Study the effects of different levels of fat and L-carnitine on performance and carcass characteristics of broiler chicks

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Abstract

An experiment was conducted in order to study the effect of 3 levels of fat (1, 3, 5%), and 2 levels of L-carnitine (0, 250 mg/kg) on 360 male Ross broiler chicks in a factorial arrangement (2×3) with completely randomized design with 6 treatments, 4 replicates, and 15 chicks in each replicates. All diets were isocaloric and isonitrogenous and were fed to chicks from 1 to 42 days of ages. During the experiment feed intake, body weight gain, and feed conversion ratio were measured weekly. Mortality was measured throughout the experiment. At 42 days of ages 4 birds from each treatment were slaughtered for determination carcass characteristics. Data of the experiment were analyzed by GLM procedure of SAS. Increasing of fat in the diets significantly improved performance of chicks in grower (22 to 42 days) and whole period (1 to 42 days) of the experiment (P<0.05). Chicks fed with diets containing 3% fat had the highest breast meat and lowest abdominal fat percentage (P<0.05). Adding L-carnitine to diets hadn't significant effect on performance and carcass characteristics. Interaction between fat and L-carnitine was significant on liver weight (P<0.05). Dietary treatments hadn't significant effect on mortality.

Keywords: fat; L-carnitine; broiler; performance; breast meat

Introduction

Excessive carcass fat accumulation, particulary in the abdominal and visceral areas, is one of the major concerns for broiler producers. This fat is generally undesirable for consumers and represents a waste product to the poultry processor. Numerous attempts have been made to minimize this fat accumulation, either genetically or by dietary manipulation, with different degrees of success**.** Dietary L-carnitine could play a role in reducing the undesirable fat in carcasses of broiler.
L-carnitine 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 (Bremer, 1983). Although cereal grains and their by-products have a low L-carnitine content (Baumgartner and Blum, 1997). They usually represent the major component of poultry diets. Consequently, L-carnitine supplementation in diet or in drinking water would be useful for facilitating fatty acid oxidation. Indeed; previous studies reported that dietary L-carnitine supplementation decreased abdominal fat deposition in broilers (Rabie et al. 1997a, Rabie and Szilagyi, 1998, Xu et al., 2003). The aim of the present study was to investigate the effects of supplemental L-carnitine in diets with different levels of fat on performance and carcass characteristics of Ross male broiler chicks**.**

Materials and methods

In a factorial arrangement with 3 levels of soy oil (1, 3, 5 %) and 2 levels of L-carnitine (0, 250 mg/kg), three hundreds and sixty, one-day old Ross 308 male broiler chicks were randomly distributed in 24 pens with 15 chicks in each pens. Diets were formulated by using of UFFDA software. All diets were isocaloric and isonitrogenous. The main ingredients in diets were corn, soybean meal and fish meal. Experimental diets were fed from 1 to 42 days of age. Starter and grower diets were fed from 1 to 21 and 21 to 42 days of age. The ingredients percentage and chemical composition in starter and grower periods are shown in Table 1. Feed and water were provided *ad-libitum* during the entire experimental period. During the experiment feed intake, body weight gain, feed conversion ratio were measured weekly. Mortality was measured throughout the experiment. In day 42, one chick from each pen, with body weight similar to pen average body weight, was selected and slaughtered to determine carcass, breast meat, abdominal fat, heart, liver weight and percentage. Feed and water were withdrawal 12, and 4 hours before slaughtering. There were 6 (3 levels of fat and 2 levels of L-carnitine) treatments and 4 replicates with 15 chicks in each replicate. Data from this experiment were analyzed using the General Linear Model (GLM) procedure of SAS (SAS Institute, 1998). When differences among means were found, means were separated using Duncan's multiple ranges test (Steel and Torrie, 1980).

Results and discussion

Results of the present experiment are presented in Tables 2 and 3. Effects of fat on feed intake was significant in all periods of the experiment ($P<0.05$).With increasing the levels of fat in diets feed intake improved. It also increased body weight gain and feed conversion ratio in grower and whole period of the experiment ($P<0.05$). These findings are in agreement with results of previous studies (Lien and Horng, 2001, Xu et al., 2003). Dietary fat had significant effect on breast meat percentage and fat content of breast meat ($P<0.05$). Increasing the level of fat in diets from 1 to 3 or 5 % improved breast meat yield. Effect of dietary fat was significant on abdominal fat and liver percentage. Supplemental L-carnitine had not significant effect on feed intake, body weight gain and feed conversion ration in all phases of the experiment. Adding L-carnitine had not significant effect on breast meat yield and liver and heart weights. Adding of L-carnitine trend to have a significant effect in lowering abdominal fat ($P=0.07$). The fat-lowering effect of dietary L-carnitine obtained in the present study may be explained, at least partly, by a reduction in hepatic lipogenic capacity, since liver is the major site of lipogenesis in poultry but other factors may be also responsible for the regulation of the rate of fat accumulation in adipose tissue. This may imply that abdominal fat is the most susceptible component of a broiler carcass for alternation by dietary L-carnitine. This suggestion was supported by the findings of other investigators that supplemental dietary L-carnitine up to 60 mg/kg significantly affected the fatty acids composition of abdominal fat and tended to improve the fattening performance of broiler chickens (Lottner et al., 1992). Conversely, other studies with poultry have been shown that abdominal fat did not affected by adding dietary L-carnitine (Barker and Sell, 1994, Cartwright, 1986). Interaction of fat and L-carnitine had not significant effect on performance, and carcass characteristics. Reports on the effect of dietary L-carnitine on growth performance are conflicting and may be related to inter-species differences, age, sex, feeding program, diet composition, level of L-carnitine, its precursors in the diet and environmental conditions (Rabie et al 1997a, Rabie and Szilagyi, 1998). Results of the present study indicated that the effectiveness of supplemental dietary L-carnitine for improving performance and carcass characteristics may be depend on condition which L-carnitine is added. Under the condition of this experiment, adding 250 mg/kg L-carnitine to broiler diet in some extend reduced abdominal fat percentage.

Table 1 Composition of diets used in starter (1-21) and grower period (22-42) days of age.

	Starter			Grower		
Ingredients	1	2	3	1	2	3
Corn	60.3	54.98	49.77	65.96	60.14	54.3
Soybean meal	33.0	34.02	35.02	28.94	30.06	31.19
Fish meal	1.80	1.80	1.80	0.00	0.00	0.00
Soy oil	1.00	3.00	5.00	1.0	3.0	5.0
Limestone	1.20	1.20	1.20	1.33	1.32	1.31
Dicalcium phosphate	1.16	1.12	1.13	1.05	1.06	1.07
Vitamin premix	0.25	0.25	0.25	0.25	0.25	0.25
Mineral premix	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin E	0.10	0.10	0.10	0.10	0.10	0.10
Salt	0.30	0.30	0.30	0.25	0.25	0.25
Methionie	0.11	0.11	0.12	0.05	0.06	0.06
Total	100	100	100	100	100	100
Composition (%)						
ME (kcal/kg)	2878	2878	2878	2940	2940	2940
CP	20.72	20.72	20.72	18.34	18.34	18.34
Ca	0.89	0.89	0.89	0.82	0.82	0.82
A_P	0.39	0.39	0.39	0.32	0.32	0.32
Methionie+cystine	0.78	0.78	0.78	0.65	0.65	0.65
Methionine	0.45	0.45	0.45	0.35	0.35	0.35
Lysine	1.12	1.12	1.12	0.95	0.95	0.95
Arginine	1.33	1.33	1.33	1.15	1.15	1.15

Diets 1, 2, and 3 contain 1, 3, 5 % of soy oil respectively.

Table 2 Effect of different levels of fat and L-carnitine on performance of broiler chicks.

Carnitine (mg/kg)		0			250		SEM
Fat (%)	1	3	5	1	3	5	
Feed intake (g)	3588.2^{e}	3606.2^{abc}	3626.0^{a}	3579.5^{abc}	3595.2^{bc}	3621.5^{ab}	25.98
Gain (g)	1942.7^{b}	1968.0^{a}	1975.5^{a}	1948.0^{b}	1969.5^{a}	1974.2^{a}	17.01
FCR (g:g)	1.847^{a}	1.832^{bc}	1.835^{b}	1.846^{a}	1.825^{c}	1.834^{bc}	0.007

Means with different superscripts in each rows differ significantly (P<0.05**).**

Table 3 Effect of different levels of fat and L-carnitine on carcass characteristics of broiler chicks (%).

L-carnitine (mg/kg)		0			250		SEM
Fat (%)	1	3	5	1	3	5	
Breast meat	15.02^{c}	17.05^{ab}	16.35^{bc}	14.82^{c}	18.03^{a}	17.59^{ab}	0.2
Brest meat fat	0.58^{c}	1.64^{a}	1.59^{a}	0.45^{c}	1.09^{b}	1.68^{a}	0.06
Abdominal fat	1.94^{a}	0.91^{b}	1.86^{a}	1.52^{a}	0.68^{b}	1.75^{a}	0.06
Liver weight	2.12^{c}	2.85^{a}	2.95^{abc}	2.30^{cb}	2.33^{cb}	2.73^{ab}	0.06
Heart weight	0.39^{a}	0.36^{a}	0.35^{a}	0.37^{a}	0.36^{a}	0.36^{a}	0.008

Means with different superscripts in each rows differ significantly (P<0.05**).**

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