



Survival, development and growth of white leg shrimp, *Litopenaeus vannamei*, zoea fed with monoalgae (*Chaetoceros* and *Skeletonema*) diets

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ABSTRACT

In this study, effect of feeding two species of phytoplankton, *Skeletonema* and *Chaetoceros*, on zoea stage of *Litopenaeus vannamei* were evaluated. The larvae were fed with microalgae from Zoea 1 (Z1) until they change to Mysis 1 (M1). Survival rate, growth (total length) and larval development was evaluated every day. The highest survival rate (66.63%) was obtained in larvae fed with *Chaetoceros*. The highest growth rate (total length) was also related to *Chaetoceros* treating larvae with an average length of 3.17 mm. After over 128 hours, the best development stages of larvae was obtained in *Chaetoceros* treating with 100% conversion of larvae to M1, whereas only 10% of larvae fed with *Skeletonema* were observed at M1. Generally, *Chaetoceros* treatment showed better results between the treatments and statistically had significant difference with *Skeletonema* treatment ($p < 0.05$).

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Introduction

Although there have been some marked changes in catch trends by country, fishing area and species, the overall global capture fisheries production continues to remain stable at about 90 million tonnes (FAO 2012) which does not meet the demands of growing world population. The experts of utilization have concluded that the only way to increase fisheries production and sustainable development is the industry of proliferation and reproducing of aquacultures (Beveridge et al, 1996). In the last three decades, world food fish production of aquaculture has expanded by almost 12 times, at an average annual rate of 8.8 percent but more slowly than in the 1980s and 1990s (FAO 2012).

Brackish water aquaculture yielded only 7.9 percent of world production in terms of quantity but accounted for 12.8 percent of total value because of the relatively high-valued marine shrimps cultured in brackish-water ponds (FAO 2012). Shrimp aquaculture output is dominated by two species, *Penaeus monodon* and *Litopenaeus vannamei*, but the main trend is the increasing proportion accounted for by *L. vannamei*, particularly since 2001, when this species was introduced into Asia (SPC, 2011).

There are two important stages of shrimp life cycle, larval stage and stage of sexual maturation, which demands for natural feeds and live foods (Mourente et al, 1995). Live feed continues to be the principal nutritional basis for culture of larvae (Richmond, 2004). Studies on different species of shrimp have shown that using phytoplankton and zooplanktons as live food in larval stage is essential and can play an important role in improving larval growth and survival (Gallardo et al, 1995). But microalgal species vary significantly in their nutritional value which is also dependent on culturing conditions (Enright et al., 1986; Brown et al., 1997). *Skeletonema* and *Chaetoceros* are two of the main phytoplankton species use in shrimp hatcheries in Iran. In view of the global activity about the proliferation of

L. vannamei as the dominant species and need of the larval stage of this species to live food and phytoplankton, this study aimed to determine the most appropriate phytoplankton diet in the larval stage of Zoea.

Material and methods

The study was conducted in Shrimp Research Institute of Iran located in Bushehr. Twenty liters' plastic tanks were used for larval rearing from Nauplius-5 to Mysis-1. Water (30 ppt.) used for the study was disinfected, de-chlorinated and treated with 10 ppm EDTA before being transferred to the tanks. Hatched larvae of N4 and N5 stages were adapted ambient condition for 15 minutes and then with 100N/L density 1000s nauplii were transferred to each experimental tank. Phytoplankton was produced under laboratory condition using F/2 medium and mass culture using TMRL medium. Ambient condition of 25 ppt. salinity, 25 to 27 °C temperature and light intensity of 5,000 to 10,000 lux were used for the cultivation of algae. Feeding started from N-6 to M-1 three times a day. Sampling was done on daily basis and length, survival rate and larval stage were recorded at the end of each day. All the physical and chemical parameters such as light, temperature, salinity and oxygen content were stable during the experiment.

This study was conducted using a completely randomized design with two treatments (*Skeletonema* and *Chaetoceros*) and 3 replicates. Data analyzes was performed using ANOVA on SAS software. To assess the difference between treatments, Duncan test at 95% confidence level was used. Graphs were plotted with Excel.

Results and Discussions

The highest survival (66.63%) and total length (3.17 mm) was recorded for the larvae fed with *Chaetoceros* compare to 55.53% survival and 2.41 mm total length for *Skeletonema* (Fig. 1). After over 128 hours of rearing, 100% of the larvae fed *Chaetoceros* converted to M-1 while only 10% of the larvae fed *Skeletonema* were converted M1. Only 24 hours later, 57.03%

of the larvae treated with *Skeletonema* converted to Mysis-1 with the total length of 2.54 mm (fig. 2).

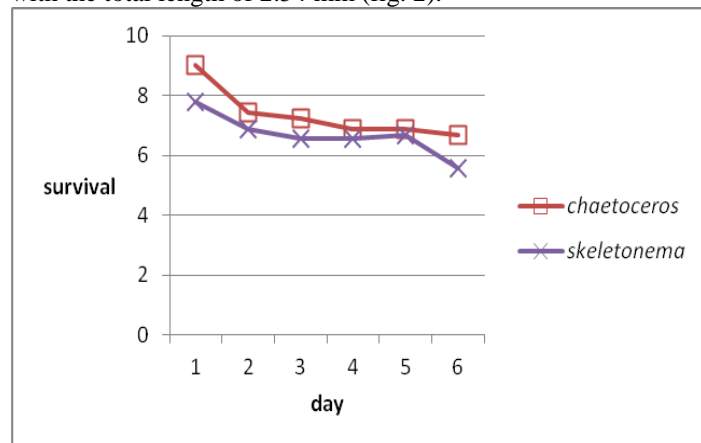


Figure 1. Survival rate of whiteleg shrimp (*Litopenaeus vannamei*) zoea larvae during fed different phytoplankton.

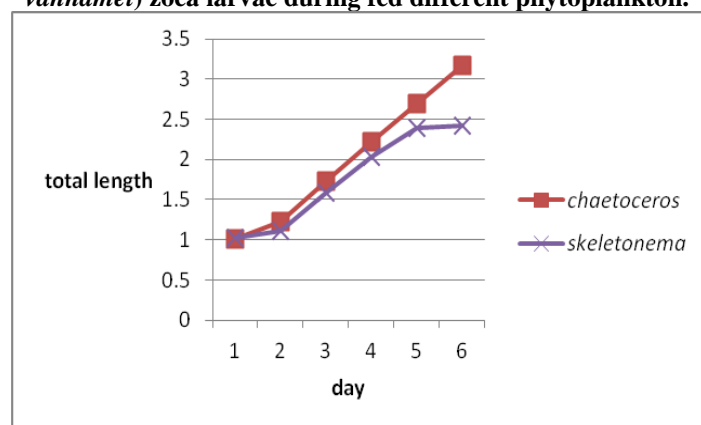


Figure 2. Growth (total length) rate of whiteleg shrimp (*Litopenaeus vannamei*) zoea larvae fed different phytoplankton

No doubt, the larval stage, especially during of the yolk sac absorption, is extremely sensitive and to prevent mortality of larvae it is essential to provide good nutrition for them. Due to the small size of larvae and their ability to swim, it is necessary to provide a food fit to their mouth size and metabolic needs (HaghNejat et al., 2005). The obtained results show that, based on statistical analysis, there is a significant difference ($P < 0.05$) in growth rate and survival of fish treated with *Chaetoceros* and *Skeletonema*. *Chaetoceros* treating showed complete dominance than *Skeletonema* treating in terms of growth, survival and larval development.

Penaeid larvae have an absolute requirement for long-chain unsaturated fatty acids, especially for C20 and C22: n-3 and n-6. In particular, their growth seems to be promoted by the polyunsaturated docosahexaenoic fatty acid (DHA) 22: 6n-3 and enhanced further by eicosapentaenoic acid (EPA) 20: 5n-3 (Jones et al., 1979, 1997; Brown et al., 1989). In addition to these, D'Souza and Loneragan (1999) found that the 20: 4n-6 arachidonic acid (ARA) could enhance growth of the protozoa stages of *P. semisulcatus*, *P. monodon* and *M. japonicus*. The difference in the rate of larval growth and survival is possibly due to differences in the fatty acid content of *Chaetoceros* and *Skeletonema* algae. Study on Indian white shrimp (*Fenneropenaeus indicus*) by Nematollahi et al. (2010) is also insisting these results. The results of this study are consistent with the results of studies on other species of shrimp. In a survey by HaghNejat in 2005 on green tiger shrimp (*Penaeus*

semisulcatus) higher survival, growth, and larval development was found for larvae fed *Chaetoceros* microalgae than *Tetraselmis* microalgae. In a study by Pina et al., (2005) on the protozoa larva of western white shrimp, the results were similar to the results of this study and *Chaetoceros* microalgae showed higher growth and survival compared to *Isocrysis* and *tetraselmis* algae. Also, in a study by Dsouza et al. (2000) on *Penaeus monodon* larvae, the results were similar to the results of this study and the highest survival rate and rapid development to Mysis-1 stage achieved in treatments containing *Chaetoceros* than *Skeletonema*.

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