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A COMPARATIVE STUDY OF GROWTH AND SURVIVAL IN JUVENILES OF "SHINNING BARB" (*Pethia conchonius*) FED WITH ARTIFICIAL FEED, PLANKTON AND THE COMBINATION OF BOTH

Upasana Sahoo[1], Saroj Swain[2], Mukesh Bairwa[3], Harshavardhan Joshi[4] and Chakradhar Patra[5]

[1]Scientist, ICAR-CIFE, [2]Principal Scientist, [3]Scientist, CIFA, Bhubaneswar, [4]Sr.S.A, Fishery Survey of India, Chennai Base, [5]Ph.D. Research Scholar, OUAT, BBSR
E-mail: upasana@cife.edu.in

Abstract: The life cycle of fish undergoes a lot of changes, starting from eggs to adult and the nutritional requirements for the fish vary with some factors such as the relationship between the diet and life stage. The experiment was conducted to have a comparative study between the effect of live feed and artificial feed on the growth and survivality of the juveniles of shinning barb consisting of three treatments i.e.T1 (plankton), T2 (artificial feed + plankton) and T3 (artificial feed) at the premises of ornamental unit of ICAR-CIFA, Bhubaneswar. The physico-chemical parameters of water such as temperature (°C), pH, dissolved oxygen (mg L^{-1}), free carbon dioxide (mg L-1), alkalinity (mg L-1) and Hardness (mg L-1) were estimated weekly. Growth parameters like Mean body weight and length, weight gain and length gain (%), specific growth rate (SGR), survival (%) of shining barb, *Pethia conchonius* was recorded in mixed diet compared to fishes fed only with live food or artificial feed alone. It indicated that the association of formulated diet and plankton was enough for fish metabolism which consequently resulted in a more suitable growth, than live food only or formulated diet only. Fishes fed with mixed diet recorded the highest growth performance and better survival than live food alone. So mixed food may be the best diet for rearing of shining barb.

Keywords: Shining barb (*Pethia conchonius*), live food, phytoplankton, artificial feed, growth and survival of juvenile.

1. INTRODUCTION

Shining barb is the one of achievement of ICAR-CIFA, developed through selection. Shining barb is a developed variety of Rosy barb (*Pethiaconchonius*) produced through selective breeding. Rosy barb is a benthopelagic species that inhabits in subtropical parts of Asia. It is native of northern India, Bangladesh, Nepal and Pakistan. It is found in Assam, Bihar, Bengal, Punjab and Deccan parts of India. It is one of the hardiest of barbs and easily available. This species grows up to 90 – 100 mm but most are fully-grown at 65 – 75 mm. in length. They are omnivorous in nature. Their colour becomes bolder during their mating

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periods. The male has a brighter pinkish colour and the female is slightly plumper. Also note that females do not have any black colour in their fins while males do. They are mature at 1.5-2.0 inches in size.

The life cycle of fish undergoes a lot of changes, starting from eggs to adult. In general, it is well accepted that fish nutritional requirements vary with some factors such as the relationship between the diet and life stage (Ricker, 1979). For many fish species, the larval period is considered critical in life history. Success of larval rearing depends mainly on the availability of suitable diets that readily consumed, efficiently digested and that provide the required nutrients to support good growth and health (Giri *et al*., 2002). Thus, in captive conditions, rearing of the juvenile fish is challenging. Growth and survival data are powerful tools for understanding the effects of both live and manufactured diets on first-feeding fish larvae (Wang *et al.,* 2005). Understanding the feeding habits and other requirements, at the larval stage is very necessary for the seed production of any species.

Ornamental sector of fisheries is intending to become a major part of aquaculture globally, as aquarium keeping is the second largest hobby. Freshwater ornamental fish trade is a million-dollar industry (Lim and Wong, 1997). Shinning barb, being new to the industry needs a lot of aspects to be standardized. Rosy barb is omnivorous in nature and so is Shinning barb. But for any species to be commercialized, the feeding protocol should be standardized. So, this small experiment of 45 days was carried out to find the best feed/feed combination for the better growth and survival of the juveniles of Shinning barb.

2. MATERIALS AND METHODS

The experiment was conducted to have a comparative study between the effect of live feed and artificial feed on the growth and survivality of the juveniles of shinning barb. The experiment was carried out in triplicates, consisting of three treatments, at the premises of ornamental unit of ICAR-CIFA. For this, 9 glass aquariums (volume – 30 litres) were taken. After proper cleaning they were filled with Borewell water (conductivity: 0.423Moho/cm; pH: 7.8; Alkalinity: 1.6ppm; Hardness: 100ppm; Dissolved oxygen: 6 ppm; temperature 28^{o}C) leaving some freeboard space. The aquariums were provided with *hydrilla* plant (approx 200g) in small beakers; with sand substrate. Continuous aeration was provided to each aquarium.

2.1. Experimental Design

The experiment was conducted for a period of 45 days. Three treatments with three replicates each were designed; T1 (plankton), T2 (artificial feed + plankton) and T3 (artificial feed).

Experimental design

Sl. No.	Treatments	Details of Experiment	No. of replicates
1	Treatment-I (T1)	Plankton	3
2	Treatment-II (T2)	Plankton + Artificial feed	3
3	Treatment-III (T3)	Artificial feed	3

2.2. Fish Stocking and Operational Details

Healthy juveniles of shinning barb (weight 0.047±0.002 g and length 1.777±0.027 cm) were collected from own resources of ornamental unit of ICAR-CIFA and stocked @ 60 juveniles in each aquarium (stocking density – 2/l). Feeding till satiation was done twice a day, in the morning and evening.

2.3. Details of feed

Plankton was collected from the pond at CIFA, in the morning hours, and fed till satiation. Plankton population was mainly dominated by the zooplankton, particularly Copepods.

The artificial feed given was floating pelleted feed, commercially available at the market, and well formulated for the growth of fish, with following composition.

COMPOSITION OF THE FEED USED FOR EXPERIEMENT	
PARAMETERS	VALUE (%)
Crude protein	26
Crude fat	5
Fibre	6
Moisture	11

2.4. Water Replenishment

Water of the experimental aquariums was replenished everyday@ 5%, after siphoning the bottom waste sediment out. Borewell water of same physico-chemical parameters was supplied to all aquariums to maintain the fixed level of water.

2.5. Water quality monitoring

Few selected parameters of water such as water temperature (°C), pH, dissolved oxygen (DO) (mg L^{-1}), free CO_2 (mg L^{-1}), Alkalinity (mg L^{-1}) and Hardness (mg L^{-1}), were measured weekly following the standard methods (APHA, 1998) in all cisterns. The water quality parameters were analysed as follows:

2.5.1. Water Temperature (°C)

Water temperature was measured on spot using a mercury thermometer having 0.5^0C accuracy.

2.5.2. pH

The pH of water samples was measured using digital pH meter (ADCO) to monitor the pH of test water.

2.5.3. Dissolved Oxygen (mg L^{-1})

For estimation of dissolved oxygen content of water, the samples were collected with all necessary precautions. Winkler's method was followed for estimation of dissolved oxygen of all cisterns (APHA, 1998).

2.5.4. Free CO_2 (mg L^{-1})

For estimation of free carbon dioxide content of water, the samples were collected with all necessary precautions. Phenolphthalein indicator method was followed for estimation of free carbon dioxide of all cisterns (APHA, 1998).

2.5.5. Alkalinity (mg L^{-1})

It was estimated by Titration method (APHA, 1998). Fifty ml of sample was taken in a conical flask, to it 2-3 drops of phenolphthalein indicator was added. When the sample became pink, it was titrated with 0.02 N sulphuric acid until the pink colour just disappeared. The quantity of acid used was recorded. Then 2-3 drops of methyl orange indicator was added and titrated against 0.02 N sulphuric acid. The end point was orange to wine red. The volume of sulphuric acid used was recorded and alkalinity was determined.

2.5.6. Hardness (mg L^{-1})

Hardness is the measure of total concentration of divalent metallic cations like calcium, magnesium, ferrous and strontium and is expressed in mg/l. It was estimated by Titration method (APHA, 1998). For testing hardness, 50 ml of the sample water was taken in a conical flask. To it 1.5 ml ammonia buffer and 3 drops of Erichrome Black-T indicator was added. Then it was titrated against standard EDTA solution till the sample water colour changed from wine red to blue. Volume of the EDTA solution used was recorded, and hardness was determined.

2.6. Growth Study

2.6.1. Sampling Frequency

Fish sampling was done on fortnight basis at 15 days interval to record their growth in terms of weight (g) and length (mm) increment. Fish samples were collected randomly from each cistern and measured. Weight of fish was taken using digital balance. Length of fish was measured by measuring scale.

2.6.2. Growth Indices

% length gain = Final length – Initial length / Initial length x 100

% weight gain = Final weight – Initial weight / Initial weight x 100

Specific growth rate (SGR): The specific growth rate of fish was calculated using the formula:

SGR = (LnW2 – LnW1) / ($t_2 – t_1$) x100

Where, W1 = Weight of fish at time t_1

W2 = Weight of fish at time t_2

t_1= Initial time

t_2= Final time

Survivality (%) = total number harvested/total number stocked x100

2.7. Statistical Analysis

Statistical analysis for each parameter was calculated using one way analysis of variance (ANOVA) (Snedecor and Cochran, 1968), with Duncan's Multiple Range Test (DMRT) to determine significant differences among different treatments.

3. RESULTS

3.1. Physico-chemical parameters of water

The physico-chemical parameters of water such as temperature (°C), pH, dissolved oxygen (mg L^{-1}), free carbon dioxide (mg L^{-1}), alkalinity (mg L^{-1}) and Hardness (mg L^{-1}) were estimated weekly and presented in Table: 1. Water temperature ranged from 26°C-29°C while pH was in the range of 7.33 to 7.37 throughout the experimental period. Dissolved oxygen concentration was recorded within the range of 6.08 to 6.15mg L^{-1} whereas. Alkalinity and hardness were recorded at a range of 92.59 to 94.00 mg L^{-1} and 97 to 99 mg L^{-1} respectively.

Table 1: Physico-chemical parameters of water for experiment during the experimental period of 45 days

Parameters	T_1	T_2	T_3
Temperature (°C)	28.55 ± 0.43	28.55 ± 0.41	28.53 ± 0.39
DO (mg L^{-1})	6.15 ± 0.04	6.08 ± 0.07	6.08 ± 0.46
pH	7.37 ± 0.15	7.33 ± 0.18	7.35 ± 0.19
Free CO2 (mg L^{-1})	4.16 ± 1.19	3.93 ± 1.19	4.08 ± 1.17
Alkalinity (mg L^{-1})	92.59 ± 1.29	94.00 ± 3.77	93.00 ± 3.68
Hardness (mg L^{-1})	98.59 ± 1.35	97.00 ± 3.45	99.00 ± 3.32

3.2. Growth parameters

3.2.1. Mean body weight and length

In present experiment, fry of shining barb average (weight 0.047±0.002 g and length 1.777±0.027 cm) were reared for 45 day and fed with different feed in different treatments. The mean weight and length data are presented in Table 2 &3.

Mean weight of shining barb fed with mix feed was significantly ($p<0.05$) higher compared to fish feed with only artificial feed or live food on 15th day as well as on 30th day. On 45th day the highest mean weight was recorded in T_2 treatment (0.503c ± 0.014 mg) whereas lowest in T_3 group (0.286a ± 0.017 mg).

Mean length of shining barb fry did not showed any significant difference ($p>0.05$) on 15th day as well as on 30th day. However there was significant different ($p<0.05$) in mean length on 45th day. The highest mean was recorded in T_2 treatment (3.400 ± 0.115) whereas lowest in (2.733 ± 0.088 cm)

Table: 2 Mean body weight (g) of shinning barb, *Pethiaconchonius* fed with different feed

Treatment	Initial	15th day	30th day	45th Day
T_1	0.046^{a} ± 0.003	0.146^{ab}± 0.014	0.226^{a} ± 0.014	0.350^{b} ± 0.011
T_2	0.050^{a} ± 0.005	0.170^{b} ± 0.017	0.360^{b} ± 0.017	0.503^{c} ± 0.014
T_3	0.046^{a} ± 0.006	0.106^{a} ± 0.017	0.200^{a} ± 0.017	0.286^{a} ± 0.017

Mean values (Mean±SE) in the same column with different superscripts differ significantly ($p<0.05$). All mean values are expressed as mean± SE.

Table 3: Mean body length (cm) of shinning barb, *Pethiaconchonius* fed with different feed

Treatment	Initial	15th day	30th day	45th Day
T_1	1.766^{a} ± 0.033	2.100^{a} ± 0.115	2.466^{a}± 0.0811	3.033^{a}± 0.088
T_2	1.766^{a} ± 0.066	2.400^{a} ± 0.057	2.966^{a}± 0.176	3.400^{b} ± 0.115
T_3	1.800^{a} ± 0.057	2.133^{a} ± 0.088	2.566^{a}± 0.145	2.733^{a} ± 0.088

Mean values (Mean±SE) in the same column with different superscripts differ significantly ($p<0.05$). All mean values are expressed as mean± SE.

3.2.2. Weight gain and length gain (%)

In present study weight gain percentage was recorded highest in T_2 treatment group (931.11 ± 111.66%) whereas lowest in T_3 group (544.44 ± 109.42%). The length gain in T_2 treatment was also significantly higher compared to other treatment groups (Table 4 & Figure 1, 2). The lowest length gain was recorded in T_3 treatment group.

3.2.3. Specific growth rate (SGR)

SGR of shining barb in treatment T_2 was significantly higher compared to other treatments (Table 4 and Figure 3). The lowest SGR was recorded in T_3 treatment group (4.067 ± 0.413) while highest in T_2 group (5.160 ± 0.232).

3.2.4. Survival (%)

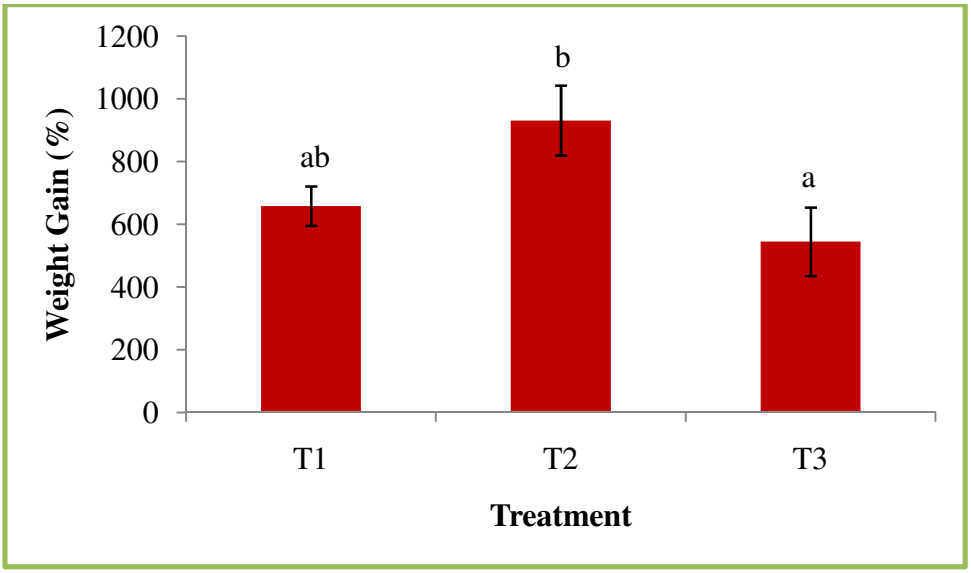
The highest survival was recorded in T_3 treatment and it was significantly ($p<0.05$) higher compared to other treatments (Table 4 and figure 4). The lowest survival was recorded in T_1 where fishes were fed with live food.

Table: 4 Growth parameters and survival of Shinning barb, *Pethia conchonius* fed with different feed

Treatment	WG (%)	LG (%)	SGR	Survival (%)
T_1	658.33^{ab}±62.74	71.787^{ab}±5.351	4.487^{ab}±0.181	37.222^{a}±2.421
T_2	931.11^{b}±111.66	92.570^{b}±3.732	5.160^{b}±0.232	63.889^{b}±1.469
T_3	544.44^{a}±109.42	52.477^{a}±9.820	4.067^{a}±0.413	83.333^{c}±1.924

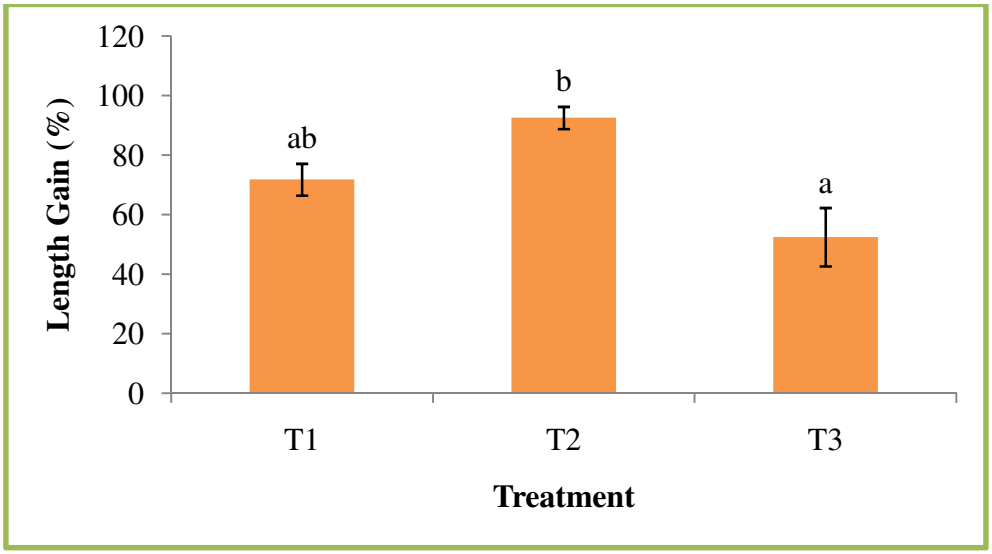
Mean values (Mean±SE) in the same column with different superscripts differ significantly ($p<0.05$). Here: WG (%): Weight gain percentage and SGR: specific growth.

Figure: 1 Weight Gain (%) of Shinning barb, *Pethiaconchonius* fed with different feed



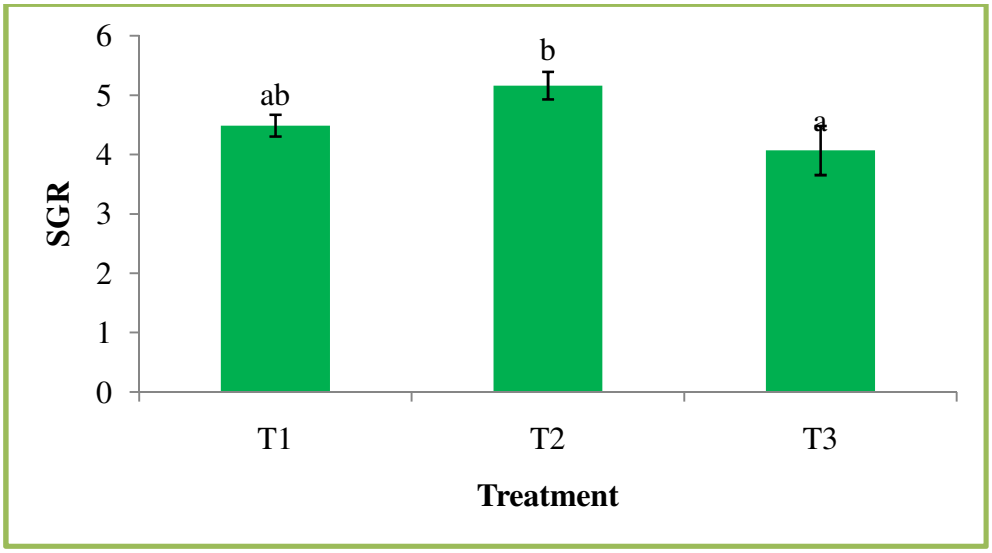
Mean values with different alphabets differ significantly among the treatments ($p<0.05$).

Figure: 2 Length Gain (%) of Shinning barb, *Pethiaconchonius* fed with different feed



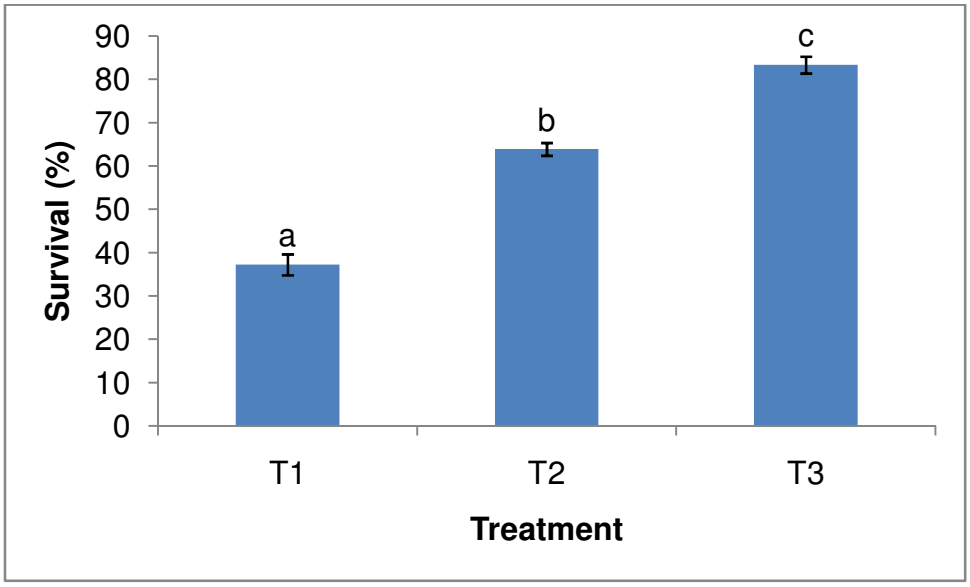
Mean values with different alphabets differ significantly among the treatments ($p<0.05$).

Figure: 3 Specific Growth rate (SGR) of Shinning barb, *Pethiaconchonius* fed with different feed



Mean values with different alphabets differ significantly among the treatments ($p<0.05$).

Figure: 4 Survival of shinning barb, *Pethiaconchonius* fed with different feed



Mean values with different alphabets differ significantly among the treatments ($p<0.05$).

4. Discussion

In present experiment shining barb, *Pethiaconchonius* fry was fed with live food, artificial commercial feed and their combination for 45 days. In present study different treatment did not affect the water quality. There was no significance difference in pH, alkalinity, hardness, CO2 and Dissolved oxygen among the treatments. The best growth performance with significantly higher weight gain (%), length gain (%) and SGR of shining barb, *Pethia conchonius* was recorded in mixed diet compared to fishes fed only with live food or artificial feed alone. It indicated that the association of formulated diet and plankton was enough for fish metabolism which consequently resulted in a more suitable growth, than live food only or formulated diet only. Olivotto *et al*. (2010) demonstrated high growth rate and percent survival of *Amphiprionclarkii*, a marine ornamental fish, when a combined diet was used. Fish would spend less time and energy to ingest rapidly available artificial food, than to ingest the same volume of plankton by sucking water Rahman *et al*., 2010). This argument explains the higher growth rate and better survival (%) of shining barb in mixed diet (FD+P). Better growth in mixed feed also supported by Sipaúba-Tavares et al 2015 who found better growth of *Bettasplendens* in mixed diet compared to live food or formulated feed alone.

The result of present study shows the highest growth in treatment T_2 where fishes were fed withmixed diet, but the highest survival (%) was obtained with artificial powder feed. Sipaúba-Tavares *et al.,* 2015 support the present study who found better survival of Siamese fighting fish, *Bettasplendens in* formulated feed compared to live feed. Ferenc Demény *et al.,*

2012 also support the present study who recoded higher survival but poor growth in artificial feed in larval rearing of Crucian Carp, *Carassiuscarassius*. The higher survival in formulated feed may be due to easy availability of food to the small fishes. The low percent survival of shining barb in with live food treatment is probably due to the high density of Copepod (around 70%), and the most these species have a rapid jumping movement, live preys may be less available to the fish for predation than Rotifera that represented (around 15%) of the total zooplankton organisms in the supplied zooplankton.

5. CONCLUSION

Although this study showed the highest survival in artificial diet but the growth performance poorest among the treatments. Fishes fed with mixed diet recorded the highest growth performance and better survival than live food alone. So mixed food may be the best diet for rearing of shining barb. Partial replacement of live feed may be the good due to easy availability of formulated feed whereas difficulty in culture and maintain live food.

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