The effects of the fig (Ficus carica) extract and onion (Allium capa) extract addition to Cyprinus carpio feeds in different amount on the growth performance

İncir (Ficus carica) ekstraktı ve soğan (Allium capa) ekstraktının Cyprinus carpio balıklarının büyüme performansı ve yem dönüşüm oranı üzerine etkisi

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Abstract: The study was conducted to investigate the effects of dietary fig extract and onion extract supplementation in diet on growth performance, feed utilization, biometric indexes in common carp (Cyprinus carpio). For this purpose, fig and onion extract were added to experimental diets at the rate of 1.3,5 g / kg respectively. Fishes were fed with trial feed for 90 days. At the end of the trial period, weight increase and specific growth rate of the fishes fed with the feed containing 1.3 g/kg fig extract and 1.3 g/kg onion extract were found to be higher than the control group; food conversion ratio was found to be lower than the control group (p<0.05). Hepatosomatic index and viscerosomatic index amounts of the fishes fed with fig extract and onion extract feeds were found to be lower than the control group; and spleen somatic index was found to be higher than the control group (p<0.05). The amount of visceral organ fat index was found to be lower among the fishes fed with the feed containing fig and onion extracts compared to the control group (p<0.05). These results indicate that dietary supplementation of 1.3 g/kg fig extract in the commercial diets could improve some biometric indexes.

Keywords: Cyprinus carpio, fig extract, onion extract, growth performance, feed utilization

ÖZ: Bu çalışmada incir ekstraktı ve soğan ekstraktıının sazan balığı (Cyprinus carpio) yemlerine eklenmesinin büyüme performansı, yem değerlendirme ve biyometrik ölçümlerle etkisi araştırılmıştır. Bu amaçla iki tıbbi biyotik ekstraktı deneme yemlerine sırasıyla 1,3,5 g/kg oranlarında ilave edilmiştir. Balıklar 90 gün boyunca deneme yemlerine beslenmiştir. Denemeler sonunda 1,3 g/kg incir ve 1,3 g/kg soğan ekstraktı içeren yemlerde bestelenin balıklarını ağırlık artışını ve spesifik büyüme oranı kontrol grubundan daha fazla, yem dönüşüm oranı ise kontrol grubundan daha düşük bulunmuş ve istatistiksel olarak önemli bir fark çıkmıştır (p<0,05). İncir ekstraktı ve soğan ekstraktı yemiyile beslenen balıkların hepatosomatik indeks ve visserosomatik indeks miktarı kontrol grubundan düşük, spleensomatik indeks miktarı kontrol grubundan yüksektir. Gruplar arasında istatistik fark vardi (p<0,05). İç organ yağ indeksi miktarında incir ve soğan ekstraktı yemiyile beslenen balıklarda kontrole göre düşük bulunmuş fakat gruplar arasında istatistik fark gözlenmemmiştir (p>0,05). Sonuç olarak yemlerde 1,3,5 g/kg orandında incir meyvesi ve soğan ekstraktıları ilavesi bazı biyometrik ölçümleri geliştirmiştir.

Anahtar kelimeler: Cyprinus carpio, incir ekstraktı, soğan ekstraktı, büyüme performansı, yem dönüşümü

INTRODUCTION

By means of the conducted studies all over the world, it has been known for ages that medical plant extracts and volatile oils have antimicrobial effects on some bacteria and fungi (Kivanc and Akgul, 1986; Digrak et al., 2002). Onion, Allium cepa L., is known to have antibacterial and antioxidant effects (Ramos et al., 2006; Jeong et al., 2009). Ficus carica, is known to have antimicrobial (Ryu and Jung, 1999) and antioxidant effects (Yang et al., 2009). Recently, several studies have been conducted about the usage of medical plant extracts as prophylactic products as a result of their usage as feed additive in the general animal products and aquaculture, of increase in the growth, and of achievement of positive results (Goda, 2008; Zheng et al., 2009; Yilmaz et al., 2015). Nowadays in aquaculture, there is a need for specifying the in vivo effective doses of alternative agents, which are natural, reliable, antimicrobial, and not giving any harm to the ecosytem, and adding them to the sector. Feed additives are supplements that are used to increase the utilization of the feed, increase the quality and quantity of the animal products, protect the health of animals and to cut down on the costs of the product the
animal provides. In addition, new approaches which bring the use of alternative feed additives into the forefront began to be adopted because of the problems arising from the extensive use of antibiotics in recent years. New alternative additives that are used in practice are: enzymes, organic acids, probiotics, oligosaccharides (prebiotics) and plant extracts (Kahraman, 2009). It is a worldwide topic that alkaloid, flavonoid, pigments, phenolic contents, terpenoids, steroids, and volatile oils are used by being added to feed. These products are seen as alternative to synthetic chemicals (Yigitarslan et al., 2011).

In the limited number of researches carried out with the aim of determining the opportunity of using plants and the active agents they contain in the cultivation, it has been reported that plant extracts added to the feed and water enhance the feed consumption, feed conversion, and growth and carcass quality (Simsek et al., 2005; Immanuel et al., 2009; Oskoii et al., 2012). Several studies have reported that oral administration of fig and onion extract in Paralichthys olivaceus (Cho, 2011), fig in Paralichthys olivaceus (Lee et al., 2015) improved growth performance.

The aim of this study is to make fig extract and onion extract utilizable in practice for the aquaculture sector. An increase in our country’s medical plants’ added value is aimed through a better growth performance and feed efficiency. It is aimed for the aquaculture sector that data to be acquired from feed efficiency and growth performance will be transferred to the sector.

**MATERIALS AND METHODS**

**Fish and Experimental Protocol**

Cyprinus carpio were obtained from a local private fish farm in İzmir, Turkey. Fish were divided into 200 L aquariums. In the trial, 840 Cyprinus carpio which has average weight of ±SD = 2.48±0.20 g was used. Fish were fed with an experimental diet two times a day at 08:00 a.m. and 16:00 p.m. at a rate of 2% of their body weight. During the experimental period water quality remained as follows: temperature 20.10±0.23°C, pH 7.47±0.01 and dissolved oxygen 7.37±0.01 mg/L. During the trial, water quality parameters were measured daily. Fish experiments were performed in accordance to the guidelines for fish research from the animal ethic committees at Adnan Menderes University.

Fig extract (Talya herbal product) and Onion extract (Talya herbal product) were added to a commercial trout feed (Kılıc Feed Company, Turkey, pellet size:2 mm, Table 1) at a dose of 0 (Control), 1 (F1), 3 (F3), 5 (F5), 1 (O), 3 (O), 5 (O) g/kg by mixer. The addition of extracts to the feed was carried out with alcohol via spraying method. With the aim of protecting the fishes from the trial environment, they were fed with commercial trout feed for 15 days. Each trial group was carried out with 3 repetitions. Trial lasted for 90 days. Relevant analyzes were carried out at the Tarbiyomer Laboratories of the Adnan Menderes University Faculty of Agriculture by me.

**Table 1. Commercial trout extruder feed (pellet size:2 mm) ingredients**

| Parameters       | Values |
|------------------|--------|
| **Proximate analyses** |        |
| Crude Protein (%) | 50     |
| Crude Lipid (%)   | 16     |
| Crude Cellulose (%) | 1.2   |
| Crude Ash (%)     | 9.7    |
| Moisture (%)      | 10     |
| **Macro elements (%)** |      |
| Calcium %         | 1.9    |
| Total Phosphate % | 1.3    |
| Sodium            | 0.5    |

Ingredients: Fish meal, fish oil, soybean and by products, wheat and by products, yeast and by products, amino acids, vitamins and minerals.

**Growth Performance and Proximate Analyses**

Growth performance and feed utilization were calculated according to the formulae given below. Proximate analyses of the diets were performed using standard methods (AOAC, 1998). Moisture was detected after drying at 105°C until a constant weight was achieved. Crude protein was analyzed by the Kjeldahl method, and crude ash by incineration at 525°C in a muffle furnace for 12 h. Crude fat was analyzed by methanol/chloroform extraction (Folch et al., 1957).

\[ \text{WG (g)} = \text{final weight (FW) (g)} - \text{initial weight (IW) (g)} \]

\[ \text{SGR} = \left( \% / d \right) \times \left( \ln \text{final weight (g)} - \ln \text{initial weight (g)} \right) / \text{days} \times 100 \]

\[ \text{FCR} = \text{feed intake (g) / weight gain (g)} \]

\[ \text{CF} = \text{body weight(g)/total length}^3 \times 100 \]

\[ \text{VFI} = \{\text{wet weight of visceral fat (g)/wet body weight (g)} - \text{wet weight of visceral fat (g)}\} \times 100 \]

\[ \text{Hepatosomatic index (HSI)} = \{\text{wet weight of liver (g)/wet body weight (g)} - \text{wet weight of liver (g)}\} \times 100 \]

\[ \text{VSI} = \{\text{wet weight of viscera and associated fat (g)/wet body weight (g)} - \text{wet weight of viscera and associated fat (g)}\} \times 100 \]

\[ \text{SSI} = \{\text{wet weight of spleen (g)/wet body weight (g)} - \text{wet weight of spleen (g)}\} \times 100 \]
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Statistical Analysis
Each value was expressed as mean ± standard error of mean (SEMs) for each parameter measured. Statistical significance was determined by one-way analysis of variance (ANOVA) followed by a DUNCAN multi comparison test with SPSS 21.0 package software. Statistical significance was established at P<0.05.

RESULTS
The two diets were equally accepted by the fish and there was no disease in any treatment. In the trial, while the best live weight increase was obtained in F3 and O5 groups, the lowest was obtained in the control group. With respect to the food conversion ratio, the highest was F5 and the lowest was F3 (p<0.05) (Table 2.3).

With respect to the specific growth rate, the highest was F5 and the lowest was F3 (p<0.05) (Table 2.3). At the end of the trial, with respect to the condition factor, the highest was O5 group and the lowest was O1 group (p>0.05) (Table 2.3). Growth data are presented in Table 2 and 3.

Table 2. Growth performance and feed utilization in Cyprinus carpio that were fed diets containing different levels of fig extract (0 (Control), 1, 3, or 5 g/kg of feed; for 90 days)

| Composition (%) | Control F1 | F3 | F5 |
|-----------------|------------|----|----|
| Initial fish weight (g) | 2.54±0.06a | 2.42±0.08a | 2.42±0.02a | 2.42±0.10a |
| Final fish weight (g) | 6.73±0.07a | 6.75±0.30a | 7.09±0.07a | 6.67±0.39a |
| Weight gain (%) | 166.40±6.43a | 173.33±10.60ab | 186.80±3.55a | 170.00±18.81ab |
| FCR | 1.32±0.01ab | 1.31±0.05ab | 1.24±0.01b | 1.33±0.07a |
| SGR (%/d) | 0.87±0.03b | 0.92±0.03ab | 0.96±0.01a | 0.91±0.08ab |
| Initial CF | 1.81±0.10a | 1.75±0.27a | 1.74±0.07a | 1.68±0.03a |
| Final CF | 3.78±0.51a | 3.73±0.24a | 3.72±0.30a | 3.60±0.10a |

Values are mean ±SE (n=6). Within a row, means with different letters are significantly different (P< 0.05).

Table 3. Growth performance and feed utilization in Cyprinus carpio that were fed diets containing different levels of onion extract (0 (Control), 1, 3, or 5 g/kg of feed; for 90 days)

| Composition (%) | Control | O1 | O3 | O5 |
|-----------------|---------|----|----|----|
| Initial fish weight (g) | 2.54±0.06a | 2.49±0.05a | 2.52±0.06a | 2.56±0.13a |
| Final fish weight (g) | 6.73±0.07a | 6.99±0.10a | 6.89±0.15a | 6.66±0.21a |
| Weight gain (%) | 166.40±6.43a | 180.26±2.66ab | 174.66±3.40ab | 186.80±3.55a |
| FCR | 1.32±0.01ab | 1.26±0.02ab | 1.28±0.02ab | 1.32±0.04ab |
| SGR (%/d) | 0.87±0.03b | 0.92±0.03ab | 0.90±0.00ab | 0.85±0.02b |
| Initial CF | 1.81±0.10a | 1.69±0.14a | 1.84±0.07a | 1.74±0.10a |
| Final CF | 3.78±0.51a | 3.26±0.27a | 3.75±0.37a | 3.62±0.23a |

Values are mean ±SE (n=6). Within a row, means with different letters are significantly different (P< 0.05).

There was not any significant differences were detected related to crude protein, crude lipid, crude ash and crude moisture between the experimental group and the control group. (Table 4, Table 5; P>0.05).

The whole-body proximate compositions of fish presented in Table 4 and Table 5.

Table 4. Whole-body proximate composition (%) of Cyprinus carpio fed diets with different levels of fig extract for 90 days

| Composition (%) | Control | F1 | F3 | F5 |
|-----------------|---------|----|----|----|
| Crude Protein | 14.76±0.91a | 13.74±0.16a | 15.08±0.75a | 14.11±0.92a |
| Crude Lipid | 3.89±0.39a | 3.99±0.45a | 4.01±0.94a | 4.31±0.63a |
| Crude Ash | 2.00±0.53a | 2.18±1.00a | 2.23±0.38a | 2.32±0.24a |
| Moisture | 71.74±1.30a | 72.90±1.06a | 73.19±0.26a | 71.44±0.69a |

Values are mean ±SE (n=6)
At the end of 90 days, VSI and HSI values were found lower in the group fed with fig and onion extract compared to the control group and statistically there is difference. VFI value was found lower in the group fed with fig and onion extract compared to the control group and statistically there is difference (Table 6.7 P<0.05). SSI value was found higher in the group fed with fig and onion extract compared to the control group and statistically there is difference (Table 6.7 P<0.05). 

**DISCUSSION**

Cho (2011) conducted an experiment with *Paralichthys olivaceus*, fed with a basal diet containing 1 g/100g fig and onion extract meal for 6 weeks, and he found that the use of 1 g/100g onion extract meal improved the fish performance (weight gain and specific growth rate). In another study, it was determined that there is no change in the survival rate, weight increase and specific growth rate of *Paralichthys olivaceus* (6.5 g) that was fed with a diet containing %2.5 fig (*Ficus carica*) (Lee et al., 2015).

It was generally observed through the nutritional value and growth performance analyses that fig and onion addition to the feed with the rate of 1,3 g/100g had positive results. These differences could be explained by the different application time of feeding and fish species, or the level of fig and onion extract in the diets. Biometric indices may increase or decrease due to factors such as unhealthy conditions (Hadi et al., 2008), feeding levels, or feeding ration (Company et al., 1999). However, in the present study, no mortality or disease in fish from any of the treatments were observed. It can be said that with the decrease in HSI amount, liver can function in a healthier way. The use of medical plants in fishes in this field is new; in a conducted study, it was reported that fig extract, onion extract and indian fig have no effect on the condition factor and HSI (Cho, 2011). It was reported in a study conducted among channel catfishes that a type of oregano (*Origanum heracleoticum L.*) decreased HSI and VSI amounts (Zheng et al., 2009). In the same study, decrease in HSI amount in parallel with VSI amount might be resulted from oregano’s effect in reducing the liver fat. Decrease in HSI amount were acquired through the use of (*Origanum heracleoticum L.* + *Astragalus radix* + *Lonicera japonica* and green tea) in different studies carried out among fishes (Francis et al., 2002; Zakes et al., 2015)

| Table 5. Whole-body proximate composition (%) of *Cyprinus carpio* fed diets with different levels of onion extract for 90 days |
|-----------------|--------|--------|--------|--------|
| **Composition (%)** | **Control** | **O1** | **O3** | **O5** |
| Crude Protein | 14.76±0.91a | 13.98±1.03a | 14.63±1.15 a | 13.45±0.83 a |
| Crude Lipid | 3.89±0.39a | 4.38±0.32a | 3.97±0.21 a | 4.08±1.21 a |
| Crude Ash | 2.00±0.53a | 2.64±0.40a | 2.13±0.83 a | 2.77±0.09a |
| Moisture | 71.74±1.30a | 71.36±1.68a | 71.55±2.20 a | 72.18±0.84a |

Values are mean ±SE (n=6).

| Table 6. Viscerosomatic index (VSI), Hepatosomatic index (HSI), Spleen somatic index (SSI) and Visceral fat index (VFI) of *Cyprinus carpio* fed different diets containing fig extract for 90 days |
|-----------------|--------|--------|--------|--------|
| **Diets** | **Control** | **F1** | **F3** | **F5** |
| VSI | 10.80±0.48a | 8.17±0.33 c | 8.57±1.06 bc | 8.47±0.75bc |
| HSI | 0.81±0.11a | 0.59±0.08 c | 0.55±0.02 c | 0.66±0.08bc |
| SSI | 0.058±0.06b | 0.078±0.08 ab | 0.076±0.03 ab | 0.080±0.07a |
| VFI | 2.63±1.09a | 1.80±0.48 a | 2.04±0.56 a | 2.33±0.37a |

Values are mean ±SE (n=6). Within a row, means with different letters are significantly different (P<0.05).

| Table 7. Viscerosomatic index (VSI), Hepatosomatic index (HSI), Spleen somatic index (SSI) and Visceral fat index (VFI) of *Cyprinus carpio* fed different diets containing onion extract for 90 days |
|-----------------|--------|--------|--------|--------|
| **Diets** | **Control** | **O1** | **O3** | **O5** |
| VSI | 10.80±0.48a | 10.00±1.13bc | 9.66±0.94 abc | 10.31±1.97 ab |
| HSI | 0.81±0.11a | 0.59±0.05c | 0.67±0.03 cc | 0.74±0.01 a |
| SSI | 0.058±0.06b | 0.065±0.02ab | 0.062±0.12 ab | 0.070±0.07ab |
| VFI | 2.63±1.09a | 2.33±0.37a | 2.33±0.68 a | 2.62±0.36a |

Values are mean ±SE (n=6). Within a row, means with different letters are significantly different (P<0.05).
When the low level of HSI amount is linked to the fat rate in liver, it can be said that the used vegetable sources reduce liver fat among carps. These results showed that undesirable VFI in Cyprinus carpio could be decreased through fig and onion extracts. In a study carried out among Japanese quails, it was reported that oregano extract oil significantly reduced abdominal fat and the percentage of abdominal fat (Denli et al., 2010). The results acquired by the researchers are similar to the findings acquired from carps. Therefore, it can be said that plant extracts can be used to reduce organ adiposity in the fishes fed with fatty feeds. The spleen is considered to be the main organ in fish where neutrophils, erythrocytes and granulocytes are produced and mature (Anderson, 1974). It appears that the spleen plays a vital role in the immune response in fish and is responsible for the high production of melano-macrophages (Kumaran et al., 2010). Studies have reported a positive relationship between increase in spleen weight and resistance to disease in fish (Hadidi et al., 2008; Wiens and Vallejo, 2010). SSI values significantly increased in both plant extract groups and they are respectively positive changes for easier digestion and higher immunity. Based on the results acquired from the study, the effects of fig and onion in different sized Cyprinus carpio and in different periods from larval period to the portion-sized period can be researched in future studies. The use of these plants in feeds of densely cultivated fishes in our country such as rainbow trout, gilthead seabream, and European seabass can be researched. The total production of these plants, which hold an important place in world trade, has a value of 6.5 million tons and 2.8 billion dollars. Spice exports in the world have reached to 3.3 billion dollars and Turkey ranks 13th with 68 million dollars among the spice exporting countries (SADC, 2005). In addition, as of 2009, Turkey’s total export value of medicinal plants and spices has reached to 96 million dollars (Çakıroğlu, 2010). The amount of production of fig and onion from plants cultivated in our country is 305,450 tons and 2,120,581 tons respectively (TSI, 2016). In our country, Abundance in the amount of fig and onion is also related to the price, while cereals and other herbal products are at 2.12 TL / kg and 0.76 TL / kg respectively as production value (TSI, 2011). Fig and onion are among the most common, cheap, and easy to find sources in our country. Significant reductions in plant prices when supplied in high quantities are necessary for fish meal production companies for an economic formulation. In addition to this, based on the positive results acquired from Cyprinus carpio as also from many animals and people, both plant extracts, particularity fig, can be used by feed companies.

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