Global Veterinaria 8 (3): 276-279, 2012
ISSN 1992-6197

Effects of Dietary L-Carnitine Supplementation on Body Composition and Growth Performance in Caspian Sea Kutum (*Rutilus firsii kutum*)

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Abstract: The effect of dietary L-carnitine on growth performance and body composition were studied in Caspian Sea Kutum (*Rutilus firsii kutum*). Fish were randomly allocated in 12 tanks (20 fish per tank) and triplicate groups of Caspian Sea Kutum (initial weight 13.21±2.5g) were fed supplementation with Biomar. The L-carnitine were used in three concentrations of 500, 1000 and 2000 mg/kg of formulate diet. The Caspian Sea Kutum in experimental treatments was fed of the three levels of L-carnitine with 7 percent body weight (3 times a day). The fish in control treatment was fed without supplemented formulate diet for 70 days. The growth factors and body composition of fish fed on L-carnitine were compared to those fishes in control treatment that fed of unsupplemented formulate diet. The results showed that fish fed the L-carnitine had not significantly increased final body weight in comparison to control treatment ($p>0.05$). The L-carnitine also had not significant positive effects on growth performance and percentage of carcass ash ($p>0.05$) but the percentage of protein and lipid had significantly different between treatments ($p<0.05$).

Key word: Caspian Sea Kutum · *Rutilus firsii kutum* · L-Carnitine · Growth Performance · Body Composition

INTRODUCTION

L-carnitine is a water-soluble quaternary amine that occurs naturally in microorganisms, plants and animals [1] and synthesized from the essential amino acids lysine and methionine with the assistance of vitamin C and other compounds produced in the body [2]. It functions as a cofactor for the transport of fatty acids into the mitochondrial matrix. Increased import of fatty acids into the mitochondria for oxidation has the potential to spare the catabolism of proteins for energy. Thus animals fed diets with elevated L-carnitine contents may have more protein energy available for growth [3].

The researchers have been studying to replace animal protein sources with proteins derived from plant material or some feed additives for stimulate to the growth. One of these additives is L-carnitine which can increase lipid catabolism and might also lead a protein sparing effect [3-5], pointed out that the improvement of vitamin C metabolism by *Spirulina* as feed supplement eventually activated lipid metabolism through L-carnitine metabolism. Several enzymes are involved in the lipid and L-carnitine metabolism process. For instance, L-carnitine palmitoly transferase, as lipolysis enzyme, performs a function to exchange of coenzyme A for carnitine to facilitate the transfer of acyl groups into mitochondria for *â*-oxidation [3, 6, 7]. So far, a relatively small amount of work has been done on the effects of L-carnitine on muscle fatty acid composition of fish.

Past studies have shown that L-carnitine has growth promoting effect on a number of fish species sea bass [8], African catfish [9] and red sea bream [10]. Furthermore, work of researchers has suggested that L-carnitine may increase the growth rate of carp [11]. Contrary to the above observation a clear effect of L-carnitine on growth of rainbow trout was not observed [12, 13]. On the other hand, inclusion of different levels of L-carnitine in diet has negligible or even negative effects on growth in warm water [14-18] and cold water species [19-22].

Although it is not clear how L-carnitine affects fish growth it is generally assumed that L-carnitine stimulates fatty acid oxidation and protein sparing action of lipids. Thus the improvement in protein utilization results in an increase in growth.

The L-carnitine pool in fish is derived both from endogenous synthesis and diet, L-carnitine is synthesized from lysine and methionine. The carbon and nitrogen atoms of L-carnitine come from the amino acid lysine while

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the N-methyl groups come from the S-methyl group of methionine [23]. The objective of this experiment was to evaluate the effects of dietary L-carnitine on growth performance and body composition of Caspian Sea Kutum.

MATERIALS AND METHODS

The L-carnitine was prepared from the LONZA LTD Company (Sweden). Also formulate diet was provided by aquatic foods company in sari (iran). Nutrient compositions of experimental diets are given in Table 1. Proximate composition of diets was carried out using the Association of Official Analytical Chemists [24] methods. Protein was determined by measuring nitrogen (N×6.25) using the Kjeldahl method; Crude fat was determined using petroleum ether (40–60 Bp) extraction method with Soxhlet apparatus and ash by combustion at 550°C.

This experiment was conducted in a completely randomized design with four treatments (three L-carnitine levels and a control), and three replicates per treatment for a total of twelve fiberglass tanks (each with a capacity of 60 liters). Caspian Sea Kutum (initial weight: 13.21±2.5 g) were obtained from the Institute of Fish Hatchery in Gorgan, Iran. The Density of fish per tank was 20 fish. Caspian Sea Kutum in control and experimental treatments were fed 7 percent of their body weight for 3 times a day (8.00, 16.00 and 24.00). The control treatment was fed without supplemented formulate diet. Water quality parameters of input water to rearing system were monitored each week throughout the experimental period. The water temperature was 19.46±1.23°C, pH was 7.85±0.26 and water oxygen level was maintained above 7.65±0.55 mg L^{-1} during the experiment an electrical air pump (by a single filtration unit).

The fish were weighed individually at the beginning and at the end of the experiment. Before distributing fish to the experimental tanks (the beginning of exogenous feeding), 60 fish were sampled from the holding tank for biometry. At the end of experiment, 40 fish from each tank were sampled and the final weight and length of body were measured. Growth parameters of fish were calculated based on the data of biometry of Caspian Sea Kutum.

Table 1: Nutrient composition of experimental diets (%)

Ingredients	%
Protein	37-40
Lipid	10-12
moisture	8-9
Ash	10-12
Vitamin	5

One-way ANOVA and Duncan's multiple range tests were used to analyze the significance of the difference among the means of treatments by using the SPSS program.

RESULTS AND DISCUSSION

The one-way ANOVA showed a significant effect of L-carnitine on body composition (percentage of protein and lipid) ($p<0.05$) in Table 2.

The maximum of body protein observed in control treatment (84.05±1.23 %) and had significantly different from other treatments ($p<0.05$), followed by T1 (82.35±1.12%) and T2 (82.15±1.19%), than for this two treatments were no significant difference among each other ($p<0.05$) and the lowest of body protein observed in T4 (79.65±1.99%) than it had significantly different from other treatments ($p<0.05$).

The maximum body ash was observed in control treatment (6.55±0.39%) and in other treatments with different supplemented dosage of L-carnitine body ash was lower than control treatment, but they had not significant different to each other ($p<0.05$).

Table 2: Body composition of Caspian Sea Kutum (*Rutilus firsii kutum*) in experimental treatments (trial 1-3) and control

	Treatment			
	Control Unsupplemented L-carnitine	T1 supplemented L-carnitine with 600 mg/kg	T2 supplemented L-carnitine with 1200 mg/kg	T13 supplemented L-carnitne with 2000 mg/kg
Protein (%)	84.05±1.23^{a}	82.35±1.12^{ab}	82.15±1.19^{ab}	79.65±1.99^{b}
Ash (%)	6.55±0.39^{a}	5.5±0.48^{a}	5.12±28^{a}	5.31±0.98^{a}
Lipid (%)	7.66±1.30^{b}	8.85±1.2^{b}	7.72±1.34^{b}	14.5±1.12^{a}

Groups with different alphabetic superscripts differ significantly at $p<0.05$ (ANOVA)

Table 3: Growth parameters of Caspian Sea Kutum (*Rutilus firsii kutum*) in experimental treatments(trial 1-3) and control

	Treatments			
Growth Indices	Control Unsupplemented L-carnitin	T1 supplemented L-carnitin with 600 mg/kg	T2 supplemented L-carnitin with 1200 mg/kg	T13 supplemented L-carnitin With 2000 mg/kg
Initial weight (g)	13.21±2.5	13.21±2.5	13.21±2.5	13.21±2.5
Final body weight (g)	17.31±0.39[a]	17.6±0.27[a]	17.41±0.45[a]	17.99±0.34[a]
Body weight increased (g)	4.1±0.53[a]	4.39±0.43[a]	4.2±0.49[a]	4.78±0.57[a]
Specific growth rate for weight (% BW day^{-1})	0.45±0.0[a]	0.49±0.0[a]	0.48±0.0[a]	0.51±0.01[a]
condition Factor	2.37±0.68[a]	2.01±0.32[a]	1.98±0.47[a]	2.04±0.26[a]

Groups with different alphabetic superscripts differ significantly at $p<0.05$ (ANOVA)

The maximum body lipid was observed in T3 (14.5±1.12%) in Table 3, and had significant different from other treatments ($p<0.05$), followed by T1 (8.85±1.2%), T2 (7.72±1.34%) and control treatment (7.66±1.30%) than other three treatments were not significantly different from each other ($p<0.05$). The body ash also had not significantly different for any of treatments.

Growth performance of Caspian Sea Kutum fed the diets containing different dietary L-carnitine levels for 70 days are presented in Table 3.

There were no external symptoms of infection or mortality during the experiment. The results clearly showed that the L-carnitine had no beneficial effects on the growth parameters on Caspian Sea Kutum, however the maximum final body weight (FBW) (17.99±0.34g) and specific growth rate (SGR) (0.51±0.01% body weight/day), were observed in treatment T3 (supplemented L-carnitine with 2000 mg/kg), but that was not significantly different from other treatments ($p>0.05$).

Effects of L-carnitine treatments on growth performance of Caspian Sea Kutum resulted no significantly difference than control treatment ($p>0.05$) and the growth parameters were not significantly affected by addition of L-carnitine to the rearing tanks.

Effects of L-carnitine on aquaculture have been investigated by researchers, and some of this researches has not shown any positive effects on growth parameters or any promising results on the cultural condition. For instance, Chatzifotis *et al*. [13], found that treatment of rainbow trout with L-carnitine has not any significant increase growth. These results agree with our findings. Similar finding were observed by Rodehutscord [12], in using L-carnitine on rainbow trout, but some of researchers clearly showed that the L-carnitine had beneficial effects on the growth parameters [8-10], These results disagree with our findings, although fish and crustaceans may respond differently to L-carnitine.

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