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Growth performance of *Carassius auratus* fry fed with *Chironomus larvae* and other pelleted feed

D. Kumar*, U. Ramesh and M. Mariselvan

Department of Molecular Biology, School of Biological Sciences, Madurai Kamaraj University, Madurai – 625 021. Tamilnadu, India. *e: mail: kumarsxc@yahoo.in

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Abstract

Gold fish fry (0.810 mg) was selected for the present investigation. During the acclimation period fry were fed *ad libitum* with minced piece of beef liver twice a day. They were acclimated to the laboratory conditions for 15 days in two large (6' X 3'X 1') cement tanks. Individual fish fed at a rate of 5% body weight twice a day at 10:00 a.m and 17: 00 p.m hours. Each group consisted of 10 individuals and triplicates. The feeding trial was continued for a period of 42 days. Three types of feeds were viz; Chironomus larvae and pelleted diet containing 40% animal protein and 40% plant protein was maintained. The water quality parameters such as pH, and DO were monitored daily. Experiments were conducted in cement tank (3"X2") containing 90 liters of water. The highest SGR (2.02 ± 0.08/day) was observed diet D1. The best FCR was in diet D1 (1.22). And the best weight gain % were observed in those fed with diet D1 (603.61%) and the lower values was observed in the diets (441.87%). The highest survival also noticed in the diet of D1 (100%). Among the three types of feed, the Chironomus larvae fed fishes (D1) had the highest level of protein (62.55 %) and the lowest protein (38.25) was recorded in diet D2. The lipid content of the feeds D2 was 6.10mg/g. In the case of D1 diet had high lipid content of 8.16.

***Key words*:** Gold fish fry feed, live feed, growth parameters

Introduction

Goldfish are considered "hardy" fish because they can survive in poor water quality. However, for optimal growth, appearance, reproduction and health, maintaining good water quality is essential. Unlike most other ornamental fish, which are tropical, koi and goldfish are temperate species. Their optimum temperature range is about 65 to 75 °F (18 to 24 °C), although they can survive at temperatures as low as 32 °F (0 °C) and as high as 95 °F (35 °C), especially if the temperature change is gradual (seasonal). Temperatures outside the optimal range may suppress the fishes' immune systems and cause decreased feeding and growth. Oxygen level should be at least 5 mg/L, though koi and goldfish will tolerate much lower dissolved oxygen for short periods.

The culture of ornamental fish remains an important activity in several Asian countries. Ng and Tan (1997) estimated a total production value of US$ 80-150 million annually from south East Asian aquarium fish farms. Live bearing species from the family Poeciliidae such as guppies (*Poecilia reticulata*), mollies (Poecilia latipinna, Poecilia sphenops), swordtails *(Xiphophorus helleri*) and platies) (*Xiphophorus maculates)* are a popular group being produced in Singapore, Malaysia, Indonesia, Thailand, India and China. According to a survey of the ornamental fish trade in the United States, guppies and swordtails accounted for 25.8% and 5.4% respectively, of total number of ornamental fish. Proteins are large, complex molecules made up of various amino acids that are essential components in the structure and functioning of all living organisms (NRC, 1983).

Ornamental fish in captivity need to utilize their dietary protein with the almost efficiency, as the breakdown products of protein metabolism (mainly ammonia) will directly pollute their living environment (Pannevis, 1993). The protein requirements of these juvenile omnivorous (guppy, goldfish, tin foil barb), carnivorous (discus) and herbivorous (redheaded cichlid) ornamental fish species are in accordance with requirements reported for food fishes (NRC, 1993).

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Requirement in the above is to be understood as a dietary percentage of protein needed for optimal growth, rather than a true requirement, that is the amount of protein needed per animal per day (Guillaume, 1997). A high requirement level for protein (53%) was found for goldfish (*Carassius auratus*) larvae, in comparison to 29% for juvenile fish.

Fish eat to satisfy their energy requirement, and protein and energy in the diet should be balanced (Macartney, 1996). Although fish use energy efficiently as an energy source, excessive dietary intake may restrict protein consumption and subsequent growth (NRC, 1977). Kruger *et al.*, (2001b) stated that it would appear that a diet with at least 45% protein at a 6% lipid level is needed for the best specific growth rate and feed conversion of growing (6–8 weeks of age) swordtails.

Fishmeal might be substituted by Soybean meal up to 37% of the diet, replacing 33% of the fishmeal protein, to achieve normal growth in juvenile tin foil barb (Elangovan and Shim, 2000). The present study therefore focused the growth performance and gonad development of *Carassius auratus* fed with different feed.

Materials and Methods

Gold fish fry were collected from local aqua farm and brought to the laboratory in polythene bags containing aerated water. They were acclimated to the laboratory conditions for 15 days in two large (6' X 3'X 1') cement tanks. During the acclimation period fry were fed *ad libitum* with minced piece of beef liver twice a day. Uneaten food was removed after one hour of feeding and aquarium water was changed once in two days. Water quality parameters viz; temperature 29^{o}c ±1^{o}c dissolved oxygen 6.1-6.6 mg/lt and pH 7.5 - 8.25 were recorded throughout the study.

The feeding trial was continued for a period of 42 days. Water was changed every day with minimal disturbance to the experimental animals full nos.

Three types of feeds were viz; Chironomus larvae and pelleted diet containing 40% animal protein and 40% plant protein was maintained throughout the experimental period. The water quality parameters such as pH, and DO were monitored daily.

The active fry of *Caraassius auratus* (0.810 mg) were selected from the acclimation tank, and divided into three groups corresponding to three different types of feeds viz, D1, D2, and D3. Individual fish belonging to corresponding pelleted diet and live feed were fed at a rate of 5% body weight twice a day at 10:00 a.m and 17: 00 p.m hours and after 2 hours the unconsumed food was collected by a pipette and dried in hot air oven at 80^{o}C. Each group consisted of 10 individuals and triplicates were maintained for each diet. Experiments were conducted in cement tank (3"X2") containing 90 liters of water. Aquarium water was changed every day to remove the accumulated faeces at the bottom. Every week interval the length and weight were recorded for the growth assessment. After the completion of the experiment the final carcass composition was analyzed.

Formula

The energy budget of the fish was calculated by following the IBP formula (Petrusewicz and Macfadyen, 1970).

$$\text{Specific growth rate SGR (\%/day)} = \frac{\text{In log Final body weight-In log initial lives weight (g)}}{\text{Experimental duration}} \times 100$$

$$\text{Food conversion ratio (FCR)} = \frac{\text{Food consumed (g)}}{\text{Wet weight gain (g)}}$$

$$\text{Weight gain (\%)} = \frac{\text{Final live weight-Initial live weight}}{\text{Days}} \times 100$$

$$\text{Average daily growth rate (\%) (ADG \%)} = \frac{\text{Growth (live wt g)}}{\text{Duration}} \times 100$$

$$\text{Survival (\%)} = \frac{\text{No of fish introduced}}{\text{No of fish survived}} \times 100$$

Statistical analysis

The influence of different diets on growth and final mean length weight, specific growth rate, average daily growth rate, survival and weight gain were analyzed by one way ANOVA. Differences in the mean values were compared using Duncan multiple range test in the software of SPSS version 13.0.

Results

During the feeding trial, the fish readily accepted all the three diets. The growth responses under different treatments are given in Table 1. The feed composition and nutrient content of the diets was presented in table 1. And the length and weight

increment was presented in fig 1 and 1.1. The higher protein content was observed in the D1 diet (62.55%) and followed diet D2 (41.98%) and diet D3 (38.25%). Initial body weight of the various dietary groups did not vary significantly, but after 42 days the growth performance varied in terms of specific growth rate (SGR%/day) food conversion rate (FCR), average daily growth rate and weight gain are higher in the D1 diet. The highest SGR (2.02 ± 0.08/day) was observed in fish fed with the diet D1 and followed other diets. The FCR was better (low) among the groups in diet D1 (1.22). And the best weight gain % were observed in those fed with diet D1 (603.61%) and the lower values was observed in the diets (441.87%). The highest survival also noticed in the diet of D1 (100%) The proximate composition of the three types of feeds was estimated to assess the food value (Table 1).

Table -1. Feed formulation and proximate composition of test diets

	Diets		
Ingredients	**D1***	**D2****	**D3*****
Rice bran	-	12.3	8.4
Tapioca	-	12.3	8.4
Ground nut oil cake	-	37.6	41.5
Fish meal	-	37.6	41.5
Vit.mix	-	0.1	0.1
Min.mix	-	0.1	0.1
Nutrient Content			
Protein (%)	62.55	41.98	38.25
Fat (%)	8.16	7.12	6.10
Ash (%)	2.15	4.62	5.00

Table -2: Effect of different diets on growth survival and body indices, flesh composition of Gold fish *Carassius auratus*

	Diets		
Parameter	**D1***	**D2****	**D3*****
Initial weight (g)	0.816 ± 0.01	0.816 ± 0.01	0.816 ± 0.01
Final weight (g)	5.55 ± 0.152	4.7 ± 0.1	4.6 ± 0. 1
SGR %/day	**2.02 ± 0.08**	1.805 ± 0.04	1.77 ±0. 03
FCR	1.22±0. 016	1.85±0. 008	2.02±0. 012
ADG (%)	11.642 ± 0.371	9.237 ± 0 .285	8.97 ± 0.26
Weight gain (%)	603.61± 6.25	480.260 ± 17.3	441.87±10.68
Survival (%)	100	95	90
Flesh composition			
Protein (%)	45.53	41.36	40.56
Fat (%)	8.63	7.12	6.22
Moisture (%)	80.66	76.52	78.69
Ash (%)	4.12	4.63	5.12

Note: Chironomus larvae * 40 % Animal Protein**, 40 % Plant Protein***

Among the three types of feed, the Chironomus larvae fed fishes (D1) had the highest level of protein (62.55 %) and the lowest protein (38.25) was recorded in diet D2. The lipid content of the feeds D2 was 6.10mg/g. In the case of D1 diet had high lipid content of 8.16.

In the growth aspects of statistical analysis revealed that, the final length a linear increment of significance difference at ($p<0.05\%$) level was noticed, when compared to diet D3, D2 and D1. and in the final weight a significant difference was observed when compared to diet D3, D1 and D2. and in the SGR significance difference when compared to diet D3, D1 and D2.

But there is no significant difference between the diet D3 and D2. And in the Average daily growth rate there a significant difference was observed when compared to diet D3 and D1. But there is no significant difference in between the diet D3 and D2. And in the weight gain a similar types of significant difference was noticed. And in the survival there is no significant difference reported. (Anova table 1).

Based on the above results it could be resumed that live Chironomus larvae were required for successful rearing of *Carassius auratus* fry and the best growth performance were reported from this present investigation.

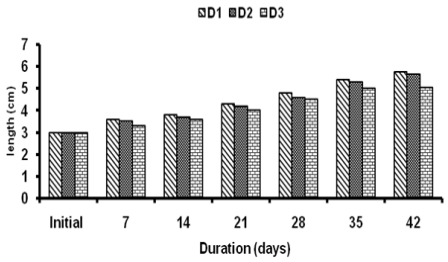

Fig.1.Length increment of *Carassius auratus* fed on different types of diets

Discussion

In the present study, the best growth performances and survival was observed in the fish fed with the Chironomus larvae diet and followed 40 % animal and 40% plant protein level were observed. Santiago *et al*., (1982) also reported that survival rate was influenced by dietary protein level in *Tilapia nilotica (O.niloticus*) fry. Watanabe *et al*., (1984) reported that muscle protein and moisture were not altered when red sea bream brood stocks were fed diets of 45 and 33% protein content. In the present study similar type of results were observed in the body composition of gold fish *Carassius auratus.*

The Chironomus larvae resulted in significantly larger growth and best survival were observed. There was a little changes in the body composition of the test animal were observed after the feeding. Numerous studies elsewhere have shown that an important contribution to dietary protein toward growth performance and the effect on the body size. Reigh and Ellis (1994) demonstrated that commonly used plant protein and animal protein supplements differ in nutritional value for cray fish, *P.clarkii*. Among plant protein ingredients soybean meal is considered as the most nutritive plant protein sources. But in our study, the best growth and weight gain and other parameters were observed in diet D1 followed by D2, D3. In diet D2 fish meal incorporated formulated diet displaced the similar types of results as observed in the study by the above said author.

Escaffre *et al.,* (1997) reported that incorporation of soybean protein concentration upto 40% in the diet did not adversely affect the survival for growth of carp larvae. Feed intake of fish depends on the size of the prey and Pradator quality density, physical attractiveness and mode of presentation of food (Hastings and Dickie, 1972; Mathavan, 1976, James *et al.,* 1993).

The active movement and high protein 62.5% content of Chironomus larvae species could have stimulatory effect on the predatory response of the experimental fish, which enhance the growth rate. James *et al.,* (1993) reported that the wriggling movement of large and nutritionally rich prey organism such as Chironomus larvae and *Culux pipiens* larvae maximize the growth of *Cyprinus carpio* which support the present findings.

Dietary protein did not affect the body moisture and ash contents of several other fish species (Berger and Halver, 1987; Daniels and Robinson, 1986; Millikin, 1982; Page and Andrews, 1973, Santiago and Laron, 1991). Body protein content of carp was almost constant regardless of dietary protein levels (Murai *et al.,* 1985). Body moisture content tended to increase with increasing dietary protein level, show an inverse relationship with body lipid content as has been reported for other fishes (Lanari *et al.,* 1999).

Table-1: One way Anova table showing the summary of the growth performance of the Gold fish *Carassius auratus* fingerlings fed on different live feeds and the each one the mean value were compared using in Duncan multiple range tests.

Length (cm)	Between groups	Sum of Squares	df	Mean square	F	Sig
Final length (cm)	Between groups	0.847	2	0.423	27.214	0.001
	With in groups	0.093	6	0.016		
	Total	0.940	8			
Final weight (g)	Between groups	2.509	2	1.254	86.846	0.001
	With in groups	0.087	6	0.014		
	Total	2.596	8			
SGR(%/day)	Between groups	0.111	2	0.055	47.397	0.001
	With in groups	0.007	6	0.001		
	Total	0.118	8			
ADG (%)	Between groups	12.960	2	6.480	67.508	0.001
	With in groups	0.576	6	0.096		
	Total	13.536	8			
Weight gain (%)	Between groups	38161.544	2	19080.772	82.963	0.001
	With in groups	1379.966	6	229.992		
	Total	39541.499	8			
Survival (%)	Between groups	288.889	2	144.444	2.600	0.154
	With in groups	333.333	6	55.556		
	Total	622.222	8			

The body crude lipid content generally decreased as dietary protein level increased, which was in contrast to results obtained in rain bow trout by Chen and Tsai, (1994).

In the present study the moisture content of fish was higher before the experiment than in any of the treatments after the experiment. The higher moisture content of younger animals is quite well known fact. All the five experimental diets had about the slight difference in moisture content. Dabrowski, (1977) found no change in the body moisture content of grass carp, *Ctenopharyngodon idella* when the dietary protein level was varied.

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