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Larvae and Fry Rearing of Bata, *Labeo bata* (Hamilton, 1822) Using Different Supplementary Feeds

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Abstract The present study was conducted under two experiments to evaluate the effects of different feeds on larval (experiment-1) and fry rearing (experiment-2) of *Labeo bata* fish. Experiment-1 was conducted in 9 bowls under three treatments each with 3 replications (T_1, T_2, and T_3). Fish larvae in T_1 were fed with plankton, T_2 with commercial feed and T_3 with laboratory prepared feed. On the other hand, six ponds were divided into three treatments (T_1, T_2 and T_3) each with two replications in experiment-2. Fish meal was used in T_1, wheat bran in T_2 and laboratory prepared feed in T_3. Results in experiment-1 revealed maximum length gain in T_1 (1.56±0.69) (cm) which was significantly (P<0.05) higher than that of T_2 (0.64±0.34) cm and T_3 (0.98±0.29) cm. Furthermore, highest specific growth rates (SGR) were found as (2.85±0.27)%, (1.55±0.11)% and (1.99±0.15)% in T_1, T_2 and T_3, respectively. On the basis of growth performance, live food (plankton) showed the highest growth performance in case of larval rearing of bata. On contrary, experiment-2 revealed the mean maximum length gain of bata fry in T_1 (3.76±0.05) cm significantly (P<0.05) higher than that of T_2 (2.85±0.02) cm and T_3 (2.56±0.01) cm. In this case, SGR was found in T_1 (0.91±0.01)% followed by T_2 (0.72±0.13)% and T_3 (0.65±0.15)%. Use of fish meal showed best growth performance during bata fry rearing in terms of growth performance. However, the survival rates were low in both the experiments; therefore further detail and intensive research are highly suggested.

Keywords: *Labeo bata, larvae, fry, fish feed, growth performance, survival, fry, larvae*

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1. Introduction

The bata, *Labeo bata* is one of the most important minor carps in Bangladesh with great demand as table fish due to its deliciousness, flavor and less spiny structure [1]. It is locally known as *bhangon bata* in Bangladesh. This fish is naturally distributed in India, Bangladesh and Myanmar and also reported from Pakistan while it is introduced in Nepal [2]. *L. bata* inhabits rivers, *haors*, *baors*, *beels*, canals and ponds of Bangladesh [1]. The bata is highly preferred fish and is of high market value [3,4]. Moreover, the *L. bata* is one of the major aquaculture species in the country. However, due to over exploitation, habitat loss and various ecological changes in its natural habitat; wild population of this species is on the verge of extinction [3,5].

According to FAO [6], aquaculture is one of the rapidly growing food sectors and its economic significance is increasing concomitantly throughout the world. Bangladesh observes above 5% average growth rate of the fishery sector during the period 1984/85 to 2008/09. Nonetheless, aquaculture enjoyed an impressive growth rate of more than 9% while inland capture fisheries and marine fisheries showed growth rates below and slightly above 4%, respectively during the same period [7]. The contribution of aquaculture production in the national fish production increased steadily during the 1995–2004 and is estimated at 46.6% of the total fish production [8].

L. bata has faster growth rate, higher market value, deliciousness and easy culture system using supplemental feeds making it popular fish to adopt in culture by medium scale fish farmers [9]. In addition to increased fish production, aquaculture can help to save this threatened species from the risk of extinction. The most important steps in successful aquaculture are larvae and fry rearing [10]. Diets play important role in both the stages. Nutritionally deficient diets can lead to poor growth and induce disease conditions which ultimately leading to death while adequate and appropriate diets can lead to successful aquaculture [11]. Different types of feeds are commonly in use for larval and fry rearing of bata. However, best suited diets for these stages of bata rearing are yet to be finalized through detailed research. Therefore, an effort has been made to find out suitable

feed for optimal growth and survival during bata larvae and fry rearing.

2. Materials and Methods

2.1. Experimental Site and Experimental Design

The present study consists of two experiments, experiment-1 and experiment-2. Experiment-1 was conducted at "Wet Laboratory" while experiment-2 was conducted in "Fisheries Field Complex", Department of Fisheries Biology and Genetics, Bangladesh Agricultural University. Experiment-1 was conducted for 35 days from 11 August to 15 September, 2009 whereas experiment-2 was done for a period of 50 days during 17 October to 6 December, 2009. In the experiment-1, nine plastic bowls (Height = 16 cm, Diameter = 40 cm) were divided into 3 treatments (T_1, T_2 and T_3) each with three replications. Fish in T_1 were fed with plankton, T_2 with commercial feed (ARC-Z) and T_3 with laboratory preparedmixed feed (Table 1 & Table 2).On the other hand, in experiment-2, six ponds (area: 81 m^2, depth: 1.0 m) were divided into three treatments (T_1, T_2 and T_3) each with two replications. Fish meal was used in T_1, wheat bran in T_2 and laboratory prepared artificial feed was used in T_3 (Table 3). The ponds were completely independent, well exposed to sunlight and had no inlet and outlet facilities.

Table 1. Ingredients of different feeds used for larval rearing of *L. bata* (experiment-1)

T_1 (Plankton)	T_2 (Commercial feed, ARC-Z)	T_3 (Laboratory prepared)
Bacillariophyceae	Astaxanthene 3000-6000 ppm	Fish meal 30%
Chlorophyceae	Omega "3" fatty acid	Rice bran 26%
Cyanophyceae	Protein Min 65%	Binder 2%
Euglenophyceae	Carbohydrate 9%	Vit-premix 1%
Rotifera	Lipids 26%	Mustard oil cake 15%
Cladocera		
Copepoda		
Cyclops		

Table 2. The number of different groups of plankton found during study period in case of T_1, experiment-1

Plankton groups	Nu rs No. (Mean±SD)/Liter of water
Cyanophyceae	17250±1238
Chlorophyceae	32000±8140
Bacillariophyceae	6750±378
Euglenophyceae	2517± 320
Rotifera	5100±210
Cladocera	2117±206
Nauplius	2066±130
Copepoda	2000±198

Table 3. Proximate composition of the feed ingredient used for fry rearing (Experiment-2)

Components	Fish meal (%)	Wheat bran (%)	Prepared feed (%)
Protein	26.5	18.4	21
Fat	4.5	7.5	3.9
Ash	18	15.15	1.7
Crude Protein	6	4.28	5.27
Moisture	11	13.42	12

2.2. Collection and Stocking of Larvae Fry of *L. bata*

Both larvae and fry of bata were collected from "Field Laboratory Complex Hatchery", Faculty of Fisheries, Bangladesh Agricultural University. Before releasing the larvae and fry, the initial length and weight of 30 randomly selected fish from each group were recorded with the help of 5 mm graph paper and a sensitive portable electric balance (DONGIL-15 kg × 50 g). 10 days-old larvae (length: 1.14±00 cm, weight: 0.02±00 g) and fry (length: 6.2±0.00 cm, weight: 3.24±0.00 g) were released in bowls and ponds, respectively after conditioning.

2.3. Feed Preparation and Feeding of Fish

The commercial feed (ARC-Z) was purchased from Swadeshi *Bazar*, Mymensingh, and the live feed i.e. plankton was collected from the ponds, Bangladesh Agricultural University using plankton net. Artificial feed in the laboratory was prepared using fish meal, rice bran, mustard oil cake, vitamin mixture. The required quantities of all ingredients were mixed manually and spreadover the surface water of the bowls and ponds while live feed was supplied in the bowls from containing beakers. The quantities of feeds (30% of total body weight) were adjusted every seven days on the basis of increase in the average body weight of the stocked biomass in first experiment and the rate of 100, 75, 40, 30 and 20% of their body weight respectively for second experiment. The diets of *L. bata* were fed twice a day (0900 and 1600 hrs) in both the experiments.

2.4. Analysis of Proximate Composition of the Feed Ingredients

Proximate composition of the feed ingredients were analyzed following the standard methods given by Association of Official Analytical Chemists [12] in the Nutrition Laboratory of the Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh.

2.5. Sampling

Sampling was done weekly in the morning (0900 to 1000 hrs) in both experiments. Twenty fish from each bowl and pond were randomly sampled length and weight was recorded. Weight and length of fish were taken using analytical balance (College B204S, Switzerland) and 1 mm graph paper in experiment-1whiledigital balance (DONGIL-15 kg x 50 g) and measuring scale were used in experiment-2.

2.6. Growth Parameters

Length gain (cm), weight gain (g), specific growth rate (SGR, %), and survival rate (%) were determined using the following formula-

i. Length gain = Average final length – average initial length

ii. Weight gain = Average final weight – average initial weight

iii. Specific growth rate (SGR) = $\frac{\text{LnW}_2 - \text{LnW}_1}{T_2 - T_1} \times 100$

Where, W_2 = Final live body weight (g) at time T_2

W_1 = Initial live body weight (g) at time T_1

iv. The survival rate = Final number of fish/Initial number of fish stocked×100.

2.7. Water Quality Requirements

Physicochemical parameters including water temperature, pH and dissolved oxygen (DO) were measured weekly in experiment-1 and every 10 days interval in experiment-2 using thermometer, digital DO meter (Multi 340i/set, Germany) and a digital pH meter (MICRO–TEMP, pH 500).

2.8. Study of Plankton Population

For the study of plankton population in both the experiments, five liters of water samples were collected every week and passed through plankton net of 55 blotting silk of 100 µm mesh size. The collected samples were concentrated to 40 ml and preserved in labeled plastic vials in 5% formalin for further analysis. From concentrated volume of plankton samples, 1 ml sub-sample was taken by dropper and then put on the Sedwich-Rafter counting cell. The counting chamber was covered with a cover slip to eliminate the air bubbles and left for few minutes to allow the plankton to settle down. The total number of both phytoplankton and zooplankton were expressed as number per liter. The qualitative analysis of plankton was done according to [13].

2.9. Statistical Analysis

One way analysis of variance (ANOVA) was used for statistical analysis followed by Duncan's Multiple Range Test (DMRT) to determine the significance of variation among the treatments' means using the computer software SPSS Version 16.

3. Results and discussion

3.1. Water Quality Parameters

In experiment-1, the water temperatures ranged from 24 to 28°C, 24.55 to 30°C and 24 to 29°C in T_1, T_2 and T_3 respectively. No significant differences in meanwater temperatures were recorded among the treatments (P>0.05). On the other hand, in case of experiment-2, the water temperatures varied between 24 and 30°C, 24.55 and 30°C and 24 and 29°C in T_1, T_2 and T_3, respectively with no significant differences (P>0.05). The water temperatures recorded during the study period in both experiments were within the suitable range for fish culture [7]. According to Hossain et al. [14] also reported similar temperature ranges during nursery practices of *L. bata*.

The ranges of pH were 7 to 8 in T_1, T_2 and T_3 in experiment-1. pH was not found significantly among the treatments throughout the study period (P>0.05). In case of experiment-2, pH values varied from 7 to 8 in T_1, 7.8 to 8.2 in T_2 and 7.7 to 8.3 (8.06±0.11) in T_3. Also in this experiment the pH was found to vary significantly among the ponds throughout the study period (P<0.05). Though there were significant differences in pH among different treatments, it is negligible as those were within the suitable range in all the cases.

In addition, the dissolved oxygen varied from 3.8 to 4.6 mg/L in T_1, 3.9 mg/L to 4.6 mg/L in T_2 and 3.9 to 4.6 mg/L in T_3 in case of experiment-1. The average dissolved oxygen was a bit lower in experiment-1 than that recommended by [7]. However, this could be due to the small size of the container and/or decomposition of excess food and was not lethal for fish. On the other hand, in case of experiment-2, the dissolved oxygen varied from 5 to 7.4 mg/L in T_1, 4.9 to 7.4 mg/L (6.06±0.19) in T_2 and 7.7 to 8.3 mg/L (6.08±0.25) in T_3. Significant differences were found in dissolved oxygen among treatments in both the experiments (P<0.05). Nonetheless, in every case average dissolved oxygen range was within suitable limit [7].

Eight groups of plankton were recorded namely Bacillariophyceae, Cyanophyceae, Chlorophyceae, Euglenophyceae, Rotifera, Cladocera, Nauplius and Copepoda in case of both the experiments which are the common groups in the study area. The number of different groups of plankton during study period in case of T_1 of experiment-1 is shown in Table 2. On the other hand,the plankton population varied from 35.5×10^5 to 36.55×10^5 cells/L with an average of $36.5\pm10.5\times10^5$ cells/L in T_1, 39.0×10^5 to 42.0×10^5 cells/L with an average of $40.2\pm12.30\times10^5$ cells/L in T_2 and $36.87\times10^5$to 38.50×10^5cells/L with an average of $36.8\pm12.0\times10^5$ cells/L in T_3 in experiment-2.

3.2. Growth performance of *L. bata*

In the experiment-1, the mean final lengths of bata were (2.7±0.3), (1.8±0.1) and (2.2±0.1) cm in T_1, T_2 and T_3, respectively (Table 4). The maximumlength gain was obtained in T_1 (1.6±0.7) cm which was significantly (P<0.05) higher than that of T_2 (0.7±0.4) cm and T_3 (1±0.3) cm. Similarly, highest mean final weight of *L. bata* was found in T_1 (0.2±0.1) g followed by T_3 (0.1±0.1) g and T_2 (0.07±0.2) g (Table 4; Figure 1).

Table 4. Growth performance of *L. bata* larvae in terms of length gain, weight gain, SGR (%) and survival rate during 35 days the experimental period (Experiment-1)

Parameters	T_1 (Mean±SD)	T_2 (Mean±SD)	T_3 (Mean±SD)
Initial length (cm)	1.14±0.00	1.14±0.00	1.14±0.00
Mean final length (cm)	2.70 ± 0.31^a	1.78 ± 0.14^c	2.12 ± 0.15^b
Length gain (cm)	1.56 ± 0.69^a	0.64 ± 0.34^c	0.98 ± 0.29^b
Initial weight (g)	0.02±0.00	0.02±0.00	0.02±0.00
Mean final weight (g)	0.20 ± 0.13^a	0.07 ± 0.23^c	0.10 ± 0.12^b
Weight gain (g)	0.18 ± 0.06^a	0.05 ± 0.03^c	0.08 ± 0.07^b
Specific growth rate (SGR)	2.85 ± 0.27^a	1.55 ± 0.11^c	1.99 ± 0.15^b
Survival rate (%)	75.00 ± 2.00^c	78.00 ± 3.00^a	76.00 ± 2.00^b

Values of the parameter in each rows with different superscripts (a, b & c) differs significantly (p<0.05).

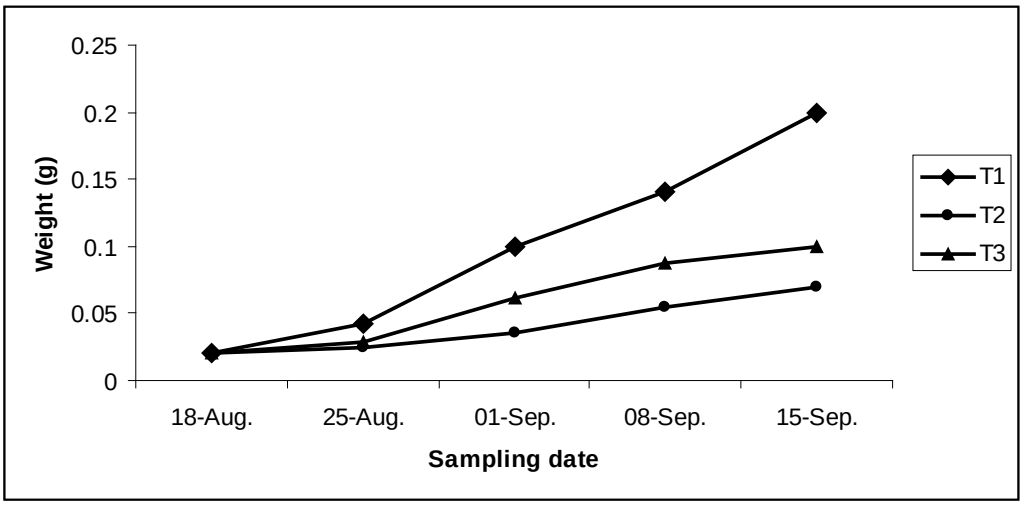

Figure 1. Mean total weight of bata larvae in different sampling dates under three treatments during the study

Mean final weight gains were (0.18±0.06) g, (0.05±0.03) g and (0.08±0.07) g in T_1, T_2 and T_3, respectively. Results clearly indicating that, applying live food (plankton) yields better results comparing to providing commercial feed (ARC-Z) and prepared feed during larval culture of *L. bata*. Furthermore, SGR (%) were found as (2.85±0.27)%, (1.55±0.11)% and (1.99±0.15)% in T_1, T_2 and T_3, respectively (Table 4), which also indicates better result in favor of providing live food (plankton). However, the highest survival rate of bata larvae was found in T_2 (78.0±3.0)% followed by T_3 (76.0±2.0)% and lowest in T_1 (75.0±2.0)% (Table 4).

On the other hand, experiment-2 alsorevealed variation in the mean final lengths of bata fry among the three treatments. The mean final lengths of bata fry were 9.96±0.8 cm, 9.05±0.9 cm and 8.76±0.6 cm in T_1, T_2 and T_3, respectively (Table 5). The maximum length gain was obtained in T_1 (3.76±0.05) cm which was significantly (P<0.05) higher than that of T_2 (2.85±0.02) cm and T_3 (2.56±0.01) cm (Table 5). The mean final weights of *L. bata* were 9.21±0.01 g, 7.39±0.05 g and 6.87±0.03 g in T_1, T_2 and T_3 respectively (Table 5; Figure 2). The maximum final weight gain found in T_1 (5.97±0.17) g was significantly higher than that found in T_2 (4.15±0.13) g and T_3 (3.63±0.26) g. In the second experiment, highest specific growth rate (SGR) was found in T_1 (0.91±0.01)% followed by T_2 (0.72±0.13)% and T_3 (0.65±0.15)% (Table 5).

Outcomes of the experiment showed better performance of fish meal over wheat meal and laboratory prepared feed in case of bata fry culture. Nonetheless, the survival rates of *L. bata* fry in different treatments were (33.0±2.0)%, (48.0±2.0)% and (40.0±11.0)% in T_1, T_2 and T_3, respectively (Table 5) much lower than that found [14] as 63.33% during ten days nursery practices of *L. bata*.

Table 5. Growth performance of *L. bata*in terms of length gain, weight gain, SGR, survival rate during 50 days experimental period (Experiment-2)

Parameters	T_1 T_1 (Mean±SD)	T_2T_2 (Mean±SD)	T_3 (Mean±SD)
Initial length (cm)	6.2±0.00	6.2±0.00	6.2±0.00
Mean final length (cm)	9.96±0.81^a	9.05±0.97^b	8.76±0.61^b
Length gain (cm)	3.76±0.05^a	2.85±0.02^b	2.56±0.07^c
Initial weight (g)	3.24 ± 0.00	3.24 ± 0.00	3.24 ± 0.00
Mean final weight (g)	9.21±0.01^a	7.39±0.04^b	6.87±0.03^b
Weight gain (cm)	5.97±0.17^a	4.15±0.13^b	3.63±0.26^c
Specific growth rate(%/day)	1.29±0.01^a	1.02±0.13^b	0.93±0.15^b
Survival rate (%)	33.00±2.00^c	48.00±2.00^a	40.00±11.00^b

Values of the parameter in each rows with different superscripts (a, b & c) differs significantly (p<0.05).

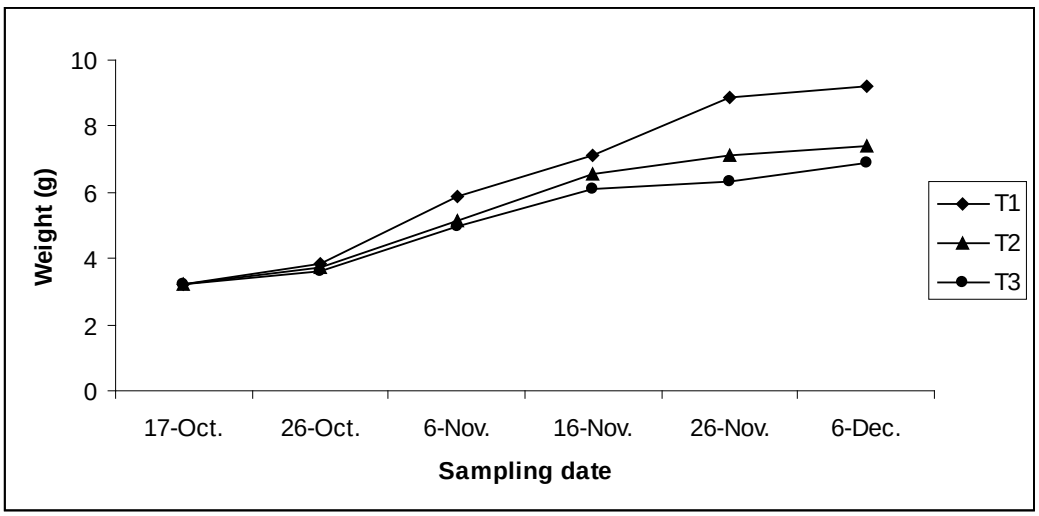

Figure 2. Mean total weight of bata fry in different sampling dates under three treatments during the study

4. Conclusion

On the basis of growth performance, live food (T_1) showed the better results in case of larval rearing of bata. On the other hand, fish meal showed better growth performance during bata fry rearing. Therefore, depending on growth performance, live food (plankton) for larval rearing and fish meal for fry rearing of bata could be recommended. However, the survival rates were low in both the experiments; therefore further detail and intensive research are highly suggested.

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