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The Influences of Vitamins C and E on the Growth Factors and Carcass Composition of Common Carp

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Abstract: This study was conducted to examine the effects of dietary vitamin C (Ascorbic Acid) and vitamin E (a-tocopherol) on growth factors and carcass composition of common carp (*Cyprinus carpio*). Four hundred carp fries (*Cyprinus carpio*) with average initial weight of 1.11±0.05 g and total average length of 4.04±0.04 cm, was fed for a period of 90 days with commercial diet with addition of vitamin C and E. The carps were divided into four different groups and fed through different feeds (Control group (A) with vitamin C, group (B) with vitamin E, group (C) with a combination of vitamin C+vitamin E). Within the trial period, the fishes were fed 3 times a day manually at a rate of 3% of their body weight. The effects of feeding through vitamin C and E in different proportions on the parameters such as growth in view of live weight and total length, survival rate, feed conversion, condition factor and protein efficacy for the carp fries were studied. The best growth in view of live weight was maintained through vitamin C and E combination in group C (4.51±0.13 g) while the best growth in terms of length was obtained through vitamin C in group A (6.68±0.08 cm). As a consequence, the growth parameters of the carp fries fed through commercial diet with the addition of vitamin C and E in different doses under empirical conditions shown affirmative effects on the survival rate, feed assessment, condition factor and protein efficacy.

Key words: Vitamin C · Vitamin E · *Cyprinus carpio* · Growth Factors · Condition Factor

INTRODUCTION

Vitamin C and vitamin E (a-tocopherol or a-T) function as biological antioxidants to protect cellular macromolecules (DNA, protein and lipids) and other antioxidant molecules from uncontrolled oxidation by free radicals during normal metabolism or under the conditions of oxidative challenge such as infection, stress and pollution. Due to their potential for interaction, dietary requirements for vitamins C and E are often considered together. In Atlantic salmon [1] and rainbow trout [2], vitamin C intake above the requirement for growth did not influence tissue vitamin E levels, irrespective of their vitamin E status. However, dietary vitamin C prevented the appearance of vitamin-E-deficiency signs in Atlantic salmon in a dose-dependent manner [1]. Hepatic a-tocopherol concentrations of normal lake sturgeon and vitamin-E-deficient yellow perch increased in fish fed high dietary concentrations of vitamin C [3, 4]. However, hepatic a-T concentration decreased with increasing dietary vitamin C in hybrid striped bass [5]. Furones *et al*. [2] found that hepatic ascorbate concentration was reduced in rainbow trout fed diets with a constant level of vitamin C and high levels of vitamin E. Vitamin C deficiency also developed earlier in Atlantic salmon fed a diet high in vitamin E due to the accumulation of the vitamin E radical (Tocopheroxyl, TO), which is otherwise reduced by ascorbic acid [1].

Vitamins C (ascorbic acid, AA) and E (tocopherols) are strong antioxidants. These two vitamins have been extensively studied in fish nutrition [6], as well as in humans and other animals [7]. Vitamin C plays an important role in growth and immunity of fish [8]. Most teleosts are unable to synthesize ascorbic acid due to the lack of L-gulonolactone oxidase (EC 1.1.3.8) which is necessary to convert L-gulonolactic acid to AA; therefore, an exogenous source of vitamin C is required in fish diet [9].

Vitamin E is a lipid-soluble vitamin that comprises four tocopherols and four tocotrienols in nature. Among them, α-tocopherol has the highest vitamin E activity [10]. Vitamin E requirement being directly related to dietary HUFA levels since they are fatty acid highly prone to oxidation [11, 12].

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Table 1: Experimental plan for raising carp fries

	Treatments			
Factors	Control	Experimental A	Experimental B	Experimental C
Number of fishes within each aquarium	30	30	30	30
Number of replications	3	3	3	3
Rate of vitamin C in feed (Vit C kg^{-1} feed)	0	0.5 mg Vit C	0	0
Rate of vitamin E in feed (Vit C kg^{-1} feed)	0	0	0.5 mg Vit E	0
Rate of vitamin C and E in feed (Vit C and E kg^{-1} feed)	0	0	0	0.5 mg Vit C+0.5 mg Vit E

One factor that may affect the dietary vitamin E requirement is the oxidative stability of the diets [13]. Addition of vitamin E to rancid diets significantly improved growth performance of the fish [14]. The objective of this study is to assess the influences of vitamin C and E on the growth factors and carcass composition of common carp.

MATERIALS AND METHODS

The carp fries used in the study were supplied from personal fish farm of Mr. Naderi. The fishes were brought to the laboratory through carrying bags with oxygen support. Following adaptation phase, lasting 15 days, all fishes were individually weighed and measured length wise. The fishes were stocked as per empirical application plan the details of which are specified in Table 1.

The feeds used in the study were supplied from Aquatic Feeds Company, Iran. As a trial, commercial diet (granulated feed); produced specifically for the freshwater fishes with 55% crude protein, 12% crude fat and metabolic energy of 4900 kcal was used. The other additives (vitamin C and vitamin E) added to the trial feed were Aqua-Myces (Vitomix Ltd. Colombia).

Within the trial period, the fishes were fed 3 times a day manually at a rate of 3% of their body weight. For this purpose, vitamin C and vitamin E additives were dissolved in water prior to addition of mixed feed for both groups added to the feed through spray method and was homogenously mixed for 5 min. Taking into account the granularity of the feeds to be in-taken by the carp fries, such feeds were placed in different cups as granule powder and the feeds remain were re-weighed within each period to calculate the consumed feed. Arrangement of the rate of vitamin C and vitamin E within trial feeds for each group was planned as given in Table 1.

Individual length and weight of the fishes were measured upon initiation of the experiment and expiration of each subsequent 30 days period as well as the amount of feed consumed. The data thus, obtained enabled calculation of the live weight and lengthwise increases, feed assessment and survival rates upon completion of each 30 days period.

One-way ANOVA and Duncan's multiple range tests were used to analyze the significance of the difference among the means of treatments by using the SPSS program.

RESULTS

Growth Performance: Out of growth performance parameters for trial groups of carp fries, the best weight-wise growth as of the completion of the trial period was attained in group C (4.51±0.13 g), where vitamin C and vitamin E were used together. This group was followed by group A, B and control group, respectively with the respective values of 4.39±0.14; 4.16±0.13 and 4.05±0.07 g (Table 2). The best lengthwise growth was observed in group A (6.68±0.08 cm), where diet was supplemented with vitamin C, followed by group B with vitamin E and control group with respective values of 6.63±0.07; 6.49±0.07, 6.37±0.06 cm (Table 3).

Condition Factor: The condition factor values for the initiation period and the subsequent periods by which time the carp fries were subject to experiment are given in Table 4. In pursuance, with the variance analysis and Duncan test conducted for condition factor for carp, the statistical differences between the trial groups proved significant ($p<0.05$).

Protein Efficacy Rate: When the protein efficacy rate is examined in general terms as of the date of completion of the tests, the highest protein efficacy was observed in group C 1.70±0.03, where vitamin C and vitamin E are used together. This is group was followed by group A (which includes vitamin C), group B (which contains vitamin E) and control group with respective values as, 1.63±0.06, 1.52±0.04 and 1.45±0.00 (Table 5).

Feed Conversion Rate: When the rates of feed assessment calculated through the amount of feed consumed and live weight, the best feed assessment rates are observed in group C, where vitamin C and vitamin E are used together (Fig. 1).

Table 2: Average live weights (g) for the carp fries subjected to test according to the periods involved

	Trial groups for carp fries			
Groups periods	Control	A	B	C
N	90	90	90	90
Commencement (11.10.2008)	1.14±0.02a	1.11±0.03b	1.12±0.03b	1.10±0.03b
N	90	90	90	90
I	1.63±0.04a	1.67±0.04a	1.63±0.04a	1.74±0.04a
N	90	90	90	90
II	2.76±0.08a	2.74±0.09a	2.61±0.08a	2.73±0.07a
N	90	90	90	90
III	4.05±0.07b	4.39±0.14ab	4.16±0.13ab	4.51±0.13a

The difference between the averages denominated in small letters within the same column is important ($p<0.05$); N: Number of fishes

Table 3: Total average length (cm) of the carp fries subjected to test based on periods

	Trial groups for carp fries			
Groups periods	Control	A	B	C
Number of fishes	90	90	90	90
Commencement (11.10.2008)	4.13±0.03a	4.03±0.04b	4.04±0.03b	4.03±0.03b
N	90	90	90	90
I	4.84±0.04b	4.81±0.03b	4.82±0.04b	4.95±0.03a
N	90	90	90	90
II	5.71±0.06a	5.82±0.06a	5.83±0.06a	5.81±0.05a
N	90	90	90	90
III	6.37±0.06b	6.68±0.08a	6.49±0.07ab	6.63±0.07a

Values within a column followed by different letters are significantly different at $p<0.05$ level of significance using; Duncan's multiple range test; N: Number of fishes

Table 4: Condition factor values for the bay fishes subjected to test depending on the period

	Trial groups for carp fries			
Groups periods	Control	A	B	C
N	90	90	90	90
Commencement (11.10.2008)	1.62±0.02b	1.73±0.05a	1.67±0.02ab	1.66±0.03ab
N	90	90	90	90
I	1.43±0.02ab	1.49±0.02a	1.43±0.02ab	1.42±0.02b
N	90	90	90	90
II	1.46±0.02a	1.35±0.01b	1.29±0.01c	1.38±0.02b
N	90	90	90	90
III	1.58±0.02a	1.45±0.02c	1.50±0.02bc	1.52±0.02b

Values within a column followed by different letters are significantly different at $p<0.05$ level of significance using; Duncan's multiple range test; N: Number of fishes

Table 5: General protein efficacy rates for the fish fries subject to test according to stipulated periods

	Trial groups for carp fries			
Groups periods	Control	A	B	C
n	3	3	3	3
PER	1.45±0.00c	1.63±0.06ab	1.52±0.04bc	1.70±0.03a

The difference between the averages denominated in small letters within the same column is important ($p<0.05$)

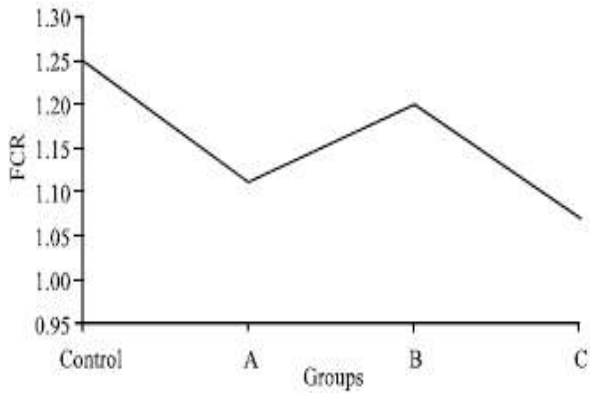

Fig. 1: Curve for general feed assessment rates for the carp fries subjected to test

DISCUSSION

In this study, the carp fries were fed for a period of 90 days with the introduction of commercial feed supplemented with vitamin C and vitamin E. Feeding through feeds with different rates of vitamin C and vitamin E was evaluated by examining the parameters such as live weights of the carp fries and total growth of length, condition factor, feed assessment and survival rate.

Out of the groups of the carp fries, whose live weight was observed to be 1.11±0.05 g at the initial stage, the best live weight average was observed in group C (4.51±0.13 g), where vitamin C and vitamin E were used together. This group was followed by group A (the group,

which includes vitamin C) and group B (the group, which includes vitamin E). The best lengthwise growth of the carp fries whose average length was 4.04±0.05 cm at the initial stage was observed in group A (6.68±0.08 cm), which was followed by group C where vitamin C and vitamin E were used together and group B (the group, which includes vitamin E).

These results agree with previous studies on some other fish [15-17]. The reduction in growth performance of fish fed the control diet in the present study seems to indicate that vitamins has a specific effect on growth as first suggested by Ram [18]. Vitamin C is an essential coenzyme in certain oxidative processes, including the oxidation of tyrosine and phenylalanine [19].

Vitamin E is a potent antioxidant that prolongs the life of erythrocytes and plays an essential role in cellular respiration [20].

Vitamins C (ascorbic acid, AA) and E (tocopherols) are strong antioxidants. These two vitamins have been extensively studied in fish nutrition [6], as well as in humans and other animals [7]. Vitamin C plays an important role in growth and immunity of fish [8]. Most teleosts are unable to synthesize ascorbic acid due to the lack of L-gulonolactone oxidase (EC 1.1.3.8) which is necessary to convert L-gulonolactic acid to AA; therefore, an exogenous source of vitamin C is required in fish diet [9].

The diet without ascorbic acid supplementation decreased the specific growth rate (2.59) of guppies and this is in accordance with studies conducted by Ai *et al*. [16] who also observed declining specific growth rate with ascorbic acid deficient diet for seabass (*Scophthalmus maximus*).

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