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# The Physiological Changes, Growth Performance and Whole Body Composition of Common Carp, *Cyprinus carpio* Fed on Diet Containing Wood Betony, *Stachys lavandulifolia* Extract

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## ABSTRACT

**The Effect of different levels of Wood Betony (WB), *Stachys lavandulifolia* extract, as complement in feed, on the performance of common carp, *Cyprinus carpio* was evaluated. The fish (44±0.62 g) was assigned to four treatments, three replicates each. The fish was fed on normal diet with no WB (control) *vs.* diet containing 2, 4 and 8% of WB extract. Fish were successively fed on the diet, 2% live body weight, three daily for 70 days. The results revealed that final weight, mean weight gain and specific growth rate were significantly improved by increasing WB levels in the diet. The highest growth performance and the lowest feed conversion ratio were recorded for 8% WB treatment. No significant changes were observed in the proximate whole body composition among different groups. Hemoglobin content and hematocrit value increased significantly in the second group in comparison with the others (P< 0.05). The highest serum total protein (5.05±1.4 g $dl^{-1}$) and globulin (2.47±0.3 g $dl^{-1}$) were recorded in the fish fed on the highest dose of WB (8%). Inclusion of 2% of WB in the diet reduced serum triglycerides (317.44±89 mg $dl^{-1}$) and cholesterol (141.51±35 mg $dl^{-1}$) in comparison with control (P< 0.05). It could be concluded that feeding common carp with the diet enriched with WB extract could enhance growth rate, improve some hematological and biochemical characteristics with no adverse effects on body composition.**

**Keywords:** Carcass quality, *Cyprinus carpio*, Growth performance, Medicinal herb.

## INTRODUCTION

For thousands of years, medicinal plants have had primitive and in time helpful roles in human life. In recent years some novel applications of these initially raw materials have been developed, to name some, are: their use as antifungal agents (Boulenouar *et al.,* 2012) or in the formulation of insecticides (Motazedian *et al.,* 2012). In aquaculture sector, the use of medicinal plants (phytochemicals) has been increased significantly over the past decade for such different purposes as sex reversal compound (Tzchori *et al.,* 2004), growth enhancer (Turan and Akyurt, 2005), immunostimulant, antipathogenic (Yılmaz *et al.,* 2013a), and antistress (Chakraborty and Henze, 2011). The fish under intensive culture are affected by such different kinds of stressors as overcrowding, transport, handling, size grading and poor water quality (Li *et al.,* 2004). One of the relatively new practiced ways to improve health conditions for cultivated aquatic organisms is using medicinal herb as an immunostimulator or growth enhancer (Citarasu, 2010). Several such herbal components as flowers, leaves, seeds and roots from different plant species have been shown to enhance growth, non-specific

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immune system, stress response as well as survival rates of such cultivated species as African catfish, *Clarias gariepinus* (Dada and Ikuerowo, 2009 and Soosean *et al.,* 2010), tilapia *Orechromis mossambicus* (Immanuel *et al.,* 2009) and common carp, *Cyprinus carpio* (Alishahi *et al.,* 2010; Pakravan *et al.,* 2012). Recent studies by Yılmaz *et al.* (2013b) showed some positive effects of dietary herbal supplements on physiological conditions of sea bass, *Dicentrarchus labrax*. Wood betony, *Stachys lavandifulia* Vahl belonging to family Lamiaceae, is grown in many parts of Iran, Iraq, Turkey, Syria, Armenia and Georgia (Javidnia *et al.,* 2004). Such fresh and dried areal parts as leaves and flowers, as well as roots have been taken advantage of, as traditional drugs for treatment of wounds and bruises, mouth ulcers, gum inflammations (Ody, 1997) and treating arthritis and respiratory inflammatory disorders (Rezazadeh *et al.,* 2009). Alkanoids (including stachydrine and trigonelline), tannins, saponines, nicotinic acid and steroids are some of the main components of wood betony showing some biological activities (Vundac *et al.,* 2007; Ghasemi Pirbalouti *et al.,* 2011). The biological activities of wood betony have not yet been fully studied in fish. Hence, the present study was aimed at evaluating the long-term (70 days) effects of dietary inclusion of wood betony extract on growth performance, some haematological and biochemical characteristics and as well as carcass quality of common carp juveniles.

## MATERIALS AND METHODS

### Fish

Juvenile common carp, *C. carpio* (44±0.62) was obtained from a fish propagation and breeding center, Isfahan, Iran. Fish were kept under the same environmental conditions, placed in 10 $m^3$ rectangular concrete tanks for 2 weeks for acclimatization. They were fed on a commercial carp food (Isfahan Mokkamel, Iran). Some proximate composition figures of the commercial diet (wet basis %) were 9.2% humidity, 32% protein, 10.2% lipid and 11.1% ash (based upon our analysis, data not shown).

### Plant Extract

In midspring 2012, wood betony aerial parts, including flowers and leaves were collected from natural habitat, Isfahan province, Iran. The plants were taken to the central herbarium of Isfahan University of Technology, Department of Natural Resources for final identification (Rechinger, 1982). Different aerial parts of the plants were washed thoroughly with distilled water and dried at room temperature in shade, following which the plants were ground into powder. One hundred g of powdered plant material was soaked in 500 ml of ethanol (75 %) for 48 hours, shacked vigorously to allow for proper extraction. Following the extract being filtered through Whatmon no. 1 paper, the filtrate was concentrated using a rotary evaporator at around 50˚C. Finally, as 20 ml sample of concentrated extract was obtained from a l00 g sample of the plant powder (each ml ~5 g).

### Feed Preparation and Feeding Trails

A basic commercial carp diet was purchased from Isfahan Mokkamel, Isfahan, Iran. The food was ground into powder. A 100 ml of distilled water was added to the basic food powder and made into noodles, a using noodle-making machine (1 mm diameter), to make for a control diet (0WB). As for the plant extracted added diet, 4, 8 and 16 ml aliquots of the concentrated plant extract were add to water, final volume adjusted to 100 ml and used for making diet containing 2, 4 and 8% wood betony extract (defined as 2, 4 and 8 WB) respectively as described above. The noodles were dried at





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room temperature till the moisture content was dropped to below 10%, when they were broken into very small pieces, packed in airtight plastic containers and kept at 4˚C throughout the entire study.

Following 2 weeks of acclimatization, the fish were randomly divided into four groups, with three replicates each group. The first treatment was fed on normal diet with no *S. lavandulifolia* addition to be taken as control. The second, third and fourth ones were fed on normal diet, but containing 2, 4 and 8% of *S. lavandulifolia*, respectively. Each replicate was comprised of 15 individuals in a fibreglass tank (110 L water volume, 50% renewed, daily). Water quality was monitored all throughout the experimental period at weekly intervals; temperature, 25±1°C, pH, 7.21±0.5 and Dissolved Oxygen (DO) concentration, 7.5±0.06 mg $L^{-1}$. Fish were fed frequently on a diet of 30% Crude Protein (CP) at a rate of 2% live body weight, three daily for 70 days. The levels of given feed were readjusted every two weeks as based on the fish weight gain. Final weight (g), Mean Weight Gain (MWG, g), Feed Conversion Ratio (FCR), Specific Growth Rate (SGR, % $day^{-1}$), Average Daily Growth rate (ADG, g $day^{-1}$) and Condition Factor (CF, g $cm^{-3}$) were estimated according to Soosean *et al.* (2010) as follows:

MWG= (Mean final weight–Mean initial weight);

FCR= Food consumed (g)/Weight gain (g);

$SGR\ (\%\ day^{-1}) = 100\times[(\ln W_1 - \ln W_0)/t]$, where $W_0$ and $W_1$ are the average initial and final body weights, respectively, and (t) time (days);

ADG (g $day^{-1}$) = Growth/Experimental duration,

CF (g $cm^{-3}$) = Weight (g)/[Length (cm)]$^3$.

## Body Composition

Proximate analysis of the fish carcass was carried out at the end of the experiment (10 weeks). For the purpose, three fish from each replicate (tank) were randomly sampled after 24 hours of starvation. The chemical compositions (moisture, protein, lipid and ash) of the whole body of the fish were determined based on methods defined by Association of Official Analytical Chemists (AOAC, 1998). Dry weight (based moisture content) was determined after drying the fish at 105°C (Binder oven, Germany), until constant weight obtained. Crude protein and lipids were analyzed through Kjeldal (Gerhardt, type VAP.40, Konigswinter, Germany) and Soxhlet extractor (Gerhardt, type SE-416, Germany) respectively. The ash content was determined using a muffle furnace (Nabertherm, Lilienthal, Germany), operating at 550°C for 15 hours.

## Physiological Analysis

### Blood Sampling, Haematological and Serum Biochemical Analysis

At the end of the experiment, blood sample were taken from some three common carps from each tank (replicate). Fish were not fed from 24 hours before sampling and were anaesthetized through clove powder (100 ppm). Blood samples were taken from caudal vein of the fish through sterile syringe. The blood samples were divided into two halves, the first half of each sample placed in heparinised 1.5 vials for haematological analysis. The haematocrit (Hct %) was assessed using heparinized microhaematocrit capillary tubes after centrifugation (2,500 rpm for 5 minutes) according to the instructions formulated by Britton (1963). Haemoglobin concentration (Hb g $dL^{-1}$) was estimated as cyanomethemoglobin spectrophotometrically at 540 nm according to Houston (1990). The other halves of the blood samples were kept at 4˚C for about 4 hours to clot. The tubes were then centrifuged at 3,000 rpm for 10 minutes and the supernatant serum collected. The serum was stored in deep freeze at -80˚C for further biochemical analysis. The serum





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Total Protein (TP) was determined colorimetrically according to Tietz, (1999), albumin (Alb) according to Doumas *et al*. (1977), globulin (Glb, total protein–albumin; g $dl^{-1}$) and albumin: globulin (A: G) ratio based on the method described by Kumar *et al.* (2005). Triglycerides (Tg) and Cholesterol (Cho) levels were determined as based upon the method described by Davidson and Nelson (1977). All themeasurements were made in duplicate for verification.

### Statistical Analysis

Statistical analysis was performed through one way ANOVA at 5% significance level. A multiple comparison test (Duncan Multiple Range Test, DMRT) was conducted to compare the significant differences among the groups using SPSS V. 19 (Duncan, 1955). Values are presented as mean±standard deviation.

## RESULTS

### Survival and Growth Performance

No mortality was observed throughout the experimental period with the survival rate being the same within all the treatments (100 %). Table (1) shows the factors of: final weight and mean weight gain were significantly the highest (89.74±4.08 and 46.08±4.19 g, respectively) in fish group fed the diet containing 8% *S. lavandulifolia* extract $kg^{-1}$ diet as compared with the control (72.56±2.18 and 28.68±3.32 g, respectively). FCR was stood the range of 2.42-2.94, showing significant improvement through an elevation of WB doses (Table 1). *SGR* and *ADG* were increased significantly in fish group fed the diets containing 4 and 8% of *S. lavandulifolia* extract $kg^{-1}$ diet as compared with the control group ($P< 0.05$; Table 1). Significant differences were noticed in final CF of juvenile common carp only in group treated with the highest dose of WB (8%) in comparison with control ($P< 0.05$; Table 1).

### Proximate Body Composition

The proximate chemical analysis of whole body (% wet weight) of common carp fed diets containing different levels of plant extract have been presented in Table (2). The results indicate that the levels of moisture contents were approximately similar (77.58±1.45, 77.77±1.25, 77.61±1.61 and 77.47±0.90; $P> 0.05$). Crude protein content in whole fish body was not significantly increased with increasing *S. lavandulifolia* levels (16.61±0.62, 16.64±1.47, 16.91±0.87 and 17.12±0.41; $P> 0.05$). Total lipid content was lowered in fish fed with a high dose of wood betony (2.04%) as compared with other groups (2.44, 2.53 and 2.44%) fed with 0, 2, and 4% of *S. lavandulifolia* levels respectively,

**Table 1.** Growth performance and feed utilization of juvenile common carp, fed diets containing various percentages of wood betony extract for 10 weeks.[a]

| Variable (Units) | Control (0) | 2% | 4% | 8% |
|---|---|---|---|---|
| Initial weight (g) | 43.88 ± 0.34 [a] | 43.42 ± 0.68 [a] | 44.53 ± 0.42 [a] | 44.02± 1.52 [a] |
| Final weight (g) | 72.56 ± 2.18[a] | 81.01 ± 4.27[ab] | 84.51 ± 7.17[b] | 89.74 ± 4.08[b] |
| Mean weight gain (g) | 28.68 ± 3.32[a] | 37.59 ± 3.69[ab] | 40.18 ± 7.72[b] | 46.08 ± 4.19[b] |
| FCR | 2.94 ± 0.01[a] | 2.68 ± 0.27[ab] | 2.64 ± 0.31[ab] | 2.42 ± 0.11[b] |
| SGR (% $day^{-1}$) | 0.72 ± 0.08[a] | 0.89 ± 0.05[ab] | 0.91 ± 0.14[b] | 1.02 ± 0.07[b] |
| ADG (g $day^{-1}$) | 0.41 ± 0.04[a] | 0.53 ± 0.05[ab] | 0.57 ± 0.11[b] | 0.65 ± 0.05[b] |
| CF (g $cm^{-3}$) | 1.73 ± 0.38[a] | 1.66 ± 0.18[ab] | 1.63 ± 0.18[ab] | 1.52 ± 0.26[b] |
| Survival (%) | 100 [a] | 100 [a] | 100 [a] | 100 [a] |

[a] Values are expressed as mean±SD. Means with the same letters in the same row are not significantly different ($P< 0.05$).





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**Table 2.** Proximate chemical analysis (% wet basis) of whole body of common carp fed diets containing different levels of plant extract for 10 weeks.[a]

| Variable (units) | Control (0) | 2% | 4% | 8% |
|---|---|---|---|---|
| Moisture | 77.58 ± 1.45 [a] | 77.77 ± 1.25 [a] | 77.61 ± 1.61 [a] | 77.47 ± 0.90 [a] |
| Protein | 16.61 ± 0.62 [a] | 16.64 ± 1.47 [a] | 16.91 ± 0.87 [a] | 17.12 ± 0.41 [a] |
| Lipid | 2.44 ± 0.30 [a] | 2.53 ± 0.42 [a] | 2.44 ± 0.26 [a] | 2.04 ± 0.33 [a] |
| Ash | 0.07 ± 0.01 [a] | 0.06 ± 0.00 [a] | 0.06 ± 0.00 [a] | 0.06 ± 0.01 [a] |

[a] Values are expressed as mean±SD. Means with the same letters in the same row are not significantly different (P< 0.05).

although there were no significant differences observed among groups (P> 0.05). The results indicated ash contents (in whole fish body) as approximately equal (0.06-0.07%, P> 0.05).

## Haematological and Serum Biochemical Analysis

The Hb and Hct stood in the ranges of 9.9-11.3 g $dl^{-1}$ and 32.25-35.01% respectively where the highest values belonged to the fish fed with diet containing 2% of *S. lavandulifolia* $kg^{-1}$, and as compared with the control (P< 0.05; Table 3). Serum total protein and globulin contents increased significantly in dose response manner (Table 3). The highest levels of these parameters were observed in fish fed on 8% of *S. lavandulifolia* $kg^{-1}$ diet as compared with those fed on control diet (P< 0.05; Table 3). There were no significant changes in the albumin and Alb:Glu ratio among all the groups (P> 0.05; Table 3). Serum triglycerides and cholesterol were significantly affected by dietary WB (P< 0.05; Table 3). Inclusion of WB in as low dose as 2% in the diet could significantly lower the levels of triglycerides and cholesterol from 461.46±11 and 172.27±22 mg $dl^{-1}$ in control group to 317.44±89 and 141.51±35 mg $dl^{-1}$ in 2 WB respectively (P< 0.05; Table 3). There were no or very limited changes observed in the levels of triglycerides and cholesterol by any further increase in WB concentration in the diets (Table 3).

## DISCUSSION

The use and application of phytochemical agents (herbal components) in aquaculture has been increasing rapidly for such different purposes as prevention of diseases and reduction in the hazardous antibiotics application (Sakai, 1999).

**Table 3.** Hematological and serum biochemical analysis of fish fed diet containing different levels of the plant extract for 10 weeks.[a]

| Variable (Units) | Control (0) | 2% | 4% | 8% |
|---|---|---|---|---|
| Hemoglobin (g $dl^{-1}$) | 10.25 ± 0.5[a] | 11.3 ± 0.47[b] | 9.9 ± 0.34[a] | 10.10 ± 0.37[a] |
| Hematocrit (%) | 32.25 ± 0.95[a] | 35.01 ± 1.41[b] | 33.50 ± 1.20[ab] | 32.50 ± 1.20[a] |
| Total protein (g $dl^{-1}$) | 2.9 ± 0.08[a] | 3.1 ± 0.14[a] | 4.07 ± 0.20[ab] | 5.05 ± 1.4[b] |
| Albumin (g $dl^{-1}$) | 0.97 ± 0.09 [a] | 1.45 ± 0.19 [a] | 1.65 ± 0.17 [a] | 2.57 ± 1.56 [a] |
| Globulin (g $dl^{-1}$) | 1.92 ± 0.12[a] | 1.65 ± 0.31[a] | 2.42 ± 0.35[b] | 2.47 ± 0.30[b] |
| Alb:Glb[b] | 0.50 ± 0.76 [a] | 0.61 ± 0.53 [a] | 0.49 ± 0.51 [a] | 1.04 ± 0.7 [a] |
| Triglyceride (mg $dl^{-1}$) | 461.46 ± 11[b] | 317.44 ± 89[a] | 295.24 ± 74[a] | 342.18 ± 90[a] |
| Cholesterol (mg $dl^{-1}$) | 172.27 ± 22[b] | 141.51 ± 35[a] | 140.81 ± 33[a] | 159.17 ± 19[ab] |

[a] Values are expressed as mean±SD. Means with the same letters in the same row are not significantly different (P< 0.05). [b] Albumin/Globulin ratio.





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In the present study survival of the fish was not significantly affected by the experimental diets. The study's results are in line with the studies of Cho *et al.* (2007), Ji *et al.* (2007a), and Pakravan *et al*. (2012) who reported no significant adverse changes in the survival rates of olive or Japanease flounder, *Paralichthys olivaceus* and common carp respectively. So, it could be concluded that adding wood betony extract (up to 8%) to the commercial diets of common carp exerted no adverse effects on survival rates.

All the growth performance parameters were significantly affected by inclusion of WB in the common carp diet when after 10 weeks past, with the main best results being obtained by use of the highest dose of WB. It has been previously reported that different plant additives can enhance growth rate in some such fish species as African catfish, *Clarias gariepinus* brood stock (Dada and Ikuerowo, 2009) and fingerling (Soosean *et al.,* 2010), red sea bream, *Pagrus major* (Ji *et al.,* 2007a) and tilapia *Oreochromis mossambicus* (Immanuel *et al.,* 2009). In contrast with these reports, the dietary inclusion of some plant extracts had no much improving effect on growth rates as indicated for juvenile pikeperch, *Sander lucioperca* fed on two medicinal herbs *Astragalus radix* and *Lonicera japonica* (Zakęś *et al.,* 2008) and as well, on common carp receiving willow herb, *Epilobium hirsutum* (Pakravan *et al.,* 2012). Such differences could be explained by variation in plants species, the rout of administration, extraction, the species specific characteristics of different aquatic species and even culturing conditions (Alishahi *et al.,* 2010). Another factor which may impact the effectiveness of the herbal adjuvant as a growth promoter is the duration through which the diet is applied, for example while the immunostimulatory effects of herbal extracts on the diet become apparent after 2-4-weeks past of the treatment, the positive impact on the growth rate was noted after 8-12 weeks past, in red sea bream, *Pagrus major* and Japanese flounder, *Paralichthys olivaceus* respectively (Ji *et al.,* 2007a; 2007b, Zakęś *et al.,* 2008). So, it should be examined to what extent an aquatic species is in a specific relation with the herbal additive, or if the aquatic body weight influences the final findings. The positive effects of WB on growth performance of the common carp would be primarily related to the chemical composition of the plants. WB is much enriched in such different chemical compounds as alkanoids, saponines and steroids which exert direct and indirect intense effects on growth and reproductive axis in different species including fish (Kavitha and Subramanian, 2011).

Limited scientific research has been carried out to evaluate the effects of medicinal plant extract on carcass quality in aquatics. Ji *et al.* (2007b) and Zakęś *et al.* (2008) demostrated the effects of medicinal herbs on the fatty acid profiles of Japanese flounder and pikeperch, respectively, reflecting the changes in the fat metabolism pathway. On the other hand, proximate body composition including the levels of moisture, crude protein, crude lipid and ash as % of wet weight were not affected by inclusion of the plant extract in the diets of Nile tilapia, *Oreochromis niloticus* (Abdel *et al.,* 2009), red sea bream (Ji *et al.,* 2007a) and common carp (Pakravan *et al.,* 2012), in agreement with our results. Several such factors as species specific characteristics, medicinal plant composition as well as the duration of the experiments can affect the response (Citarasu, 2010).

The haematological indices present a useful index, reflecting such culture conditions as the effects of dietary treatments on fish well-being, stress responses or as a diagnostic characteristic for the distinction of some infectious diseases (Houston, 1990; Hlavova, 1993). Throughout the present study, the Hb and Hct levels were significantly increased by WB addition at least for fish fed on 2% WB. It could be concluded that inclusion of WB in as low a dose as 2% had positive effects on such haemopoietic tissue as head kidney of common carp which may have helped the





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fish to adjust to such stressful conditions as either low oxygen availability or its being over dosed.

Total proteins as well as their major components, albumin and globulin play key roles in the immune system activities in different species including fish (Siwicki *et al.,* 1994; Kumar *et al.,* 2005). The present study's results confirm the positive significant effects of WB extract diet on elevating total protein and globulin in carp, even up to more than 100% increase. Although some certain herbal extracts have been observed to show positive effects on increasing total proteins and their component as reported for rohu, *Labeo rohita* (Vasudeva Rao *et al.,* 2004), tilapia *Oreochromis mossambicus* (Immanuel *et al.,* 2009) and common carp (Alishahi *et al.,* 2010), some other species did not show any such of these effects as reported in rainbow trout *Oncorhynchus mykiss* (Ispir and Mustufa, 2005). The increase in total protein content usually supported by elevating the white blood cell counts (WBC) as a major source of serum protein (Misra *et al.,* 2006) could show the positive effect of dietary WB on non-specific immunity in carp. Such further immunity analyses as lysozyme activity and differential WBC counts are recommended to test for the hypothesis.

Triglycerides and cholesterol got reduced through WB administration. Similar results have been obtained by feeding four medicinal plants Bermuda grass, *Cynodon dactylon*, Deal, *Aegle marmelos*, Winter cherry, *Withania somnifera* and Ginger, *Zingiber officinale* (1% w $w^{-1}$) to Mozambican tilapia (Immanuel *et al.,* 2009). Feeding aquatics with diets containing phytochemicals can affect fat metabolism (Ji *et al.,* 2007a; 2007b) and maybe this mechanism is active in the common carp being fed WB diets which could help them more effectively utilize lipid as a source of energy. This would mean that other sources of energy like protein can be used more effectively in somatic growth (Zakęś *et al.,* 2008), as seen in the experiment, where higher growth rate in common carp being obtained by increasing wood betony extract in the diet.

Finally, it may be concluded that long-term inclusion of wood betony in the diet of common carp can act as a growth promoter, an antistress (based on the Hb and Hct content) and an immunostimulant agent (based on serum protein content) in the species to promote the aquaculture production without any tangible adverse effects on the proximate carcass quality.

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# تغییرات فیزیولوژیک، کارایی رشد و ترکیب بدنی کپور معمولی *Cyprinus carpio* تغذیه شده با جیره حاوی عصاره چای کوهی *Stachys lavadulifolia*

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## چکیده

توانایی سطوح مختلف عصاره چای‌کوهی *Stachys lavandulifolia* بر عملکرد کپورمعمولی *Cyprinus carpio* ارزیابی شد. ماهیان (۰/۶۲ ± ۴۴ گرم) در چهار گروه آزمایشی، هرگروه شامل سه تکرار توزیع و با استفاده از جیره معمول بدون عصاره چای‌کوهی (شاهد) و جیره های حاوی ۲، ۴ و ۸٪ عصاره چای کوهی تغذیه شدند. تغذیه ماهیان به صورت متوالی به میزان ۲٪ وزن بدن، سه مرتبه در روز، به مدت ۷۰ روز صورت گرفت. وزن نهایی، میانگین افزایش وزن و نرخ رشد ویژه با افزایش سطح عصاره چای کوهی در جیره به طور معنی‌داری افزایش یافت. بالاترین کارایی رشد و کمترین ضریب تبدیل غذایی در ماهیان تغذیه شده با بالاترین میزان عصاره چای کوهی در جیره (۸٪) مشاهده شد. ترکیب لاشه کامل ماهیان در بین تیمارهای مختلف بدون تغییر باقی ماند. محتوای هموگلوبین و میزان هماتوکریت خون در ماهیان تغذیه شده با جیره حاوی ۲٪ چای‌کوهی به نسبت سایر گروه‌های آزمایشی، افزایش یافت ($P < ۰/۰۵$). بیشینه میزان پروتئین کل سرم (۱/۴ ± ۵/۰۵) و گلوبولین (۰/۳ ± ۲/۴۷) گرم در دسی لیتر در ماهیان تغذیه شده با جیره حاوی بیشترین عصاره چای‌کوهی (۸٪) مشاهده شد. عصاره چای‌کوهی به میزان ۲٪ جیره، منجر به کاهش معنی‌دار در تری گلیسیرید (۸۹ ± ۳۱۷/۴۴) و کلسترول سرم (۳۵ ± ۱۴۱/۵۱) میلیگرم در دسی‌لیتر در مقایسه با گروه شاهد شد ($P < ۰/۰۵$). می‌توان بیان داشت که تغذیه کپور معمولی با جیره‌های غنی شده با عصاره چای کوهی می‌تواند منجر به بهبود رشد، بهبود برخی پارامترهای خون‌شناسی و بیوشیمیایی خون بدون تاثیر منفی بر کیفیت لاشه شود.



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