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Original Article

Some aspects in early life stage of giant gourami, *Osphronemus goramy* (Lacepede) larvae

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Abstract

The sexual maturity of female giant gourami, *Osphronemus goramy* was studied by determining fecundity and gonadosomatic index (GSI). It was found that the size at sexual maturity of female giant gourami was with 33.88±7.42 cm in total length (mean ± SD) and 968.75± 68.78 g in body weight. Fecundity was 5,508±1,547 ova/fish and gonadosomatic index (GSI) was 2.32±0.5%.

Newly hatched larvae of giant gourami were produced by semi-controlled natural method. The hatching period, hatching out and hatching rate experiments were carried out in a 15-liter glass aquarium (water volume 10 liters) containing 300 eggs. It was found that the eggs were floating and rounded. The fertilized eggs had a diameter of 2.185±0.19 mm. The average hatching out was 26 hr 18 min, hatching period was 6 hr 13 min and hatching rate was 61.60% at water temperature of 28-30° C.

The newly hatched larvae were 4.48±1.41 mm in total length with yolk sac volume of 7.768.72±1.205.83 mm^3. The yolk sacs were completely absorbed within 228 hr after hatching. All the larvae opened their mouth at about 50 hr after hatching (6.87±0.10 mm TL) with mouth measuring 324.30144.60 mm in height.

Feeding experiments were carried out in 15-liter glass aquaria with 10 liters of water containing 1000 larvae aged 1.5 days post-hatching (before mouth opening. *Moina* was fed to them at a density of 10 individual/ml. At 2-hourly intervals 20 larvae were collected randomly from the aquarium, preserved in 10% formalin and then dissected to determine *Moina* in the digestive tract. At 110 hr after hatching, the mouth size was measured to be 486.45±14.47 mm. The onset of feeding showed 0.27 individual *Moina*/ larva.

Keywords: yolk absorption, mouth opening, start of feeding, giant gourami, *Osphronemus goramy*

1. Introduction

Giant gourami, *Osphronemus goramy*, is an important species in the ornamental as well as the edible species aquaculture industries. This fish has become one of the main species being cultured and is in great demand in the aquaculture industry. However commercial scale propagation of this fish in hatcheries is yet to be standardized. Information on the early life history of fish such as yolk absorption, mouth, digestive tract development and start of feeding of the larvae is needed for optimization of large-scale culture and ultimately for the management of the fish stocks. It is recognized that the critical period of larval rearing begins at

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the time yolk absorption is completed. If some larvae do not begin to eat during that period, then they become weak and eventually die (Kosutaruk and Watanabe, 1984; Holm, 1986; Eda *et al.*, 1994; Amornsakun and Hassan, 1996; Amornsakun *et al.*, 1997; Amornsakun, 1999; Amornsakun *et al.*, 2002; Amornsakun *et al.*, 2004). Survival of fish larvae is determined by the interplay of various environmental factors, such as temperature, food supply with a suite of species-specific characteristics, egg and larval size, yolk and oil quantity and resorption rates, and time of onset of feeding and feeding behaviour. Larvae can use a varying part of their yolk sac energy content for various activities (Blaxter, 1974; May, 1974). Mouth size development is very important in the first feeding of larvae as it should match appropriate prey size. Mouth size at first feeding stage of various larval fish to encounter their prey size has been well documented for a number of cultured fish (Shirota, 1970; Nash *et al.*, 1974; Fukuhara, 1986; Doi and Singhagraiwan, 1993; Eda *et al.*, 1994).

There is litter information about giant gourami regarding their yolk absorption and mouth development, in relation to feeding on *Moina*. The objective of this study was to investigate yolk absorption, mouth development and the onset of feeding of larval giant gourami. This information could provide a baseline for the optimization of commercial scale aquaculture management practice in hatcheries.

2. Materials and Methods

All the experiments for this research were carried out at the facility of the Fisheries Technology Program, Faculty of Science and Technology, Prince of Songkla University Pattani campus, Thailand, from October 1, 2006 to September 30, 2007.

Larvae of giant gourami were produced by semi-controlled natural method. The size of sexually matured fishes were 1-2 kg per individual and ratio of male and female brooders was 1:2. The cultured were in an earthen pond with the density of 100-150 pair-fishes per rai. The water depth in the spawning pond was 1.5 meter and 10% water replacement was carried out daily. Fiber from palm tree as fish nest was prepared for spawning activities and observation often eggs at the fish nest was made once a day at 0800 hr.

2.1 Yolk absorption experiment

Fertilized eggs were transferred to an aquarium hatching tank. Hatching-period, hatching-out and hatching-rate experiments were carried out using a 15-liter glass aquarium (water volume 10 liters) containing 300 eggs. A profile projector was used to measure the size of yolk sac and thereby to determine time of yolk absorption. At 2-hour intervals 20 larvae were sampled randomly from the rearing tanks to determine the size of yolk sac until the yolk sac was fully absorbed. Yolk volume was calculated from the formula $4/3 \times \pi (R1/2)^2 \times R2/2$ (R1, minor axis; R2, major axis) (Fukuhara, 1986). The specimens after measurement were fixed in 10% buffered formalin solution. The mean and standard deviation of yolk volume in each stage were calculated.

2.2 Mouth development experiment

Until the mouth was fully opened, 2-hourly samples of 20 larvae were collected and measured for size of mouth opening and upper jaw length. The mouth opening was calculated by multiplying upper jaw length by $\sqrt{2}$ (Shirota, 1970). The mean and standard deviation of mouth height in each stage were calculated.

2.3 Start of feeding experiment

Feeding experiments were carried out in 15-liter glass aquaria with 10 liters of water containing 1000 larvae aged 1.5 days post-hatching (before mouth opening) in three replicates. *Moina* were fed to them at a density of 10 individuals/ml. At 2-hourly intervals 20 larvae were collected randomly from the aquarium, preserved in 10% formalin and then dissected to determine *Moina* in the digestive tract which would signal the onset of feeding (Pechmanee *et al.*, 1986). The procedure was repeated in triplicate. The mean number of *Moina* at start of feeding were calculated.

Data analysis in all experiments used the Microsoft Excel Software (Walpole and Myers, 1978).

3. Results

The size at sexual maturity of female gourami was 33.88±7.42 cm (mean±SD) and 968.75±68.78 g in total length and body weight, respectively. Eggs were floating and round. Fecundity was found to be 5,508±1,547 ova/fish and gonado-somatic index (GSI) was 2.32±0.5%. The diameter of fertilized egg was 2.185+0.19 mm (n=80). The hatching out, hatching period and hatching rate were 26 hr 18 min, 6 hr 13 min and 61.60%, respectively, at 28-30°C water temperature.

Newly hatched larvae were 4.48±1.41 mm (mean±SD, n=20) and 7,768.72±1,205.83 mm^3 in total length and yolk sacs volume, respectively. Within 224 hr after hatching, the yolk sac was completely absorbed, at 28-30°C water temperature. All the larvae showed mouth opening with 324.30±14.47 mm height and total length of 6.87±0.10 mm about 50 hr after hatching (Figures 1 and 2). After 110 hr hatching larvae started feeding on *Moina*. Digestive tracts were fully developed within 110 hr after hatching with mouth height 486.45±14.47 mm (Figure 3) and total length 7.97±0.05 mm, at the same only 17.9% of the initial yolk sac volume remained. With the onset of feeding, the average number of *Moina* in the digestive tract per larva was 0.27 individuals, at 28-30°C water temperature.

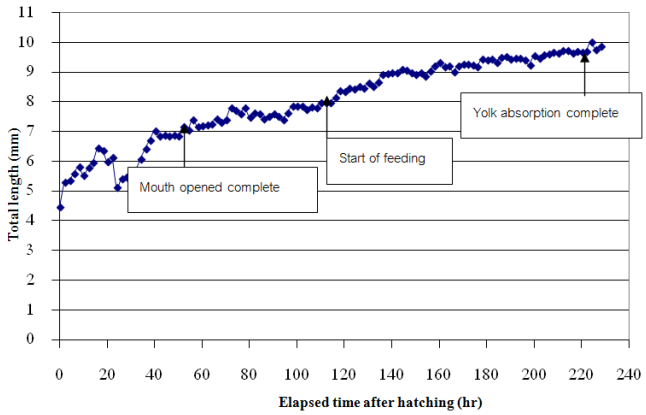

Figure 1. Increase in length of giant gourami larvae at elasped time after hatching
Mouth height: 50 hr after hatching
Started of feeding: 110 hr after hatching
Yolk absorption : 228 hr after hatching

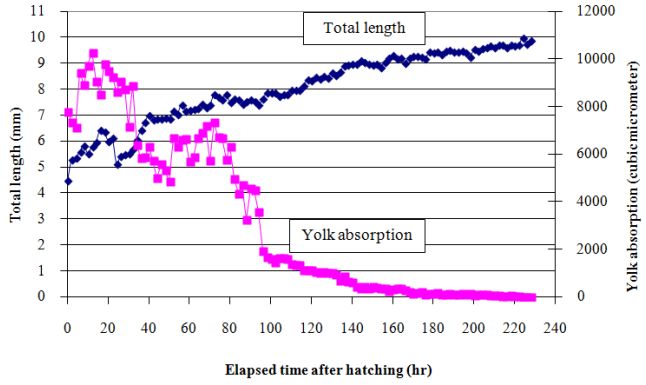

Figure 2. Total length (TL) and yolk absorption of larval giant gourami at elapsed time after hatching YV: Yolk volume

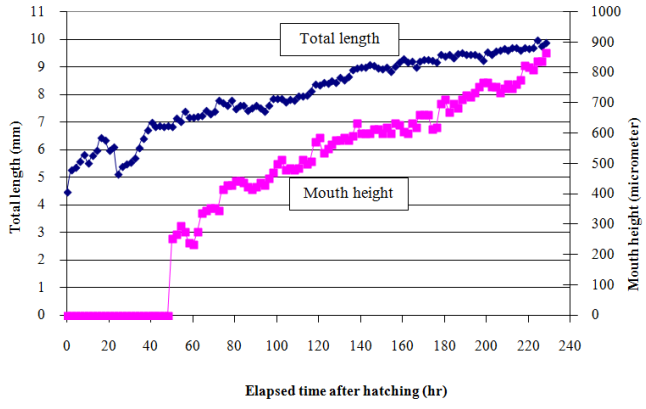

Figure 3. Total length (TL) and development of mouth opening of larval giant gourami at elapsed time after hatching MH: Mouth height

4. Discussion

Female giant gourami, *Osphronemus goramy*, was found to have a size at sexual maturity of 33.88±7.42 cm in TL and 968.75±68.78 g in average body weight. The fecundity was 5,508 ova/fish and gonadosomatic index (GSI) was 2.32%. It is one kind of freshwater fish that has low fecundity-lower than the other fishes. Amornsakun *et al.* (2004) reported the sexual maturity of female Siamese gourami, *Trichogaster pectoralis*, was 18.07 cm in TL and 94.20 g in average body weight and the fecundity was 26,261 ova/fish. Amornsakun *et al.* (2005) reported the size of the sexual in total length mature female climbing perch, *Anabas testudineus*, was 15.20 cm and 61.10 g in body weight and the fecundity was 24,120.5 ova/fish. Fecundity varies with different species depending on age, length-weight, environmental parameters, etc. (Ghafari and Jamili, 2010; Shivasanthini *et al.,* 2008; Zalina *et al.*, 2012) Accordingly mature fish with low fecundity, have a lower gonadosomatic index (GSI), that of giant gourami was found to be less than other fishes which have high fecundity. Several studies have observed that the GSI of Siamese gourami was 10.9%, climbing perch was 10.4% (Amornsakun *et al.*, 2004; Amornsakun *et al.*, 2005; Tarnchalanukit *et al.*, 1982).

According to the studies of Amornsakun (1999) and Amornsakun *et al.* (2004; 2005), the size of fertilized eggs of giant gourami (2185 mm) was similar to that of red tail catfish, *Mystus wyckioides*, 2,278.80 mm diameter but bigger than Siamese gourami and *Anabas testudineus* with 908.25 mm and 830 mm, respectively (Zalina *et al.*, 2012). Very small size was of the fertilized eggs was reported in *Cyprinus carpio* with 800-1,100 mm (Haniffa *et al.*, 2007; Ghosh *et al.*, 2012)

Hatching period is very important in management of larvae in hatcheries. The giant gourami showed hatching out in 26 hr 18 min at 28-30°C, which was longer than in green catfish (18 hr), red tail catfish (23 hr 40 min), Siamese gourami (22 hr 10 min) and climbing perch (20 hr 30 min). *C. carpio* showed 72 hours for hatching at 26- 28°C (Amornsakun, 1999; Amornsakun *et al.*, 2004; 2005; Haniffa *et al.*, 2007; Ghosh *et al.*, 2012).

The complete yolk absorption period for the giant gourami larvae (9.5 days) was longer than for some marine and freshwater fishes such as green catfish, sand goby, red tail catfish, Siamese gourami and climbing perch with 3, 3.4, 4.3, 4.5 and 3.8 days, respectively, at 27-30.05°C (Amornsakun *et al.*, 1997; Amornsakun, 1999; Amornsakun *et al.*, 2002; Amornsakun *et al.*, 2004; 2005). At 26-27°C, the white mullet larvae, *Mugil curema* V. showed complete yolk absorption by 3.5 days (Houde *et al.*, 1976). Interestingly, the yolk absorption varied with other fishes also such as, milk fish, *Chanos chanos* (2.5 days) at 26.4-29.9°C and freshwater catfish, *Clarias* sp. of about 3-4 days (Tarnchalanukit *et al.*, 1982).

Onset of exogenous feeding with *C. carpio* was between 3-3.5 days (Haniffa *et al.*, 2007; Ghosh *et al.*, 2012) compared to *Siganus guttatus* (Rabbit fish) start exogenous

feeding before the yolk was completely absorbed, because of having rapid development of eye, mouth and alimentary canal during the yolk sac stage itself (Bagarinao, 1986). Likewise, cod, *Gadus morhua*, are also able to ingest food before the exhaustion of the yolk (Kjorsvik *et al.*, 1991). In the current study, microscopic evaluations showed all larvae had mouth opened after 50 hrs of hatching and about 62.27% yolk remaining, but had not yet started exogenous feeding. The onset of feeding in giant gourami (110 hr) while having the 17.9% remaining of yolk sac volume was earlier than that in green catfish (52 hr and 31.20%), but later than in red-tail catfish (64 hr and 13.03%) and sand goby (80 hr and 6.16%). Grey mullet (*Mugil cephalus*) showed an increase in growth curve coupled with rapid yolk absorption on first day (Kuo *et al.*, 1973). Initial feeding plays a major role in the hatchery production of larvae. Delayed feeding in association with yolk absorption (time of feeding) showed reduced growth and poor swimming activity of black sea bream larvae (Fukuhara, 1987). The time since hatching to first feeding is correlated with the nutrients stored in the yolk sac (Hodson and Blunt, 1986; Ware, 1975) and with environmental factors (Houde, 1974). Decrease in water temperature delayed initial feeding in *Tilapia sparmanii*, only on 2nd day at 30°C, on 3rd day at 27°C and 6th day at 24°C.

Size of first live food and the mouth size of the larvae have direct relationship. Over-sized feed will not be accepted by the larvae, resulting in decline of survival in hatchery conditions, even though other parameters are given at the optimum (physciso-chemical). Size of *Moina* was 250 mm width which was 51.3% of the mouth size of giant gourami (486.45 mm). Most fishes accept 20-40% of the mouth-sized feed during initial feeding (Ito and Suzuki, 1977; Hunter, 1980; Amornsakun *et al.*, 1997; Amornsakun, 1999). It could be thus considered that the larvae of giant gourami is not a difficult species to be hatchery reared as food size up to 51% compared to mouth size is accepted by the larvae. Larvae of sand goby is difficult to rear as they prefer food size less than 18.7% of the mouth height (Amornsakun *et al.*, 2002).

The onset of feeding in larval giant gourami with a mouth height of 486.5 mm was similar to that of green catfish (553 mm) and red-tail catfish (534 mm). Even though the mouth height was similar, the time after hatching was different between the giant gourami (110 hr), green cat fish (52 hr) and sand goby (64 hr) (Amornsakun *et al.*, 1997 and Amornsakun, 1999). Contrary to this, mouth height at initial feeding was greater in giant gourami than in rabbit fish (*S. guttatus*) with 125 mm and *Epinephelus malabaricus* (Bloch & Schneider) with 169.7±16.1 mm while feeding on rotifers of size (91-100 mm) (Juario *et al.*,1985; Maneewong *et al.*, 1986).

Hatchery rearing of larvae and juveniles depends on mouth size, which is the limiting factor while feeding them (Hyatt, 1979). In mullet, *Mugil cephalus*, the mouths are open after the jaws are ossified with sufficient development of eye pigments. Larvae with larger mouths grew faster than those with smaller ones (Shirota, 1970; Arumugum and Geddes, 1987). In the current study the mouth height of giant gourami larvae showed linear relation to total length, likewise in larvae of perch, *Perca fluviatilis* (Guma, 1978).

Moina could be considered as a live feed for giant gourami larvae because of size suitability as well as ease of culture. During the onset of feeding, the number of *Moina* found in the digestive tract was 0.27 individual/larva, which was less than in green catfish (Amornsakun *et al.*, 1997) with 6.05 mm total length (1.8 individual/larva) after 52 hr hatching.

It was concluded that the sexual maturity of female giant gourami was attained at 38.8±7.42 cm (mean±SD) total length and 968.75±68.78 g body weight. Fecundity was 5,508±1,547 ova/fish and GSI was 2.32±0.5%. The size of sexually mature fishes at a ratio of male and female brooders was 1:2 cultured in earthen pond with density of 100-150 pair-fishes per hectare. The round and floating fertilized eggs had a diameter of 2.185±0.19 mm. The average hatching out was at 26 hr 18 min, hatching period 6 hr 13 min, and the hatching rate 61.60% at 28-30°C water temperature.

The newly hatched larvae were 4.48±1.41 mm in total length with yolk sac volume of 7.768.72±1.205.83 mm^3. Within 224 hr after hatching, yolk sac was completely absorbed. All the larvae opened their mouth by about 50 hr after hatching (6.87±0.10 mm TL) with mouth height measuring 324.30± 144.60 mm. At 110 hr after hatching, the mouth size was 486.45±14.47 mm and at the onset of feeding, the digestive tract contained 0.27 individual *Moina*/ larva, at 28-30°C water temperature.

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