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Preliminary Study on the Feeding Regime of Laboratory Reared Mud Crab Larva, *Scylla serrata* (Forsskal, 1775)

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Abstract: Survival of larvae of mud crab, *Scylla serrata* (Forsskal, 1775) is a persistent issue in the field of induced breeding of the species. A preliminary study was conducted on feeding regimes of laboratory reared larvae and juveniles of *S. serrata*. The results showed that the survival of the larvae fed with green water alone or green water with plankton and feed was not significantly different from the control where no feeding was given. All the larvae died at $Zoea_1$ after 4 days of culture without metamorphose to $Zoea_2$ stage. Larvae fed with green water, rotifer and *Artemia* nauplii or fed with green water and fed with rotifer, artificial plankton, prepared diet and *Artemia nauplii* showed similar results with growth and metamorphosis of the larvae reared in green water and fed with *Artemia* nauplii. The larvae reared in green water, rotifer and *Artemia nauplii* showed better survival rate of Zoea compared to larvae reared in green water and *Artemia nauplii* but the latter only metamorphosed to $Crab_1$ Stage. Further researches are proposed to evaluate differential nutritional composition of the live feeds to support the life of mud crab larvae.

Key words: Feeding regimes · *Scylla serrata* · Survival rate · Metamorphosis

INTRODUCTION

Mud crab, *Scylla serrata* (Forsskal, 1755) known as mangrove or green crab is widely distributed in the Indo-Pacific region. This species belongs to the family Portunidae, order Decapoda and class Crustacea. Well-known for its size, nutrient value, price and potential for export [1] this is an important species for aquaculture. The demand for mud crab is increasing for the last few decades. Apart from local demand, several countries such as France, USA, England, Japan, Taiwan, Hong Kong, Singapore, Korea, etc. are involved in marketing of the species. Less survival rate was faced by many researchers where 60% survival in Taiwan [2] and 26% in Australia in a recirculation system [3]. Furthermore, 15% survival observed by [4] and 20% by [5] in Malaysia were also reported. High mortality is being observed when *S. serrata* megalopa molt to the first crab stage, a phenomenon commonly referred to as 'molting-death-syndrome'. This mortality seems to be a result of the inability of the larvae to completely shed their exoskeleton during molting [6]. Although the main reason for this problem has not fully been understood, it is believed to be associated with inappropriate nutrition [7-9]. The present study was an attempt to assess the various effects of feeding regimes on the survival of larval population of mud crab (*S. serrata*).

MATERIALS AND METHODS

Mud crab larvae were obtained from the marine hatchery unit of Institute of Tropical Aquaculture, University Malaysia Terengganu, Malaysia. Newly hatched one day old larvae were stocked at a density of 20 larvae/liter in 24 units, 450 liter circular fiber glass tanks containing 100 liters of water. Four replicate tanks were maintained for each treatment. A total of 6 feeding following regimes were planned for maintaining the crab larvae for the present study.

Treatment 1: Sea water without any additional feed (control).

Treatment 2: Reared in green water (containing chlorella).

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Treatment 3: Reared in green water, fed with rotifer and *Artemia nauplii*; rotifer up to $Zoea_2$ stage, artemia from $Zoea_3$ to crab stage (10-15 individuals/ml).

Treatment 4: Reared in green water, fed with artificial feed, rotifer and *Artemia nauplii*; rotifer (15-30 individuals/ml) fed up to $Zoea_2$ stage and prepared feed of 2-3 g/m^3 from $Zoea_3$ was used.

Treatment 5: Reared in green water, fed with artificial feed and *Artemia nauplii*, artificial feed of 0.2-0.3 g/m^3 (up to $Zoea_2$) and 2-3 g/m^3 (from $Zoea_3$).

Treatment 6: Reared in green water, fed with *Artemia nauplii* alone.

Dead larvae and uneaten food were siphoned out from the tanks daily. An exchange of 30% water was given every day using 1 µm filtered seawater. Live food and supplemental feed were given at around 0800 hrs and 1500 hrs after the water exchange. Water quality parameters such as temperature salinity, pH, dissolved oxygen and ammonia were recorded. Daily sampling using larval scoop net was done to assess the larval stage development. Growth rate was calculated upon attainment of each larval metamorphosis. Statistical analysis of data was done using ANOVA and LSD methods ($p<0.05$).

RESULTS AND DISCUSSION

It was observed that in treatments I, II and V, larvae survived at $Zoea_1$ stage until day 4 without undergoing to $Zoea_2$ stage. This showed that supplement of green water (treatment II) and artificial plankton, prepared food and green water (treatment V) could not support larvae to develop to $Zoea_1$ stage even by maintaining the larvae alive for longer period than the control group where no feeding was given). Duration of larval stages is the most important factor to be considered in the metamorphosis studies. In treatments III, IV and VI it was shown that, larvae of $Zoea_1$, $Zoea_2$ and $Zoea_3$ stages lasted for 3-4 days, $Zoea_4$ for 4-5 days, $Zoea_5$ for 5-6 days and Megalopa over 7 days (Figure 1). It was reported [10] that Megalopa stage is substantially longer than Zoea stage (8-10 days vs 3-4 days) which is in agreement of the present study. In both treatments III and IV, $Zoea_1$ and $Zoea_2$ stages, completed their metamorphosis to the preceding stages faster than in the treatment VI. This might be due to the availability of rotifers in diet. In the treatment for rearing Megalopa, rotifer was avoided; since

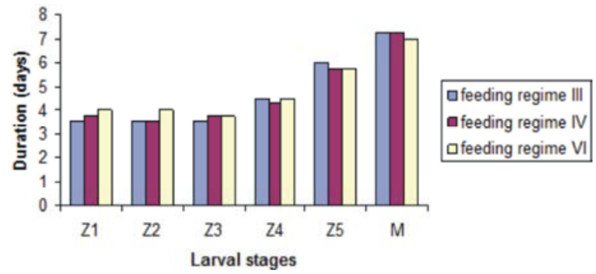

Fig. 1: Duration of mud crab larvae reared with different feeding regimes

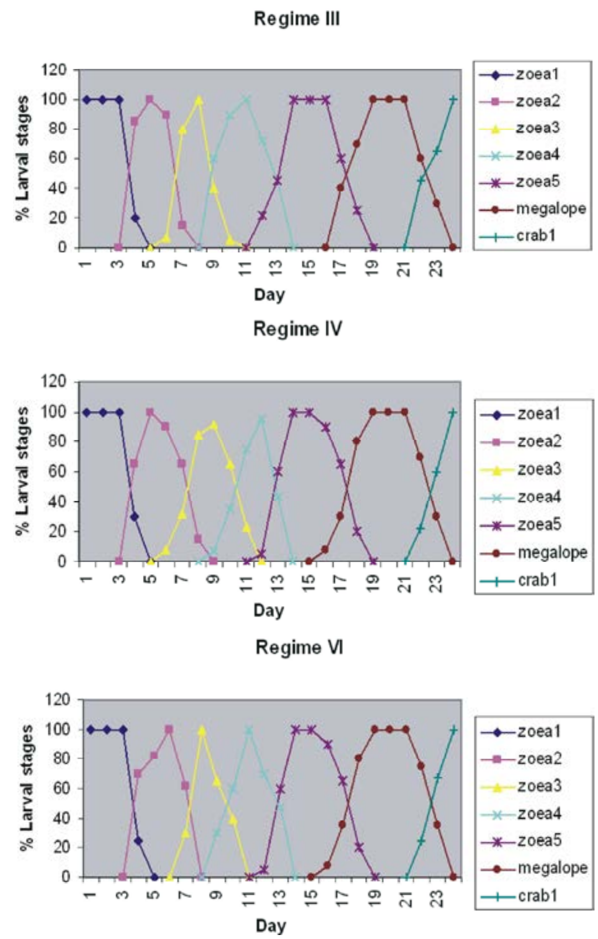

Fig. 2: Metamorphosis of mud crab larvae reared under different feeding regimes

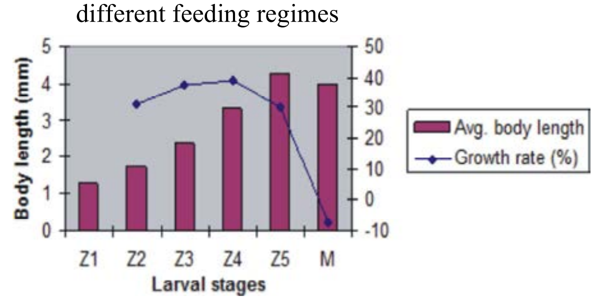

Fig. 3: Average body length and growth rate of mud crab larvae reared under different feeding regimes

the size of the animal was enough to take other types of bigger sized diets. This was supported by the [11] stating that rotifers are definitely outside the ideal food particle size range for the Megalopa of *S. serrata*.

Analysis of daily molting performance of larvae in treatments III, IV and VI showed similar results which are presented in Figure 2. In all these treatments, $Crab_1$ appeared after 21 days of rearing and all larvae completed their Megalopa stage during 24 days of culture. This has also been reported by [12] where a mean duration of reaching to the $crab_1$ stages ranging between 21 and 42 days and reared at temperatures 23-32°C. Results showed that the $Zoea_2$ stage appeared from day 4; $Zoea_3$ from day 7; $Zoea_4$ from day 9; $Zoea_5$ from day 12 and Megalopa from day 15-16. Since the molting pattern was occurred at equal times, not more than two stages were found together at a time and most of the larval stages reached 100% in larval composition.

In treatment IV, although larvae were supplemented with artificial plankton and artificial diet reared in green water than the treatment III with rotifer, artemia and green water, metamorphosis of the larvae was not improved. So it can be a reason that *Artemia nauplii* are an important nutrient carrier for the mud crab larvae to metamorphose successfully. This can be supported by the reports of [6] which stated that *Artemia nauplli* with a combination of 25-75% micro bound diet (MBD) showed highest survival rate than with the other lesser concentrations. Previous researches reported that zoea III larvae of*S. serrata* fed with unenriched Artemia showed clear signs of essential fatty acid deficiency, including prolonged intermolt period, low survival and reduced swimming activity [13].

Average size in body length (BL) i.e., total length of larvae reared under different feeding regimes and their growth rate are presented in Figure 3. BL of $Zoea_1$ in all treatments was 1.314 mm. Through molting BL of $Zoea_2$, $Zoea_3$, $Zoea_4$ and $Zoea_5$ increased and attained sizes 1.735, 2.37, 3.3 and 4.28 mm, respectively. The percentage rises were 31.3, 37.3, 38.9 and 30.2% from the preceding stage respectively. $Zoea_5$ after moulting to Megalopa recorded an average BL of 3.9 mm which was 6.95% shorter than that of $Zoea_5$.

When survival rate is referred, in treatment VI it was decreased to 25.5% from $Zoea_1$ to $Zoea_2$. Meanwhile, in treatments III and IV, similar rate of 83.5% and 84% respectively were recorded in $Zoea_2$. During the course of advancement, a constant survival rate of 21% was showed in treatment VI until $Zoea_5$, while on the other hand, it dropped to 50.5% and 55.5% in treatment III and IV respectively in $Zoea_5$. Death rate was a problem reported in previous researches too, but observed a reduction with daily mortality in due course of treatments [6, 14]. In the metamorphosis of Megalopa to $Crab_1$ the survival rate was found to be 18%, 9.5% and 15.5% with treatments III, IV and VI respectively. Furthermore a serious decline was achieved with the treatments reaching only 1.08%, 1.28% and 2.93%. It is quite unknown, the reason for sudden decline with the megalopa larvae. It is assumed that since the prepared food supported with additional nutritional requirements was included in the treatment regime IV, it is therefore further researches be done to confirm this hypothesis.

The water quality parameters recorded were such as temperature (25.5-30°C), salinity (29-30 ppt), dissolved oxygen (6.2-6.7 ppm) and ammonia (0.02-0.08 ppm). It was reported earlier by [3] that the Zoea stage was maximized in developing to first crab stage at 27°C. They also reported that the artemia supplementation also increased the larval metamorphosis. Some reports [12] also supported the current findings by getting a better survival rate at temperature of 29°C. So it could be concluded that the mean temperature for rearing of the larvae of mud crab is 29°C. But there are also reports on the occurrence of genotypes within a population with temperature optima significantly different from the mean population [15]. Given the large geographic range of *S. serrata*, the potential for site specificity in regard to temperature optima needs to be considered. Larvae of South African *S. serrata* suffered high mortality at temperatures above 25°C [16], whereas Japanese larvae at 29°C [12].

The results of the study can be considered for modifications to be brought in the hatchery rearing of mud crab larvae. Even though the result of the experiment produced less $crab_1$ juveniles, the different diets suitable for larval stages were successfully found. Cost effective rearing is the most important fact in aquaculture and too the larval diet selection for each larval stage can be modified from the current research.

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