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Effect of Dietary Administration of Carrageenan on Growth, Survival and Feed Utilization of Common Carp, *Cyprinus Carpio*

Abstract

The efficiency of carrageenan as immunostimulant on growth, survival and feed utilization of common carp, *Cyprinus carpio* was evaluated. Carrageenan was incorporated at 0.5% and 1.0% in a 30% protein diet, while basal diet without supplementation of carrageenan served as control. The experimental diets were fed to fingerlings for 60 days in fiberglass tanks. The diets were given twice daily at a rate of 5% of body weight during the first 15 days and reduced to 3% later on. Common carp fed 1% carrageenan supplemented diet showed relatively better growth in terms of specific growth rate, feed utilization, protein efficiency ratio and food conversion rate and survival.

Keywords: Carrageenan; Immunostimulant; Growth; Survival; Cyprinus carpio

Opinion

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Shivananda Murthy H*, Shrikala D, Prakash Patil and Shankar R

Department of Aquaculture, College of Fisheries, India

***Corresponding author:** Shivananda Murthy H, Department of Aquaculture, College of Fisheries, KVAFSU, India, Email: hsmurthy05@yahoo.com

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Introduction

Aquaculture industry is gaining a lot of importance globally, more so in the developing countries. Aquaculture has shown considerable advancement in the past decade due to a steady increase in demand for aquatic organisms. Recent years have witnessed the stagnation in landings from capture fisheries, hence aquaculture offers a potential source of fish production to meet the current and future demands of fish and shellfish. It has been found that fish in a human diet is known to reduce the risk of cardiovascular diseases and also provide protection against renal diseases, thus it has medical and therapeutic significance. Further, fish protein has also got special significance in human nutrition since it contains all essential amino acids, vitamins, minerals and polyunsaturated fatty acids. The increased need and demand for dietary protein for human consumption can meet partially from aquatic sources such as fish and shellfish. This has led to the intensification of culture of fish and shrimp in several parts of the world and the success of fish culture depends on several management measures. Among the several measures, artificial feeding has been considered as the most important because the optimum amount of food with well balanced nutrients (protein, carbohydrate, fat, minerals and vitamins) is required to achieve maximum production.

Due to gradual reduction of water bodies and consequent shifting towards intensive system of culture practices will likely to increase incidences of diseases. The fish diseases will cause considerable economic loss in aquaculture by reducing production and increasing the production costs. Considering the above facts, one of the preventive measures is incorporation of immunostimulants in fish diet to enhance their immune system. In fact, immunostimulants are the chemicals, drugs, stressor that elevates the non-specific defense mechanism or specific immune response. The use of immunostimulants has become an important aspect in fish culture recently for improving the fish production. Several fish food manufacturers in Europe now offer diets supplemented with immunostimulants for use in salmonid culture. Most of the immunostimulants are the molecules that are derived from microbial sources such as peptidoglycans, β-glucans and lipopolysaccharides have successfully used to initiate a series of non-specific defense activities. Carrageenan is a family of linear sulphated polysaccharides extracted from red seaweeds and is available in the form of powder in different forms. Carrageenan is used as an ingredient in diets to provide the phospholipids needed by various species of aquatic animals and to impart proper physical characteristics to the animals [1-4].

Common carp, *Cyprinus carpio* is a widely cultured freshwater fish native to Asia and Eastern Europe. It is capable of interbreeding in captivity and found suitable for polyculture with Indian major carps. However, they are also used in monoculture particularly by small and artisan farmers in rural aqua farming. This carp is an omnivorous, feeds on detritus and other wastes (aquatic vegetation) in nature. The advantage of common carp over the other carp species that too in a tropical country like India is, they can be bred almost throughout the year, it has a shorter generation time and readily accepts pellet feeds. Common carp is found to grow much faster than the major carps rohu and mrigal but, its growth is almost equal to that of *catla*.

Material and Methods

Experimental animals

Cyprinus carpio, Common carp fry procured from a Government Fish Seed Farm at the Bhadra Reservoir Project in Shivamogga, to the fish farm of the College of Fisheries in Mangaluru, were acclimatized to the pellet diet containing 30% protein for a period of two months.

Formulation, preparation of experimental diets

Experimental diets were prepared incorporating carrageenan at two graded levels namely 0.5 (T_1) and 1% (T_2). Diet without carrageenan served as control (T_0). The basal diet with a crude protein content of 30%, using fish meal and groundnut cake as major protein sources was formulated by employing Square Method [5]. All the diets were analyzed for proximate composition according to AOAC [6]. Moisture content was estimated by heating samples at 105°C for 30 minutes and then cooled and weighed till a constant weight was obtained. Crude protein was analyzed using Kjeltec system, fat content by Soxtech system and fiber content using Fibretech system. Nitrogen free extractives (NFE) was calculated by the difference method [7].

Experimental system

The experiment was carried out in fibre-glass aquarium tanks measuring 1.25 x 0.5 x 0.5m at the indoor aquaculture system of the College of Fisheries, Mangaluru. The aquaria were cleaned and filled with water from a nearby perennial open well. Uniform sized common carp fry (0.36g) were stocked at a rate 15 numbers per aquaria in three replicate groups. They were fed twice daily at the rate of 5% of the body weight during the first 15 days and 3% ther after. Unconsumed feed was siphoned out daily in the morning before offering the feed. After every sampling, the amount of feed given was adjusted based on the weight increase of the fish.

Water quality analysis

Water from experimental tanks was analyzed for physic chemical parameters every week. A digital portable kit model CK 704 was used to record pH and temperature. Dissolved oxygen was estimated by Winkler's method. Total alkalinity, ammonia and free carbon dioxide were determined by Standard Methods [8]. The evaporation loss and deterioration in water quality due to accumulation of metabolites was overcome by periodic partial exchange of water.

Growth studies

Fishes in each tank were sampled fortnightly and individually measured their weight and length. The growth performance of the experimental animals was assessed at the end by calculating weight gain and percentage of survival using the following formula

$$SGR = \frac{Log\ final\ weight\ (g) - Log\ initial weight\ (g)}{Number\ of\ days} \times 100$$

$$FCR = \frac{Dry\ weight\ of\ feed\ given\ (g)}{Gain\ in\ wet\ weight\ of\ fish (g)}$$

$$Survival(\%) = \frac{Final\ number\ of\ fish}{Initial\ number\ of\ fish} \times 100$$

$$PER = \frac{Increment\ of\ body\ weight\ (g)}{protein\ intake\ (g)}$$

Results and Discussion

Proximate composition of experimental diets

The proximate composition of the experimental diets fed to common carp fry is presented in Table 1. All the diets had about 30% protein and the values of crude protein ranged from 29.45% in T_2 to 29.94% in T_1. Moisture content of diets ranged from 3.3% in T_1 to 4.05% in T_2, but crude fat levels were ranged from 2.3% in T_0 to 3.75% in T_2. Similarly, the crude fibre content of diets ranged from 11.5% in T_0 to 21% in T_2. Overall, the proximate composition results of the experimental diets indicated that there was no significant difference between the diets after incorporation of carrageenan.

Table 1: Proximate composition of test diets (Mean ± SD).

Components	Diets		
	T_0	T_1	T_2
Moisture (%)	3.45+0.21	3.3+0.24	4.05+0.19
Dry matter (%)	96.55+0.23	96.7+0.12	95.95+0.21
Crude protein (%)	29.67+0.33	29.94+0.25	29.45+0.27
Crude fat (%)	2.3+0.18	2.65+0.29	3.75+0.18
Crude fibre (%)	11.5+0.21	11.9+0.25	21.0+0.19
Ash (%)	19.15+0.19	19.55+0.22	18.49+0.26
NFE (%)	33.93+0.24	32.66+0.19	23.26+0.20

Water quality parameters

During the experimental period, the water temperature ranged from 25.1 to 28.8°C, pH from 6.1 to 7.6, dissolved oxygen from 6.4 to 8.6 mg/l, free carbon dioxide from 0.15 to 4.8mg/l, and total alkalinity from 32 to 65.7 mg/l of CaCO3. These water quality parameters recorded during the experimental period were found suitable and well within the range for common carp culture. Further, it also show that the incorporation of carrageenan in diet did not affect the culture water.

Growth Studies

Data on the growth, survival, food conversion ratio and protein efficiency ratio of common carp fed on the graded levels of carrageenan incorporated diets are given in Table 2. Highest growth in terms of specific growth rate was observed in 1% (T_2) carrageenan incorporated diet fed common carp, compared to T_0 and T_1. However, highest survival (76.5%) and PER (0.06) were recorded for T_1 treatment but, lower FCR of 2.5 was recorded in treatment, T_0. Further, it was observed that there were no significant differences between experimental groups in survival and PER, but there were significant differences in SGR and FCR of treatments.

Table 2: Survival, SGR, FCR and PER of *Cyprinus carpio* fed graded levels of carrageenan incorporated diets.

Parameters	Diets		
	T_0	T_1	T_2
Survival (%)	73	76.5	76
SGR (% / day)	0.86	0.94	1.23
FCR	2.50	2.68	3.31
PER	0.08	0.06	0.08

After seven week feeding trial, enhanced weight gain was observed in fish fed on diets supplemented with 1 and 2% Grobiotic-AE compared to those fed the basal diet [9]. The beneficial influence of Grobiotic-AE on growth was possibly due to alteration of the intestinal microflora by mannan oligo fructose, lactose from the dietary ingredient [9]. Brewers yeast has been recognized to have potential as a substitute for live food in the production of certain fish [10]. There was no significant difference in weight gain and specific growth rate between treatments during the feeding trial [11]. Lara-Flores et al. [12] investigated the effects of whole brewers yeast *S. cerevisiae*, as a probiotic on growth, body composition and digestibility of diet in fry of Nile tilapia (*O. niloticus*) and found that the addition of 1 % yeast to a diet with an optimum protein content (40%) administered in low density tanks produced the best growth. No significant difference in survival and weight gain were observed among treatments when *L. vannamei* fed with sodium alginate [13]. Hybrid striped bass fed the diets supplemented with 1% and 2% dried brewer's yeast had up to 20 % more weight gain compared to fish fed the basal diet [14]. The survival rate of shrimp improved progressively with increment of *Sargassum fusiforme* polysaccharide extract (SFPSE) supplemented but the individual body weight displayed a decline trend as *Sargassum fusiforme* polysaccharide extract (SFPSE) increased [15]. Shrimp fed diets supplemented with ≥ 35 mg/kg had significantly ($P<0.05$) greater weight gain [16]. The weight gain was highest in shrimp fed 75 and 100 mg Vitamin E /kg diet [17]. Survival was highest in shrimp fed 70-150 mg Vitamin E /kg diet. Significantly higher weight gain (138%) was observed in shrimp fed the diet containing 0.2% of vitamin C in feed and the food conversion ratio was significantly lower [18]. Diet supplemented with enzyme probiotics @ 3 g/kg gave better weight gain, specific growth rate and condition factor in *L. rohita* fry [19]. Vitamin C when fed at elevated level of 500 mg/kg practical diet resulted in significantly higher specific growth rate and food conversion ratio in comparison with control group of fish. Growth, specific growth rate and protein efficiency ratio were significantly better in fish fed 50 mg/kg than in the control [20]. Turan & Akyurt [21] also obtained significantly higher growth in African catfish (*Clarias gariepinus*) fed androstenedione based diets.

It may be concluded that carrageenan, which is a carotenoid pigment used for enhancement of colour and other purposes in different animals found to enhance growth and survival of common carp when supplemented at 1% in the diet.

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