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Research article

Impacts of different diets on growth and survival of stinging catfish, *Heteropneustes fossilis*

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ABSTRACT

The present study was conducted to determine the suitability of different larval feeds of *Heteropneustes fossilis* under laboratory condition. For this purpose, 30 days old *Heteropneustes fossilis* larvae were collected from local hatchery at Cachra in Jessore and acclimatized in a large rectangular aquarium for 2 days. The feeding trial was conducted for 30 days in triplicate with 30 larvae (0.74± 0.01 g; 2.95 ± 0.12 cm) in glass aquaria (54×36×36 cm^3) each containing 30 L of water. Four different feeding trial i.e. *Tubifex sp*. (Ts), commercial pellet feed (Cf), snail meat (Sm) and mixed diet i.e. commercial feed and snail meat on alternative day (CfSm) were applied. The larvae were fed two times per day until reaching satiation level. The larvae fed with tubificid worms (Ts) and mixed diet (CfSm) showed significantly better results ($P<0.05$) in terms of length, percent weight gain and specific growth rate (SGR %) compared to other diets. Water quality parameters were monitored throughout the experimental periods and the parameters did not vary significantly ($P>0.05$) among the treatments. On the basis of larval development and survival rate, it could be suggested that the live tubificid worms (Ts) and mixed diet (CfSm) are suitable for *Heteropneustes fossilis* larvae.

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1. INTRODUCTION

The Asian stinging catfish, *Heteroneustes fossilisis* is one of the commercially important high value native fish species (Rahman et al., 2013). It has both high market value and consumer acceptance. The species has high content of iron (226 mg 100 g-1) and fairly high content of calcium compared to many other freshwater fishes (Saha and Guha, 1939). This fish is recommended in the diet of sick and convalescents due to its high nutritive value (Kohli and Goswami, 1989). Being a lean fish it is very suitable for people for whom animal fats are undesirable (Rahman et al., 1982). Unfortunately, this native species, *Heteroneustes fossilisis* is threatened now due to poorly planned water management policy for irrigation, over exploitation, illegal fishing and various ecological changes in its natural habitat (Chakraborty, 2010). So, it is time to take attention on the culture of this native species considering the importance of these species form the nutritional, economic and biodiversity point of view. Although, seed unavailability was the main problem for culturing this species few years ago, the situation has been improved already. A countable number of hatcheries have already been established all over the country and are producing enough fingerling to run the aquaculture. Baseline survey found 59 hatcheries that were producing *Heteroneustes fossilisis* fingerling in Jessore. The survey also identified some major problems in *Heteroneustes fossilis* is hatchery such as brood source, sudden change of larval feed and catching method. Generally, the hatchery owner use *tubifex* as larval feed whereas, the farmer use commercial feed during culture due to higher rate of *tubifex*. The larval growth remains good at hatchery due to use of live feed but due to sudden change of food types in culture pond, the constant growing rate of the larvae is hampered and farmers do not get satisfactory growth. So, it is essential to understand better feed compared to *Tubifex*. Growth and survival data are powerful tools for understanding the effects of both live and manufactured commercial diets on first feeding fish larvae. Growth and survival date were therefore used in the present study to evaluate the effects of live food and commercial diets on first feeding of shing *(H. fossilis).*

2. MATERIALS AND METHODS

The experiment was started on 18 June and continued up to 20 July 2013 in the aquarium (54 × 36 ×36 cm3) in the wet fish laboratory under Fisheries and Marine Resource Technology Discipline, Khulna University, Khulna.

2.1. Fry collection and rearing

Thirty days old fry of *H. fossilis* was collected from commercial hatchery of Chachra in Jessore. They were transferred in a large aquarium of wet fish laboratory and conditioned for two days before starting the experiment.

2.2. Water quality management

Prior to stocking of fry, each of the aquariums was cleaned, dried and prepared with all the facilities necessary to run the experiment efficiently. Each aquarium was fitted with a submerged filter and an air diffuser. Submerged filter kept the water clean. About three fourth (3/4) of the water was changed once per week. Water exchange was done by siphoning and feces, uneaten feed and the dead juvenile were removed every day. Adhered dirt inside the aquarium walls and shelter pipe was cleaned also once a week. Continuous aeration was ensured for rearing throughout the experimental periods. During the experimental period, temperature, dissolved oxygen (DO), pH and Ammonia (NH_4) of water in larval rearing system were monitored regularly. Temperature reading was taken with a Celsius thermometer, dissolved oxygen (DO) of water was measured by a digital DO meter and PH reading was taken with the help of a portable PH meter. All the parameters were equal and no significant difference (P>0.05) was found among different treatment (Table 1).

Table 1. Water quality parameter (mean± SD) of different treatment

Parameters	Treatments			
	Ts	Cf	Sm	SmCf
DO (mg/L)	6.70±0.51	6.50±0.48	6.80±0.50	6.92±0.56
pH	8.10±0.15	8.00±0.10	8.00±0.10	8.10±0.13
Ammonia (mg/L)	0.09±0.06	0.07±0.07	0.05±0.07	0.06±0.06
Temperature (0C)	28.76±0.51	28.66±0.46	28.8±0.51	28.86±0.46

2.3. Stocking

Thirty days old Shing *(Heteropneustes fossilis)* of initial total length of 2.95 ± 0.12 cm and weight 0.74± 0.01g were stocked in aquarium (54 × 36 ×36 cm3) containing 30L of water at a stocking density of 30 fry per aquarium. During the study period, the Shing fry were fed with four different types of feed such as *Tubifex spp*. (Ts), commercial feed (Cf), snail meat (Sm) as well as mixed diet i.e. commercial feed and snail meat on alternative day (CfSm). There were three replications of each treatment and larvae were reared for 30 days.

2.4. Feed collection

Commercial feed and live *Tubifex* were purchased from the local aquarium shops. Fresh *Tubifex* were kept under the dropped water coming from the basin tap to keep it live in the wet laboratory of Khulna University, Khulna. Thus, the *Tubifex* remained live and fresh until five or six days. Before feeding, live snails were collected from the shrimp farmer. Snail meat were chopped into small pieces by blade and scissor and preserved in refrigerator in a form of small cube. Before feeding, each snail meat cube was thawed and given to the fish.

2.5. Feeding frequency

The feeding frequency was two times per day (8.30 am and 8.30 pm) at their satiation level. Before introducing feed for the next feeding, previous uneaten feeds and feces in aquarium were removed by siphoning using a plastic pipe.

2.6. Protein content of feed and juvenile

The level of protein (%) in samples was determined according to AOAC (1980). In brief, the sample was digested with concentrated Sulphuric acid (H_2SO_4) and solvent followed by distillation with 40% NaOH, zinc powder and distilled H_2O. At the end of the experiment, protein content of reared fishes was also determined.

2.6. Growth performance

The growth of larvae was measured every seven days interval for both experiments. The following parameters were used to evaluate larval growth.

2.6.1. Measurement of length and weight

Sampling was done by the scoop net and ten fishes were caught randomly from each aquarium and then length and weight of the individual fish were measured. Weight and length were taken by an electric balance and length by a measuring scale.

2.6.2. Weight gain

Weight gain of the larvae was calculated by the following formula (Sandifer and Smith, 1974)

Weight gain= Mean final weight (g) - Mean initial weight (g)

2.6.3. Specific growth rate

According to Elangovan and Shim (1997), the specific growth rate (%) of larvae was calculated

$$\text{SGR (\%)} = \frac{\text{In final weight (g) - In intital weight (g)}}{\text{Time (day)}} \times 100$$

2.6.4. Survival rate

Each dead fish were recorded and removed everyday (if necessary) prior to feeding. The survival rate (%) was calculated by using the following formula (Mahmood et al., 2004).

$$\text{Survival rate} = \frac{\text{Number of total live fish}}{\text{Total number of stocked fish}} \times 100$$

2.7. Statistical analysis

Data are reported as arithmetic mean ± standard deviation (SD). After appropriate transformation (arcsine or logarithm), one way analysis of variance (ANOVA) was applied on the data to assess the treatment effect. All the statistical analyses were done on a computer using statistical software package SPSS (version 12).

3. RESULTS

For the determination of larval food, four types of feed combinations were used. After four weeks of feeding trial, it was noted that mixed diet (SmCf) was feasible for H. fossilis without significant differences in growth parameters compared to those fed with control diet (Ts). Obtained length (7.10±0.40 cm) and weight (2.58±0.16 g) for SmCf were comparable to the length (8.70±0.44 cm) and weight (3.35±0.26 gm) of control group, Ts (Figure 1, 2). A comparison among four treatments in terms of weight gain and specific growth are depicted in Figure 3 and Figure 4. Weight gain percent (1.025 gm) and Specific growth rate percent, (SGR) (2.87%), recorded in treatment SmCf were also comparable to weight gain percent (1.45 gm) and Specific growth rate percent (3.66%) of control diet (Ts). No mortality was recorded during the period of the feeding trial. The result also found poor growth of the fish who fed with commercial feed only.

Proximate composition analysis of fish larvae was carried out to determine protein content in terms of wet weight basis before and after rearing. Before rearing, the average protein (%) of fish selected for Ts, Cf, Sm and SmCf were 13.12±0.88, 13.44±0.67, 12.61±1.15 and 12.91±1.22, respectively. After 30 days rearing, the average protein (%) for Ts, Cf, Sm and SmCf were found 19.23±0.69, 14.75±0.32, 16.37±0.27 and 17.27±1.06, respectively (Figure 5). The result reflects similar protein percentage among control group and SmCf with no significant variation (P>0.05).

Figure 1. Cumulative growth of *H. fossilis* larvae in terms of length during the study period (data are expressed as mean ± SE, bar with different letters differs significantly (P<0.05))

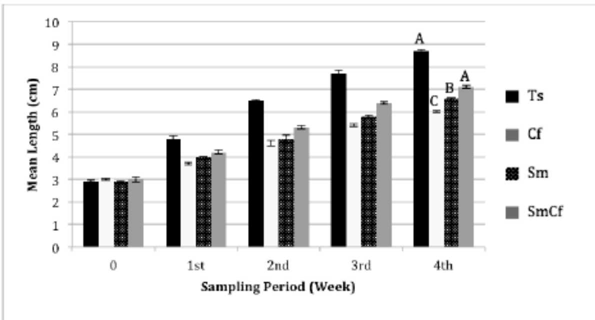


Figure 2. Cumulative growth of *H. fossilis* larvae in terms of weight during the study (data are expressed as mean ± SE, bar with different letters differs significantly (P<0.05))

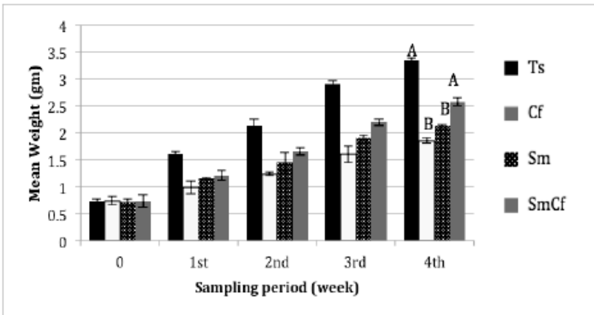


Figure 3. Weight gain of *H. fossilis* larvae during the study period

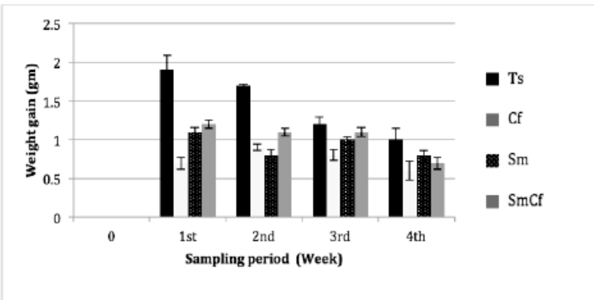


Figure 4. Specific growth rate (%) of *H. fossilis* larvae among the treatments (data are expressed as mean ± SE, bar with different letters differs significantly (P<0.05)

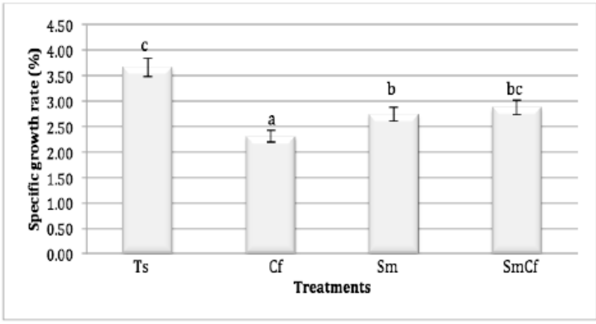
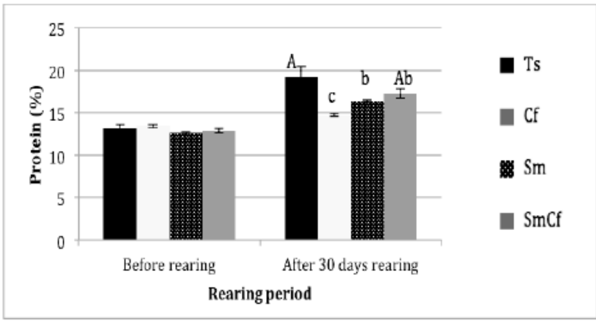


Figure 5: Protein (%) of *H. fossilis* larvae before and after rearing (data are expressed as mean ± SE, bar with different letters differs significantly (P<0.05))



4. DISCUSSION

Water quality parameters for the rearing of *Heteropneustes fossilis* larvae in the experiment were not changed significantly. Each aquarium was fitted with a submerged filter and an air diffuser. Water temperature, pH, dissolve oxygen and ammonia were in the acceptable range which is supported by the other authors (Boyd, 1982; Jhingram and Pullin, 1985; Rahman et al., 1982). Temperature is one of the most important physico-chemical parameters, which directly influences the physical, chemical and biological nature of water body. The pH in water body generally regulates considerably the water chemistry. Any sudden fluctuations cause death of many aquatic species. On the other hand, low pH reduces ammonia toxicity (Whitfield, 1974) but mobilize metals, including iron and aluminum, which can reduce yields in aquaculture ponds (Simpson et al., 1983). Low pH also can reduce natural productivity by reducing the availability of nutrients (Alasbaster and Lioyd, 1980). The range of water pH in this present study was in productive level. Banergea (1967) reported 7.0 mg/L of dissolve oxygen in water body is good for productivity whereas the range from 3.0-5.0 mg/L is unproductive for fish culture. George (1961) stated that the productive range of dissolved oxygen is 4.5-9.9 mg/L for fish culture. Ali et al. (1982) stated that the favorable DO range is 7.2 - 12.5 mg/L for fish culture. In the present study, DO levels vary among the treatments from 6.9 to 8.9 mg/l. From the overall findings of water quality parameter it can be said that temperature, pH, and DO in all treatments were in optimum level for the *Heteropneustes fossilis* larvae.

The growth and survival rates of larvae were highly influenced by different larval feeds. As evident from Figure 1 and Figure 2, the present study determines that the larvae fed with *Tubifex* showed highest growth performance. Hecht and Appelbaum (1987) conducted an experiment with the larvae and juveniles of *Clarias gariepinus* and also concluded that live food was preferred to formulated feed and suitable for fish growth. Haque and Barua (1989) found that non-live feeds (fish meal and wheat flour) were not at all suitable for the larvae of *Heteropneustes fossilis*, while live food (tubificid worms) resulted in the best growth and survival. Fermin and Boliver (1991) reported that the specific growth rate of *Clarias macrocephalus* larvae fed live feed was higher than those fed non-live food. Bairage et al. (1988) tested the effect of Artemia nauplii, zooplankton and a formulated artificial feed on *Clarias batrachus* larvae for a period of four weeks and found live feed (Artemia nauplii) as the best feed with regard to growth and survival. According to Rahman et al. (1974), the growth and survival of the larvae of C. batrachus was better in larvae fed tubificid worms than those fed non-live feeds, egg yolk in particular. Haque and Barua (1989) found that non-live feeds (fish meal and wheat flour) were not at all suitable for the larvae of *Heteropneustes fossilis*, while live food (tubificid worms) resulted in the best growth and survival.

In the present study the mixed showed better result than the commercial feeding or snail meat feeding only. *Heteropneustes fossilis* larvae are mainly carnivorous so that they prefer live feed. In that sense, the larvae fed with snail meat should achieve second highest growth. But the present study reflects different result that is very interesting output in this experiment. It may happen due to variation of food responsible to increase the taste and demand of food intake that resulting higher growth.

6. CONCLUSION

The present study was conducted to determine larval feed of *Heteropneustes fossilis* the result showed that variation of diet considerably influenced the growth of larvae during 30 days experimental period. *Tubifex* fed juvenile consistently showed the higher growth as control group. *Tubifex* is very costly and not available in local market. So, the present study was investigated to find out comparable diet. The larval growth fed with mixed diet was very much similar with control group. So, this mixed diet can be used as potential alternative feed in *H. fossilis* culture.

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