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EFFECT OF DIFFERENT DIETS ON THE GROWTH AND SURVIVAL OF THE LARVAE AND JUVENILES OF SPOTTED BABYLON SNAILS (*Babylonia areolata* LINK 1807)

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Abstract: Growth and survival experiments were conducted to determine the suitable feed for larvae and juvenile of spotted babylon snail (*Babylonia areolata*). Three types of phytoplankton (*Isochrysis* sp., *Chaetoceros* sp., and *Tetraselmis* sp.) were used in the larval experiment, and three types of feed (Adult brine shrimp, fresh fish, and fresh green mussel) were used in the juvenile experiment. The larval experiment was conducted in 500 L tanks (400 larvae per L), and the juvenile experiment was conducted in rectangle tanks size measuring 60 x 40 x 30 cm (400 snails per tank). Both experiments were conducted in three replicates. The larval experiment was terminated on achieving of larva metamorphosis to settle juvenile, while juvenile experiment was terminated once any treatment of the juveniles reached 1 cm shell length. The results showed that larvae fed with *Isochrysis* sp. and *Chaetoceros* sp. was not significantly different in growth (0.081 and 0.076 mm per day respectively) and survival (2.75% and 2.01% respectively). The larva fed with *Tetraselmis* sp. died on the 6th day of the study. For the juvenile experiment, the snails fed with adult brine shrimp (44.48%) showed significantly higher survival compared to green mussel (19.34%). The snails fed with fresh fish was significantly low in feed conversion ratio. There was no significant difference in growth (shell length and width) for all treatments in the juvenile experiment. In conclusion, *Isochrysis* sp. and *Chaetoceros* sp. could be used for larvae and fresh fish is the most suitable food for juvenile stage.

KEYWORDS: Spotted babylon snail, Phytoplankton, different diets

Introduction

Spotted babylon snail or ivory shell (*Babylonia areolata* Link 1807) is a new commercial gastropod and is highly demanded in China, Japan, Taiwan, Thailand and Vietnam (Chaitanawisuti *et al.*, 2001a; Van Ha, 2003; Chen *et al.*, 2005). This gastropod shows a potential for commercial aquaculture due to its resistance to the environment; it is fast growing; delicious meat, commands a high price and is relatively simple culture technique compared to another gastropod (Chaitanawisuthi and Kritsanapuntu, 2000; Zhou *et al.*, 2007). The market demand for this gastropod has rapidly increased due to the sharp decline in natural stock due to overfishing. Therefore, the culture of spotted babylon snail is important in order to support market demand and also for natural wildstock conservation. From an aquaculture point of view, food availability is found to be the main constraint in cessation of growth and survival of marine gastropod and bivalve especially in larva and juvenile stage and considered to be crucial in developing the gastropod production (Patterson *et al.*, 1995; Britz, 1996; Chaitanawisuti and Kritsanapuntu, 1999). This study aims to determine suitable feed for better growth and survival of larvae and juveniles of spotted babylon snail.

Materials and Methods

This study was conducted at Sakom Research and Hatchery Aquatic Animal Unit, Prince of Songkla University, Thailand. Larvae and juveniles were produced through natural breeding of broodstock kept in hatchery. Egg capsules were collected from broodstock tank and dipped in freshwater for 3 seconds to eliminate copepod and other parasites before being transferred to the experimental tank. The egg capsules were incubated in experimental tanks for 7 days before hatching and used for the experiment. Three types of plankton (*Isochrysis* sp., *Chaetoceros* sp., and *Tetraselmis* sp.) used in the larvae experiment were cultured indoor three weeks prior to the experiment. The diet used in the juvenile experiment comprise of adult brine shrimp (*Artemia* sp.) purchased from a private farm in Petchaburi province, Thailand; and fresh fish (*Selaroides leptolepis*); and fresh green mussel (*Perna viridis*) purchased from the local market.

The sea water which was used in the larval and juvenile experiments was filtered through a 50 µm screen and was later sterilized by using chlorine and dechlorinated by aeration for 24 hours before being used. The water quality parameters was controlled; a temperature of 27-30ºC was maintained, salinity was at 32-34 ppt (examined by using Reflecto-Salinometer), pH of 7.00-8.00 (examined by using pH meter); alkalinity of 70-120 mg/L (examined by using indicator method (Munsin, 2003); dissolved oxygen of 5-6 mg/L (examined by using YSI DO meter) and ammonia not more than 1.00 mg/L examined by using phenate method (Munsin, 2003).

Study on larvae fed with different phytoplankton

Three types of phytoplankton namely *Isochrysis* sp., *Chaetoceros* sp., and *Tetraselmis* sp. were tested. The experiment was conducted in nine 500 L tanks with the density of larvae at 400 individuals/L (Siripan and Wongwiwatanawute, 2000). Static water system was used in the experiment and the water was changed for every 2 days to refresh the minerals element in the sea water which is essential for the growth of larva. The larvae were fed twice a day (20,000-30,000 cells /mL/ time). One hundred larvae were collected every 3 days for shell length measurement (the longest dimension) by measuring at 40x using a microscope equipped with an ocular micrometer (Zheng *et al.*, 2005). The experiment was terminated when all larva metamorphosed to the settled juvenile. The juveniles were collected and the survival rate was retarded. This experiment was conducted for 3 weeks.

Study on juveniles fed with different feeds

The experiment started with the juveniles with an average shell length and body weight of 0.45 cm and 0.02 g respectively. Four hundred juveniles were placed (stocking density 1,000 per m^2) in tanks measuring 60 x 40 x 30 cm (0.4 m^2). Three types of food namely adult brine shrimp (*Artemia* sp.), fresh fish (*Selaroides leptolepis*) and fresh green mussel (*Perna viridis*) were tested with three replicates. The juveniles were fed ad libitum once a day. The adult brine shrimp was cooked at 100 ºC and kept cool before feeding. Feeds were weighed before and after feeding in order to calculate the food conversion ratio. Ten percent of snails (40 juveniles) were measured and weighed shell length, width and body weight. The water in the experiment tanks was changed every 3 days. The experiment was terminated once the juveniles in any treatment reached an average length of 1 cm. This experiment was conducted for 60 days.

Data analysis

All statistical analysis was performed using the SPSS program. Differences in growth and survival of larvae and juveniles between treatments were determined by one-way analysis of variance (ANOVA) at α =0.05. Turkey's range test (α =0.05) was used to compare pair of means if ANOVA was significantly different ($P< 0.05$).

Formulas

Growth rate (shell length) = L_1-L_0 / T_1- T_0

Growth rate (shell width) = W_1-W_0 / T_1- T_0

Growth rate (Body weight) = BW_1-BW_0 / T_1- T_0

Feed conversion ratio (FCR) = Total amount of feed intake (wet weight)/ Increase in total wet weight of snails

*where L_1 and L_0 are length at the time T_1- T_0 respectively

W_1 and W_0 are width at the time T_1- T_0 respectively

BW_1 and BW_0 are body weight at the time T_1- T_0 respectively

Results and Discussion

The growth rate (shell length) of spotted babylon snail larvae is shown in Figure 1. The growth and survival rate of larva fed with *Isochrysis* sp. and *Chaetoceros* sp. were 0.081±0.006 mm/day and 2.75±1.54, and 0.076±0.007 mm/day and 2.01±0.82 % respectively (Figure 2). The larvae fed with *Tetraselmis* sp. died on day 6 of the experiment. There was no significant difference (P>0.05) between *Isochrysis* sp. and *Chaetoceros* sp. treatments in both growth and survival rate. For the juvenile experiment, average growth rates in shell length, shell width and body weight are shown in Figure 3, 4 and 5 respectively. There was no significant difference of growth in shell length and width. But the juvenile fed with fresh green mussel was significantly different from other treatments in body weight. Survival and feed conversion ratio (FCR) are shown in Table 1. The highest survival was found in juveniles fed with adult brine shrimp (44.58±5.92 percent), which was significantly different (P<0.05) from juveniles fed with fresh green mussel (19.34±7.34 percent) but not significantly different (P>0.05) from juvenile fed with fresh fish (39.00±15.50 percent). In case of FCR, the lowest FCR was found in the fresh fish treatment (1.34±0.64), which was significant difference (P<0.05) from juveniles fed with fresh green mussel (2.39±0.62) but not significantly different (P>0.05) from juvenile fed with adult brine shrimp (1.90±0.25).

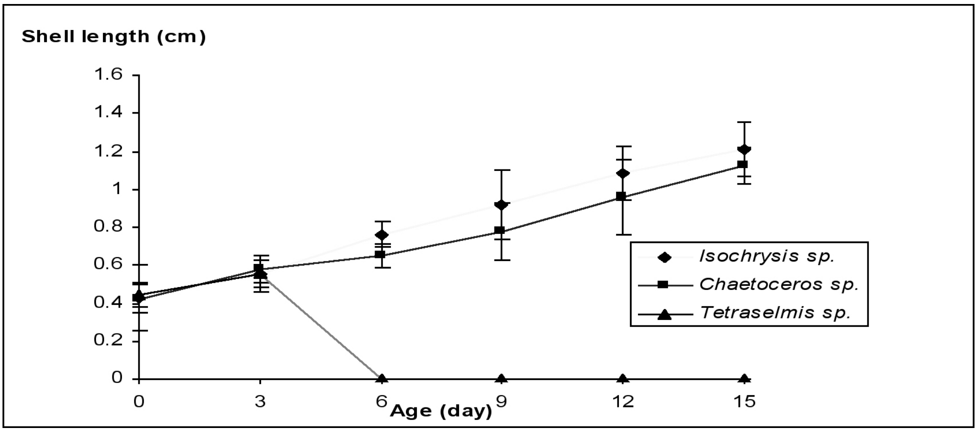

Figure 1: The average growth in shell length of larvae of spotted babylon snail (*Babylonia areolata*) fed with different phytoplankton

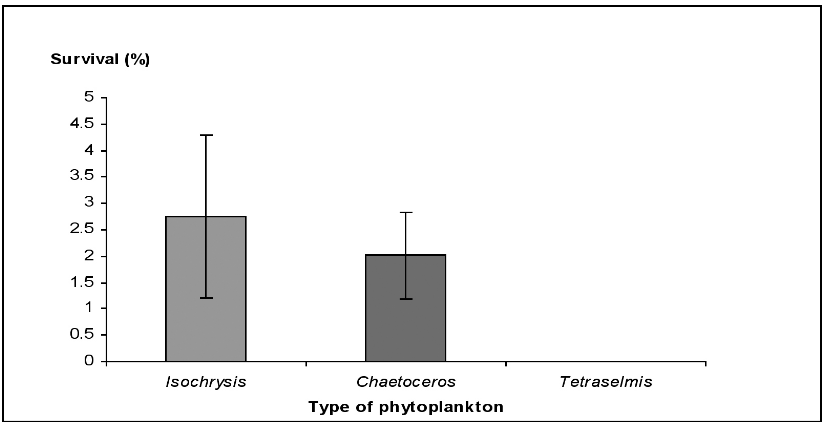

Figure 2: The average survival rate of larvae of spotted babylon snail (*Babylonia areolata*) fed with different phytoplankton

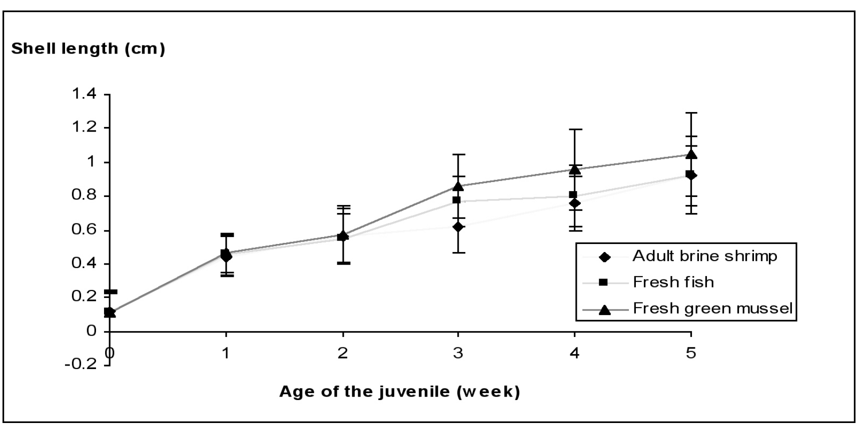

Figure 3: The average growth in shell length of juveniles of spotted babylon snail (*Babylonia areolata*) fed with different diets

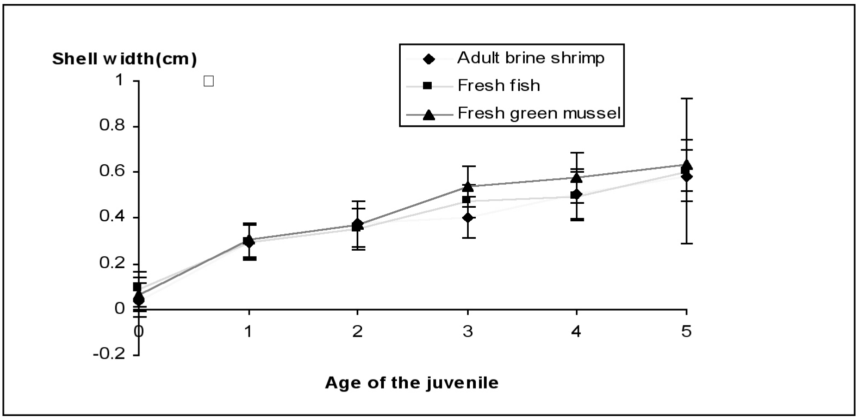

Figure 4: The average growth in shell width of juveniles spotted babylon snail (*Babylonia areolata*) fed with different diets

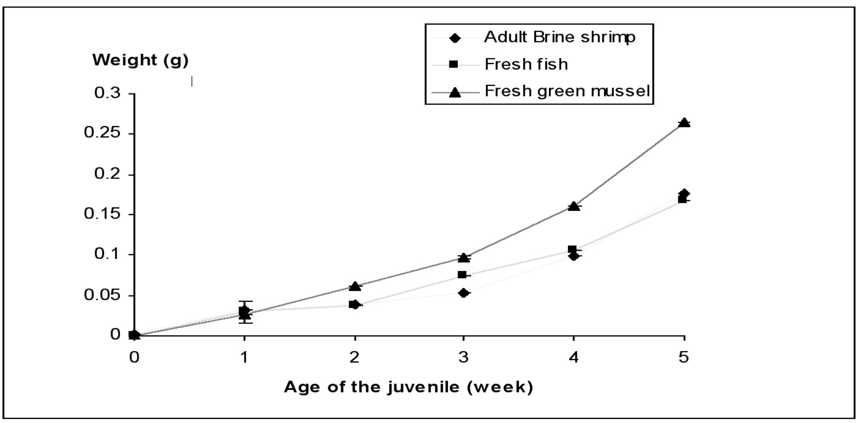

Figure 5: The average growth in body weight of juveniles spotted babylon snail (*Babylonia areolata*) fed with different diets

Table 1. Growth parameters of spotted babylon snail juveniles fed with different feeds

	Treatments		
	Adult brine shrimp	**Fresh fish**	**Fresh green mussel**
Initial width (cm)	0.09±0.12 [a]	0.09±0.15 [a]	0.09±0.15 [a]
Final width (cm)	0.58±0.16 [a]	0.60±0.42 [a]	0.63±0.15 [a]
Initial length (cm)	0.120±0.16 [a]	0.112 ±0.21 [a]	0.115±0.21 [a]
Final length (cm)	0.92±0.18 [a]	0.93±0.23 [a]	1.05±0.25 [a]
Initial weight (g)	0.0010±0.0001 [a]	0.0006±0.0003 [a]	0.0006±0.0003 [a]
Final weight (g)	0.1763±0.0199 [a]	0.1674±0.0073 [a]	0.2652±0.0217 [a]
Growth rate in width (mm/day)	0.0068±0.0015 [a]	0.0067±0.0022 [a]	0.0078±0.0007 [a]
Growth rate in length (mm/day)	0.0114±0.0022 [a]	0.0112±0.0013 [a]	0.0140 ±0.0010 [a]
Growth rate in weight (g/day)	0.0037 ±0.0008 [a]	0.0033 ±0.0001 [a]	0.0057±0.0005 b
Survival (percent)	44.58±5.92 [b]	39.00±15.50 [ab]	19.34±7.34 [a]
FCR	1.90±0.25 [ab]	1.34±0.65 [a]	2.39±0.62 [b]

A study on the larvae and juveniles of spotted babylon snail with different feeds, the results of larval experiment showed that survival was relatively low if compared to Darunchu and Thongsriphong (2004) which were fed with phytoplankton by adding brine shrimp. The previous study reported that the survival of larvae fed with phytoplankton added with brine shrimp was 28.69% (430 larvae achieved to juvenile stage) with density of 62.5 larva per L (1500 larvae in 24 liters tank). Liu *et al.* (2006) reported that high stocking density of larvae would affect survival due to food, oxygen depletion, predation or other environmental stresses. The present study showed that phytoplankton, *Isochrysis* sp. and *Chaetoceros* sp. were suitable for culturing of larvae of spotted babylon snail.

An experiment on juveniles fed with different feeds showed that the juvenile fed with fresh fish resulted in low FCR, high growth and survival rate. The survival rate recorded in this study was lower than those reported by Chaitanawisuthi *et al.* (2001b). The later fed juvenile of spotted babylon snail (*Babylonia areolata*) with fresh fish and formulated diets at different levels of protein (35% and 45%). Chaitanawisuthi *et al.* (2001b), grown the juvenile (size 1.139 cm shell length) in indoor rectangular tank with 100 m^2 for 6 months. The results show that the survival of the juvenile exceed 95% in all treatment. The smaller size and higher stocking density of juveniles in this study may have possibly affected the juvenile's survival. Darunchu *et al.* (2005) concluded that fresh fish is a suitable feed for growing out juvenile spotted babylon snail as similarly found in the present study.

Conclusion

The aspect of larva of spotted babylon snail is interesting and should be further studied in order to determine a suitable feed for larva. Further studies should focus on using other species of phytoplankton, mixed phytoplankton and zooplankton that have been used for nursery in other species of gastropod. The present study indicated that spotted babylon can be fed with various types of food. In fact, Chaitanawisuthi *et al.* (2001a) reported that spotted babylon snails is a good candidate for commercial mariculture due to its ability to accept various types of food. High survival rate, low FCR and faster growth rate are the features considered in reaching this conclusion.

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