Effect of Various Feeding of Live Feeds on the Growth and Survival Rate of Black Tiger Shrimp Larvae (Penaeus Monodon)

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Keywords: Live Feeds, Black Tiger Shrimp *(Penaeus Monodon*), Growth, Survival Rates.

Abstract: The aim of this research was to investigate the effect of variousfeeding of live feeds on the growth and survival rates of black tiger shrimp larvae (*Penaeus monodon*). The complete randomized experimental design was used with 4 treatment levels and 4 replications. The live feed treatments were (A) *Chlorella* sp., (B) *Tertraselmis chuii,* (C) *Spirulina* sp and (D) *Skeletonema costatum*. The larvae were fed with 120,000 cells/ml with feeding frequency of 4 times daily for 11 days. The results showed that different live feed had significant effect on weight gain, length gain, daily growth rate, specific growth rate and survival rate. Duncan's further test showed that the optimum weight gain, length gain, daily growth rate, specific growth rate and survival rate were found in treatment D (*Skeletonema costatum*) with 0,0006±0,0008gram, 3,94±0,15 mm, 0,0005±0,0001g/day, 14,98±2,47 %/day and 83,50±5,29 %, respectively. Thus, it is concluded that the recommended live feed for black tiger shrimp larvae feeding was *Skeletonema costatum*.

1 INTRODUCTION

As a tropical country, Indonesia has abundance of fisheries resources and natural diversity (Muchlisin et al., 2016; Muchlisin et al., 2017). Black tiger shrimp (*Penaeus monodon*) is one of the leading non-oil export commodities of fishery aquaculture sector (Raya, 2011). The cultivation of black tiger shrimp has become one of the industries in tropical and subtropical countries (Adger, 1998). As one of tropical country, Indonesia has reached its heyday in maintaining black tiger shrimp. Unfortunately, the production of black tiger shrimp in Indonesia is declining nationally, as illustrated in 1995 the production reached 180,000 tons but fell to 125,000 tons in 2000 (Soetrisno, 2004) *Penaus monodon* is an active organism foraging at night (noctural), the type of feed varies greatly depending on the level of its life cycle, and the larval stadia. The main food is the type of plankton (*phytoplankton* and *zooplankton*), but in the adult stadium the tiger prawn likes softfood or mollusk (clams, oysters, snails), polychaeta worms, and crustaceans (Soetrisno, 2004). In intensive and semi-intensive cultivation ponds, in addition to commercial feeds, the tiger shrimps also obtain live feeds growing in ponds, among others, moss, plankton, and benthos. But if the lack of food occurs, they will be cannibal in other small or weak shrimps especially during the turn of the skin or moulting (Rothlisberg, 2000).Live feeds such as phytoplankton and zooplankton are commonly given in shrimp larval culture to post-larval stadia (FAO, 2013). *Penaeid* larvae are mostly cultured on live unicellular algae during the *protozoea* stadia. Algaes are shortly consumed from zoea 1 until about postlarvae (PL) 2. The target density for algae such as *Chaetocerosmuelleri* or *Skeletonemacostatum* is 100 000 cells/ml as the only algae fed.

We used several potential live feeds for black tiger shrimp larval in this experiment such as*Chlorella sp.Tetraselmischuii,Spirulina sp.* and*Skeletonemacostatum. Chorella sp.* is a single-celled green algae and the cell wall is thin, rather hard, solid, and 3-8 microns long. *Chlorella* sp.is very suitable to be consumed by the fish larvae, apart from that *Chlorella sp*. containing 30% protein and 15% lipid, but it also contains carotene pigment in the form of lutein (Bachtiar, 2003). *Tetraselmis chuii* is a single-celled organism including plant species, whose body size is 7-12 microns. Chitri chitiel has high glycemic content, 54.66% protein, 18.31% carbohydrate and 14.27% fat. Chlorophyll chlorophyll pigments consist of two kinds, namely

Putra, D., Mariana, ., Abidin, M. and Sanani, .
Effect of Various Feeding of Live Feeds on the Growth and Survival Rate of Black Tiger Shrimp Larvae (Penaeus Monodon).
DOI: 10.5220/0008883001280132
In *Proceedings of the 7th International Conference on Multidisciplinary Research (ICMR 2018)* - , pages 128-132
ISBN: 978-989-758-437-4

carotene and xanthophylls (Bachtiar, 2003).

Spirulina sp. is a green algae that is classified into Cyanobacteria, one-celled and spiral-shaped. Based on its habitat, *spirulina sp.*it can thrive in tropical and subtropical waters. (Chen Y.Y. et. Al,2016) explains that spirulina contains five main nutrients: carbohydrate, protein, fat (Gama Linoleat, Omega 3, 6, and 9), vitamins (B-complex, E), minerals (Fe, Ca, k), as well as natural pigments (Beta carotene, chlorophyll, Xantofil, Fikocyanin). The cell is 1-3 microns in diameter, and *Spirulina sp.*containshigh protein and lipid (Chen Y.Y.et. al. 2016). *Skeletonema costatum*is a phytoplankton of a single-celled diatomae type and cell size ranges from 4-15 µm, *Skeletonema costatum* is widely used in shrimp culture due to its high nutrient content, which is 30.35% protein, 1.55% fat. Based on above description,in this study, we would like to investigate the effect of different live feeds feeding on the growth performance and survival rate of black tiger shrimp.

2 METHODOLOGY

2.1 Experimental Procedure

Black tiger shrimp*, Penausmonodon* larvae were obtained from Center for Brackishwater Aquaculture Ujung Batee, Aceh Besar District, Indonesia. The experimental system consisted of 16 aerated tanks (25 l volume) of 100 shrimp larvae used within each tank (10 l). Shrimp's larvae used were ranging from Stadia zoea to Stadia mysis. Shrimps were fed four times daily at 08.00; 12.00, 16.00, 20.00 for eleven days. *Penausmonodon* larvae were fed 120,000 cells/ml (Panjaitan et al., 2014) of following treatments:
Treatment A: *Chlorella sp*.
Treatment B: *Tetraselmis chuii*
Treatment C: *Spirulina sp.*
Treatment D: *Skeletonema costatum*.

2.2 Observation Parameters

The following variables were calculated:Survival Rate (SR)was calculated using the formula (Putra et. Al, 2016).

$$SR = \frac{N0 - Nt}{N0} \times 100 \quad (1)$$

Information :
SR = Survival Rate (%) Nt = Final number of live shrimp
No = Initial number of live shrimp
Weight gain (WG), calculation of absolute weight growth using the formula Steffens (1989) as follows:

$$\Delta G = Wt - Wo \quad (2)$$

Information:
ΔG = weight gain (g) Wt = Weight of shrimp at end of experiment (g) Wo = Shrimp weight at the beginning of experiment (g)
Length gain (LG) of shrimp was calculated by the formula (Putra et al., 2016)

$$L = Lt - Lo \quad (3)$$

Information:
ΔL = increase Absolute length (cm) Lt = Average length of research (cm)
Lo = average length of initial study (cm)
Specific growth rate (SGR)the calculation of specific growth rates (Steffens, 1989) as follows:

$$SGR = \frac{(Ln\ Wt - Ln\ W0)}{t} X\ 100 \quad (4)$$

Information:
SGR = Specific growth rate (% / day) Wt = Shrimp biomass test at end of study (g) W0 = Shrimp biomass test at start of study (g) t = Maintenance time (day)
Daily growth rate (DGR), the daily growth rate according to Steffens (1989) as follows:

$$DGR = \frac{Wt - W0}{t} \quad (5)$$

information:
DGR = Daily growth rate (g / day) Wt = The weight of shrimp biomass test at the end of the study (g); W0 = The weight of shrimp biomass test at baseline.

2.3 Statistical Analysis

One way ANOVA and Duncan's multiple range test (Duncan. 1955) was used to investigate the significance of the difference among the means of treatments through SPSS version 22.

3 RESULT

The results showed that the increase of tiger shrimp weight gain (WG) ranged from 0.0002±0.0002gram to 0,0006±0.0008 gram, length gain(LG) ranged from 1,54±0,02mm to 3,94±0,15mm,daily growth rate (DGR) ranged from 0,0002±0,0001 gram/day to 0,0005±0,0001 gram/day the specific growth rate (SGR) ranged from 8,95±5,20%/day to 14,98±2,47

%/day, and the survival rate (SR) ranged from 35,55±3,61 % to 83,50±5,29 %(Table1& 2).

The results of ANOVA (Analysis of Variant) showed that live feed had significant effect on weight gain, length gain,daily growth rate, specific growth rate, and survival rate of black tiger shrimp larvae (P <0,05). Duncan's advanced test showed black tiger shrimp fed with *Skeletonemacostatum* (treatment D) showed the best performance of weight gain, length gain, daily growth rate, specific growth rate and survival rate.

Table 1: Weight gain (WG), Length gain (LG) of black tiger shrimp larvae *(P. monodon*) for 11 days feeding.

Treatment	WG (g)	LG (mm)
Chlorella sp.*(A)*	0,0003±0,0001[b]	2,29±0,03[b]
Tetraselmischuii (B)	0,0005±0,0001[c]	3,54±0,073[c]
*Spirulina*sp.*(C)*	0,0002±0,0002[a]	1,54±0,02[a]
Skeletonemacostatum (D)	0,0006±0,0008[d]	3,94±0,15[d]

Table 2: Daily growth rate (DGR), Specific growth rate (SGR) and Survival rate (SR) of black tiger shrimp larvae *(P. monodon*) for 11 days feeding.

Treatment	DGR (g/day)	SGR (%/day)	SR (%)
Chlorella sp.*(A)*	0,0002±0,0001[b]	10,91±2,72[b]	35,55±3,61[b]
Tetraselmischuii (B)	0,0004±0,0002[c]	13,88±4,11[c]	66,72±5,54[c]
*Spirulina*sp *(C)*	0,0002±0,0001[b]	8,95±5,20[a]	55,52±7,08[a]
Skeletonemacostatum (D)	0,0005±0,0001[d]	14,98±2,47[d]	83,50±5,29[d]

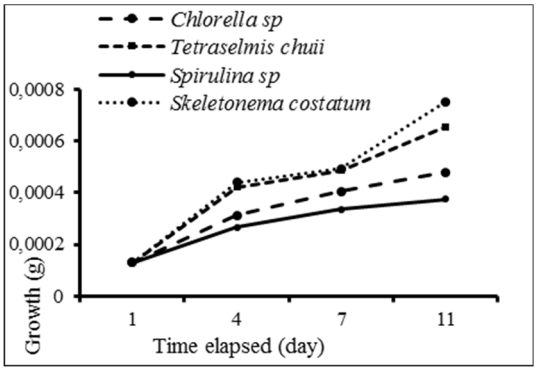

Figure 1: the growth of black tiger shrimp for 11 days feeding.

The highest growth performance was found at shrimp fed with *skeletonemacostatum* as seen at Figure 1. The result also indicated that better weightgain was found in treatment D with *skeletonema costatum* feed type.

Water quality measurements showed a pH ranging from 7.9 to 8.8, temperatures ranging from 27ºC-30.05ºC, DO ranging from 5.00ppm-6.07 ppm and salinity ranging from 25-35 ppt (data not shown).

4 DISCUSSION

The results showed that feeding of different live feeds expressed significant effect on weight gain, length gain, daily growth rate, specific growth rate, and survival rate on black tiger shrimp larval. This is in accordance with Rothlisberg (1998) stating that shrimp protozoa stages feed mostly on phytoplankton and small zooplankton where it developed from mysis through to postlarva (PL), and there was a transition to active predation on larger zooplankton (Lovett & Felder, 1990).

In aquaculture activities, particularly in shrimp culture, the use of live feed at larval stadia to stimulate the growth performance is highly recommended (Fitriani et al., 2017). We found that feeding *Skeletonema costatum* showed the best growth performances on *Penausmonodon.* We assumed that *Skeletonema costatum*meet the nutritional needs of tiger shrimp larvae. Studies about shrimp nutrition especially on shrimp lipids have shown that shrimp absolutely require essential fatty acids (EFA) for their normal growth development (Liao & Liu, 1989). *S. costatum* is a phytoplankton from diatome that is suitable given in mysis stadia, single cell and small cell size ranging from 4-15 µm, containing 32.05% protein, 7% fat, 2.09% fiber, 44.37 ash % and water content of 8.41% (Erlina et al., 2004). In addition to ,*S. costatum* has a thin cell wall that is easily digested by shrimp larval. It has autolysis enzymes that can help digestion, small cell size in accordance with opening the mouth of the larvae, moving actively that can attract shrimp larva to catch the algae (Bachtiar. 2003). In terms of color,*S. costatum* has a brownish color that attracts shrimp attention to eat it.

S. costatum is widely used in other penaid culture (Stafford. 1999). Beside as feed suplement, *S. Costatum*also avalaible in dried form (Lestari et al., 2014). The application of microalgae and macroalgae in shrimp culture does not only stimulate the growth performance but also shrimp immune system. Several studies have been conducted showing that the dietary administration of microalgae and macroalgae in shrimp diet can

significantlyaffect the immune system (Chen et al., 2016; Chen et. al. 2014; Kitikiew et al., 2013; Lin et al., 2013).

The shrimp mortality during the study was varied from 35-83 %. We assumed that it was due to the moulting activity when growing up. When moulting occurs, shrimp body resistance weakens and appetite decreases so that larvae will be more passive and may cause cannibalism by healthy shrimp.

Water quality parameters are important factors that must be considered in the maintenance of tiger shrimp larvae. Water quality is closely related to the growth and survival of tiger shrimp larvae. In this study, the water quality has not changed significantly, therefore the water quality in the rearing area is still in the normal range. The measured water temperature ranges from 27ºC-30ºC, the measured water pH ranges from 7.9-8.7, DO ranges from 5.00ppm-6.07ppm and the measured salinity ranges from 25-34ppt. According to Boyd (1989) the optimal temperature of shrimp larvae growth between 26-32 0C, optimal pH range of tiger shrimp larvae maintenance between 7,8-8,8 and optimal salinity range of shrimp larvae 24 ppt-35 ppt.

5 CONCLUSION

Based on the result, it is concluded that different live feed feeding has significant effect on growth performance and survival rate of black tiger shrimp (*P.monodon*), where the recommendedlivefeed in this research is *Skeletonema costatum.*

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