Effects of different levels of Aloe vera L.extract on growth performance, hemato-immunological indices of Cyprinus carpio L.

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Abstract

This study was conducted to determine the effects of administration of different concentration of Aloe vera Crud Extract (ACE) as a food supplement on growth performance, immune response and disease resistance against Aeromonas hydrophila (Chester) infection in Cyprinus carpio. 360 juvenile C.carpio were randomly divided into four equal groups in triplicates. Groups 1 to 4 were fed by basal food supplemented with zero, 0.1, 0.5 and 1% ACE respectively, for 60 days. At the end of the experimental period growth performance indices including: Specific Growth Rate (SGR), Food Conversion Rate (FCR), Food Efficacy Rate (FER) and Percentage Weight-Gain (PWG) were evaluated. Blood samples were taken from each treatment and Haematological parameters including: Red Blood Cells (RBC) & White Blood Cell(WBC) count, differential count, Hemoglobin (Hb), Hematocrit (Hct), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH) and the Mean Corpuscular Hemoglobin Concentration (MCHC) as well as Immunological parameters including: lysozyme activity, serum bactericidal activity, alternative complement activity, respiratory burst activity, serum total protein and globulin were evaluated. Finally challenge with Aeromonas hydrophila was performed and commutative mortality was calculated.

Results showed significant improve in growth indices of groups 3 and 4 (p<0.05). PCV and MCV, as well as most of the immune parameters including lysozyme activity, complement activity, respiratory burst activity and serum bactericidal activity were significantly (p<0.05) higher in groups 3 and 4. In addition the rate of challenge mortality was significantly lower in the 0.5 and 1% ACE treated fishes than other groups (p<0.05). In conclusion supplementation of food with 0.5 and 1% ACE has immunostimulating, growth stimulation effects, as well as resistance against bacterial infection in C.carpio.

Keywords: Aloe vera extract, Cyprinus carpio, Aeromonas hydrophila, immunostimulant, hemato-immunological parameters

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Introduction

As fishes are placed in lower levels of evolutionary system, non-specific immunity has more important role against pathogens in fishes, so the use of immunostimulatory agents seems to have a good result in fish immune response (Zapata et al., 2006; Swain et al., 2007). Herbal immunostimulants have numerous potential benefits in comparison to vaccines and drugs like antibiotics. They are not expensive and are available almost all around the world; in contrast vaccines are generally expensive and are not available for all kinds of disease (Raa et al., 1992 and Rojhan, 2007). Nowadays abuse of antimicrobial drugs and disinfectants in aquaculture has obviously led to the evolution of resistant strains of bacteria (Kim et al., 1999), but fortunately this is not the case with herbal immunostimulants (Raa, 1996). Therefore, using immunostimulants seems to be an attractive alternative way of controlling fish diseases and the recent use of immunostimulants in fish farms has been becoming popular for enhancing the activity of nonspecific defense mechanisms and conferring protection against diseases (Raa, 1996).

Aloe vera L. Burm.f or Aloe barbadensis Miller is a tropical member of the lily family (Liliaceae) which is characterized by lance-shaped leaves. Aloe vera is recognized for its widespread use and reported healing powers (Krishnan, 2006), alleviating pain and treating a variety of ailments (Shelton, 1991).

Acemannan (a kind of polysaccharide), is the main part and functional component of Aloe vera’s gel (Lee et al., 2001). The refined polysaccharide has been shown to act as an immunostimulant, displaying adjuvant activity and enhancing the release of different kinds of cytokines (Peng et al., 1991) as well as stimulating hematopoiesis (Egger et al., 1996). Acemannan have been reported to have antimicrobial properties, including anti-bacterial, anti-fungal, anti-viral, and anti-parasitic properties (Boudreau and Beland, 2006).

Although the immunomodulatory potentials of Aloe vera in mammals particularly in human have been well confirmed (Tan and Vanitha, 2004), few works were done on effects of Aloe vera on fish (Kim et al., 1999 and Alishahi et al., 2010).

Common carp is one of the most important fishes in the world and Iran aquaculture. Recently various mass mortalities were reported in carp culture of Iran (Sattari, 2008) and use of immunostimulants is a suggestible alternative to antibiotics in this species.

In this study the growth performance indices and hematoimmunological parameters of Cyprinus carpio were investigated following feeding different doses of ACE.

Materials and methods

Fishes

360 juvenile common carps, weighing an average of 45±3 gr were purchased from a cyprinid fish farm in Ahvaz, Khuzestan province, south Iran. Water quality parameters including water temperature, dissolved oxygen, pH, NH₃ and NO₂ were, 26±1°C, 9±1 mg l⁻¹, 7.7±0.33, <0.01 mg l⁻¹ and <0.1 mg l⁻¹, respectively. Fish were acclimatized for two weeks prior to the experiment and during experiment period, physicochemical parameters of water was checked and maintained in standard range by using of automatic aquarium heaters, bio-filters and frequent water changes.

Aloe Extract

Crude extracts of Aloe vera were prepared by method that has been described previously by Alishahi et al. (Alishahi et al., 2010). Briefly the process was removing the thick green outer layer of Aloe leaves, extracting the inner gel and purifying it by squeezing, homogenating and filtering.

Grouping

Fishes were randomly divided into four groups (in triplicate) of 90 fishes and each group divided to triplicates of 30. Each of 12 treatments placed into 150 L aquarium equipped with thermostat controlled heaters, aeration, external biofilters and automatic feeders.

Experimental food preparation

The commercial common carp food (Beiza
Co, Iran) were used as a basal diet. For better homogenation of ACE with food, initially granulated food converted to paste by adding distilled water in it, then 0.1, 0.5 and 1% (w/w) ACE added to food and homogenized with electric mixture. Finally food pelleted by means of special meat grinder. Control food prepared in the same way without any supplementation of ACE. Prepared experimental foods were packed in nylon bags, labeled and stored at 4 ºC until use.

**Growth performance**

The Percentage Weight-Gain (PWG), Specific Growth Rate (SGR), Food Conversion Ratio (FCR) and Food Efficiency Ratio (FER) were calculated according to the following equations (Azza, 2009):

\[
\text{PWG (g/fish)} = \frac{\text{Average final weight} - \text{Average initial weight}}{\text{initial weight}}
\]

\[
\text{SGR (%/day)} = \frac{[\text{final body weight} - \ln \text{initial body weight}] \times 100}{\text{experimental period (day)}}
\]

\[
\text{FCR} = \frac{\text{Food intake}}{\text{weight gain}}
\]

\[
\text{FER} = \frac{\text{Body weight gain}}{\text{Food intake}}
\]

(All of the fish weights in top equations were calculated in gram unit).

**Blood and serum sampling**

At the end of the feeding experiment, fish anaesthetized by immersing in water containing 70 ppm concentration of MS-222. Blood-samples were collected from the caudal vein, by using needles impregnated with heparin for the evaluation of hematocrit, white blood cell count (WBC) and WBC differential count (Thrall, 2004). For serum separation, another blood-sample was withdrawn from the caudal vein; into blood Eppendorf tubes without anticoagulant in syringe. The Eppendorf tubes, containing the blood samples were centrifuged at 2500 g for 15 min and supernatant serum was collected. The serum was stored at -20 ºC in Eppendorf tubes until use for immunological studies.

**Lysozyme activity**

The lysozyme activity was measured using photoelectric colorimeter equipped with attachment for turbidity measurement. A series of dilution was prepared by diluting the standard lysozyme from hen egg-white (Sigma) and mixed with *Micrococcus lysodeikticus* (Schroeter) (Sigma) suspension for establishing the calibration curve. Ten µl of standard solution or serum were added to 200 µl of micrococcus suspension (35 mg of Micrococcus dry powder/95 ml of 1/15 M phosphate buffer + 5.0 ml of 1M NaCl solution). The changes in the extinction were measured at 546 nm by measuring the extinction immediately after adding the solution which contained the lysozyme (start of the reaction) and after 20 min incubation of the preparation under investigation at 40 ºC (end of the reaction). The lysozyme content is determined on the basis of the calibration curve and the extinction measured (Thrall, 2004).

**Serum bactericidal activity (SBA)**

Bactericidal activity was studied following procedure by (Azza, 2009) with slight modification. Sera samples were diluted three times with 0.1% gelatin-veronal buffer (GVBC2) (v/v), (pH 7.5, containing 0.5 mM ml⁻¹ Mg²⁺ and 0.15 mM ml⁻¹ Ca²⁺). *A. hydrophila* (live, washed cells) suspended in the same buffer at concentration of 10⁵ CFU ml⁻¹. The diluted sera and bacteria were mixed at 1:1 v/v, incubated for 90 min at 25 ºC with shaker. Control group containing bacterial suspension was also included. The number of viable bacteria was then determined by counting the colonies after culturing on Tripticas Soy Agar (TSA) plates for 24 h at room temperature 25 ºC.

**Respiratory burst assay**

The respiratory burst activity was measured by the reduction of Nitro Blue Tetrazolium (NBT) by intracellular superoxide radicals (Anderson and Siwicki, 1994). Briefly, 100 ml of heparinised blood from fish of each group was mixed with 100 ml of 0.2% NBT (Merk, Germany) solution for 30 min at 25 ºC. After incubation, 50 ml of the above mixture was added to 1 ml of N,Ndiethylmethyl formamide (Sigma, USA) and then centrifuged at 3000 g for 5 min. The optical density of the supernatant was measured at 540 nm and
compared among treatments.

**Alternative complement activity**

The activity of the alternative complement pathway was assayed using Sheep Red Blood Cells (SRBC) as targets (Ortuno et al., 1998). SRBC were washed in phenol red free hank’s balanced salt solution (HBSS) containing Mg²⁺ and EGTA and resuspended at 3% in HBSS. Aliquots (500 µl) of test serum as complement source, diluted in HBSS, was added to 500 µl of SRBC to give final concentrations of 10, 5, 2.5, 1.25, 0.625, 0.313, 0.1565 and 0.078%. After incubation for 1 h at 22 ºC, the samples were centrifuged at 800 g for 5 min at 4 ºC to remove non-lysed erythrocytes. The relative haemoglobin content of the supernatants was assessed by measuring their optical density at 540 nm in a spectrophotometer. The values of maximum (100%) and minimum (spontaneous) haemolysis were obtained by adding 500 µl of distilled water or HBSS, respectively. The degree of haemolysis (Y) was estimated and the lysis curve for each specimen was obtained by plotting Y/1-Y against the volume of serum added (ml) on a log-log scaled graph. The volume of serum producing 50% haemolysis (ACH50) was determined and the number of ACH50 units ml⁻¹ was obtained for each experimental group.

**Total serum protein and globulin**

The total serum protein level was estimated by the method of Bradford (Bradford, 1976) using the standard protein estimation kit (Zist Shimi Co, Iran). For globulin estimation, 50 ml saturated ammonium sulphate solution was added drop wise to 50 ml serum followed by vortexing. Centrifugation was done at 10,000 g for 5 min. Then 20 ml of this sample dissolved with 80 ml carbonate-bicarbonate buffer (pH 9.3) and the protein content was estimated through the method of Bradford using the standard protein estimation kit (Zist Shimi Co, Iran).

**Hematological parameters**

Blood samples immediately analyzed for the estimation of numbers of erythrocytes and, Hemoglobin (Hb), Hematocrit (Hct), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH) and the Mean Corpuscular Hemoglobin Concentration (MCHC). Number of erythrocytes was determined by the hemocytometer method (Ellis, 1990); haematocrit was determined by the microhematocrit method (Fox, 1997) and hemoglobin measurement was determined by the cianometa-hemoglobin method (Goldenfarb, 1971). MCV, MCH and MCHC were calculated by using the formulas as follow (Hu, 2005):

\[
MCV \ (\mu m^3 \ cell^{-1}) = \frac{\text{Packed cell volume as percentage}}{\text{RBC in millions cell mm}^{-3}} \times 10
\]

\[
MCH \ (pg \ cell^{-1}) = \frac{(\text{Hb in g} \ 100 \ ml^{-1}/ \ RBC \ in \ millions \ cell \ mm^{-3})}{10}
\]

\[
MCHC \ (g \ 100 \ ml^{-1} \ Hct) = \frac{(\text{Hb in g} \ 100 \ mL^{-1} \ packed \ cell \ volume \ as \ percentage)}{100}
\]

White blood cell count (WBC) and Differential count was made from 6 animals of each group in a Neubauer counting chamber as described by Schaperclaus (Schaperclaus et al., 1991). For Differential count of leukocytes whole blood on glass microscope slides, dried in air, and stained with May-Grunwald/Giemsa. leucogram was assessed for each fish under an oil immersion lens. One hundred white blood cells from each smear were assessed and the percentage of different types of leucocytes was calculated following the method of Schaperclaus (Schaperclaus et al., 1991).

**Challenge with Aeromonas hydrophila**

After the 60 days of the feeding experiment, 10 fish from each aquarium were challenged intraperitoneally with 0.2 ml of 2×LD₅₀ concentration of live A. hydrophila. The challenged fish were kept under observation for 10 days. Cause of death was ascertained by re-isolating the A. hydrophila from kidney and liver of dead fish. The mortalities were recorded daily for 14 days and mortality percentages were compared among the groups.

**Statistical analysis**

Data are presented as Mean±SD of the number of fish per group. Growth indices,
hematological and immune parameters were analyzed using the one way ANOVA followed by Duncan’s multiple range test to compare the difference in values between Aloe treated and control fish using the statistical package (SPSS).

Results

Growth performance

Results of growth parameters are shown in table 1. The use of 0.5% and 1% of ACE (Groups 3&4) concentrations had a significant effect on enhancement of growth parameter including Growth Rate, SGR and FCR \( (p<0.05) \). No significant difference was seen between 0.1% group and control \( (p>0.05) \). Mortality was same for all groups.

Lysozyme activity

The serum lysozyme activity significantly increased with ACE 0.5% and 1% \( (p<0.05) \). Group 2 did not show any difference in lysozyme activity with control treatment.

Serum bactericidal activity (SBA)

As shown in table 1, the use of 0.5% and 1% of ACE, significantly decreased the count of bacterial colonies in comparison to 0.1% ACE and control group \( (p<0.05) \).

Respiratory burst assay (obtained from NBT reduction)

The production of superoxide, examined by NBT reduction, was significantly higher in blood leukocytes of fishes in group 3 than leukocytes of the groups 1 and 2 \( (p<0.05) \). This parameter was also higher in group 4 than groups 1 and 2, but the difference was not significant \( (p>0.05) \).

Alternative complement activity

According to results that are shown in table 1, groups 3 and 4 had more competent activity than groups 2 and 1 \( (p<0.05) \).

Total serum protein and globulin

Highest levels of total serum protein and globulin were seen in groups 3 and 4 which have a significant difference with groups 1 and 2 (table 1).

Hematological parameters

The results of hematological parameters of treatments are shown in table 1.

In PCV and MCV measurement, groups 0/5% and 1% ACE show significantly higher levels of PCV and MCV than 0/1% ACE and control.

In Hb measurement and RBC count, 1% ACE was the only group which had a significant difference with control and other ACE concentrations.

No significant differences were seen between four groups in other hematological parameters (i.e. MCH, MCHC, Heterophil, Lymphocyte, Monocyte and Eosinophil count).

Discussion

Immuno stimulating effects of many herbal medicines in various fish species is proven. Enhancement of immune responses of *Cyprinus carpio* (Jian and Wu, 2004), *Oncorhynchus mykiss* (Dügenci et al., 2003), *Carassius auratus gibelio* (Chen et al., 2003) consequent to administration of different herbal compounds has been reported before. *Aloe vera* inner gel possess some kinds of polysaccharides that have been shown to act as an immunostimulant and adjuvant in mammals, but the published data about *Aloe* effects on fish immune system are scarce (Kim et al., 1999 and Alishahi et al., 2010). Kim et al. used *Aloe vera* as a disease suppressing agent against *Vibrio alginolyticus* infection rather than as an immunoprophylactic (Kim et al., 1999). In our previous work, we report some immunostimulatory effects of ACE in *C.carpio* but in this study the dose dependent response of *C.carpio* to ACE were evaluated (Alishahi et al., 2010).

In the present study, it was observed that most of investigated immunological, haematological and growth parameters were affected in fish fed with 0.5 and 1% ACE supplemented food. According to the results, Food supplemented with 0.5% and 1% ACE, stimulates following growth
Figure 1. Results of lysozyme activity in 3 different concentrations of ACE and Control. Significant differences ($p<0.05$) are marked by different letters.

Table 1. Details of growth indices, immune parameters and Hematological parameters are shown in this table. Significant differences ($p<0.05$) are marked by different letters.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control</th>
<th>ACE 0.1%</th>
<th>ACE 0.5%</th>
<th>ACE 1%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Growth indices</strong></td>
<td></td>
<td>--------------</td>
<td>--------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Growth rate</td>
<td>82.16 ± 12.64</td>
<td>81.90 ± 14.01</td>
<td>102/5 ± 10.31</td>
<td>91.89 ± 6.27</td>
</tr>
<tr>
<td>SGR</td>
<td>1.37 ± 0.21</td>
<td>1.36 ± 0.23</td>
<td>1.71 ± 0.17</td>
<td>1.46 ± 0.10</td>
</tr>
<tr>
<td>FCR</td>
<td>3.1 ± 0.21</td>
<td>3.05 ± 0.20</td>
<td>2.44 ± 0.24</td>
<td>2.62 ± 0.09</td>
</tr>
<tr>
<td>Mortality</td>
<td>12 ± 3.33</td>
<td>10 ± 5.09</td>
<td>8.89 ± 5.09</td>
<td>10 ± 3.33</td>
</tr>
</tbody>
</table>

| **Immune parameters**           |               |--------------|--------------|---------------|
| SBA assay                       | 186.3 ± 22.7  | 191.4 ± 35.3 | 124.6 ± 31.2 | 118.3 ± 23.9  |
| NBT assay                       | 0.312 ± 0.07  | 0.306 ± 0.05 | 0.395 ± 0.07 | 0.355 ± 0.06  |
| Complement activity             | 408 ± 18.2    | 402 ± 31.2   | 443.3 ± 30.3 | 462.3 ± 31.2  |
| Total protein (g dl$^{-1}$)     | 3.26 ± 0.51   | 2.97 ± 0.38  | 3.59 ± 0.69  | 3.61 ± 0.64   |
| IgM (g dl$^{-1}$)               | 1.86 ± 0.55   | 1.68 ± 0.39  | 2.32 ± 0.55  | 2.77 ± 0.76   |

| **Hematological parameters**    |               |--------------|--------------|---------------|
| PCV%                            | 31.4 ± 8.48   | 32.7 ± 8.24  | 39.8 ± 6.49  | 43 ± 7.43     |
| Hb                              | 8.15 ± 1.36   | 8.06 ± 1.65  | 8.98 ± 1.91  | 9.57 ± 1.75   |
| MCV (fl)                        | 246.7 ± 65.7  | 281.7 ± 92.6 | 305.8 ± 42.5 | 311 ± 80.5    |
| MCH (pg)                        | 64.9 ± 16.6   | 68.5 ± 18.5  | 68.8 ± 14.2  | 69.1 ± 18.3   |
| MCHC (%)                        | 27.6 ± 8.35   | 26.1 ± 6.13  | 22.9 ± 5.52  | 22.7 ± 5.46   |
| RBC ($\times 10^6$ cell/mm$^3$) | 1.29 ± 0.22   | 1.21 ± 0.21  | 1.31 ± 0.19  | 1.44 ± 0.33   |
| Heterophil (%)                  | 16 ± 2.54     | 18.8 ± 3.86  | 17.2 ± 2.98  | 17.5 ± 3.72   |
| Lymphocyte (%)                  | 83.2 ± 3.17   | 80 ± 3.94    | 81.1 ± 4.64  | 81.5 ± 3.96   |
| Monocyte (%)                    | 0.4 ± 0.51    | 0.8 ± 0.68   | 0.73 ± 0.7   | 0.73 ± 0.59   |
| Eosinophil (%)                  | 0.4 ± 0.51    | 0.33 ± 0.49  | 0.33 ± 0.49  | 0.33 ± 0.62   |
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Figure 2. Data of WBC count is shown. As we can see, groups 0/5% and 1% significantly have higher levels of WBC (P<0.05).

Figure 3. Mortality rate in group 0/5% and 1% ACE after challenge with bacteria is lower than two other groups and this difference is statistically significant (P<0.05). * shows significant difference with control group.

indices: AWG, SGR, FCR and FER in C. carpio fed for up to 60 days. Several authors have reported relationships between the use of immunostimulants and promotion in growth rate (Citarasu et al., 2003).

According to the results of present study lysozyme activity enhanced in groups 3 and 4. Lysozyme is a very important part of immune system as it is widely distributed in serum, tissues and mucus. It is effective in lysis of not only Gram-positive bacteria but also Gram-negative microbes. Lysozyme may become effective after complement and other enzymes have unmasked inner peptidoglycan layer (Alishahi and Buchmann, 2006). Similar results of elevated lysozyme activity were observed in Labeo rohita fed with 0.5% of Achyranthes aspera seed (Rao et al., 2006) and microbial levan (Gupta et al., 2008), in C. carpio with dietary Astragalus radix and Ganoderma lucidum (Yin et al., 2009).

Although supplemented diet with 0.5% and
1% ACE were significantly increased the serum bactericidal activity against A.Hydrophila (p<0.05), diet supplemented with 0.1% had no stimulating effect on serum bactericidal activity compared to the control group. Divygagnaneswari et al. (Divygagnaneswari et al., 2007) in tilapia and Misra et al. (Misra et al., 2006) in Indian major carp (Labeo rohita) reported an increase in serum bactericidal activity after administration of some herbal extracts.

NBT activity, an indicator of respiratory burst activity in phagocytes in fish (Secombes, 1996), significantly increased in fish fed with 0.5% ACE enriched diet compared to control group, but other level of ACE did not induce any significant change in NBT activity of leukocytes. This stimulatory effect may be due to the proliferative responses of leukocytes as reported in rainbow trout macrophages following in vitro treatment with Glycyrrhiza glabra extract (Jang et al., 1995) or due to the enhancement in the respiratory burst activity and expression of interleukins in Ergosan injected fish (Peddie et al., 2002). The similar result of enhanced leukocytes NBT activity in rainbow trout by dietary 1% aqueous extract of ginger roots (Dügenci et al., 2003) and Zeranol (Keles et al., 2002) were also reported.

Complement, another component of the non-specific humoral immune response, was also studied in the present work. Fish treated with 0.5 and 1% ACE supplemented food showed significant increase in the alternative pathways when compared with control fish. Increase in complement activity could be partly related to the rise in the complements component and their activity in the serum. Thus, complement activity could contribute to protection against bacterial infection in ACE treated groups. Although in some similar works increase in complement activity were reported (Boshra et al., 2006 and Cheng et al., 2007), there are other studies found that oral administration of immunostimulants to turbot (Baulny et al., 1996) and C.carpio (Selvaraj et al., 2005 and Alishahi et al., 2010) did not induce any change in complement activity.

Although total serum protein contents and total globulin were markedly increased in fish treated with 0.5 and 1% ACE supplemented food, change in serum protein and globulin content was independent to the dosages of ACE. The increase in serum protein content might be correlated with an increase of other proteins like serum lysozyme, complement factors and bactericidal peptides. Elevated total protein and globulin were reported following administration of medicinal plants in fish (Misra et al., 2006; Alishahi et al., 2010 & 2011).

In this study significant increase in some haematological parameters (PCV, RBC, WBC and Hb) was seen in groups 3 and 4. PCV and RBC are general indicators for fish health and help to describe abnormalities caused by immunostimulants (Selvaraj et al., 2005). The main reason of this promotion can refer to the effect of Aloe on fish haematopoetic activity, and the increase in the leucocyte count might have resulted in the enhancement of the immune responce, because phagocytic cells are the key elements in the immune system and are the major affector and effector cells on which Aloe exerts its activities. Although WBC value showed significant increase in groups 3 and 4 (p<0.05), no significant change observed in types of leucocytes (lymphocytes, neutrophils, monocytes and eosinophiles) among the experimental groups (p>0.05).

For testing efficacy, it is very essential to estimate the increased protection in fish treated with immunostimulants (Sakai et al., 2001). The present study revealed that oral administration of 0.5 and 1% ACE significantly improved the survival rate of C.carpio against challenge with the pathogen A.hydrophila. The enhancement of nonspecific immune parameters by 0.5 and 1% ACE incorporated in food is possibly an important factor in reducing the percentage mortality and thereby protecting the fish against live A.hydrophila challenge. The present finding is in agreement with the results of Abutbul et al. (Abutbul et al., 2004) in tilapia fed with a diet containing extract of Rosmarinus officinalis and
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Fujiki et al. (Fujiki et al., 1994) in carp administered with the Undaria pinnatifida. In another study fish resistance against A. hydrophila was enhanced in L. rohita fed with 0.5% of Achyranthes (Rao et al., 2006). Besides the methanolic herbal extracts of Andrographis paniculata and Psoralea corylifolia helped to increase the survival and growth and reduced the bacterial load even in the shrimp, Peneaus monodon, post larvae (Citarasu et al., 2003).

To conclude, we have found that although oral administration of Aloe vera Crud Extract or ACE (0.5% and 1% in food) had stimulating effects on growth performance and hematoimmunological parameters of the C. carpio, food supplemented with 0.1% didn’t show such effects. There was no significant difference in assayed parameters between fish fed with food supplemented with 0.5% and 1%, thus 0.5% ACE supplementation of food can be recommended as an immunostimulant in common carp.

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بررسی اثر غلظت‌های مختلف عصاره‌ی خام گیاه الوئه ورا به عنوان مکمل غذایی بر شاخص‌های رشد فاکتورهای ایمنی‌شناسی و خون‌شناسی ماهی کپور معمولی

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چکیده
تحقیق حاضر با هدف بررسی تاثیر عصاره‌ی خام الوئه ورا بر اندیس‌های رشد ویژه، ضریب تبدیل غذایی، ضریب کارایی غذایی و درصد افزایش وزن ماهی کپور معمولی صورت گرفت.

۲۶۷ ماهی جوان بصورت تصادفی به ۴ گروه تقسیم شدند. گروه‌های اول، دوم، سوم و چهارم ماهی از این گروه‌ها به ترتیب با مقادیر ۷/۷، ۱/۷، ۵/۷ و ۱ درصد عصاره‌ی خام ال‌وئه ورا در غذا به مدت ۶۷ روز تغذیه شدند. در پایان دوره تغذیه، شاخص‌های رشد شامل نرخ رشد، ضریب تبدیل غذایی، ضریب کارایی غذایی و درصد افزایش وزن محاسبه گردیدند.

یکی از اهداف این تحقیق بررسی ایمنی‌شناسی ماهی نیز بود که شامل میزان فعالیت لیزوزوم سرم، فعالیت باکتریکشی سرم، فعالیت الترتیبی کمیل‌مان، تعداد افرادی گلبول‌های سیفید و سریع، تعداد گلبول‌های رنگی و همچنین میزان همیژی گلبول‌ها بود.

به‌طور کلی، افزودن عصاره‌ی الوئه ورا به میزان ۵/۷ و ۱ درصد بهبود رشد و درصد افزایش وزن ماهی در مقایسه با دستگاه‌های کنترلی مزین بوده‌است.

واژگان کلیدی: عصاره‌ی الوئه ورا، کپور معمولی، اترونوس هیدروفیلا، محکم‌کننده، فاکتورهای ایمنی‌شناسی، فاکتورهای هماتوایمونولوژی