Effect of L-carnitine supplementation on fattening and carcass parameters of broiler chickens

Cyril Hrnčár*, Simona Verguliaková, Peter Svorad, Ján Weis, Henrieta Arpášová, Slavomír Mindek, Martin Fik, Jozef Bujko

Slovak University of Agriculture in Nitra, Slovak Republic

The aim of the present study was to evaluate the functional efficiency of feed additives on base L-carnitine (30 %) in drinking water on performance and carcass parameters of broiler chickens. The study was realised on 100 Ross 308 broiler chickens randomly divided into two groups. Chickens from the experimental group were supplemented with preparation on the base L-carnitine in drinking water (1 ml per 1.2 l) during three periods: from 1 to 5, 19 to 23, and 37 to 41 days of age. The study evaluated the effect of L-carnitine supplemented to chickens on performance and slaughter parameters. It was found that L-carnitine supplemented to drinking water increase final body weight and improved feed consumption over the whole fattening period. From carcass parameters addition of preparation on base L-carnitine statistically significant increased proportion of leg muscle in males, not significantly reduced the proportion of breast muscle in males and females and increased carcass yield in both of sexes. The addition of L-carnitine in broiler chickens from the experimental group had little effect on the percentage of fat, gizzard, liver and heart in the carcass.

Keywords: broiler, chicken, L-carnitine, fattening, carcass

1. Introduction

L-carnitine is synthesized in vivo from lysine and methionine, and it is formed with contributions from vitamins B_3, B_6, B_{12}, C and folic acid, as well as iron (Golzar Adabi et al., 2011; Michalczuk et al., 2012). It has been reported that L-carnitine has two major functions. The best known is to facilitate the transport of long-chain fatty acids across the inner mitochondrial membrane. L-carnitine also facilitates the removal of short and medium-chain fatty acids from the mitochondria that accumulate as a result of normal and abnormal metabolism (Matalliotakis et al., 2000; Buyse et al., 2001; Xu et al., 2003).

Thus, dietary L-carnitine supplementation promotes the β-oxidation of these fatty acids in order to generate adenosine triphosphate (ATP) energy and improve energy utilization (Rabie et al., 1997; Neuman et al., 2002; Corduk et al., 2007).

Consequently, L-carnitine supplementation in diets reduces the amount of long-chain fatty acids availability for esterification to triacylglycerols and storage in the adipose tissue (Barker and Sell, 1994; Xu et al., 2003).

In addition, L-carnitine has secondary functions, including the containment, buffering and removal of potentially toxic acyl groups from cells, equilibrating the ratio of free CoA and acetyl-CoA between the mitochondria and cytoplasm, participating in biological processes such as regulation of gluconeogenesis, stimulating fatty acid and the metabolism of ketones, branched-chain amino acids, triglycerides and cholesterol (Novotny, 1998; Corduk et al., 2007).

The objective of the study was to investigate the effect of preparation on the base L-carnitineon performance of broiler chickens and results of slaughter analysis.

2. Material and methods

The experiment was realised in extensive conditions in breeding pens with deep litter with housing density 30 kg m^{-2}. A total of 100 broiler chickens Ross 308 were randomly divided into two groups (control and experimental – preparation with 30 % of L-carnitine). Broiler chickens in the control (C) and experimental groups (E) received a feed of the same nutritional value and chickens from experimental group were supplemented by preparation on the base L-carnitine (30.00 %), arginin chloride (19.33 %), taurine (13.33 %), magnesium gluconate (6.67 %), N-acetylocysteine (6.67 %), biotine (0.00667 %), sorbitol (0.30 %), aromatic additives (5.28 %) and vehiculum (wheat feed flour ad 1000 g). Broiler chickens were fed commercial feed

***Correspodence:** Cyril Hrnčár, Slovak University of Agriculture in Nitra, Faculty of Agrobiology and Food Resources, Department of Poultry Science and Small Animal Husbandry, Tr. Andreja Hlinku 2, 949 76 Nitra, Slovakia, e-mail: cyril.hrncar@uniag.sk

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Table 1 Nutritive values of feed mixtures in experiment

Nutrient	Units	Starter	Grower	Finisher
Crude protein	%	min. 20.00	min. 18.30	min. 17.00
Fat	%	min. 4.80	min. 4.00	min. 6.00
Fibre	%	max. 4.00	max. 5.00	max. 5.00
Lysine	%	min. 1.20	min. 1.10	min. 0.90
Methionine	%	min. 0.52	min. 0.48	min. 0.45
Calcium	%	min. 0.80	min. 0.80	min. 0.55
Phosphorus	%	min. 0.55	min. 0.55	min. 0.50
Sodium	%	min. 0.12	min. 0.12	min. 0.12
Cupper	mg kg^{-1}	min. 15.00	min. 15.00	min. 15.00
Zinc	mg kg^{-1}	min. 80.00	min. 80.00	min. 80.00
Manganese	kg kg^{-1}	min. 120.00	min. 70.00	min. 100.00
Iron	mg kg^{-1}	min. 120.00	min. 100.00	min. 100.00
Iodine	mg kg^{-1}	min. 0.90	min. 0.40	min. 0.40
Selenium	mg kg^{-1}	min. 0.20	min. 0.10	min. 0.10
Vitamin A	m.j. kg^{-1}	min. 12000	min. 10000	min. 10000
Vitamin D3	m.j. kg^{-1}	min. 5000	min. 5000	min. 5000
Vitamin E	mg kg^{-1}	min. 60.00	min. 50.00	min. 50,00
Natrium salinomycinate	mg kg^{-1}	60.00	60.00	–
Endox	mg kg^{-1}	125.00	125.00	125.00

mixtures: starter (days 1 to 21), grower (days 22 to 35) and finisher (days 36 to 42). The nutritive values of the feed mixtures are presented in Table 1.

During the experiment broiler chickens were weighted for individual body weight at 1, 7, 14, 21, 28, 35 and 42 days of age, feed consumption and mortality were recorded at the end of fattening period. In 42 day of fattening, 5 male and 5 females with body weight similar to the mean were chosen from each group for slaughter weighed and subjected to a 12-hours feed withdrawal. After slaughter, carcasses were chilled, weighed and subjected to simplified dissection. Abdominal fat, edible giblets and breast and leg muscles were collected and weighed. The results obtained were used to calculate dressing percentage and the percentage of carcass components. We used SAS software version 9.3.1 (2003) to conduct statistical analyses, *t*-test was used to calculate basic statistic characteristics and to determine significant differences between experimental and the control groups. The choice of tests was made automatically according to the distribution of the data. Data presented were given as mean and standard deviation (SD). Differences between groups were compared for statistical significance at the level $P < 0.05$.

3. Results and discussion

Table 2 showed the average body weights of broiler chickens at 1, 7, 14, 21, 28, 35 and 42 days of fattening. The experimental group chickens with supplementation of L-carnitine achieved higher body weights in comparison with the control group. Significant differences ($P < 0.05$) were noted at 28, 35 and 42 days of fattening. At the end of fattening period, supplementation of preparation on the base L-carnitine statistically increased ($P < 0.05$) body weight in males (Table 3). The preparation also had an effect on final body weight of females, but the differences were not significant ($P < 0.05$). Nouboukpo et al. (2009), who investigated the effect of L-carnitine supplementation in drinking water on the growth ability of broiler chickens, observed at 7 days of rearing that chickens from the control group had significantly lower body weight compared to the experimental groups receiving 30 and 60 mg of L-carnitine in 1 l of drinking water. Rabie and Szilagyi (1998) and Buyse et al. (2001) observed a positive effect of L-carnitine on the body weight of chickens on the end of fattening period but the differences were not significant ($P < 0.05$). Other authors who studied the effect of L-carnitine on broiler performance found that it had no effect on body weight (Leibetseder 1995; Lien and Horng, 2001; Xu et al. 2003; Cevik and Ceylan 2005).

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Table 2 Comparison of body weight of broiler chickens in control and experimental groups during fattening period in grams

Day of fattening	Group	
	control	experimental
	mean ± SD	mean ± SD
Day 1	45.09 ± 4.39	46.11 ± 4.52
Day 7	119.62 ± 16.47	127.84 ± 17.69
Day 14	291.29 ± 44.42	309.57 ± 47.61
Day 21	684.71 ± 98.76	704.53 ± 96.04
Day 28	1149.86 ± 142.86[b]	1288.05 ± 144.52[a]
Day 35	1647.27 ± 199.31[b]	1799.64 ± 197.69[a]
Day 42	2226.88 ± 238.47[b]	2375.38 ± 227.63[a]

[a, b] – means in a row with different superscript differ significantly (P <0.05)

Table 3 Comparison of body weight of broiler chickens in control and experimental groups in 42 day of fattening in grams

Sex	Group	mean ± SD
Male	control	2456.43 ± 203.18[b]
	experimental	2588.07 ± 205.67[a]
Female	control	2096.43 ± 195.25
	experimental	2134.07 ± 197.42

[a, b] – means in a row with different superscript differ significantly (P <0.05)

Totally feed consumption per kg live body weight was different between groups (1.74 vs. 1.79 kg) in benefit of experimental group with 1 ml preparation on the base L-carnitine per 1.2 l of drinking water. Similar results were observed by other authors (Rabie and Szilagyi, 1998; Geng et al., 2004; Czeczot and Ścibor, 2005; Geng et al., 2007). Our results are not supported by the studies of Buyse et al. (2001) and Rezaei et al. (2007), according to these authors L-carnitine supplemented to chickens had no effect on feed conversion.

The mortality rate in the both groups was identical (4.00 %). De Simone et al. (1982) and Daskirian and Teeter (2001) observed decrease in mortality in broilers receiving dietary L-carnitine.

Addition of L-carnitine in drinking water to the experimental group caused a non-significant (P <0.05) decrease in the percentage of breast muscle in males and females compared to the control group (Table 4). The addition of acetyl-L-carnitine caused a non-significant increase (Zhang et al., 2010) or significantly increases (Xu et al., 2003) in the proportion of breast muscle in the carcass. Daskirian and Teeter (2001) reported that dietary L-carnitine supplementation no affected the proportion of breast muscle.

Supplementation of L-carnitine to the experimental group of males statistically significant increased of leg muscle and non-significant decreased the proportion of leg muscle in females compared to the control group

Table 4 Comparison of some carcass items of broiler chickens in control and experimental groups in slaughter analyse in %

Carcass item	Sex	Group	Mean ± SD
Breast muscle	male	control	30.76 ± 0.51
		experimental	29.27 ± 0.39
	female	control	30.37 ± 0.54
		experimental	29.98 ± 0.48
Leg muscle	male	control	19.62 ± 0.71b
		experimental	22.33 ± 0.64a
	female	control	20.01 ± 0.62
		experimental	19.98 ± 0.58
Abdominal fat	male	control	1.72 ± 0.27
		experimental	1.66 ± 0.29
	female	control	2.14 ± 0.62
		experimental	2.12 ± 0.49
Carcass yield	male	control	75.09 ± 0.88
		experimental	75.46 ± 1.14
	female	control	74.49 ± 1.12
		experimental	74.88 ± 1.37

[a, b] – means in a row with different superscript differ significantly (P <0.05)

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Table 5 Comparison of some edible giblets of broiler chickens in control and experimental groups in slaughter analyse in %

Giblet	Sex	Group	Mean ± SD
Liver	male	control	2.14 ± 0.17
		experimental	2.12 ± 0.16
	female	control	2.27 ± 0.24
		experimental	2.32 ± 0.29
Gizzard	male	control	0.85 ± 0.09
		experimental	0.84 ± 0.06
	female	control	1.22 ± 0.11
		experimental	1.18 ± 0.10
Heart	male	control	0.54 ± 0.05
		experimental	0.51 ± 0.04
	female	control	0.53 ± 0.05
		experimental	0.55 ± 0.04

[a, b] – means in a row with different superscript differ significantly (P <0.05)

(Table 4). Zhang et al. (2010) recorded statistically non-significant increase in the proportion of leg muscle.

L-carnitine supplementation decreased carcass abdominal fat in broiler chickens of both sexes (Table 4). Xu et al. (2003) found a decrease in the abdominal fat of carcasses from males. In the group supplemented with L-carnitine, the abdominal fat content decreased significantly in relation to the control group. Similar results were recorded by Kamińska (2003) and Wang et al. (2003). These authors recorded statistically significant decrease of fat content in the experimental broiler chickens supplemented with L-carnitine. Opposite results to those in the L-carnitine study were obtained by Buyse et al. (2001), who observed the proportion of abdominal fat to increase in the experimental group of males and to decrease in females.

Carcass yield of males and females was higher in the experimental group in both sexes that received L-carnitine compared to the control group (Table 4), but the differences were not significant (P <0.05). Similar results were obtained by Daskirian and Teeter (2001) and Zhang et al. (2010) that the carcass yield of which increased as a result of L-carnitine supplementation, but the differences were not significant. Different results were recorded by Celik and Ozturkcan (2003), Celik et al. (2003) and Kidd et al. (2009) who observed that supplementation of L-carnitine had no effect on carcass yield.

The supplementation of L-carnitine in broiler chickens from the experimental group had little effect on the percentage of gizzard, liver and heart in the carcass (Table 5). In males, the proportion of gizzard remained almost unchanged and the proportion of liver and heart slightly decreased in the L-carnitine-supplemented group compared to the control group. In females from the experimental group, the proportion of gizzard and heart decreased, the proportion of liver increased, but the differences were not significant (P <0.05). Arslan et al. (2004) showed a significant increase in liver percentage in group with L-carnitine supplementation. Buyse et al. (2001) observed average liver and heart weight to not significant increase in both males and females. Decreased weight of gizzard was found by Rabie and Szilagyi (1998), however, differences between control and experimental group (50 mg of L-carnitine per 1 kg of feed) were not significant. Not significant increase in average liver weight was also reported by Celik et al. (2003). In contrast, Rezaei et al. (2007) recorded decrease of liver weight in broiler males with L-carnitine addition.

4. Conclusions

In this experiment feed additive of preparation on the base L-carnitine with 30.00 % of L-carnitine had a positive effect on body weight and feed consumption in the end of fattening period. The addition of L-carnitine in drinking water positively affected the proportion of leg muscle in broiler chickens males. In other slaughter parameters we recorded statistically non significant differences between experimental group with supplementation of L-carnitine and control group.

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