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Research Article

NUTRITIONAL EFFECT OF FROZEN CHIRONOMIDAE LARVAE ON GROWTH PERFORMANCE OF C*ATLA CATLA* FINGERLINGS

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ABSTRACT

Chironomous are one of the most abundant and widely distributed flies in Indian freshwater ecosystems and occupy important position of major food source in the food chain for many fishes. Chironomid larvae, called also blood worms, are well known fresh water organisms due to their invaluable significance in aquaculture. These organisms are excellent and widely used live food for fish larvae. To study the effects of frozen chironomidae larvae diet & formulated basal diet on growth parameters. Fish fed with basal diet and frozen chironomidae larvae (CHIBD2) elicited higher feed consumption (6.70 g).The food conversion and food metabolized was higher (0.70 and 5.89 g) in CHIBD4 and CHIBD2 feed types. The absorption rate, conversion rate and metabolic rate were found to be maximum 28.92, 26.49 and 25.65g in feed BD, CHI, and CHIBD3 respectively. Frozen chironomidal larvae feed with basal diet (CHIBD1, CHI, and CHIBD3) showed better growth (0.94, 0.93 and 0.83 g) than control group (0.76 g).The highest enhancement in length (1.27 cm) was found when fishes fed with frozen chironomidae larvae &basal diet (CHIBD1) and minimum (0.86 cm) in basal diet (BD). The results obtained in this study, it can be concluded that frozen chironomidae larval diet fed with basal supplementary feed to C*atla catla* fingerlings resulted in simultaneous increase in weight and length.

Keywords: Freeze dried bloodworms, Chronomidae larvae, Nutritional effect, Growth parameters.

INTRODUCTION

Aquatic ecosystem monitoring has been carried out in India based on either chemical or biological analysis (Vijayan *et al*., 2018). Adversely human activities are directly or indirectly affect the environment (Jayakumar *et al*., 2018). Carp is one of the most cultivated fish species in the world and the most important species in aquaculture. Despite containing biologically important proteins, fish meat is one of the main sources of essential fatty acids in human diet. As regards carp, the main natural source of essential fatty acids is chronomidae larvae, especially *Chironomus plumosus* as the dominant species in carp ponds. Larvae rearing depend mainly on zooplankton groups like *Claclocera, Artemia, Tubifex, Olgocheta* and chironomids larvae. Chironomid larvae are a good source of vitamins, nutrients, iron and are used in frozen form in aquaculture. Chironomid larvae nutritional value is very high and biochemical analyses showed that their dry weight contains the high digestibility (73.6%) and 56% protein (Maleknejad *et al*., 2014; Sahandi, 2011; Zivic *et al*., 2013). Chironomidae is a large family of the order Diptera including non-biting midges. Members of this family live in different habitats from Artic to Antarctic and from fresh water source to very pollutant waters. Some of them are semi terrestrial and some others are territorial. Chironomids often have short life and their reproduction area is wide. Larval stage of chironomids called as blood worms are valuable for feeding of some cultured aquatics as a live food. Body analysis of blood worms has shown valuable composition for feeding aquatics especially as a source of iron. Proximate analysis of blood worm bodies revealed high amounts of crude protein and total fat.

The midges of genus chironomous are one of the most abundant and widely distributed flies in Indian freshwater ecosystems and occupy important position of major food source in the food chain for many fishes and invertebrates.

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They represent an abundant group of benthos insects in fresh water ecosystem (Da, 2014). Processed and freeze dried blood worms are easier to be digested. They are more production have excellent digestive coefficient in fish. Their dried bodies are crispier than their frozen ones. Moreover, moveable disease factors can be avoided due to exposition to high heat during pasteurization and preparation to dryness. For getting good return from rearing of larvae of fin fish and shellfish they should be fed with nutrient rich diet. Larval rearing is one of the riskiest phases of aquaculture, but it could be one of the most profitable ventures. Special planning and strategies are required to overcome the risk of high mortality during this phase of culture. The present study was to determine the effects of frozen chironomidae larvae and supplementary diet on growth parameters in *Catla catla* fingerlings.

MATERIALS AND METHODS

Collection and rearing

The fingerlings of *C. catla* were procured from fisheries department, Mettur in Salem District. They were carefully transported to the laboratory through oxygenated polythene bags. These animals were brought to the lab condition and were stocked in the plastic troughs. Much care was taken to avoid overcrowding during transportation and stocking. These fishes were allowed to acclimatize for a period of 15 days. Then they were subjected to experiments.

Experimental diets

The fishes were fed with frozen commercial chironomidae larvae and formulated basal pelleted feed. The following five experimental diets were used; basal diet (BD), frozen chironomidae larvae (CHI), frozen chironomidae larvae + basal diet at 1:1ratio (CHIBD1), frozen chironomidae larvae + basal diet at 1:2 ratio (CHIBD2), frozen chironomidae larvae + basal diet at 1:3 ratio (CHIBD3).Composition and proximate analysis of basal diet and frozen chironomidae larvae are shown in (Table 1).

Experimental procedure and feeding

Experiment was conducted over a one month period at laboratory of Zoology department, Government Arts College, Salem -7, Tamil Nadu. Selected *Catla* fingerlings having same size, their average live body weight was 1.25±1.00 g and the average total length was 3.50 ±1.00 cm. Their sex was not taken into consideration. Feeding experiments were conducted with basal diet, chironomidae larvae + basal diet at 1:1 ratio (CHIBD1), chironomidae larvae + basal diet at 1:2 ratio (CHIBD2), chironomidae larvae + basal diet at 1:3 ratio (CHIBD3). Experimental fishes were placed in a trough with a size of 34 x 12 cms, which is filled with 15Lts of water. The troughs were placed side by side in two lines. Each treatment was applied in trip licates. Feeding rate for all the diet types were 5% of body biomass. The fish were fed twice a day. Satiations were determined based on visual observation of acceptance and refusal of feed. The fish wastes (unconsumed feed and excrement) from the bottom of the troughs were siphoned with a rubber pipe daily. The dissolved oxygen level of water was maintained at 5.10± 1 mg/lt. To supply oxygen to the troughs, air pumps were used. Carbon dioxide level was 6 ppm and temperature was 27˚ to 28˚C. After every week, cultured experiment fish fingerlings were captured from each treatment using drag net and weight. After recording the data for wet body weight (WBW), they were released back into their respective troughs. The total length of fish was also recorded at weekly intervals .The feeding regime (10%) was re adjusted at every week intervals on the basis of wet weight gain (WBM). At the end of the experiment, fish fingerlings from all treatments were weight, based on which the growth parameter weight gain (%), All weighting made in an electrical digital balance too an accuracy of 1mg. Feed Conversion Ratio (FCR), Specific growth rate (SGR) and survival (%) were calculated.

Energy budget

Rates of feeding, absorption, conversion and metabolism were calculated by dividing the respective quantities of the products of initial weight of the fish (mg) and duration day of the experiment. The rate was expressed as mg dry wt/gm live fish/day.

Consumption rate (Cr) = Food consumed (mg)/Live wt. of fish (mg) x No. of days

Absorption rate (Ar) = Food absorbed (mg)/Live wt. of fish (mg) x No. of days

Conversion rate (Pr) = Food converted (mg)/Live wt. of fish (mg) x No. of days

Metabolic rate (Mr) = Food metabolized (mg)/Live wt. of fish (mg) x No. of days

Food conversion Ratio (FCR) = Dry food intake/Wet body weight gain

Specific growth rate (SGR) = In $W_o - W_1$ / t x 100, Where

W_o= Final live weight

W_1 = Initial live weight

T = Experimental duration

Average daily gain (ADG) = Growth (live weight)/Experimental duration

Food conversion efficiency (FCG) = Growth (live weight)/Consumption x 100

Percent gain weight = Average final weight- Average initial weight/ Average initial

Weight X 100

Percent gain length =Average final length – Average initial length/Average initial length X 100.

RESULTS AND DISCUSSION

The 30 days experiment was conducted with a view to observing the effects of frozen chironomidae larvae in combination of basal diet on the growth of *C. catla* fingerlings. After feeding experiments, the growth parameters such as survival rate, wet weight gain, specific growth rate, food conversion ratio, fish length gain and bioenergetics were individually determined. The overall energy budget of *C. catla* fed on the frozen chironomidae larvae and basal diet feed with different combinations was recorded in Table 1 to 5. In the present work, the amount of day substance gained or loosed by the fish after 30 days of feeding at different test diets was calculated and expressed gram dry substance gained/lost/fish/day. The feed given were adjusted at 10 days intervals after the fish were weighted.

The results showed that different feed types (BD, CHI, CHIBD1, CHIBD2 and CHIBD3) had significant effect on the feeding parameters. The rate of consumption of fish fingerlings were different, fish fed with basal diet and frozen chironomidae larvae (CHIBD2) elicited higher feed consumption (6.70g) (Table 2).The lower consumption (5.36 g) was noticed in control basal diet (BD). The results obtained by Mohseni *et al*. (2012) showed that the chironomidae larvae were eaten completely. Similar type of observations was noticed during this present work. Regarding the absorption, the maximum of 5.81 g was observed in basal diet with frozen chironomidae larvae (CHIBD3) feed type, minimum of 4.74 g was observed to basal diet (BD) feed type. The food conversion and food metabolized was higher (0.70 and 5.89 g) in CHIBD4 and CHIBD2 feed types.

The maximum consumption rate 30.00g was observed in fish consuming frozen chironomidae larvae diet alone. The absorption rate, conversion rate and metabolic rate were found to be maximum 28.92, 26.49 and 25.65 g in feed BD,CHI, CHIBD3 respectively (Table 3). Similar trend of results were reported by Witeska *et al*. (2007) reported that natural live feed is an optimum source of nutrient for fish, these diets had significantly enhance feed utilization performance also. Food conversion ratio (FCR) was observed to be highest (8.27) in basal and frozen chironomidae larval feed (CHIBD2) feed and lowest (5.78), and frozen chironomudae larvae (CHI) feed type (Table 1). FCR increased dietary protein and decreased for diet above 40% protein. The better food conversion values observed with diets frozen chironomidae larvae suggested that addition of live feeds improved feed utilization. These FCR result trends are in agreement with that obtained.

The highest food conversion efficiency (FCE) was found to be 17.30 g (Table 5) in frozen chironomidae larval feed (CHI), which is significantly higher than that rest of the treatments. The specific growth rate was ranged from 0.43 to 0.66 (Table 4). Same trends of results were observed by Mohseni *et al*. (2012). The weight gain, SGR feed efficiency of fish chironomidae larvae were significantly higher than those of fish fed other diets. The growth rate of fish fingerlings fed with different feed type (BD, CHI, CHIBD1, CHIBD2 and CHIBD3) is depicted in table 4 respectively. Maximum increase in average body weight of *C. catla* fingerlings was observed as 0.94 g in feed CHIBD1 type however the minimum increase in bodyweight was 0.76 g in BD feed. The highest percent weight gain was 58.13 and 58.12 respectively as observed in the *C. catla* fingerlings fed with feed CHI and CHIBD1 type respectively (Table 4). These results correspond to the results found that the raw protein in the bodies of bloodworm (60.1%) effect on the fish growth, particularly bloodworms as powder added to the fodders of fish increase their growth and provide them energy needed for their activities. Similar observations have been reported for sturgeon by Szlaminska & Przybyl (1986) noticed that a mixed diet composed of live food and inert food in variable proportions gave better results; distributed in small quantities. This is particularly true in the present study due to the higher growth (0.94 g) of *Catla* fingerlings fed on frozen chironomidae larvae diet mixed with basal formulated diet in equal proportions (CHIBD1).

Frozen chironomidal larvae feed with basal diet (CHIBD1, CHI, and CHIBD3) showed better growth (0.94, 0.93 and 0.83 g) than control group 0.76 g (Table 4). This results in agreement with the findings of (Maleknejad *et al*., 2014) who reported that the diet containing the frozen live of organisms contain all the nutrients such as lipids, essential proteins, vitamins, carbohydrates, amino acids, minerals and fatty acids and since are commonly known as “living capsules of nutrition”. Chironomidae larvae had a significant higher content of omega3 fatty acids (8.22 ± 0.89%), it has a positive impact on growth of carp fishes. The nutrition values of the dried blood worm have been higher, the high level of amniotic acids which serves as complementary component to build up the fish bodies (Zivic *et al*., 2013).

The highest enhancement in length (1.27 cm) was found when fishes fed with frozen chironomidae larvae and basal diet (CHIBD1) and minimum (0.86 cm) in basal diet BD (Table 5). The highest percent length gain 31.28 was noticed in frozen chironomidae larvae and formulated feed (CHIBD1).The results of the present study correlates with the findings of (Mohseni *et al*., 2012), found that fish fingerlings fed chironomidae larvae and formulated feed had better growth performance than those fed other feeds. Results of the present study substantiate the fact that frozen chironomous larvae have direct growth promoting effects on *C. catla* fingerlings. The survival rate of *C. catla* fingerlings in all the treatments was found to be 100% after 30 days of experiment.

Table 1. Proximate composition of basal diet and frozen chironomous larvae diet.

S. No.	Contents	Basal diet	Chironomous larval diet
1	Protein	32	52
2	Fat	03	04
3	Fiber	05	05
4	Moisture	10	05

Table 2. Bio-energetic of *Catla catla* fingerlings fed with frozen chironomous larvae in combinations with basal diet.

S. No.	Experimental diets				
	BD	CHI	CHIBD1	CHIBD2	CHIBD3
Consumption	5.36 ± 0.10	5.38 ± 0.08	5.75 ± 0.05	6.70 ± 0.20	6.50 ± 0.20
Absorption	4.74 ± 0.04	4.75 ± 0.07	4.94 ± 0.04	5.79 ± 0.09	5.81 ± 0.09
Conversion	0.56 ± 0.04	0.69 ± 0.09	0.75 ± 0.05	0.65 ± 0.05	0.66 ± 0.03
Metabolized	4.65 ± 0.05	4.62 ± 0.34	4.65 ± 0.10	5.88 ± 0.13	5.65 ± 0.05

Table 3. Bio-energetics rate of *Catla catla* fingerlings fed with frozen chironomous larvae in combinations with basal diet. Each value (gms) represent average of three observation.

S. No.	Parameters	Experimental diets				
		BD	CHI	CHIBD1	CHIBD2	CHIBD3
1	Consumption rate	26.96	30.00	28.69	28.94	30.00
2	Absorption rate	28.92	26.49	25.36	24.96	25.65
3	Conversion rate	29.60	22.25	22.39	22.22	22.77
4	Metabolized rate	55.68	45.03	46.11	64.68	61.80

Table 4. Growth indices of *Catla catla* fingerlings fed with frozen chironomous larvae in combinations with basal diet each value (gms) represent average of three observation.

S. No.	Parameters	Experimental diets				
		BD	CHI	CHIBD1	CHIBD2	CHIBD3
1	Initial weight	1.54	1.60	1.76	2.25	2.02
2	Final weight	2.30	2.53	2.70	3.05	2.85
3	Weight gain	0.76	0.93	0.94	0.81	0.83
4	Percent weight gain	49.35	58.13	58.12.	35.55	41.09
5	Average daily weight gain	0.025	0.031	0.031	0.027	0.028
6	Specific growth rate	0.60	0.66	0.66	0.43	0.50
7	Food conversion ratio	7.05	5.78	5.78	8.27	7.83

Table 5. Morphometric data of *Catla catla* fingerlings fed with frozen chironomous larvae in combinations with basal diet. Each value (gms) represent average of three observation.

S. No.	Parameters	Experimental diets				
		BD	CHI	CHIBD1	CHIBD2	CHIBD3
1	Initial length	4.60	4.46	4.06	4.56	4.40
2	Final length	5.46	5.36	5.33	5.56	5.26
3	Length gain	0.86	0.90	1.27	1.00	0.87
4	Percent length gain	18.69	20.18	31.28	21.93	19.54
5	Average daily length gain	0.029	0.030	0.042	0.033	0.029

CONCLUSION

From these results, it can be concluded that frozen chironomidae larval diet has a great impact than artificial supplementary feed. Specifically, pelleted feeds decomposes into small particles in contact with water, while frozen chironomidae larval diet stays compact in the water much longer until it is eaten by *C. catla.* Based on the results obtained in this study, it can be concluded that frozen chironomidae larval diet fed with basal Supplementary feed to *C. catla* fingerlings resulted in simultaneous increase in weight (0.94 gm) and length (1.2 cm). It is clear whether there are any interaction between some components of the formulated feed, the live feed and nature of such interaction. This needs to be further researched on. From this present work, the final conclusion is that frozen chironomidae larvae represent a potential suitable natural component of farm fish diet.

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