Dietary administration of sea grape powder (*Caulerpa lentillifera*) effects on growth and survival rate of black tiger shrimp (*Penaeus monodon*)

D F Putra¹*, M Rahmawati¹, M Z Abidin¹, and R Ramlan²

¹Department of Aquaculture, Faculty of Marine and Fisheries, Syiah Kuala University
Kopelma Darussalam 23111, Banda Aceh, Indonesia
²Center for Brackishwater Aquaculture Development, Aceh Besar, Indonesia
*Email: dfputra@unsyiah.ac.id

Abstract. The objective of the study was to determine the dietary administration effect of sea grape powder (*Caulerpa lentillifera*) in the diet on the growth performance and survival rate of black tiger shrimp (*Penaeus monodon*). Two hundred forty shrimps (PL 15) averaging 0.0020 g were randomly distributed into 24 of 10 l tanks. The 10, 20, 30, 40 and 50 g/kg of sea grape powder was supplemented into six formulated feed. The result showed that the application of the sea grape (*Caulerpa lentillifera*) meal in the diet gave a significant effect on the weight gain, specific growth rate, daily growth rate, absolute length, feed conversion ratio, and feed utilization efficiency, but no significant effect on survival rate. The optimum weight gain, specific growth rate, daily growth rate, absolute length, feed conversion ratio and feed utilization efficiency were found at treatment D (30 g/kg diet) with the values were 0.20 gram, 7.86% /day, 0.003 g/day, 26.6 mm, 0.81 and 123.84% respectively. Based on these result, it is concluded that the recommended level of sea grape powder dietary level (*Caulerpa lentillifera*) in shrimp feed (*Penaeus monodon*) was 30 g/kg.

1. Introduction

Indonesia is well-known with its high level of biodiversity including fish and shrimp [1, 2, 3]. Shrimp is one of the popular food consumption in Indonesia and Aceh province particularly [3]. The shrimp’s production from aquaculture sector in Aceh, Indonesia has decreased from 11.807 ton in 2003 to 6,120 in 2010 [4], this showed that there was a problem in the shrimp culture sector that needs to be addressed. Similar data from shrimp catches were shown in 2003 from 5,173 tons to be 2,046 tons in 2010, the facts showed the shrimp population in nature also increasingly reduced. On the other hand, shrimp export demand is increasing, it can be seen from shrimp export data showing in 2003 Aceh did not export shrimp, but in 2010 Aceh has exported 116 tons [4]. Therefore, to meet the shrimp demand then shrimp production through aquaculture needs to be improved. One of the most popular and commercial shrimp species from Aceh province is black tiger shrimp (*Penaeus monodon*).

Feed is one of the factors that determine the success of shrimp culture. The current condition showed that shrimp farming is still highly dependent on commercial feed that is very expensive depending on international currency fluctuation. The feed is also an aquaculture component that absorbs the most cost about 70% [5]. Therefore, need to look for alternative sources of other proteins which cheap and can be utilized by shrimp well. A lot of studies were done using macroalgae as an alternative of protein source. Several popular macroalgae used by scientists were *Sargassum sp, Ulva sp, gracilaria sp* etc [6, 7, 8]. Another potential macroalgae is sea grape *Caulerpa lentillifera* [9].
Seagrape (*Caulerpa lentillifera*) has anti-bacterial, anti-viral, and anti-fungal properties, which are used for fungicides, herbicides, and various industrial applications [10, 11]. Unfortunately, the use of sea grape *Caulerpa lentillifera* as shrimp feed, especially black tiger shrimp have not been reported. Therefore, sea grapes *Caulerpa lentillifera* has the potential to be used in shrimp feed as an effort to reduce costs, increase shrimp health and also substitute for a fish meal as a protein source in shrimp feed.

2. Materials and Methods

2.1. Experimental design

Two hundred forty shrimps (PL 15) averaging 0.0020 g were randomly distributed into 24 of 10 l tanks. Before the study, we acclimatized the shrimp for 1 hour. After the acclimation period completed, the experimental shrimp was starved for 24 hours. The formulated feed in crumble form was given 4 times a day at 08.00, 12.00, 16.00, and 20.00 by the amount according to treatment and feeding gave at 5% of body weight. The experiment was held for 60 days of rearing. The completely Random Design was used with 6 treatment levels and 4 replications. The treatment in this research was as follows:

- **Treatment A** = No sea grape flour (control)
- **Treatment B** = Addition of sea grape flour 10 g / kg of feed
- **Treatment C** = Addition of sea grape flour 20 g / kg of feed
- **Treatment D** = Addition of sea grape flour 30 g / kg of feed
- **Treatment E** = Addition of sea grape flour 40 g / kg of feed
- **Treatment F** = Addition of sea grape flour 50 g / kg of feed

We installed the aeration on each container to support dissolved oxygen (DO) on water. Then water heater on each container to adjust the temperature according to shrimp larval rearing. The plot of research containers was placed randomly. The sampling of shrimp were conducted every 7 days using a digital scale with 0.001 mg accuracy. Before weighing, the water contained on the surface of the shrimp body was absorbed first with a tissue. Measurement of shrimp begins before the shrimp was dispersed into a container of maintenance. Supporting parameters observed were water quality parameters including temperature, pH and dissolved oxygen. The parameters were measured 4 times during the 8 weeks study period.

2.2. Research Parameters

The following variables were calculated:

We calculated the survival rate (SR) using the formula [12, 13, 14]:

\[
SR = \frac{N_0 - N_t}{N_0} \times 100
\]

Information :

- **SR** = Survival Rate (%)
- **Nt** = Final number of live shrimp
- **No** = Initial number of live shrimp

We calculated the weight gain using the formula [15] as follows:

\[
\Delta G = W_t - W_0
\]

Information:

- **\(\Delta G\)** = weight gain (g)
- **Wt** = Weight of shrimp at end of the experiment (g)
- **Wo** = Shrimp weight at the beginning of the experiment (g)

We calculated Length gain (LG) of shrimp using the formula [12, 13, 14]

\[
LG = L_t - L_0
\]

Information:

- **LG** = Length gain (cm)
- **Lt** = Average length of research (cm)
- **Lo** = average length of initial study (cm)

We calculated Specific growth rate (SGR) using the formula [12, 13, 14, 15] as follows:

\[
SGR = \left( \frac{ln W_t - ln W_0}{t} \right) \times 100
\]
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 [12, 13, 14, 15] as follows:
\[
\text{DGR} = \frac{W_t - W_0}{t}
\]

Feed efficiency (FE)
The calculation of feed efficiency using the formula [16] that is:
\[
\text{FE} = \frac{1}{\text{FCR}} \times 100
\]

Feed conversion rate (FCR)
Conversion of the observed feed to calculate the feed conversion and calculated based on the formula [17] namely:
\[
\text{FCR} = \frac{F}{W_t - W_0}
\]

We analyzed the data using one way ANOVA. The significance of the difference among the means was analyzed by Duncan’s multiple ranges [18]. We used the statistics software of SPSS version 22. Data displayed in tabular form.

3. Results and Discussions
The dietary administration effect of various doses of sea grape powder (Caulerpa lentillifera) in the diet was determined based on several parameters such as weight gain, length gain, daily growth rate, specific growth rate, feed conversion ratio, feeding efficiency and survival rate (Table 1). The result of ANOVA (Analysis of Variant) test showed that the difference of dosage of sea grape powder in feed had a significant effect on weight gain, length gain, daily growth rate, specific growth rate, feed conversion ratio and feed efficiency (P <0.05), but no significant effect on survival rate (P> 0.05) (Table. 1). Based on the Duncan test showed that the best weight gain, length gain, specific growth rate, daily growth rate, feed conversion ratio, and feed efficiency were found in the treatment D (sea grape dosage of 30 g / kg of feed).

The results showed that the addition of sea grape powder gave better growth, survival and feed utilization value than no sea grape powder (control). Shrimp growth increased with increasing dosage of sea grape from 10 g / kg to 30 g / kg, and growth decreases after 30 g/kg. Thus, the optimum sea grape powder dosage was 30 g / kg of feed.

As has been explained that the better growth and feed utilization was found in shrimp that are fed with sea grape powder. This is related to the nutritional composition of sea grape. Seagrapes contains essential amino acids such as threonine, valine, leucine, phenylalanine, isoleucine, and lysine even beyond the essential amino acid content of soy flour [10]. According to [19], essential amino acids that greatly affect the metabolism of growth are methionine and lysine. Seagrape also has a lysine value of 6.63% compared to soy flour (6.1%).
Sea grape has a high content of immunostimulant. It may promote better growth performance in black tiger shrimp, *Penaeus monodon*. This is in accordance with the opinion of [20] that the immunostimulant content in seaweed *Sargassum sp.* was proven to increase the total amount of hemocytes in tiger shrimp that plays an important role in the endurance of the body so that energy in the body can be used for growth. Other studies about the use of seaweed in shrimp diet have been conducted [21, 22, 23, 24].

During the culture, water quality parameters are one of important factors in the maintenance of black tiger shrimp larvae (*Penaeus monodon*). The growth and survival is closely related to water quality. In our study, the water quality was still within a tolerance range of shrimp’s culture. The measured water temperature ranged from 27-30.7°C, measured water pH ranged from 8-8.9 and DO ranged from 5.00 ppm to 6.08 ppm and salinity ranged from 25-35 ppt. According to [25], the optimal range of temperature, pH, DO and salinity for shrimp farming was 25-31°C; 6.5-8.0; 4-8 mg/l; and 15-35 ppt, respectively. This concluded that the range of values of water quality parameters of black tiger shrimp culture was still in tolerable range.

### Conclusion

It can be concluded that dietary administration of sea grape *Caulerpa lentillifera* powder has a significant effect on the weight gain, length gain, daily growth rate, specific growth rate, feed conversion ratio and efficiency of black tiger shrimp *Penaeus monodon*, but no significant effect on survival rate. The optimum dosage of sea grape powder was 30 g / kg of feed.

### References

[1] Muchlisin Z A, N Nurfadillah, I I Arisa, A Rahmah, D F Putra, M Nazir, A Zulham 2017 *Biodiversitas* 18(2): 752-757

[2] Rizwan T, T K Nasution, I Dewiyanti, S A E Rahimi, D F Putra 2017 *AAACL Bioflux* 10(5):1180-1185

[3] D F Putra et al 2018 *IOP Conf. Ser.: Earth Environ. Sci.* 216 012022

[4] Ministry of Marine Affairs and Fisheries Republic of Indonesia (MMF) 2010 Statistics of capture fisheries, aquaculture, and import-export of every province throughout Indonesia 2003-2010 Center for information and statistics

[5] Jillian P F, Nicholas A M, David C L, Michael C M and Ling C 2018 *Environ. Res. Lett.* 13 024017

[6] Nurfajrie, Suminto, R Sri 2014 *Journal of Aquaculture Management and Technology* 3(4): 142-150

[7] Hafezieh M, D Adjari, A Por A and Hosseini 2013 *Iranian Journal of Fisheries Sciences* 13(1):
[8] Nuttarin S, Jiann C C, Yong-C L, Su T Y, Chyng H. L., L L C, Su S S ans Siau L C 2011 *Fish & Shellfish Immunology* **31**(6), 848-855

[9] Paul N A, A D Symon and R D N 2009 *Green caviar and sea grapes: Targeted Cultivation of High-Value Seaweeds from the Genus Caulerpa*, School of Marine and Tropical Biology, James Cook University, Townsville 4811

[10] Pattama R A and A Chirapart 2006 *Food Chemistry* **40**: 75-83

[11] Reia F L, Cabial H T Keh, Erika F B J, Marie E B H Nazal and N L Lianos 2015 The Chemical Analysis of Omega-3 Fatty Acid and Cadmium in Caulerpa lentillifera and Euchema denticulatum using High-Performance Liquid Chromatography and Atomic Absorption Spectroscopy. *De La Salle University, Manila, Philippines*

[12] Putra D F, Fanni M, Muchlisin Z A, Muhammadar A A 2016 *AACL Bioflux* **9**(5):944-948

[13] D F Putra *et al* 2018 *IOP Conf. Ser.: Earth Environ. Sci.* **216** 012005

[14] Putra D F, L Armaya, S A E Rahimi, N Othman 2019 *BIOTROPIA* **26**(2): 136-142

[15] Steffens W 1989 *Principles of fish nutrition. Ellis Horwood Limited*, West Sussex, England, pp. 384

[16] Zonneveld N E, A Huisman and J H boon 1991 *Prinsip-prinsip budidaya ikan* PT Gramedia Pustaka Umum Jakarta

[17] Tacon A G 1987 *The nutrition and feeding of farmed fish and shrimp-a training manual. FAO of The United Nations*. Rome, 106-109.

[18] Duncan, D. B. 1955. *Multiple Range and Multiple F Tests*. Biometrics 11:1

[19] Wahyu J 1985 *Ilmu nutrisi unggas. Fakultas Peternakan Institut Pertanian Bogor*, Bogor. 143 pp

[20] Huxley A D and A P Lipton 2009 *Asian Journal of Animal Science* **4**(2): 192-196

[21] Chen Y Y, J C Chen, C M Tayag, H F Li, D F Putra, Y H Kuo, J C Bai, Y H Chang 2016 *Fish Shellfish Immunol* **55**: 690-698

[22] Chen Y Y, J C Chen, Y C Lin, D F Putra, S Kitikiew, C C Li, J F Hsieh, C H Liou, S T Yeh 2014 *Fish. Shellfish Immunol. 36*:352-366

[23] Kitikiew S, J C Chen, D F Putra, Y C Lin, S T Yeh, C H Liou 2013 *Fish. Shellfish Immunol. 34*: 280-290.

[24] Lin Y C, J C Chen, W Z W Morni, D F Putra, C L Huang, C C Chang, J F Hsieh 2013 *PLoS ONE* **8**: e69722.

[25] Boyd C E 1990 *Water Quality in Ponds for Aqua Culture* (Auburn University: Alabama Agricultural Experiment Station) 482 p