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Effects of Orally Administered *Ferula coskunii* (Apiaceae) on Growth, Body Composition and Histology of Common Carp, *Cyprinus carpio*

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Abstract: This is the first study investigating the effects of dietary *Ferula Coskunii* (FC) on growth, body composition and liver histology of common carp (*Cyprinus carpio*). Experimental diets prepared by supplementation of 0, 1.5, 3.0 and 4.5 g FC commercial trout diet kg^{-1} (‰) and randomly assigned to triplicate groups. Dietary inclusion of *F. coskunii* affected the growth and feed conversion negatively, but increased the protein and lipid content of fish fed diet with 3.0 and 1.5 and 4.5 g kg^{-1} FC; respectively ($p<0.05$). Hepatosomatic and viscera somatic index values of fish increased with the increasing rates of FC ($p<0.05$). Gonadosomatic index values did not change for male and female carp significantly. In addition, different levels of dietary FC had no detrimental effects on liver tissue and general fish health.

Key words: *Ferula coskunii*, FC, common carp, growth, histology

INTRODUCTION

The roots and seeds of *Ferula* sp. (Apiaceae) have been traditionally used in the Middle East as a potential aphrodisiac for both men and women[1,2]. Herbal products containing *Ferula* sp. extracts are sold in the dietary supplement market claiming a sexual function enhancement[3]. Also, they are advertised as a natural therapy in women protection from the menopausal complaints. Laboratory studies conducted with some animals confirmed the efficacy of the plant as an anti-impotence agent[4]. On the other hand, several toxic effects, such as decreased growth performance, hepatomegaly atrophic testis and a negative influence on sexual behavior were observed as a consequence of the repeated administration of *Ferula* in male rats[5].

Besides the anti-fertility and anti-implantation effects, severe changes were found in the histological features of the ovary[6]. Similar findings were reported in rats administered with *Ferula jaeschkeana*[7,8]. But there is no record about the effects of *Ferula coskunii*, as an endemic plant species for Hatay, Turkey[9]; on fish growth, histological structure of organs and body composition. Therefore, it was aimed to investigate the effects of *Ferula coskunii* on growth, body composition, histology of the liver and gonads (testis and ovary) of common carp, *Cyprinus carpio*.

MATERIALS AND METHODS

Common carp fry were obtained from a local fish hatchery (DSI, the Vith Regional Directorate of the State Hydraulic Works, Adana, Turkey) and 15 fish stocked in 96-l glass aquaria (triplicates of four treatments, in 12 aquaria). For the experiment a total of 180 fry were used. The aquarium system was static bath with changing water manually. After 10 days acclimization, the experimental diets were given the fish *ad libidum* each day at 10:00-16:00. The daily water exchange rate was 80%. Water remained at the constant temperature of 25±1°C. Oxygen varied 5.9-6.5 mg L^{-1}, pH 7.85-8.29 and total alkalinity 250-255 mg CaCO3 L^{-1}. The feeding trial was conducted for two months.

Ferýla coskunii (root of the plants) were collected in Yayladagi district of Hatay (Turkey) province, air dried, transported to Faculty of Fisheries and Aquaculture and stored for using in the experiment. Three different dosages of ferula were added with the ratios of 1500, 3000 and 4500 mg ferula kg^{-1} to commercial trout diet. In the preparation of the experimental diet, ferula powder was mixed with pulverized commercial trout diet (43 % CP), in which water (450 mL kg^{-1}) was added and resultant dough passed through a food grinder with a 2 mm diameter die plate. Then pellets were dried at 45°C and stored at 4.0±1.0°C until use.

The proximate compositions of the basal diet (commercial trout feed) and fish fillets were analyzed according to standard procedures[10] as follows: moisture was determined by oven-drying at 105°C for 24 h, crude protein (N×6.25) by the Kjeldahl method and crude ash by combustion in a muffle furnace at 550°C for 16 h. Total lipid concentration was determined by extract with the chloroform-methanol method described by Bligh and Dyer[11].

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Table 1: Growth performance and some body indices of common carp fed diet containing different levels of *Ferula coskunii* (g kg^{-1}) for 60 days*

FC	IW	FW	WG	SGR	FCR	HSI	VSI	GSI♀	GSI♂
0	26.13±0.56	57.90±1.88^{a}	31.77±0.28^{a}	1.32±0.01^{a}	1.71±0.07^{a}	2.06±0.18^{a}	11.23±0.34^{a}	0.84±0.09^{a}	0.34±0.05^{a}
1.5	26.61±0.43	52.11±1.24^{b}	25.46±0.09^{b}	1.12±0.04^{b}	2.01±0.02^{b}	2.52±0.22^{ab}	12.18±0.38^{ab}	0.85±0.11^{a}	0.33±0.04^{a}
3.0	26.32±0.46	51.64±1.55^{b}	25.32±0.33^{b}	1.12±0.02^{b}	2.07±0.02^{b}	2.89±0.28^{b}	12.55±0.35^{b}	0.73±0.20^{a}	0.27±0.03^{a}
4.5	27.36±0.43	53.30±1.41^{b}	25.94±0.21^{b}	1.11±0.01^{b}	2.11±0.08^{b}	2.92±0.22^{b}	12.89±0.38^{b}	0.84±0.12^{a}	0.30±0.04^{a}

*Values (mean ± standard error of triplicate) with different superscripts in each column indicate significant differences ($p<0.05$). WG (weight gain; g) = Final weight (FW)-Initial weight (IW), SGR (specific growth rate; %) = ([lnW2-lnW1]/[T2-T1]) X 100, where W1 and W2 are mean body weight at times when the first and second samples were taken (T1 and T2). FCR (food conversion ratio) = (dry feed intake/wet weight gain), HSI (hepatosomatic index, %) = (liver weight/body weight) X 100, VSI (viscerosomatic index, %) = (viscera somatic weight/body weight) X 100, GSI (gonadosomatic index, %) = (gonad weight/body weight) X 100, FC, *Ferula coskunii*

On completion of the feeding trial, all fish were starved for 48 h, killed and weighed. All fish were dissected to determine hepatosomatic index values and for histopathological examination. Liver and gonad specimens were manually fixed (4% neutral buffered formaldehyde) for histology and embedded in paraffin wax. Sections (5 μ) were cut and mounted on glass slides (Leica) before staining with Mayers Hematoxylin and Eosin (H and E). Stained sections were examined and photographed under a light trinocular (Olympus BX50) microscope[12].

Final fish weight, live weight gain, specific growth rate, feed conversion ratio, carcass composition, hepatosomatic, viscerosomatic and gonadosomatic index values were all subjected to one-way analysis of variance to determine if significant differences occurred among the dietary treatments. Data were statistically analyzed with one-way ANOVA and Duncan's multiple range tests. Effects with a probability of $p<0.05$ were considered significant. Statistical analyses were performed using SPSS for Windows (Standard Version 9.0 SPSS Inc. Illinois). Data were expressed as mean values ± SEM.

RESULTS AND DISCUSSION

The effects of different concentrations of dietary *Ferula coskunii* on growth performances and some body indices of common carp fingerling for 60 days are shown in Table 1. During *Ferula coskunii* administration period, no mortality was observed. Dietary inclusion of *F. coskunii* did not improve the growth and feed conversion, but increased the protein and lipid contents of fish fed diet with 3.0 and 1.5 and 4.5 g kg^{-1} FC; respectively ($p<0.05$). Hepatosomatic and viscera somatic index values of fish increased with the increasing rates of FC ($p<0.05$). Show in Table 2. However gonadosomatic index data did not change for male and female carp. All examined visceral tissues (liver and gonad) were observed as normal structurally.

This was the first report to our knowledge regarding the potential effects of *Ferula coskunii* on

Table 2: Body composition parameters of fish fed diet with different levels of *Ferula coskunii* (g kg^{-1})*

FC	Moisture	Crude protein	Crude lipid	Crude ash
0	78.77±0.11^{a}	18.00±0.33^{ab}	2.31±0.23^{a}	0.93±0.03^{a}
1.5	77.71±0.33^{b}	17.33±0.74^{a}	3.74±0.34^{b}	1.10±0.13^{ab}
3.0	77.02±0.30^{bc}	19.85±0.36^{c}	2.61±0.39^{ab}	1.22±0.02^{b}
4.5	76.29±0.05^{c}	18.94±0.32^{cb}	3.66±0.35^{b}	1.11±0.03^{ab}

*Values (mean±standard error of triplicate) with different superscripts in each column indicate significant differences ($p<0.05$). Body composition data were presented on a wet basis. FC: *Ferula coskunii*

growth, feed utilization, some body indices and histology of common carp fingerling. Raw *Ferula coskunii* at the higher inclusion rates (3.0, 4.5 g kg^{-1}) affected the fish growth negatively compared to some earlier reports. *Tribulus terrestris* (TT) (Zygophyllaceae), is an herb that is widely distributed in China, Japan, Korea, the western part of Asia; treatment at the concentration of 0.15 and 0.1g L^{-1} significantly improved the growth rate of *Poecilia reticulata* ($p<0.01$) and body length and weight of fish treated with 0.15 g L^{-1} TT group significantly increased compared to control[13]. Also several toxic effects, such as decreased growth performance, atrophic testis and a negative influence on sexual behavior were observed in male rats fed with repeated administration of *Ferula*[4,5]. On the contrary, from a chemical composition point of view, FC increased the level of protein and lipid content in carp fingerling. Similar findings were also reported on bagrid catfish to which tamoxifen increased the level of lipid[14]. Park *et al.* used tamoxifen-incorporated feed to access the relative growth effect on bagrid catfish through pelleted diets and found a promoted growth rate to a significant level over the controls and the 50 ppm concentration recorded a maximum growth rate[14]. Hepatosomatic and viscerosomatic index values increased with the increasing rates of FC. Although no cellular swelling or fatty change (degeneration) was observed, liver weights tended to increase in fish fed higher levels of FC.

Our results showed that dietary FC treatment affected the growth performance negatively for tested levels. Therefore, in a future research, the effects of low levels of FC and other *Ferula* species on fish performance should be investigated for common carp and other cultured fish species.

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