The effect of fishmeal on *Oithona* sp. (Claus, 1866) production through density and growth analysis

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Abstract. The natural feed is a non-artificial sourced feed used to increase the growth of aquaculture commodities. One of the widely used natural feed was *Oithona* sp. The development of *Oithona* sp. is expected to be increased by using a fish meal. The purpose of this study was to analyze the effect of fish meal on the production of *Oithona* sp. This study used a Completely Randomized Design (CRD) consisting of 3 replications and 4 treatments (A: *Oithona* sp. with the feed of *Chaetoceros* sp. 200 x 10^4 cells/ml, B: *Oithona* sp. with a fish meal of 0.03 gram/L of water, C: *Oithona* sp. with a fish meal as much as 0.10 gram/L of water, and D: *Oithona* sp. with a fish meal of 0.17 grams/L of water. The research parameters observed included the density and growth of *Oithona* sp., also its water quality. The results showed that giving fish meal did not significantly affect the density and growth of *Oithona* sp. This was indicated that fish meal was not effectively used to increase the production of *Oithona* sp.

1. Introduction

The natural feed is the feed that is used to increase the growth of fish larvae and determines their development. Natural food is live food for fish or shrimp larvae and seeds which includes phytoplankton, zooplankton and benthos [1], [2], [3]. Natural food has the advantage of containing complete nutrition and easy to digest, does not pollute the aquatic environment and media for the maintenance of seeds or fries, suitable for food for various age levels of seed or fry larvae, easy to eat and cheap [4], [5].

The natural feed that is widely used in fish and shrimp hatcheries is *Oithona* sp. *Oithona* sp. is one type of copepod which has the characteristics of small protrusions found in the first segment of the urosome and is widely used in fish farming because it has a relatively cheap price compared to *Artemia* sp. and high nutritional content, namely protein of 59.53% and calcium which exceeded *Artemia* sp. [6].

One of the obstacles in using *Oithona* sp. as the initial feed for larvae is the failure of *Oithona* sp. so that the production is not sufficient for feed-in fish hatcheries [7]. Factors affecting the cultivation of *Oithona* sp. are environmental and feeding factors. The feed is used by *Oithona* sp. to support growth and reproduction. If the calcium and protein content in the feed used is not sufficient for *Oithona* sp. it will result in lower growth and feed efficiency [8].

Oithona sp. is usually derived from phytoplankton, but the protein content of phytoplankton only ranges from 21.85-37% [9]. The feed that can be used for *Oithona* culture besides phytoplankton is fish meal. The use of fish meal used in this study has a protein content of up to 62.35% [10]. The use of fish

meal in *Oithona* sp. This study aimed to analyze the effect of fish meal on the *Oithona* sp. production so that it could meet needs.

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 a plankton net of 300 μm, then put into each container as much as 100 ind/l according to previous studies [11]. Maintenance was carried out for 14 days with 3 times daily feeding according to treatment. and carry out regular water quality control. This study used a Completely Randomized Design (CRD) consisting of 3 replications and 4 treatments (A: *Oithona* sp. with the feed of *Chaetoceros* sp. 200 x 10^4 cells/ml, B: *Oithona* sp. with fish meal of 0.03 gram/L of water, C: *Oithona* sp. with fish meal as much as 0.10 gram/L of water, and D: *Oithona* sp. with fish meal of 0.17 grams/L of water. *Chaetoceros* sp. seeds used were from the Lampung Marine Aquaculture Development Center while the fish meal was from Sidomulyo, Lampung. Phytoplankton culture was carried out in with 1L of seawater media. The place for culture was equipped with aeration, lighting for photosynthesis of microalgae, and fertilization using 1 ml of Conway fertilizer, 1 ml of silicate and 1 ml of vitamin C. The seed volume was put into each culture bottle with a density of 10^4 ind/ml. The calculation of the microalgae volume seeds for culture uses the following formula [12] :

$$V1 \times N1 = V2 \times N2$$

Note:
V1 = volume of inoculum (ml)
V2 = volume of culture media used (ml)
N1 = amount of pure stock inoculum (cell/ml)
N2 = desired initial density (cell/ml)

2.2 Research parameter calculation

The research parameters observed included the density and growth of *Oithona* sp., also its water quality. The calculation of population density of *Oithona* sp. was done every day. Sampling for each treatment was repeated 10 times. At each sampling, the number of organisms based on the phase was also counted. The results of the average calculation of the number of *Oithona* sp. converted into the amount of ind/l with the following formula [13]:

$$a = b\ x\ (p/q)$$

Note:
a = number of *Oithona* sp. individuals on culture media (individual/liter)
b = average number of *Oithona* sp. of the calculation loop (individual/liter)
p = volume of culture media (liter)
q = volume of culture media sample water (liter)

Oithona sp. growth is taken from population density data, then calculated using a modified formula [14]:

$$\mu = \frac{\mathrm{LnNt} - \mathrm{LnNo}}{\mathrm{t}} \times 100\%$$

Note :
No: initial population density (ind/l)
Nt : population peak density (ind/l)
T : time (days)
M : population growth rate (%/day)

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 [15]. Water quality measurements were conducted 3 times a day.

Population data of *Oithona* sp. was analyzed by using the normality and homogeneity test. If the data were normally distributed and homogeneous, it was continued with the variance test (ANOVA) with a 95% confidence level. If there were significantly different results, it would be followed by the Least Significant Difference test using the SPSS 22 program [16].

3. Result and discussion

3.1. Oithona sp. *Density*

The density of *Oithona* sp (figure 1.). which was fed with different amounts of *Chaetoceros* sp. and fish meal showed an increase in numbers. The addition of *Chaetoceros* sp. as feed yields the final amount of *Oithona* sp. of 1030 ind/ml, while *Oithona* sp. that were fed fish meal with an amount of 34 mg/l; 100 mg/l and 167 mg/l for 1497 ind/ml; 1367 ind/ml and 1030 ind/ml. The results of population density observations of *Oithona* sp. these consist of the nauplii, copepodite, and adult phases. Based on the graph of the population growth rate of *Oithona* sp. above could be seen in Figure 2.

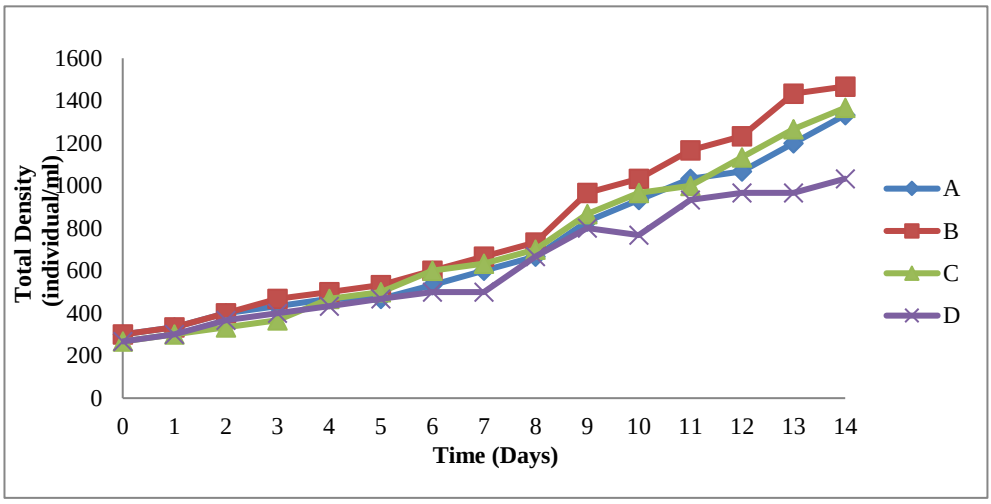

Figure 1. *Oithona* sp. density during 14 days of maintenance (A: *Oithona* sp. with the feed of *Chaetoceros* sp. 200 x 10^4 cells/ml, B: *Oithona* sp. with fish meal of 0.03 gram/L of water, C: *Oithona* sp. with fish meal as much as 0.10 gram/L of water, and D: *Oithona* sp. with fish meal of 0.17 grams/L of water).

The results showed that treatment A 707 ind/ml with a standard deviation of 24.1, treatment B 795 ind/ml with a standard deviation of 30.6, treatment C 720 ind/ml with a standard deviation of 41.6, and treatment D 629 ind/ml with standard deviation 31.6. The results showed that there was no significant difference. This was presumably because the fish meal given affected the turbidity in the culture medium. Turbidity in the media causes oxygen availability to decrease because it interfered with the photosynthesis process. Thus, *Oithona* sp. experienced death and showed insignificant results. Previous studies had suggested that feeding could cause turbidity in water [17]. Previous studies had also stated that high turbidity causes disruption of water transparency and affected the photosynthesis intensity [18], and suboptimal photosynthesis would cause death in plankton [19].

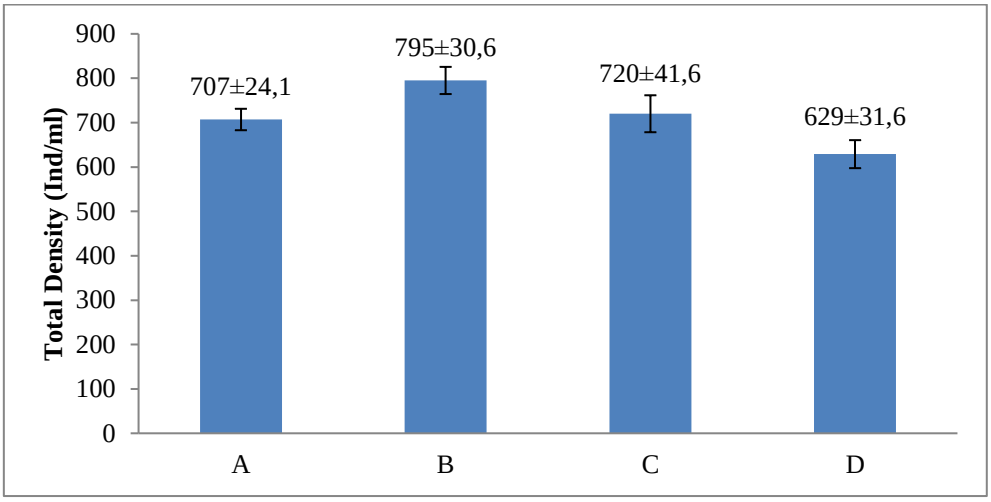

Figure 2. Density of *Oithona* sp. after 14 days (A: *Oithona* sp. with the feed of *Chaetoceros* sp. 200 x 10^4 cells/ml, B: *Oithona* sp. with fish meal of 0.03 gram/L of water, C: *Oithona* sp. with fish meal as much as 0.10 gram/L of water, and D: *Oithona* sp. with fish meal of 0.17 grams/L of water).

3.2. Growth of Oithona sp.

Based on Figure 3, it could be seen that treatment A was 1.439 ind/ml with a standard deviation of 0.557, treatment B was 1.612 ind/ml with a standard deviation of 0.543, treatment C was 1.256 ind/ml with a standard deviation of 0.232, and treatment D was 1.264 ind/ml with a standard deviation 0.106. The population growth rate in *Oithona* sp. increased in all treatments. The *Oithona* sp. growth was affected by feed intake according to the type, size, and dose. If the feed could be digested by *Oithona* sp., it would be used as nutrition for growth. Although there was no significant difference in this study, the fish meal causes turbidity in the water compared to the use of *Chaetoceros* sp. According to previous research, the use of natural food in fish had the advantage of not polluting the cultivation media and made the water turbid [20].

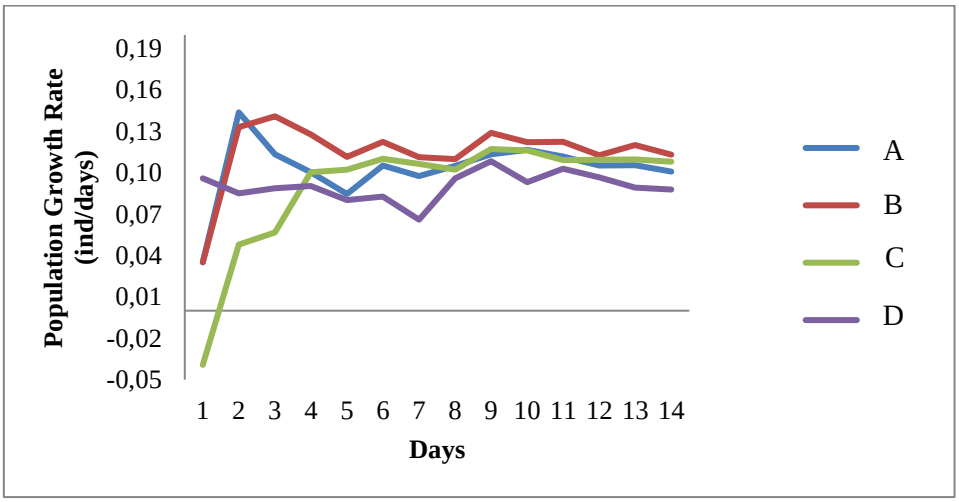

Figure 3. Growth rate popullation of *Oithona* sp. (A: *Oithona* sp. with the feed of *Chaetoceros* sp. 200 x 10^4 cells/ml, B: *Oithona* sp. with fish meal of 0.03 gram/L of water, C: *Oithona* sp. with fish meal as much as 0.10 gram/L of water, and D: *Oithona* sp. with fish meal of 0.17 grams/L of water).

3.3. Water Parameter.

Based on the water quality measurement results (Table 1.), the temperature, pH, and salinity parameters were still within the tolerance threshold for plankton growth. This study showed low DO values, especially in treatments C and D. Treatments C and D contained more fish meal as feed for *Oithona* sp. than others, which caused turbidity in the water and consequently reduce the photosynthetic intensity [17], [18]. The lack of photosynthetic intensity would affect the oxygen content because photosynthesis would produce oxygen in the water [24]. The fishmeal application also has disadvantage. If it was excess it could cause ammonia to increase thereby reducing appetite [25], [26].

Table 1. Water quality parameters during *Oithona* sp. culture (A: *Oithona* sp. with the feed of *Chaetoceros* sp. 200 x 10^4 cells/ml, B: *Oithona* sp. with fish meal of 0.03 gram/L of water, C: *Oithona* sp. with fish meal as much as 0.10 gram/L of water, and D: *Oithona* sp. with fish meal of 0.17 grams/L of water).

Treatment	Parameter			
	Temperature (^oC)	pH	DO (mg/l)	Salinity (ppt)
A	24-27	7.5-7.7	4-4.5	30-35
B	25-27	7.3-7.6	4-5.1	30-35
C	24-27	7.3-7.6	2.7-4.1	30-35
D	25-27	7-7.6	2.1-3.4	30-35
Range	25-29.5[a]	6,6-7,8[b]	4-6[c]	20-35[d]

Note: [a][21], [bc][22], [d][23].

4. Conclusion

The results showed that giving fish meal did not significantly affect the density and growth of *Oithona* sp. This was indicated that fish meal was not effectively used to increase the production of *Oithona* sp.

5. References

[1] El-Naggar H A, Allah H M K, Masood M F, Shaban W M, and Bashar M A 2019 *Egypt. J. Aquat. Res*. 45 273-280.

[2] Chouvelon T, Strady E, Harmelin-Vivien M, Radakovitch O, Brach-Papa C, Crochet S, Knoery J, Rozuel E, Thomas B, Tronczynski J, and Chiffoleau J F 2019 *Maret. Pollut. Bull.* 146 1013-1030.

[3] Buda M, Suparta I N G, and Rifai A 2018 *Bul. Tek. Litkayasa Akuakul* 16 113-115.

[4] Ashour M, Abo-Taleb H, Abou-Mahmoud M, and El-Feky M M M 2018 *Turk J. Fish. Aquat. Sci.* 18 1163-1175.

[5] Al Adawiyah L, Ulkhaq M F, and Kenconojati H 2020 *J. Aquac. Fish Health* 9 155-163.

[6] Perumal P, Rajkumar M, and Santhanam P 2009 *J. Envirol. Biol.* 30 1001-1003.

[7] Aliah K, and Yaniharto D 2010 *J. Sains Teknol. Indonesia* 12 45-52.

[8] Taufiq N, Rachmawati D, Cullen J, and Yuwono 2010 *ILMU KELAUTAN IJMS* 15 119 – 125.

[9] Erlina A, Amini S, Endrawati H, and Zainuri M 2004 *ILMU KELAUTAN IJMS* 9 206-210.

[10] Fahrizal A, and Ratna R 2018 *Gorontalo Fish. Jour.* 1 10-21.

[11] Eldy W F, Murwani S, and Rusyani E 2014 *Pros. Sem. Nas.* 1 107-114.

[12] Febrinawati N, Putri B, and Hudaidah S 2020 *J. Perikanan Unram* 10 20-28.

[13] Diana S U R R, and Carmudi, Kusbiyanto 2012 *Pros. Sem. Nas. Pengembang. Sumber Daya Pedesaan Kearifan Lokal Berkelanjutan* 3 46-52.
[14] Becker W A 1984 *Manual of Quantitative Genetics. Forth Edition* (Washington: Academic Enterprises) p 190.
[15] Taragusti A S, Santanumurti M B, and Rahardja B S 2019 *E&ES* 236 012088.
[16] Ghozali I 2006 *Aplikasi Analisis Multivariate dengan Program SPSS* Ed. IV (Semarang: Badan Penerbit Universitas Diponegoro) p 312.
[17] Santoso B, and Arfianto A D 2014 *Jur. Ilmiah Teknol. Inform. ASIA* 8 33-48.
[18] Rikardo I, Melani W R, and Apriadi T 2016 *Jur. Umrah* 2 1-12.
[19] Gallo C, d'Ippolito G, Nuzzo G, Sardo A, and Fontana A 2017 *Nat. Commun.* 8 1-11.
[20] Raharjo E I, and Sahrio M 2017 *JR Jurn. Penel. Kajian Ilmu Perikan. Kelautan* 4 1-6.
[21] Rusyani E, Erawati L, Hermawan A 2005 *Budidaya Zooplankton dalam Pembenihan Kuda Laut* (Lampung: Balai Budidaya Laut Lampung DKP Lampung) p 56.
[22] O'Bryen P J, and Lee C S 2005 *Copepods Aquac.* 18 245-253.
[23] 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.
[24] Barber J 2017 *Nature Plants* 3 1-5.
[25] Handajani H, Setiawati M, and Budiardi T 2018 *AACL* 11 495-504.
[26] Yanuhar U, Rahayu D T, Musa M, and Arfiati D 2018 *IOP Conf. Ser. Earth Environ. Sci.* 137 012014.

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