Effect of L-Carnitine Supplementation on Growth Performance and Carcass Composition of Caspian Roach (Rutilus rutilus Caspicus)

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Abstract: An experiment was conducted on Caspian roach (Rutilus rutilus caspicus) juveniles to investigate the effect of dietary L-carnitine supplementation on growth performance and carcass composition. A total of 120 fish (14.82±2.10 g) were randomly distributed on 12 aquaria (10 fish/aquarium) and fed on either control diet as well as control diet supplemented with 500, 1000 and 2000 mg L-carnitine/kg diet, over a 70-day period. Results showed there were no significant changes in weight gain, weight gain percentage, SGR, condition factor and carcass ash content (P>0.05). However, fish fed on 2000 mg L-carnitine/kg diet showed significantly higher lipid carcass content compared to the other treatments (P<0.05). Likewise, this group showed the lower protein content compared to the control group (P<0.05). Results suggested that although dietary L-carnitine had no significant effects on growth performance, which might be as a result of its endogenous sufficient synthesis, however it significantly affected carcass chemical quality.

Key words: L-Carnitine %Protein %Lipid %Fish

INTRODUCTION

L-carnitine is a non-essential nutrient which is sometimes known as an amino acid compound [1]. Amino acids lysine and methionine are the precursor of L-carnitine [2]. L-carnitine is naturally biosynthesized in the animal liver and kidney. The most important role of L-carnitine is related to its mediatory role in long chain fatty acid transferring into the mitochondria in order to oxidation [3]. Thus, L-carnitine serves as a carrier to transfer the long chain fatty acids from cytoplasm to mitochondria and without L-carnitine fatty acids' oxidation and energy production is impossible [2]. Increased fatty acid oxidation via L-carnitine mediation is accompanied with decrease in essential amino acids catabolism [2]. The advantage of dietary L-carnitine supplementation for growth performance is related to optimum dietary utilization as well as inhibition from lysine and methionine catabolism [4]. To date, the major of the studies have been conducted on fish in early life stages; because it is believed that higher growth rate at this stage needs the carnitine levels higher than its synthesis in the body [1]. It seems that some factors such as age, diet composition and species metabolic requirements affect the fish response to dietary L-carnitine supplementation [5].

Several studies on the use of L-carnitine in aquatic organism diets in order to growth increment. Santulli and Amelio [6], Torreele et al. [4], Becker and Focken [7], Chatzifotis et al. [8], Shakeri [9], Jalali Hajiabadi [10] and Ghaffari [11] found the advantages of dietary L-carnitine supplementation on Dicenterarchus labrax, Clarias gariepinus, Cyprinus carpio, Pagrus major, Oncorhynchus mykiss and Huso huso growth performance. However, Burtle [12], Rodehutscord [13], Seifabadi et al. [14], Hosseini et al. [15] found no positive effect of dietary L-carnitine supplementation on growth performance in Silurus glanis, O. mykiss, Rutilus frisii kutum and O. mykiss, respectively.

There are many studies about L-carnitine effects on other animals and human for example: the effect of L-carnitine on performance in Japanese Quail [16], on semen characteristics of chilled rabbit [17] and adipocytokines and lipid profile in obese women [18].

The present study was conducted to investigate the effect of dietary L-carnitine supplementation on growth performance and carcass composition in Caspian roach.
Table 1: Control diet composition

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish meal</td>
<td>43.47</td>
</tr>
<tr>
<td>Meat meal</td>
<td>13</td>
</tr>
<tr>
<td>Wheat meal</td>
<td>27.53</td>
</tr>
<tr>
<td>Fish oil</td>
<td>6</td>
</tr>
<tr>
<td>Soybean oil</td>
<td>3</td>
</tr>
<tr>
<td>Lysine</td>
<td>1.5</td>
</tr>
<tr>
<td>Methionine</td>
<td>1.5</td>
</tr>
<tr>
<td>Vitamin mix</td>
<td>4</td>
</tr>
</tbody>
</table>

Chemical composition

<table>
<thead>
<tr>
<th>Moisture</th>
<th>9.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude protein</td>
<td>38.5</td>
</tr>
<tr>
<td>Crude lipid</td>
<td>14.3</td>
</tr>
<tr>
<td>Ash</td>
<td>10.5</td>
</tr>
</tbody>
</table>

MATERIALS AND METHODS

A total of 120 Caspian roach (14.82±2.10 g) were randomly distributed on 12 glass aquaria (30x40x60 cm) filled with 60 L water. Fish were fed on the control diet (Table 1), over a 10-day period as acclimation period. All aquaria were continuously aerated using air pomp. After acclimation period, the aquaria were assigned as 4 treatments (three replications per treatment) receiving the control diet or control diet supplemented with 500, 1000 and 2000 mg L-carnitine/kg diet. Fish were fed based on 5% body weight over the first month and 3% thereafter. Feeding was performed twice a day. Water temperature was monitored daily being 17.8-19.6°C. Dissolved oxygen, total hardness and pH were 5-5.5, 270±0.2 mg/l and 7.5±0.3. Water exchange was 25% every other day. The feeding trial continued over a 60-day period. Fish were biometric at the start of the experiment and 1 and 2 months thereafter and food amount was adjusted accordingly. At end of the experiment, weight gain (WG), weight gain percentage (WG%), condition factor (K) and SGR were calculated as follow:

\[ \text{WG} = W_f - W_i \]  \hspace{1cm} [19]

\[ \text{WG} \% = 100 \times \frac{W_f - W_i}{W_i} \]  \hspace{1cm} [19]

\[ K = \frac{W_f}{L^3} \times 100 \]  \hspace{1cm} [19]

\[ SGR = 100 \times \frac{\ln W_f - \ln W_i}{T} \]  \hspace{1cm} [19]

Where \( W_f \) was the final weight, \( W_i \) was initial weight, \( L \) was final total length and \( T \) was the experiment duration.

At the end of the trial, 5 fish were selected from each treatment for carcass analyses. The fish were killed after anesthesia and decapitation, the viscera were removed and the carcasses were stored at -18°C for chemical analyses. Samples' moisture (at 105°C for 24h), crude protein (Kjeldahl apparatus, Gerhardt, Königswinter, Germany. Nitrogen* 6.25), crude fat (extraction with petroleum ether by Soxhlet apparatus, Behr, Düsseldorf, Germany) and ash (incineration at 600°C for 6 h) were determined according to AOAC [20].

Data normality was tested by Shapiro-Wilk's test. Data were subjected to one-way ANOVA and significant difference between the treatments was determined by Duncan's test. Data are presented as treatment mean±SD. The values of \( P<0.05 \) were considered significantly different. All analyses were performed using statistical software SPSS v. 16.

RESULTS

There were no significant differences in WG, WG%, K and SGR (Table 2). Data of treatments' carcass chemical composition are shown in Table 3. There was no significant difference in carcass moisture and ash content between the treatments (\( P>0.05 \)). However, carcass lipid and protein showed significant difference between the treatments (\( P<0.05 \)). The highest lipid values were related to fish fed on 2000 mg L-carnitine/kg diet. There was no significant difference in lipid values between the control, 500 and 1000 mg L-carnitine/kg diet treatments (\( P>0.05 \)). In the case of carcass protein content, significant
difference was only detected between the control and 2000 mg L-carnitine/kg diet in which control diet showed significantly higher levels (P<0.05).

**DISCUSSION**

Increase in food efficiency is desired in any aquaculture activity. L-carnitine insufficiency will lead to essential amino acid catabolism and growth impairment. Thus L-carnitine supplementation is performed to increase growth performance.

In the present work, there was no significant difference in growth performance between the treatments suggesting L-carnitine supplementation ineffectiveness in Caspian roach. Harpaz et al. [21] suggested that L-carnitine supplementation is ineffective some species. Chatzifotis et al. [22] found no significant effect of L-carnitine supplementation (1, 2 and 4 g/kg) on growth performance in rainbow trout fingerling. Working with a similar species, *R. frisii kutum*, Seyfabadi et al. [14] found no advantage of dietary L-carnitine supplementation (400, 800 and 1200 mg/kg) on growth performance. However, there are antonym reports suggesting the benefit of L-carnitine supplementation on growth performance in fish fry or fingerlings. Shakeri [9] reported the significant increase in growth performance in rainbow trout with 24 g body weight. Likewise, Jalali Hajiabadi [10] found significant increase in growth performance in rainbow trout fen on L-carnitine-supplemented diets. Torreele et al. [4] fed African catfish with the diets supplement with 121, 230, 480, 581, 1934 and 3961 mg/kg. They found L-carnitine elevation from 121 to 581 mg/kg led to growth increase, however, growth increment decreased beyond 581 mg/kg.

L-carnitine supplementation was led to change in carcass chemical composition. Chatzifotis et al. [23] found increase in carcass lipid content as a result of dietary L-carnitine supplementation (2088 mg/kg). Jalali Hajiabadi [10] reported change in carcass lipid and protein content in rainbow trout fed on L-carnitine supplemented diets. On the other hand, Becker and Focken [7] observed no significant difference in carcass composition due to L-carnitine supplementation (200, 400 and 600 mg/kg) in common carp. Likewise, Hosseini et al. [15] and Seyfabadi et al. [14] found similar results in rainbow trout and *R. frisii kutum*.

According to the results, L-carnitine has no advantages on growth performance in Caspian roach and its application for this purpose is not advised but it significantly affected carcass chemical quality.

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**REFERENCES**


