JPPIPA 9(3) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Possible Usage of Various Microalgae Species from Rawa Besar Small Lake as Aquaculture Feedant

Fadhlurrahman Maulana[1], Nining Betawati Prihantini[1*]

[1] Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Indonesia, Kampus UI, Depok, 16424, Indonesia.

Received: December 29, 2022
Revised: March 22, 2023
Accepted: March 25, 2023
Published: March 31, 2023

Corresponding Author:
Nining Betawati Prihantini
nining@sci.ui.ac.id

DOI: 10.29303/jppipa.v9i3.2768

Abstract: One of Rawa Besar Small Lake's roles for the surrounding community is as a fishing spot. Locals would often go fishing at the edges of the small lake. The ability of a lake to provide fishes to catch is partly due to the availability of food in the ecosystem, most importantly the microalgae community as the main producer in the freshwater food web. This concept is used in aquaculture as a way to obtain a more sustainable ingredient for feedant. Microalgae are used for aquaculture feedant due to its nutritional value. However, it is important to assess the safety and suitability of microalgae used for feedant due to the difference in toxicity and nutritional value of various microalgae species. Observation of the water samples taken from Rawa Besar Small Lake shown that potential microalgae species like *Kirchneriella* and *Arthrospira* lives in Rawa Besar Small Lake. However, toxic microalgae species like *Planktothrix* has been found in said water sample as well. Isolation of potential species is necessary in order to produce a healthy feedant for aquaculture out of Rawa Besar Small Lake's microalgae community.

Keywords: Aquaculture; Feedant; Microalgae; Nutritional value; Rawa besar small lake

Introduction

The usage of fish meal and fish oil-based aquaculture feedant is facing sustainability problem, mainly due to competitions with producers of feeds for other animals, human food supplement, and pharmaceuticals (Pike et al., 2010). This problem necessitates finding fish meal replacements to obtain a more sustainable aquaculture feedant (Kiron et al., 2016; Sarker et al., 2016). One of the alternatives proposed to replace fish meal in aquaculture feedant is microalgae (Ashour, 2020).

Microalgae can grow in a wide variety of habitat with various environmental conditions. Some microalgae used for aquaculture are easier to cultivate due to their ability to grow naturally in aquaculture farms (Muller-Feuga et al., 2003). Microalgae is used as feedant or feedant additives for various fish, shrimp, and mollusks due to its high nutritional value. Microalgal feedant is often used to grow various larvae, coloring salmonoids' flesh, and inducing other biological activities (Hemaiswarya et al., 2011). However, there are microalgae species that can produce harmful toxins (Muller-Feuga et al., 2003). Toxin produced by those microalgae is harmful to both the animals in the aquaculture farm and to public health. It is important to avoid contamination from those harmful microalgae (Chia et al., 2009).

Rawa Besar Small Lake is the second largest lake in Depok City, West Java, Indonesia. It is located at the center of the city (Tambunan et al., 2021). Locals would often catch fishes at the edge of the lake (Setiawati, 2019). Freshwater fish cultivation also exists at the lake (Kurniawan et al., 2018). Research on the usage of Rawa Besar Small Lake's microalgae as aquaculture feedant can be useful to support local fisheries and ensure its sustainability and safety.

Method

Research Scheme

This research consists of several steps. Those steps are water sample collection, sample observation, microalgae identification, microalgae cell counting, species richness calculation, and species dominance

How to Cite:
Maulana, F., & Prihantini, N.B. (2023). Possible Usage of Various Microalgae Species from Rawa Besar Small Lake as Aquaculture Feedant. *Jurnal Penelitian Pendidikan IPA*, *9*(3), 1292–1296. https://doi.org/10.29303/jppipa.v9i3.2768

calculation. General schematic of this research can be seen in Figure 1.

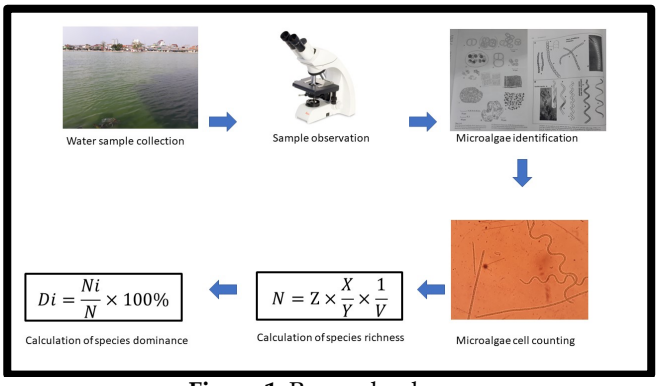

Figure 1. Research scheme

Sampling Location and Water Sample Collection

Water sample is acquired from one sampling point at Rawa Besar Small Lake, Depok, West Java in May 9th 2022. The sampling point can be seen in (Fig. 1). The water sample is collected using plankton net with mesh size 30µm. Six small bottles are filled with 10 ml of water samples each. Three bottles containing samples preserved using formaldehyde, while three other bottles containing fresh samples.

Figure 2. Map of Rawa Besar Small Lake and sampling point (Source: Google Earth with alterations)

Microalgae Identification and Counting

A drop of water sample from each sample bottles were observed under the microscope for identification, counting, and documentation. Microalgae species observed under the microscope were identified based on the characteristics shown in identification books by Edmonson (1963), Bold et al. (1978), Pentecost (1984), Geitler (1985), Hoek et al. (1995), and Whitton (2002).

Analysis and Processings of Data

Microalgae identification results was analyzed descriptively. Microalgae plankter was counted to calculate microalgae richness and dominance at Rawa Besar Small Lake. The formula for microalgae richness in a liter of water sample is as follows (APHA, 2005).

$$N = Z \times \frac{X}{Y} \times \frac{1}{V} \quad (1)$$

Where,
N: Richness (cell/L)
Z: Cell number
X: Sample volume (mL)
Y: Subsample volume (mL)
V: Volume of filtered water (L)

The formula of dominance percentage among microalgae species found in the water samples is as follows (Cox, 1996).

$$Di = \frac{Ni}{N} \times 100\% \quad (2)$$

Where,
Di: Dominance percentage
Ni: Total number of species i
N: Total number of all species combined

Result and Discussion

Microalgae Identification Results

Observation using microscope reveals that water samples from Rawa Besar Small Lake contains four different species of microalgae (Table 1, Figure 2).

Table 1. Microalgae Found in Water Sample from Rawa Besar Small Lake

Order	Family	Genus	Species
Oscillatoriales	Microcoleaceae	*Planktothrix*	*Planktothrix* sp.
Oscillatoriales	Microcoleaceae	*Arthrospira*	*Arthrospira* sp.
Synechococcales	Merismopediaceae	*Merismopedia*	*Merismopedia* sp.
Sphaeropleales	Selenastraceae	*Kirchneriella*	*Kirchneriella* sp.

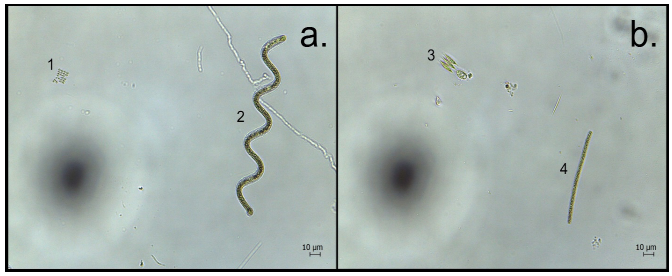

Figure 3. Microalgae of Rawa Besar Small Lake (a1) *Merismopedia*, (a2) *Arthrospira*, (b3) *Kirchneriella*, (b4) *Planktothrix*. Bar = 10 µm.

Microalgae Richness and Dominance

Average microalgae richness in Rawa Besar Small Lake is 23.46 cells/L. The most abundant species in Rawa Besar Small Lake is *Planktothrix* sp. with an average of 12.61 cells/L. The least abundant species in Rawa Besar Small Lake is *Kirchneriella* sp. with an average of 0.03 cells/L (Table 2).

Calculation of dominance percentage confirms the dominance of *Planktothrix* sp. and *Arthrospira* sp., with the average percentage of 53.81% and 45% respectively (Table 3).

Table 2. Richness of Microalgae Cells in Water Sample from Rawa Besar Small Lake

Microalgae Species	Richness (Cell/L)						Average
	Preserved 1	Preserved 2	Preserved 3	Fresh 1	Fresh 2	Fresh 3	
Planktothrix sp.	17.67	14.81	16.36	10.48	6.77	9.59	12.61
Arthrospira sp.	17.30	11.26	10.73	7.79	5.79	10.48	10.56
Merismopedia sp.	0.69	0.32	0.08	0.36	0.12	0	0.26
Kirchneriella sp.	0.12	0	0	0	0.04	0	0.03
Total	35.78	26.39	27.17	18.63	12.72	20.07	23.46

Table 3. Microalgae Dominance in Water Sample from Rawa Besar Small Lake

Microalgae Species	Dominance (%)						Average
	Preserved 1	Preserved 2	Preserved 3	Fresh 1	Fresh 2	Fresh 3	
Planktothrix sp.	49.37	56.10	60.21	56.23	53.20	47.76	53.81
Arthrospira sp.	48.34	42.65	39.48	41.79	45.51	52.24	45
Merismopedia sp.	1.93	1.25	0.31	1.98	0.97	0	1.07
Kirchneriella sp.	0.36	0	0	0	0.32	0	0.12

A major problem in utilizing Rawa Besar Small Lake's microalgae as aquaculture feedant is the dominance of *Planktothrix* sp. *Planktothrix* is known to produce toxins such as microcystin. Microcystin can inhibit fish growth and considered a possible human carcinogen (Humpage et al., 2007). Handling toxic microalgae contamination in a certain area requires further monitoring (Chia et al., 2009).

Microalgae from Rawa Besar Small Lake is still a potential source of feedant despite contamination by *Planktothrix*. Two out of four microalgae species found in the water samples from Rawa Besar Small Lake have been used as ingredients in aquaculture feedant. *Arthrospira* is the second most abundant species, and has been used to make feedants for white shrimp (*Litopenaeus vannamei*) (Macias-Sancho et al., 2014), Nile tilapia (*Oreochromis niloticus*) (Abdel-Tawwab et al., 2009), and sea bass (*Dicentrarchus labrax*) (Hasanein et al., 2018). *Kirchneriella* has been successfully tested on mollusks such as pearl mussels (*Hyriopsis myersiana*) (Kovitvadhi et al., 2008), but it is the least abundant species of microalgae in Rawa Besar Small Lake. A possible solution to develop those microalgae into aquaculture feedant is to isolate those microalgae and grow them in a controlled environment that is ideal for their growth (Kasan et al., 2020).

Mass-producing the isolated microalgae species requires further planning in order to compete with low-cost and large-scale conventional fish meal production. One of the most recent suggestions for mass-producing microalgae feedstock is to grow those microalgae in open photobioreactors or raceway ponds and incorporating a business model where residues obtained from the cultivation can be used to make another product. This business model can increase the cost efficiency of microalgae cultivation and reduce the amount of waste produced from the cultivation process (Fabris et al., 2020).

Conclusion

Rawa Besar Small Lake has two microalgae species that are potential for aquaculture feedant, which are *Arthrospira* and *Kirchneriella*. *Arthrospira* are very abundant in the lake and can be used for various kinds of feedstock. However, *Kirchneriella* are very scarce. The lake is also dominated by toxic microalgae *Planktothrix*, which requires further study and monitoring in order to handle the situation. The potential microalgae from Rawa Besar Small Lake should be isolated and grown in a controlled environment to develop those microalgae into aquaculture feedstock. Further utilization of those microalgae requires cultivation in open photobioreactors or raceway ponds and a cost-efficient business model.

Acknowledgements

This study was supported by Hibah Publikasi Terindeks Internasional (PUTI) Pascasarjana for the 2022-2023 Fiscal Year to Dr. Nining Betawati Prihantini, M.Sc., Grant no. NKB-285/UN2.RST/HKP.05.00/2022.

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