

Effect of *Aloe vera* Extract on Growth Parameters of Common Carp (*Cyprinus carpio*)

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Abstract: In this study, the effect of ethanolic *Aloe vera* extract as a natural antibiotic on growth performance of common carp (*Cyprinus carpio*) was studied. Fish with an average weight of 29.74 ± 1.20 g and the mean length of 11.50 ± 0.28 cm were divided randomly into 4 treatments (a control and other groups treated with the extract of 0.1, 0.5 and 2.5% in the diet with 3 replicates and density of 10 fish per each replicate. After 8 weeks of feeding, growth parameters such as WG, SGR, FCR and FCE were examined. Comparing the results of the final length and weight and growth indicators in treatments fed with the extract were better in higher dose of extract. The results of this study showed that *Aloe vera* extract as a growth promoter, appetite stimulator, tonic and immunostimulant in the diet can reduce stress, reduce food losses and protect fish in order to better growth of fish.

Key words: Aquaculture • *Cyprinus carpio* • Growth Parameters • Herbs

INTRODUCTION

Common carp, *Cyprinus carpio*, is one of the most important fish species in aquaculture [1]. Common carp is an economically significant fish species cultivated mainly in Asia and Europe. Global production of cultivated common carp was about 6.14% of the global aquaculture production [2]. It is a warm water freshwater fish species that is native to Asia. It is cultivated commercially [3] in other parts of the world, including Australia and South America, because of its fast growth rate, facile cultivation and high feed efficiency ratio [4]. China is by far the widest commercial manufacturer of common carp, which reports nearly 70% of the country's freshwater fish production [5]. In the last two decades the annual production of common carp raised exponentially and obtained more than 3 million tons in 2010 [6]. Currently, it represents 14% of the total world freshwater aquaculture production and is mostly cultivated in Asian countries, especially in China which accounts for 70% of the total global production [6]. A natural population of wild carp is widely distributed throughout the Iranian waters of the Caspian Sea, mainly in coastal waters of the Golestan province [7]. *C. carpio* is found in brackish water of Caspian Sea as a commercially important fish which is caught by the fisherman in north of Iran [8]. It is a

potential species for fish culture and is highly tolerant to changes in water pH [9]. As a source of protein for human food, this fish species is not classified as being in a high-priced class. Enhancing carp aquaculture could be a decisive section of efforts referring to global food security subjects [10]. The development of the common carp industry is challenged by many factors including the protection from disease outbreaks [11]. Common carp in natural conditions decrease feeding and activity with decreasing water temperature in winter to save energy. The optimum temperature range for carp is 20–28°C and usually carp stop feeding in the range 12–4°C and stop motion at water temperatures below 6–4°C in natural situations [12].

Aloe barbadensis Miller (*Aloe vera*) is a perennial plant of the lily (Liliaceae) or Aloeaceae family [13]. It is a perennial succulent cactus-like plant, which grows in hot, dry climates [13]. Since aloe has naturalized throughout the warm regions around the world, it is difficult to correctly establish its origin [14]. It is supposed to be native of North Africa or the Nile region in Sudan [14]. The genus *Aloe* contains over 400 different species with *Aloe barbadensis* Miller (*Aloe vera*), *Aloe aborescens* and, *Aloe chinensis* being the most popular [14]. *Aloe barbadensis* Miller is considered to be the most biologically active [14]. In fish, essential nutrients such as

proteins, essential fatty acids, vitamins C and E, polysaccharides and some minerals have a pivotal importance to reinforce normal immune functions [15]. Aloe gel consists mainly of water (>98%) and polysaccharides (pectins, cellulose, hemicellulose, glucomannan, acemannan and mannose derivatives). Acemannan is pondered the principal practical part of *Aloe vera* and is constituted of a comprehensive chain of acetylated mannose [16]. The physiological action of *Aloe vera* polysaccharides has been greatly presented. Glucomannan and acemannan were demonstrated to hasten wound healing, activate macrophages, arouse the immune system and have antibacterial and antiviral results [16, 17]. The gel and extracts of *Aloe vera* (*Aloe barbadensis* Miller) are greatly used informally in topical and internal traditional medicines, in drinks and in cosmetic something that is produced [18]. In addition, antiviral activity [19], antibacterial [20], immunostimulative activity [21], decreasing radiation-induced skin responses and hastened wound healing [22] have been presented for Acemannan Hydrogel, a polydispersed acetylated mannan discovered in the inner leaf gel [22]. Anyway, opposing consequences have been sometimes faced, such as a case of opposed (hypersensitivity) side result [23] and postpone in wound healing in both animal and human researches [24]. Beside the problem of high cost of fish feeds and quality seed, disease outbreak is a major challenge in fish farming [25], herbal care was improved for restraining the most injurious parasitic illnesses infecting humans, animals and fishes.

The aim of this study was to evaluate growth performance of common carp (*Cyprinus carpio*) fed with three dose of ethanolic *Aloe vera* extract.

MATERIALS AND METHODS

Animals and Feeding: Fingerlings of *C. carpio* used in this experiment were derived from a commercial farm (Gaz seaport, Golestan, Iran). The animals were acclimatized for 2 week to the experimental conditions and diets. At the start of the experiment, the fish were fasted for 24 h and weighed after being anesthetized with 0.01% MS-222 (Sigma, USA). *C. carpio* (mean initial weight 29.74 ± 1.20 g) were randomly selected and distributed into 12 rearing fiberglass tanks for the growth trial (10 fish/tank). Fish were divided into 3 experimental and one control groups. Each treatment had 3 replicates and contained 30 fish. Fish were hand-fed two percent of body weight to apparent

satiation three times (08:30, 12:30 and 18:00) daily for 8 weeks. The control diet was a commercial food (Energy 3002) obtained from Mahiran Company (Tehran, Iran). Before fish feeding, ethanolic *Aloe vera* extract at different levels (0.1, 0.5 and 2.5% of diet) was sprayed on the fish diet using perfume sprayer, then, fish were fed with different levels of *Aloe vera* extract.

Growth Performance: At the termination of the experiment, the fish were fasted for 24 h before harvest. The mean body weights and mean total lengths of fish were measured. Based on recording the weight of each fish, Weight Gain (WG), specific growth rate (SGR), feed conversion ratio (FCR) and Food Conversion Efficiency (FCE) were calculated using the following equations:

$$\text{Weight Gain\%} = 100 \times (\text{final body weight} - \text{initial body weight}) \div \text{initial body weight}$$

$$\text{SGR} = 100 \times (\ln \text{ final weight} - \ln \text{ initial weight}) \div \text{total duration of the experiment}$$

$$\text{FCR} = \text{feed given} \div \text{weight gain}$$

$$\text{FCE} = \text{weight gain} \div \text{feed given}$$

Water Physiochemical Parameters: During the experiment, water temperature ranged from $17 \pm 3^\circ\text{C}$, pH 6.9–7.7, $\text{NH}_3\text{-N}$ 0.13 ± 0.05 mg/l, dissolved oxygen content was approximately 6.5 mg/l, the photoperiod used was a 12 h light/12 h dark cycle.

Herbal Products Used in the Study: The ethanolic *Aloe vera* extract was obtained from Giah Essence Phytopharm Company (Golestan, Iran).

Statistical Analysis: Data were analyzed by one-way ANOVA. When the differences were significant at $P < 0.05$ level, Duncan's multiple range test was utilized to compare the mean values among the treatments due to the main effects. Statistical analysis was conducted using SPSS 20.0 for Windows package.

RESULTS

The growth performance of common carp after 8 weeks feeding on the diets containing different levels of *Aloe vera* extract are shown in Table 1.

Table 1: Growth performance of common carp fed with (trials 1–3) or without (control) diets supplemented with ethanolic *Aloe vera* extract after 8 weeks

Parameters/ treatment	Control	0.1 <i>Aloe vera</i>	0.5 <i>Aloe vera</i>	2.5 <i>Aloe vera</i>
Initial weight (g)	27.93±2.28 ^a	27.21±1.45 ^a	27.08±2.09 ^a	26.40±2.07 ^a
Final weight (g)	35.48±1.45 ^c	36.30±1.44 ^{bc}	37.95±3.22 ^{ab}	38.27±2.23 ^a
Initial total length (cm)	11.83±0.29 ^a	11.89±0.28 ^a	11.76±0.38 ^a	11.63±0.32 ^a
Final total length (cm)	13.52±0.26 ^b	13.85±0.25 ^a	14.02±0.36 ^a	14.07±0.51 ^a
Weight Gain (g)	27.48±6.90 ^c	33.60±5.46 ^{bc}	40.59±12.83 ^{ab}	45.60±12.02 ^a
SGR %	0.43±0.10 ^c	0.52±0.07 ^{bc}	0.60±0.16 ^{ab}	0.67±0.15 ^a
FCR %	1.26±0.42 ^a	0.97±0.18 ^b	0.88±0.27 ^b	0.76±0.25 ^b
FCE %	0.87±0.26 ^c	1.06±0.20 ^{bc}	1.25±0.42 ^{ab}	1.43±0.41 ^a

Means with the same superscript letters at the same row are not significantly different

The specific growth rate (SGR) of the *C. carpio* was significantly affected by dietary ethanolic *Aloe vera* extract ($P < 0.05$). During the whole experimental period, the *C. carpio* fed with experimental diets, tended to have better growth performance compared with the control. The greatest improvements in final weight (Table 1), WG, SGR, FCR and FCE were seen in the 2.5% ethanolic *Aloe vera* extract of diet group ($P < 0.05$).

DISCUSSION

According to Food and Agriculture Organization (FAO) of the United Nations, the aquaculture production has raised from about 28.3 million tons to 40 mt in 2009 [26]. Aquaculture is one of the rapidest growing food-producing sectors around the world.

This study demonstrated effect of ethanolic *Aloe vera* extract on growth parameters of common carp (*C. carpio*). However, there are studies about the effects of *Aloe vera* extract on different diseases and interesting results have also obtained, but no particular research has found the effect of ethanolic *Aloe vera* extract on growth parameters of common carp (*C. carpio*) or other fish to be compared with this study results. Thus, the results of this study has been analyzed and try to be examined other researches on this plant and other medicinal plants in aquaculture.

Recently due to intensive cultivation applications, infectious diseases display a main problem in aquaculture industry, causing heavy loss to farmers. The usage of antibiotics and chemicals in cultivation is often costly and unacceptable since it leads to antibiotic and chemical resistance and customer unwillingness. Hence, immunostimulants like some medical plant extracts or products have been used to restrain fish and shellfish diseases and significantly increase the phagocytic activity in different fish [27-29].

Medicinal plant products have been presented as antistress, growth promoters, appetite stimulators, tonic and immunostimulants and to have aphrodisiac and antimicrobial characteristics in finfish and shrimp larviculture due to the active principles such as alkaloids, flavanoids, pigments, phenolics, terpenoids, steroids and necessary oils [30]. The active principles of herbs have growth advancing ability and perform as appetizer, trigger the immune system, perform as wide spectrum antimicrobial and include anti-stress properties which will be of massive function in fish and shrimp cultivation. Many authors have presented that the immunostimulation also have growth-promoting activity. Black tiger shrimp fed with peptidoglycan-supplemented feed displayed better growth and feed changing ratios [31] anyway in rainbow trout peptidoglycan did not affect the growth rate after 60 days feeding the enriched diet [32].

Influences of dietary medical plants supplementation on growth have been evaluated with several aquacultured species with varied results. *Gynostemma pentaphyllum* is a customary Chinese herbal medicine blend into fish feed caused a raised weight gain, feed conversion efficiency and specific growth rate in grass carp *Ctenopharyngodon idella* [33]. Dietary supplementation of *Q. saponin* enlarged the growth rate in *C. carpio* [34].

Influences of dietary *Aloe vera* supplementation on growth have been evaluated with another species with varied results. According to Farahi *et al.* [35], dietary *Aloe vera* supplementation was not efficient ($P > 0.05$) in growth performance (Body weight increase (BWI), SGR and FCR) of rainbow trout (*Oncorhynchus mykiss*) but was reported beneficial for immunity and survival rate of fish. According to Gopalakannan and Arul [27], some medicinal plants at levels of 1% in Mono Sex Nile Tilapia (*Oreochromis niloticus*) diets have a positive response on growth performance, feed conversion, nutrient utilization, protein efficiency and physiological parameters.

Herbs have been used in different countries to restrain shrimp and fish diseases and victorious consequences have been presented in Mexico, India, Thailand and Japan [36]. Immunostimulants like for example some medicinal plant extracts are efficient means of enlarging the immunocompetency and disease resistance by enhancing both specific and non-specific protection mechanisms of fish and shellfish and other animals [37]. Comparable immunostimulatory influence has been discerned in *O. mossambicus* administered with azadirachtin, a triterpenoid originated in the seed kernel of *A. indica* [38] and with other plant extracts in mice [39] and broiler chicken [40]. The function of natural products containing plant extracts in the care of lymphocystis disease virus (LDV) [41] and some parasitic diseases such as myxobolosis, trichodinosis, gyrodactylosis, argulosis, scuticocliates, etc., in cultivated hot freshwater fish has been presented [42, 43].

Plant extracts like ginger (*Zingiber officinale*) raised the phagocytic potential of the cells in rainbow trout significantly [44] and feed including extracts of four Chinese herbs (*R. officinale*, *A. paniculata*, *I. indigotica* and *L. japonica*) enhanced phagocytosis of white blood cells in crucian carp [45]. Oral administration of *Q. saponin* increased the immunity of yellow tail [46] and feeding with *C. roseus* plant extract increased the immune response in *L. rohita* [47]. *Aloe vera* as an immunostimulant has been presented that has the bactericidal and bacteriostatic activity [48]. It was obvious that oral administration of aloe advanced the resistance of juvenile rockfish to the septicity of *V. alginolyticus* [29].

CONCLUSION

According to this study ethanolic *Aloe vera* extract has effective influence on growth performance. *Aloe vera* extract in the diet can perform as a growth promotor, appetite stimulator and immunostimulant, reduce stress, reduce food losses and protect fish in order to better growth of fish.

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