The effect of *spirulina* meals on *Oithona* sp. (Claus, 1866) production through growth analysis

S H Samara[1], M B Santanumurti[1], A G Widyantoro[2], B Putri [2], S Hudaidah[23]

[1]Department of Fish Health Management and Aquaculture, Faculty of Fisheries and Marine, Universitas Airlangga, Surabaya 60115 Indonesia

[2]Department of Fisheries and Marine Science, Faculty of Agriculture, University of Lampung, Jl. Prof. Sumantri Brojonegoro, Bandar Lampung, Lampung 35141, Indonesia

[3]Corresponding author: idahasan64@gmail.com

Abstract. *Oithona* sp. is widely used for natural feed of larval stage. Therefore it is necessary to develop its culture method. The appropriate nutrient will affect the development of *Oithona* sp production. One of the highly nutritious ingredients is *Spirulina* meals. This study was conducted to determine the effect of *Spirulina* meals application on the population density of *Oithona* sp. The treatments in this study were A (*Oithona* sp. fed with *Chaetoceros* sp. of 2×10^6 cell/ml), B (*Oithona* sp. fed with 83 mg/L of *Spirulina* meals), C (*Oithona* sp. fed with 167 mg/L of *Spirulina* meals), D (*Oithona* sp. fed with 249 mg/L of *Spirulina* meals). The results showed that *Spirulina* meals had an effect on the population density of *Oithona* spp. This study also showed that the use of 83 mg/L of *Spirulina* meals could produce the best results with the amount up to 1067 ind/ml and grow speed of $0{,}78 \pm 0{,}08$ ind/day

1. Introduction

The rearing of fish larvae requires a sufficient amount of natural food, according to the size of the fish larva's mouth opening and the nutrient content according to the larva's needs. Natural feeds that are commonly used as feed for fish larvae are *Artemia* and Rotifer [1], [2]. *Artemia* is the main choice because it has a high nutrient content and size according to the needs of fish larvae. Protein content reaches 60%, 20% carbohydrates, 20% fat, 4% ash and 10% moisture content [3]. The high price of *Artemia* and still dependent on imports has become an obstacle to this day. Rotifers can be mass cultured, culture time is relatively short and has a high reproductive rate although the nutritional content is not equivalent to Artemia [4]. Another alternative as a substitute for *Artemia* which has equal nutrition is the copepod type *Oithona* spp.

Copepod *Oithona* spp. has varying sizes, 60-220 μm [5]. Copepods are rich in protein, fat, essential amino acids that can accelerate growth, increase endurance, and brighten the colour of shrimp and fish [6]. *Oithona* spp. contains protein 59.53-69.61%, carbohydrates 3.43-6.59%, fat 10.76-17.68%, ash content 3.26-4.46% [7]. The nutritional content of copepods *Oithona* sp. which can be used as an alternative natural food for fish larvae. Copepod production is highly dependent on the feed given. In this study, we culture *Oithona* spp. In laboratory scale by using *Spirulina* sp. flour as a source of nutrition to get maximum production results. *Spirulina* sp. flour has a carotenoid content that reaches 17% [8]. The content of these carotenoids can be utilized by copepods as compounds that are able to prevent photooxidation, besides that carotenoids are precursors of vitamin A [9]. Provision of *Spirulina* sp. flour expected to improve the quality of *Oithona* sp. This study was conducted to determine the effect of *Spirulina* meals application on the population density of *Oithona* sp.

2. Material and methods

2.1. Sample preparation

Oithona sp. used in this study was from the Lampung Marine Aquaculture Development Center. Broodstock of *Oithona* sp. was obtained by filtering using plankton net of 300 μm, then put into each container as much as 100 ind/l according to previous studies [10]. Maintenance was carried out for 14 days with 3 times daily feeding according to treatment. and carry out regular water quality control. *Chaetoceros* sp. seeds used were from the Lampung Marine Aquaculture Development Center while the *Spirulina* sp. was from the University of Lampung. The treatments in this study were A (*Oithona* sp. fed with *Chaetoceros* sp. of $2x10^6$ cell/ml), B (*Oithona* sp. fed with 83 mg/L of *Spirulina* meals), C (*Oithona* sp. fed with 167 mg/L of *Spirulina* meals), D (*Oithona* sp. fed with 249 mg/L of *Spirulina* meals) and 3 replication each.

2.2 Research parameter calculation

The parameters measured were population density, growth and water quality parameter (pH, temperature, salinity, and light intensity) The calculation formula for population density was adapted from the following method [11]:

$$r = \frac{\ln Nt - \ln N_0}{t}$$

Description:
t   : Length of culture time (days)
N_0 : Initial density (ind/ml)
Nt   : Final total density (ind/ml)

    Water quality parameters measured were temperature, pH, DO, and ammonia. Temperature measurement was done using a thermometer, pH measurement using a pH meter, dissolved oxygen measurement using a DO meter, ammonia measurement using a spectrophotometer as described in the previous study [12]. Water quality measurements were conducted 3 times a day.

3. Result and discussion

3.1. Density of Oithona sp.

The population density increased until the 8th day of maintenance for each treatment (Figure 1.). This was because *Spirulina* sp. was rich in protein, fat, carbohydrates and other important elements [13]. The population density in treatment A and B continued to increase until the end of maintenance, while treatment C occurred until day 9 and treatment D until day 8 after that decreased until the end of maintenance. The decline in population in treatment C and D was thought to be due to a decrease in the quality of the maintenance media due to the large amount of *Spirulina* sp. that had settled so that it interfered with the feeding activity and movement of *Oithona* spp. Precipitation occured due to the high dose of feed given to *Oithona* spp which caused turbidity. Turbidity in the media would affect oxygen availability because it disturbed the photosynthesis process. Previous studies had suggested that too much feeding could cause turbidity in water [14]. Previous studies had also stated that high turbidity causes disruption of water transparency and affected photosynthesis intensity [15], and suboptimal photosynthesis would cause death in plankton [16]. The average growth rate of Oithona sp showed in Table 1.
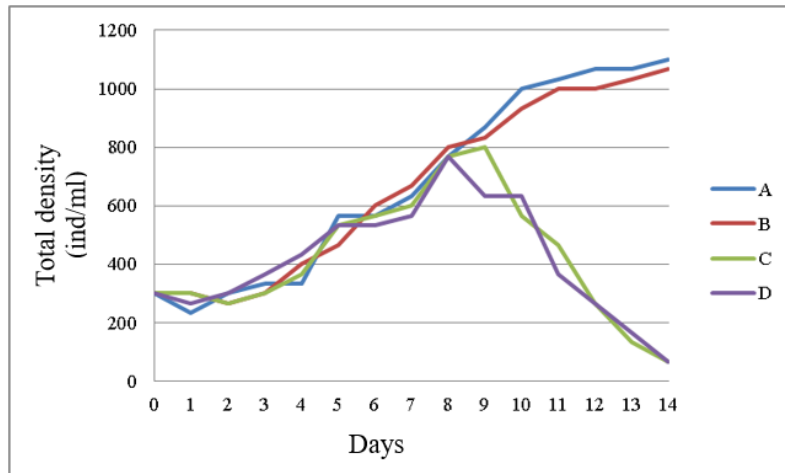
Figure 1. Population density of *Oithona* sp

Note: density of A, *Chaetoceros* sp. 2 x10^5 sel/ml, B = *Spirulina* sp. flour 83 mg/L, C = *Spirulina* sp. flour 167 mg/L,D = *Spirulina* sp. flour 249 mg/L

Table 1. The average growth rate of *Oithona* sp.

Treatment	Growth rate (ind/day)
A	$0,55 \pm 0,09$ [a]
B	$0,78 \pm 0,08$ [ab]
C	$0,23 \pm 0,05$ [ac]
D	$0,30 \pm 0,07$ [ad]

The data showed that the population growth rate of *Oithona* sp fed with *Spirulina* sp. 83 mg showed the highest average growth rate of 0.78 ind/day. This was because the treatment did not affect turbidity and provided proper nutrition for the growth of *Oithona* sp. Providing proper nutrition and environment would make *Oithona* sp. grow and develop well [17].

3.2. Water Parameter Measurement

The results of measuring the water parameter showed in Table 2. Comparison with literature shows that temperature, pH, DO and salinity are still under the environment of *Oithona* sp.

Table 2. Water quality parameters measurement.

Treatment	Parameter			
	Treatment (^{o}C)	pH	DO (mg/l)	Salinity (ppt)
A	23-25	7.6-7.8	3.5-4.6	30-35
B	23-25	7.2-7.7	3.6-5	30-34
C	23-25	7.3-7.8	2.5-3.1	30-35
D	23-25	7.3-7.8	1.7-2.2	30-35
Standard	25-29,5[18]	6,6-7,8[19]	4-6[19]	20-35[20]

4. Conclusion

This study also showed that the use of 83 mg/L of *Spirulina* meals could produce the best results with the amount up to 1067 ind/ml and grow speed of $0{,}78 \pm 0{,}08$ ind/day.

5. References

[1]   Le T H, Hoa N V, Sorgeloos P, and Van Stappen G 2019 *Rev. Aquacult* 11 1169-1175.
[2]   Hamre K 2016 Aquaculture 450 136-142.
[3]   Wibowo S, Utomo B S B, Suryaningrum D, and Syamdidi 2013 *Artemia for Fish and Shrimp Feed* (Jakarta: Self-Help Spreader) p 98.
[4]   Giliberto S, and Mazzola 1981 *J. Word Maricul. Soc*. 12 61-62.
[5]   Lavens P, and Sorgeloos P 1996 *Manual on the production and use of live food for aquaculture, fisheries technical paper, food and agriculture* (Rome: Organization of The United Nation) p 361.
[6]   Syahidah D 2012 *Life cycle of marine copepods from Gondol-Buleleng waters* (Bali: Proceedings of the Indoaqua-Aquaculture Technology Innovation Forum) p 112.
[7]   Perumal P, Rajkumar M, and Santhanam P 2009 *J. Environ. Biol* 30 1001-1003.
[8]   Sari L A, Masithah E D, and Alamsjah M A 2018 *JFMR* 2 9-14.
[9]   Linan-Cabello M A, Paniagua-Michel J, and Hopkins P M 2002 *Aquacult. Nutr.* 8 299-309.
[10]   Eldy W F, Murwani S, and Rusyani E 2014 *Pros. Sem. Nas.* 1 107-114.
[11]   Cheng S H, Ka S, Kumar R, Kuo C S, and Hwang J S 2011 Hydrobiologia 669 289-299.
[12]   Taragusti A S, Santanumurti M B, and Rahardja B S 2019 *IOP Conf. Ser. Mater Sci. Eng.* 236 012088.
[13]   Gumbo J R, and Nesamvuni C N 2017 *J. Chem. Pharma. Scien.* 10 1317-1325.
[14]   Santoso B, and Arfianto A D 2014 *Jur. Ilmiah Teknol. Inform. ASIA* 8 33-48.
[15]   Rikardo I, Melani W R, and Apriadi T 2016 *Jur. Umrah* 2 1-12.
[16]   Gallo C, d'Ippolito G, Nuzzo G, Sardo A, and Fontana A 2017 *Nat. Commun.* 8 1-11.
[17]   Broach J S, Cassiano E J, Watson C A 2017 *Aquac. Res.* **48** 4461-4469
[18]   Rusyani E, Erawati L, and Hermawan A 2005 *Budidaya Zooplankton dalam Pembenihan Kuda Laut* (Lampung: Balai Budidaya Laut Lampung DKP Lampung) p 56.
[19]   O'Bryen P J, and Lee C S 2005 *Copepods Aquac.* 18 245-253.
[20]   Thariq M, Mustamin, and Putro D W 2002 *Biologi Zooplankton dalam Budidaya Fitoplankton dan Zooplankton* (Lampung: Balai Besar Pengembangan Budidaya Laut Lampung. Dirjen Perikanan Budidaya DKP Lampung) p 88.

6. Acknowledgement