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Research Article

The effect of *Coriandrum sativum* extract supplementation diets on lipid, carbohydrate and protein levels of rainbow trout, *Oncorhynchus mykiss*

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Abstract: This study was conducted to investigate the effect of coriander (*Coriandrum savitum*) extract on protein, lipid and carbohydrate levels of rainbow trout (*Oncorhynchus mykiss*). For this purpose, trout with an average weight of 40-45 g were used. Coriander was added to the feed as 0, 0.5, 1.0, 2.0 mg% and experimental groups were formed. The prepared feeds were weighed daily as 2% of the fish weight and fed in the morning and evening. Liver, spleen, kidney and muscle tissues were removed from the fish on the 42nd day of the first feeding and protein, carbohydrate and lipid levels were determined. Liver protein contents of fish fed the 1.0 and 2.0% supplemental *C. sativum* extract diet were statistically similar but were significantly lower than those fed the control diet. Liver lipid level significantly decreased in fish fed 2% *C. sativum* extract but did not differ among the groups fed lower dietary levels (0, 0.5 and 1.0% *C. sativum* extract). Dietary treatments did not significantly affect carbohydrate values of all tissues.

Keywords: Coriander, *Coriandrum savitum*, Rainbow trout, *Oncorhynchus mykiss*, Protein, Lipid, Carbohydrate

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1. INTRODUCTION

The primary reason for the preference of trout farming in our country is the suitability of water resources. Among the trout species, the most commonly farmed species in our country is the rainbow trout (*Oncorhynchus mykiss*). Rainbow trout is widely cultivated due to its high adaptability, efficient feed utilization, short incubation periods, and resistance to diseases (Alpbaz, 2005).

Coriander (*Coriandrum sativum*), a plant belonging to the Apiaceae family, has been used in medicine and as a food ingredient since the 15th century BCE (Ulutaş Deniz et al., 2018). *C. sativum* also called Coriander or Chinese parsley belongs to the family Apiaceae, native to the Southern Europe and The Western Mediterranean region (Abascal & Yarnell, 2012). Coriander, which can serve as an alternative to traditional winter crops, is cultivated in our country in the provinces of İzmir, Denizli, Burdur, Erzurum, Mardin, Gaziantep, and the Central Black Sea region (Albayrak et al., 2012). Coriander, from the Apiaceae family, is a medicinal and spice plant known in our country by various names such as "kişniş," "aşotu," and "kuzbere" (Baytop, 1984).

Coriander is an aromatic plant, prevalent in the Mediterranean region, known for its leaves and seeds, which are widely used in culinary applications (Mandal & Mandal, 2015) and medicine (Ravi et al., 2007) (Megaloudi, 2005). Coriander is rich in various nutrients, including vitamins A, C, E, and K, as well as potassium and iron (Hornok, 1992; Bhat et al., 2014). Its antioxidant properties protect the body from the harmful effects of free radicals (Burdock & Carabin, 2009; Sahib et al., 2013). Additionally, it supports digestive system health (Dara, 2010) and may help regulate cholesterol levels (Ertaş et al., 2005; Ramadan et al., 2008; Laribi et al., 2015).

C. sativum are used for traditional medicinal purposes. One medicinal plant that has been supported as an immunostimulant agent is *C. sativum* (Khan & Khatoon, 2008; Laribi et al., 2015). It has been reported that *C. sativum* has anti-hypertensive, anti-hyperlipidemic, anxiolytic effects, anti-hyperglycemic, anti-oxidant, anti-proliferative, anti-nociceptive, anti-convulsant, and anti-fertility (Chrysant & Chrysant, 2017).

The aim of this study was to evaluate the effect of *Coriandrum sativum* extract on lipid, carbohydrate and protein levels of rainbow trout.

2. MATERIAL AND METHOD

2.1. Plant and Extract Preparation

The extraction was taken according to the cold maceration process method of Kim et al. (2011). *C. sativum* leafs were washed in sterile distilled water, dried, powdered and stored at -20°C until used. One hundred grams of the powder leaf was extracted with 1000 ml of 85% ethanol and filtered. The extraction material was extracted with cold maceration process using absolute ethanol (99.98% v/v) by intermittent shaking for 7 days. The solvent was evaporated using a rotary vacuum evaporator and the obtained residues were stored at -20°C until used.

2.2. Fish and Experimental Design

Rainbow trout for the experiment (approximate weight: 40-45g) were obtained from a commercial fish farm in Kahramanmaraş (Türkiye). The fish were kept in a 225 L fiberglass tank. Prior to each experiment the fish were transferred tank containing aerated well water and acclimated for a minimum for 14 days. Fish were fed *ad libitum* with a commercial (Ecobio, Türkiye) feed throughout the experiments.

Fish were stocked in 4 groups (50 fish/per group) in the fiberglas tanks. The experiment was conducted in two replications, utilizing a total of 400 fish, with 50 fish in each group.

After 15d of acclimation to the condition, to study the hemato-immune mechanisms, fish were fed diets containing three doses of *C. sativum* (0.5, 1.0 and 2.0 ml/100 g feed) extract. Also control group only was fed with commercial feed. Fish were fed to apparent satiation twice daily (between 08:00-09:00 and 16:00-17:00) for 42 days.

2.3. Water Quality Parameters

Light/dark cycle was 12L:12D. Water quality parameters were monitored daily for each tank. Throughout the experiment, average water temperature (WTW, Monoline Oxi 3310), dissolved oxygen (WTW, Monoline Oxi 3310) and pH (HACH, HQ11d) were measured as 12±0.22 °C, 8.5±0.14 ppm and 7.8±0.09 respectively.

2.4. Biochemical Analysis

After the test period, the fish were anesthetized using an anesthetic substance (50 mg/L, benzocaine) (Hseu et al., 1998). The entire bodies of the fish were then wrapped in aluminum foil and stored at -20°C until biochemical processes were performed. Kidney, spleen, muscle and liver tissues were obtained and kept in storage box at -80ºC until the analysis of the biochemical parameters. Total protein, total lipid, and total carbohydrates % of the spleen, liver, muscle and kidney tissues were measured using the standard methods of the Association of Official Analytical Chemists (AOAC, 1990).

2.5. Statistical Data Analyses

Statistical analysis of the data obtained in the experiment was carried out using the SPSS 10 package statistics program (IBM SPSS Statistics 23). Changes in some biochemical parameters of the control and three experimental groups of fish were tested with one-way analysis of variance (ANOVA) and Duncan's multiple comparison tests. Differences among the groups were considered important if $p < 0.05$.

3. RESULTS

The muscle of fish fed the 0.5% supplemental *C. sativum* extract diet had lower protein. The values of these parameters for fish receiving the 1.0 and 2.0% supplemental *C. sativum* extract diets did not significantly differ, these were also significantly different from those fed the control diet (0% *C. sativum* extract). Liver protein contents of fish fed the 1.0 and 2.0% supplemental *C. sativum* extract diet were statistically similar but were significantly lower than those fed the control diet (Figure 1). Dietary *C. sativum* extract levels had no effect on kidney and spleen protein level.

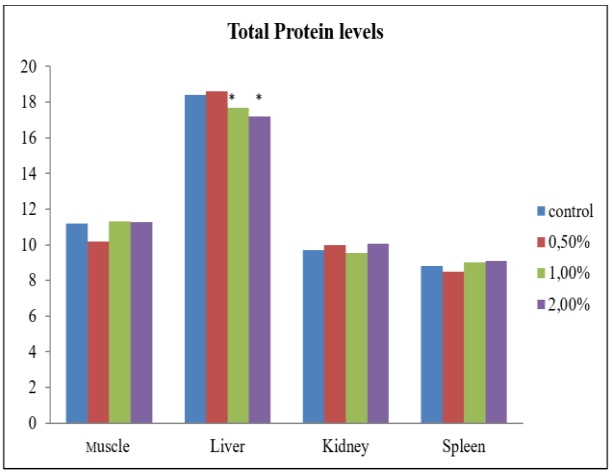

Figure 1. Total protein levels in the several tissues of rainbow trout
*Significant difference from control groups $p < 0.05$

The muscle lipid level of fish fed the 0.5 and 1.0% added *C. sativum* extract diet did not differ from that of fish fed the control and 2.0% *C. sativum* extract diets but was higher than that fed the basal diet. Dietary *C. sativum* extract levels had no effect on kidney and spleen lipid level. Liver lipid level significantly decreased in fish fed 2% *C. sativum* extract but did not differ among the groups fed lower dietary levels (0, 0.5 and 1.0% *C. sativum* extract) (Figure 2).

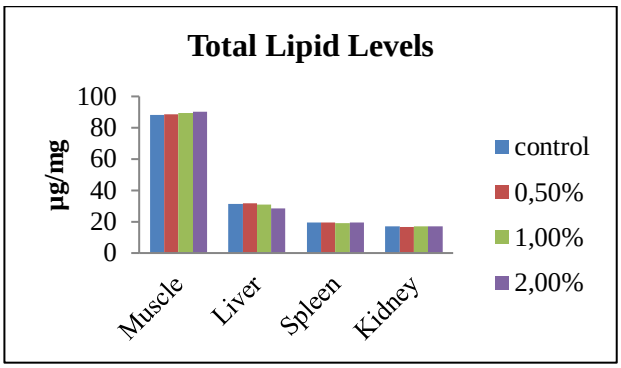

Figure 2. Total lipid levels in the several tissues of rainbow trout

The effects of the *C. sativum* extract on total carbohydrate level in rainbow trout are presented in Figure 3. Dietary treatments did not significantly affect carbohydrate values of all tissues.

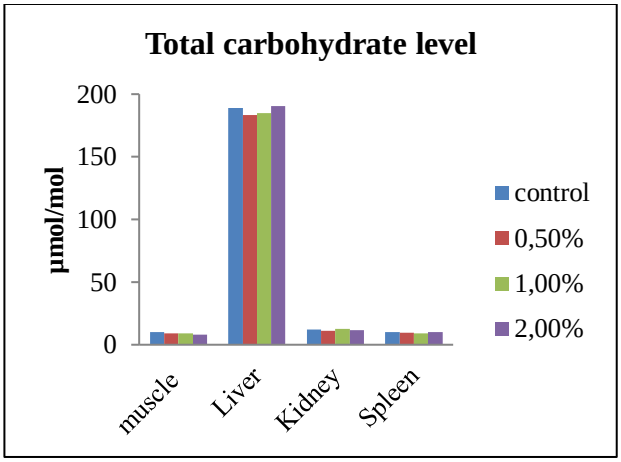

Figure 3. Carbohydrate levels in the several tissues of rainbow trout
*Significant difference from control groups $p < 0.05$

4. DISCUSSION AND CONCLUSION

This research aimed to investigate the impacts of the influential concentrations of *C. sativum* extract of 0%, 0.5%, 1% and 2% in the feed on total protein, total lipid and total carbohydrate parameters in liver, kidney, spleen and muscle tissues of rainbow trout (*Oncorhynchus mykiss*).

Nutrient ingredients in fish meat are nearly related to their digestibility levels and the nutrient contents of feeds (Jauncey, 1982). Liver protein contents of fish fed the 1.0 and 2.0% supplemental *C. sativum* extract diet were statistically similar but were significantly lower than those fed the control diet ($p < 0.05$). The decrease in total protein in liver tissues may be due to the possible utilization of degraded products for metabolic purposes.

Oxidation of the lipid arising from the reaction of lipid with oxygen and its hydrolysis is affected by the activity of lipolytic enzymes (Deis, 2006; Min et al., 2006). In this study, Liver lipid level significantly decreased in fish fed 2% *C. sativum* extract but did not differ among the groups fed lower dietary levels (0, 0.5 and 1.0% *C. sativum* extract.

Carbohydrate used the most easily by fish is glucose and the only sugar in the blood. With the breakdown of glucose, the energy needed to maintain vital activities is provided (Hoşsu et al., 2001). Dietary treatments did not significantly affect carbohydrate values of all tissues. Carbohydrates in fish tissue are important because they provide the necessary energy for the fish to perform various functions (Sasikumar & Prakash Sahaya Leon, 2022).

The results of this study demonstrate that dietary *C. sativum* levels are an important factor in a practical diet for rainbow trout. A dietary *C. sativum* level of 2% provided the best fish performance based on biochemical parameters. Further work is needed to explore *C. sativum* impact on nutrient digestibility, fish health, and innate fish immunity.

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Authors' Contributions:

Üİ: Manuscript design, Field sampling, Draft checking, Writing, Draft checking, Reading, Editing, Laboratory experiments, Statistical analyses, and Approved the final manuscript.
MK: Draft checking, Writing, Draft checking, Reading, Editing, Laboratory experiments, Statistical analyses, and Approved the final manuscript.
MÖ: Draft checking, Writing, Draft checking, Reading, Editing, Laboratory experiments, Statistical analyses, and Approved the final manuscript.

Conflict of Interest

The authors declare that there is no conflict of interest.

Statement on the Welfare of Animals

Ethical approval: The experimental protocols for the present study were approved by the Animal Experimentation Ethics Committee of Kahramanmaras Sutcu Imam University (protocol no KSUZIRHAYDEK2018/02-2).

Statement of Human Rights

Ethical approval: For this type of study, formal consent is not required.

Data Availability Statements

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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