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Observations on Larval Growth and Survival of *Labeo rohita* in Response to Different Diets and Stocking Densities

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Abstract: Larval rearing of *Labeo rohita* were carried out under different stocking densities and including live food. Micro-algae *Spirulina*, *Phacus* and *Brachionus calyciflorus* were used as live food. The rotifer was nutritionally enriched before introducing to larval culture system. Larvae of *Labeo rohita* were experimentally stocked in three density levels for three types of diets. The low, medium and high stocking densities included 15, 30 and 45 individuals. $10L^{-1}$ respectively. Three diet types were traditional, single live food (*Brachionus calyciflorus*) and mixed live food (*Spirulina* & *Brachionus calyciflorus*). The maximum survival (91%), average length attainment (3.28 mm/day) and weight gain (3.94 mg/day) were observed at low density- mixed live food system. The growth performance in mixed live food was around 2.5 fold higher than traditional method and approximately 1.45 fold higher than single live food diet. While single live food diet showed about 1.8 fold higher growth than traditional method. In conclusion, the larvae of *Labeo rohita* responded best with mixed diet including phytoplankton (*Spirulina*) and rotifer (*Brachionus calyciflorus*).

Key words: *Spirulina* · *Brachionus calyciflorus* · *Labeo rohita* · Larvae · Survival · Growth

INTRODUCTION

Bangladesh is a small country with more than 50% wetlands. These vast freshwater habitats provide the sustenance of 266 freshwater fish species [1]. Fish is one of the main diets and fulfils 63% of the protein requirement [2]. Marine fish is less popular in this country and the supply of fish was broadly based on harvesting from open waters. The demand of fish is increasing and the water-bodies are decreasing here because of agriculture, urbanization and siltation. To meet the increasing demand, aquaculture programs were launched and soon became popular among mass people. But, due to different geographical, climatic and environmental conditions, wild fries collection is now only restricted to Halda River. So, the practice of collection and production of fries were shifted from wild harvest to hatchery production.

In the last few decades, 783 fish hatcheries were established in Bangladesh including 112 government hatcheries. Spawn production in these hatcheries were 2, 76,481 kg in 2005, while natural fish fry collection was only 1975 kg [3]. But still the production is inadequate according to demand.

In the present study *Spirulina* and *Brachionus calyciflorus* were used to feed the larvae of *Labeo rohita.* Fish larvae from the age of 96 hours to 20 days were reared under three different stocking densities i.e. low stocking density (LSD), medium stocking density (MSD) and high stocking density (HSD) and three unlike diets i.e. traditional method (TM), single live feed (SLF) and mixed live feed (MLF).

MATERIALS AND METHODS

Stocking Density: The study was conducted in mesocosm at Zoological Garden, University of Dhaka. The larvae of *Labeo rohita* were reared experimentally in three different stocking densities named low, medium and high stocking densities. The number of hatchling stocked in low, medium and high densities were 15, 30 and 45 individuals/ 10 L, respectively.

Feeding Schedule for Fish Larvae: The larvae of *Labeo rohita* were fed on three different diets in their experimental rearing system. The larval rearing was followed the feeding schedule presented in Table 1.

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Table 1: Feeding schedule of *Labeo rohita* larvae for three different diets

Methods	Name of Food	96hrs-5th day	6th-10th day	11th-20th day
Traditional Rearing Method	Egg yolk	1pc.day^{-1}100L^{-1}	Nil	Nil
	Wheat	15% of BW	Nil	Nil
	Mastered oil cake	Nil	12% of BW	10% of BW
Single Live Food	*Brachionus calyciflorus*	1500 ind.larva^{-1}. day^{-1}	1400 ind.larva^{-1}. day^{-1}	1400 ind.larva^{-1}. day^{-1}
Mixed Live Food (Algae & Rotifer)	*Spirulina*	1.2 X 10^{6} cells. larva^{-1}.day^{-1}	1.4 X 10^{6} cells. larva^{-1}.day^{-1}	1.6 X 10^{6} cells. larva^{-1}.day^{-1}
	Brachionus calyciflorus	1000 ind.larva^{-1}. day^{-1}	800 ind.larva^{-1}.day^{-1}	800 ind.larva^{-1}. day^{-1}

RESULTS

Survival of Fish Larvae: Rearing of larvae of *Labeo rohita* in three different diets and stocking densities showed significant ($p<0.05$) variation both in survival and growth performance. The lowest survival rate (38%) was recorded in high density-traditional diet category and the highest rate (91%) was observed in the mixed live food and low-density medium. Relationships of survival rate with both stocking density and diet category were found significant ($p<0.05$).

Although survival in different diets showed significant ($p<0.05$) variations, in each diet type, the maximum survival was observed in low density. Best effort was provided to maintain similarity in supplying food and maintaining water quality in each stocking density tank, but also the mortality showed its density dependency. But mortality was proportionately less in live food supply systems even though the density was high (Figure 1).

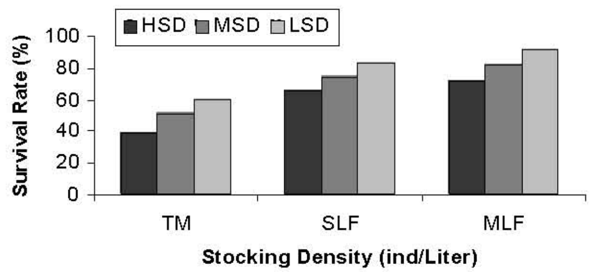

Fig. 1: Survival rate of larvae of *Labeo rohita* at different density with three diet types

Growth Performance: Outstanding growth performance was observed in mixed live food diet. Growth was around 2.5 folds higher than the traditional method. The mean maximum weight gain was 63.04±0.08 mg at 17-days rearing trail with the mixed live food diet.The growth performance was satisfactory in both live food diet systems, but the mixed diet was more useful and relatively cost-effective (Table 2). Daily increase in size and net regular weight gain was also recorded during the study and the result was almost uniform.

Table 2: Length and weight based growth performance of *Labeo rohita* larvae in response to three types of diet supply at three different density levels

Diet type	Density level	Average initial length, S.D. And range (mm)	Average final length, S.D. And range (mm)	Average Length attainment (mm)	Specific Growth rate [expressed as body length attained per day] (mm)	Average initial weight, S.D. And range (mg)	Average final weight, S.D. And range (mg)	Average weight gain (mg)	Specific Growth rate [expressed as body weight gain per day] (mg)
Traditional	Low (15 ind/10L)	4.2±0.07	26.2±0.11			26.2±0.11	28.06±0.18		
		4.18-4.22	25.8-26.5	22	1.29	2.09-2.20	26.90-28.50	25.92	1.62
	Medium	4.2±0.07	21.8±0.14			2.14±0.09	21.66±0.21		
	(30ind/10L)	4.18-4.22	21.0-22.1	17.6	1.04	2.09-2.2	20.09-21.80	19.52	1.22
	High	4.2±0.07	17.5±0.17			2.14±0.09	16.40±0.22		
	(45 ind/10L)	4.18-4.22	16.9-18.2	13.3	0.78	2.09-2.2	15.20-16.80	14.26	0.89
Single live food	Low	4.2±0.07	43.5±0.09			2.14±0.09	43.92±0.9		
(*B.calyciflorus*)	(15 ind/10L)	4.18-4.22	42.9-43.8	39.3	2.31	2.09-2.2	43.01-44.00	41.78	2.61
	Medium	4.2±0.07	35.6±0.09			2.14±0.09	33.60±0.10		
	(30 ind/10L)	4.18-4.22	35.2-36.1	31.4	1.85	2.09-2.2	32.80-34.02	31.46	1.97
	High	4.2±0.07	28.8±0.10			2.14±0.09	25.10±0.10		
	(45 ind/10L)	4.18-4.22	28.2-29.3	24.6	1.44	2.09-2.2	24.80-26.01	22.96	1.43
Mixed live	Low	4.2±0.07	60±0.08			2.14±0.09	65.18±0.08		
food (*Spirulina*	(15 ind/10L)	4.18-4.22	58.8-60.4	55,8	3.28	2.09-2.2	64.90-65.60	63.04	3.94
& *B.calyciflorus*)	Medium	4.2±0.07	48.3±0.09			2.14±0.09	49.80±0.09		
	(30 ind/10L)	4.18-4.22	47.9-48.5	44.1	2.59	2.09-2.2	48.90-50.00	47.66	2.98
	High	4.2±0.07	39±0.10			2.14±0.09	36.87±0.09		
	(45 ind/10L)	4.18-4.22	38.7-39.5	34.8	2.04	2.09-2.2	36.10-37.32	34.73	2.17

DISCUSSION

Rearing of larvae of *Labeo rohita* using three diets and densities conditions showed significant variations both in survival and growth performance. The highest rate was observed in the mixed live food and low-density medium.

The conventional diet of larval rearing of rohu includes 10.2% moisture, 20.36% protein, 10.97% fat, 35.25% carbohydrate, 21.06% ash and 12.36% crude fibre [4]. But this diet lacks unsaturated fatty acid specially (n-3) HUFA. However, most of the larval fish requires (n-3) HUFA levels to boost up their growth [5]. Enriched rotifer is rich in (n-3) HUFA, EPA and DHA [6]. In our present study growth was higher in both live food supply system. It could be due to the nutritional enriched rotifer (*Brachionus calyciflorus*). In addition spirulina has GLA, glicolipid and sulpholipid with 8% minerals and 86% vitamins that may have an enormous influence on rohu larval growth. *Labeo rohita* being a carp undergoes the both types (phytoplankton and zooplankton) of larval rearing diet. Almost no fish is a specific feeder in the adult stage and each fish is stenohyaline in its larval stage, the superiority in growth performance in mixed live food diet may be was found for all of these issues. 3-5 folds higher growth rate of common carp (*Cyprinus carpio*) was observed with live food treatment than traditional way [7]. In this study the mixed live food diet showed 2-2.5 folds higher growth than the conventional method. The trend of both results is similar but the difference in rate may be due to species variation. The growth rate of *Labeo rohita* is less than that of common carp. The maximum survival 91% was at a density of 15 larvae per 10 liter of water, which means 48562 larvae per decimal or 102 gm per decimal. This stocking density level was even double of traditional hatchery practice.

It was concluded that the main barrier to boost up our carp culture is limited production of fries and their low quality and poor survival rate. Present study reveals that live food supply can increase the fry production in existing hatcheries dramatically. Use of other species in live food production may be effective. Hence the local cultivable algal and zooplankton species should be listed and their culture techniques should be experimented. Nutritional value of the cultivable species should also be determined to choose the best one.

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