95	15.1
ADFI, lb	1.54	1.44	14.1
F/G	1.69	1.71	16.5
d 0 - 35			
ADG, lb	.87	.83	13.9
ADFI, lb	1.17	1.10	13.2
F/G	1.46	1.42	13.7
Initial wt, lb	11.40	11.40	19.9
35 d wt, lb	42.06	40.60	12.4

[a]A total of 128 pigs, 4 pigs/pen, 16 pens/treatment.
[b]No treatments effect ($P > .10$).
[c]No carnitine supplementation throughout phases I and II.
[d]Carnitine supplementation throughout phases I and II.

Table 4. Influence of L-Carnitine on Growth Performance of Growing-Finishing Pigs[ab]

Item	Control[c] 15-230 lb	Carnitine[d] 50-230 lb	Carnitine[e] 15-50 lb	Carnitine[f] 15-230 lb	CV
d 35 to 135 lb					
ADG, lb	1.76	1.75	1.74	1.75	5.1
ADFI, lb	4.87	4.83	4.86	4.80	5.6
F/G	2.77	2.75	2.80	2.75	5.1
d 135 to 230 lb					
ADG, lb	1.78	1.76	1.72	1.76	8.1
ADFI, lb	6.62	6.48	6.33	6.57	10.4
F/G	3.72	3.69	3.67	3.74	5.3
d 35 to 230 lb					
ADG, lb	1.77	1.75	1.72	1.75	16.0
ADFI, lb	5.70	5.62	5.66	5.58	17.8
F/G	3.22	3.21	3.25	3.24	11.9

[a]A total of ninety-five pigs, 3 pigs/pen, 8 pens/treatment.
[b]No treatment effect (P>.10).
[c]No carnitine supplementation throughout trial.
[d]Carnitine supplementation only in growing-finishing phase.
[e]Carnitine supplementation only in phases I and II.
[f]Carnitine supplementation throughout trial.

Table 5. The Influence of L-Carnitine on Carcass Measurements[a]

Item	Control[b] 15-230 lb	Carnitine[c] 50-230 lb	Carnitine[d] 15-50 lb	Carnitine[e] 15-230 lb	CV
Dressing percent	71.08	71.50	71.39	70.8	22.4
Carcass length, in	31.40	31.16	31.45	31.20	2.6
Backfat thickness, in.[fg]	1.27	1.29	1.32	1.24	7.7
LEA, in.[2h]	5.14	5.66	5.32	5.36	9.5
Kidney fat, g	1,826	1,748	1,919	1,895	9.9
Kidney, g	340	306	322	304	15.9
Heart, g[ij]	317	317	300	296	8.6
Liver wt, g[ij]	1,331	1,402	1,400	1,477	9.4
Marbling[hj]	3.40	2.80	3.00	3.05	14.6
Color	2.60	2.60	2.70	2.50	21.1
Firmness	2.05	2.25	2.20	2.50	24.4
Crude protein, %[k]	15.25	16.00	15.45	15.73	6.6

[a]A total of 40 pigs, 10 pigs/treatment, 5 pigs/sex.
[b]No carnitine supplementation throughout trial.
[c]Carnitine supplementation only in growing-finishing phase.
[d]Carnitine supplementation only in phases I and II.
[e]Carnitine supplementation throughout trial.
[f]Carnitine (15-50 lb) vs Carnitine (15-230 lb) (P=.07).
[g]Control vs Carnitine (15-50 lb) (P=.09).
[h]Control vs Carnitine (50-230 lb) (P<.05).
[i]Control vs Carnitine (15-230 lb) (P<.05).
[j]Control vs Carnitine (15-50, 50-230, 15-230) (P<.09).
[k]Control vs Carnitine (50-230) (P=.13).