

The concentration of microplastics in epibiont of green mussel (*Perna viridis*) from Maccini Baji waters, Pangkajene Kepulauan

by R A

Submission date: 05-Sep-2022 06:57PM (UTC-0400)

Submission ID: 1893279983

File name: Perna_viridis_from_Maccini_Baji_waters,_Pangkajene_Kepulauan.pdf (1.3M)

Word count: 4879

Character count: 26267

PAPER · OPEN ACCESS

3
The concentration of microplastics in epibiont of green mussel (*Perna viridis*) from Maccini Baji waters, Pangkajene Kepulauan

To cite this article: Gita Natalia Taruk Linggi ⁴ *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **860** 012099

View the [article online](#) for updates and enhancements.

3

The concentration of microplastics in epibiont of green mussel (*Perna viridis*) from Maccini Baji waters, Pangkajene Kepulauan

Gita Natalia Taruk Linggi, Khusnul Yaqin, Basse Siang Parawansa, Liestiaty Fachruddin, Budiman Yunus and Sri Wahyuni Rahim

Aquatic Resource Management, University of Hasanuddin, Indonesia

Email: khusnul@gmail.com

Abstract. The discharge of microplastics into marine waters harms aquatic ecosystems, especially for filter feeder organisms such as green mussels. The purpose of this study was to analyze the shape, size, and color of microplastics and the concentration of microplastics in the epibiont associated with green mussels (*Perna viridis*) and the effect of the presence of epibionts on the concentration of microplastics in green mussels as a substrate. Sampling was done using the purposive random sampling method. Determination of the number of samples using Lemeshow's formula and obtained 99 green mussels associated with epibiont. The samples were divided into three groups, namely mussel associated with epibiont with microplastic found in epibiont, mussel associated with epibiont with microplastic found in mussel, and mussel without epibiont with microplastics in mussel. The results showed that the number of microplastics contaminated to the mussel group associated with epibiont with microplastic in the epibiont was 46 samples, to the mussel group associated with epibiont with microplastic in mussel was seven samples, and the mussel group without epibiont with microplastic in mussel there were 11 samples. The results also showed that if the microplastic were present in the epibiont, the green mussels associated with the epibionts did not contain microplastics. Conversely, if microplastics contaminated the green mussels, then epibionts were not contaminated by microplastics. The microplastics found ranged from 0.1-4.9 mm in length. The microplastic forms found were fibers and fragments. The microplastic colors found were red, blue, white, and black. The mean values of microplastic concentrations in epibiont, mussel associated with epibiont, and mussel without epibiont were 3.629 items/g, 0.7160 items/g, and 1.032 items/g, respectively.

1. Introduction

Plastics are synthetic polymers that are difficult to decompose naturally, so it takes a long time for plastics to decompose completely. Meanwhile, the increasing use of plastic can have a bad impact on the environment, especially marine waters, because the time the plastic decomposes with the amount of plastic waste is not balanced, resulting in the accumulation of plastic [1]. Thompson (2006) stated that 10% of plastic produced will be dumped into rivers and ended up in the sea [2]. This resulted in 165 million tonnes of plastic per year entering Indonesia's marine waters. Almost all habitats in the ocean, both benthic and pelagic, are found in plastics waste of various sizes. The degradation of plastics in marine waters will produce small particles called microplastics [2].



Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

Microplastics are plastic particles whose diameter or length is less than 5 mm [3]. The large number of microplastics scattered in marine waters will also have an impact on consumption animals originating from marine waters. Its persistent nature means that microplastics that enter the water are not easily lost [4]. Nearly 85% of microplastics are present on sea surfaces. The particle size of microplastics found in many water areas around the world is <5 mm [5]. According to Sun et al., (2017) microplastics are found in marine biota [6]. Microplastics are also found in bivalves which are filter feeder organisms [7]. Epibionts that live attached to bivalves make them susceptible to contamination by microplastics.

Epibionts are organisms that attach to and grow on the surface of abiotic and biotic substrates in waters [8]. The presence and amount of epibionts usually vary depending on the time of day and water conditions [9]. However, the existence of epibiont is often considered as a fouling organism that can damage the place where they attach. Therefore, they are often also called biofouling. One of the epibiont substrates is green mussels (*Perna viridis*) [10]. Research on the microplastic content of green mussels has been carried out in various waters. The results of research conducted in the Java Sea showed that the microplastic content in green mussels with a concentration of 4-20 particles/gram with the type of microplastic found in the form of fibers, fragments [11]. Even in Sulawesi waters, there have been several studies explaining the findings of microplastics in green mussels. One of them is a study that found microplastics in green mussel from Maccini Baji Waters, Labakkang District, Regency Pangkajene Islands, South Sulawesi [12]. Maccini Baji waters are one of the waters that produce green mussels which are usually sold by fishermen for public consumption.

However, there has been no research on microplastics in epibionts associated with green mussels and the effect of the presence of epibionts on green mussels in filtering microplastics. In this regard, it is necessary to research to analyze the concentration, shape, size, and color of the microplastics in the epibionts associated with green mussels and the effect of epibiont on green mussels as a substrate in filtering microplastics to obtain information on the association between epibionts and green mussels in microplastics polluted conditions.

2. Materials and methods

2.1. Sampling

The research was conducted from November 2019 to March 2020. Sampling was carried out in Maccini Baji waters, Labakkang District, Pangkajene Islands Regency, and continued with sample analysis at the Laboratory of Aquatic Animal Physiology and Water Quality Laboratory, Department of Fisheries, Faculty of Marine and Fisheries Sciences, Hasanuddin University, Makassar.

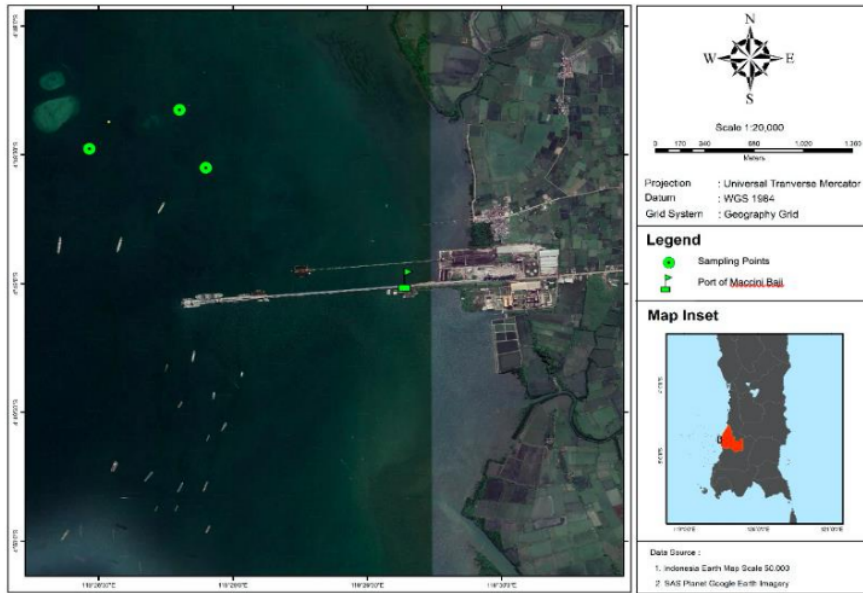


Figure 1. Map of sampling locations for green mussels (*Perna viridis*) in Maccini Baji, Labakkang District, Pangkajene Islands Regency.

The purposive random sampling approach was used in this study. Green mussels were picked up by hand at a seaweed farm area. To find out the number of samples to be taken, the Lemeshow's formula was used whose population was unknown [13], as follows:

$$n = \frac{Z^2 \times P(1 - P)}{d^2}$$

n = Number of samples

Z = Z score at 95% confidence = 1.96

P = Maximum estimation = 0,5

d = alpha (0,10) or sampling error= 10%

Based on Lemeshow's formula, it was known that the minimum sample taken was 96 samples, but we took 99 samples of green mussel. The 99 samples were then divided into three groups based on the length of the green mussel shell, which were, the mussel group associated with epibiont with microplastic on epibiont, the mussel group associated with epibiont with microplastic in mussel's tissue, and the group of mussel contained microplastics that was not associated with epibiont.

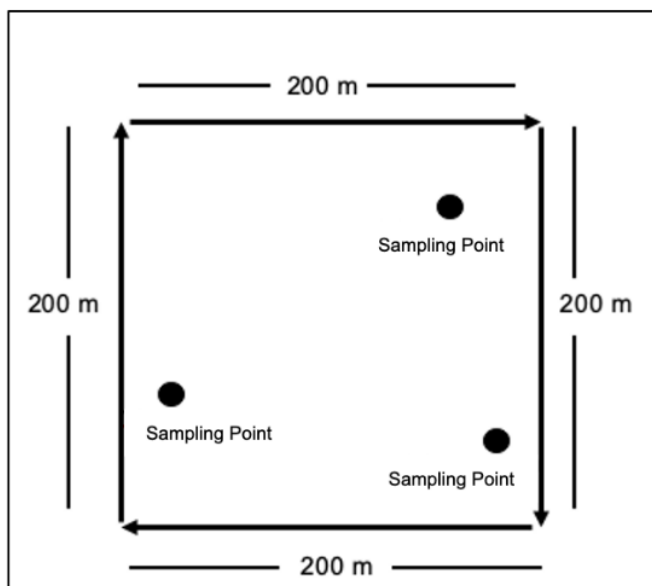


Figure 2. Water sampling illustration.

A sampling of microplastics in the waters was carried out using a neuston net (330 μm) which was towed by a boat with a towing length of 200 m [14]. After that, the water sample in the neuston net bottle was put into the sample bottle and given a station marker. After that, the water sample was stored in a cool box for further analysis in the laboratory.

2.2. Tissue digestion

All equipment used in the digestion process was sterilized with aquabidest. Before the epibiont is separated from the green mussel, identification was performed using the identification book [15]. After the epibiont was separated from the mussel, the weights of epibionts (sponge and macroalga) were measured using a digital scale. The green mussels were measured in length, width, height, and total weight using a caliper and a digital scale. The mussel tissues were separated from the shell using a scalpel and then the tissues were weighted before put into the sample bottle. The shellless epibiont was cut into pieces and put into the sample bottle. Epibiont which has a shell such as barnacles, the tissues were removed from the shell and put into a sample bottle. After that, 10% KOH solution was added to each sample bottle with a volume of three times the volume of samples [16].

2.3. Microplastic identification

After the samples were digested with KOH for three weeks, the sample solutions were filtered using a Whatman cellulose nitrate membrane filter with a pore size of 0.45 μm and a diameter of 45 mm. After that, the identification of microplastics was carried out using the visual observation method under a stereomicroscope. The parameters observed were the number, shape, size, and color of the microplastic particles. The length of the microplastic was determined using the Image J application.

3. Variable analysis

3.1. Frequency of occurrence (FO)

The frequency of occurrence of microplastics in sentinel organisms (epibiont and green mussel) is the percentage of the number of sentinel organisms identified as containing microplastics. The frequency of occurrence is calculated based on the Frequency of occurrence formula [17] as follows:

$$FO : \frac{\text{The number of sentinel organisms containing microplastics}}{\text{The total number of sentinel organisms observed}} \times 100\%$$

3.2. Microplastic concentration

The concentration of microplastics in sentinel organisms is the microplastic content found in sentinel organisms and is expressed in units of item/g. The concentration of microplastics is obtained by dividing the number of microplastic particles in sentinel organisms by the weight of the sentinel organisms [11]:

$$\text{Microplastic concentration (items/g)} = \frac{\text{The number of microplastics in sentinel organisms}}{\text{The weight of the sentinel organism}}$$

3.3. Statistical analysis

Statistical analysis was performed using the one-way ANOVA test to analyze the comparison of microplastic concentrations in sentinel organism groups. To analysis between two shapes of microplastics, the Student T-test was performed. The ANOVA and the student T-test were run using the Graphpad Prism software.

4. Results and discussions

4.1. Microplastics in the epibiont of green mussel (*Perna viridis*)

Epibionts associated with green mussels are sponges, *Clathria (Microciona) atrasanguinea*, macroalgae, *Gracilaria* sp, and barnacles, *Balanus* sp. Barnacles are the predominant organisms found in research as epibionts. On the island of Baranglompo, the barnacles were also found to be the dominant epibionts [18]. These epibionts were contaminated with microplastics. The microplastics found in epibionts associated with a green mussel in Maccini Baji Waters, Labbakang District, Pangkajene Islands Regency were microplastics in the form of fibers and fragments in black, white, blue, and red colors which can be seen in Figure 3. The contamination of the epibionts with microplastics is a result of plastic waste from community activities around Maccini Baji waters which are disposed of by the community. The existence of plastic waste in these waters has been around for a long time so that macro plastic waste was degraded into microplastics. Most of the community work as fishermen and seaweed farmers. The activity of seaweed farmers who use plastic ropes and bottles in the seaweed cultivation process was also one of the contributors to microplastics in the waters. In addition, the existence of a port which, was used as a place for crossing between islands was also very potential as a contributor to microplastic pollution.

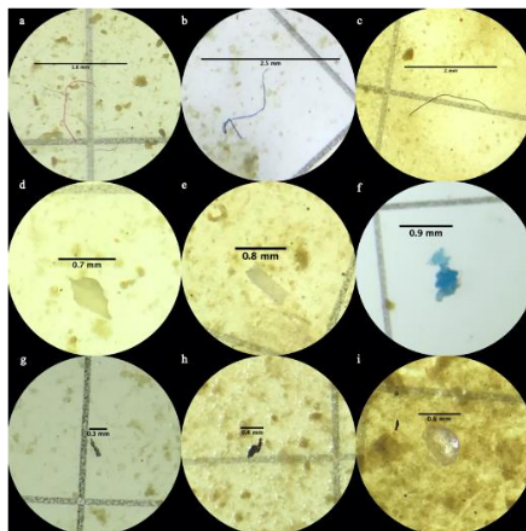


Figure 3. Microplastics we found in epibionts associated with green mussels (*Perna viridis*). (a-c) microplastic in the form of fibers, (d-i) microplastic in the form of fragments.

The length of the microplastics found in the entire study sample in Maccini Baji waters, Labakkang District, Pangkajene Islands Regency was in the range of 0.1 mm - 4.9 mm. This indicates that epibionts can absorb small and large microplastics. Microplastics were found in epibionts due to the feeding behavior of epibionts such as barnacles and sponges by filtering the water so that the microplastics in the waters can enter the body. According to research by Yu and co-workers, microplastics were found in the larvae of barnacles [19]. The discovery of microplastics in epibionts from seaweed species confirmed the research of Li and co-workers who have observed microplastic contamination in the production of seaweed *Pyropia* spp [20].

4.2. Frequency of occurrence (FO)

The frequency of occurrence (FO) of microplastics indicates the number of identified green mussels and epibionts containing microplastic particles. The total numbers of samples of green mussels in this study were 99 samples. Green mussel samples associated with epibionts were 83 samples and 16 samples were not associated with epibionts. Of the 83 samples, it was found that 53 samples contained microplastics with 7 samples whose microplastics were found in the tissue of green mussel and 46 samples whose microplastics were found in epibionts. 16 samples of green mussels that were not associated with epibionts, 11 of which contained microplastics.

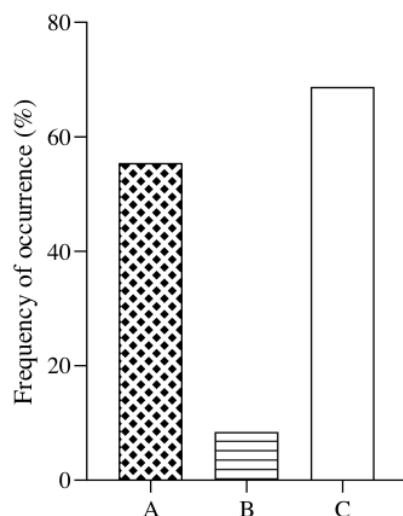


Figure 4. The percentage of frequency of occurrence of microplastics in various groups of green mussel-epibiont association. Green mussels associated with epibionts with microplastics in epibionts (A); Green mussels associated with epibionts with microplastics on mussels tissue (B); Green mussels not associated with epibionts and contain microplastics (C).

The frequency of occurrence of microplastics in the group of green mussels associated with epibionts with microplastics in epibionts (A) was found to be 55.42% contaminated with microplastics. Meanwhile, the group of green mussels associated with epibionts with microplastics on mussels tissue (B) was found to be 8.43% contaminated with microplastics. This indicates that microplastics are filtered more by epibiont than by green mussels if calculated based on the green mussels group associated with epibiont alone. From the data, it can also be seen that the FO percentage of microplastics in green mussel without epibiont (C) was the highest among all groups, 68.75%. This indicates that epibionts can reduce microplastic contamination in green mussels. In addition, this FO data showed that ecologically the presence of epibionts in green mussel indicates interspecific competition for food between the two entities [21,22].

4.3. Microplastic concentration

Microplastic concentration data on epibionts can be seen in Figure 5. The average value of microplastic concentrations in the three groups; green mussels associated with epibionts with microplastics in epibionts (A), green mussels associated with epibionts with microplastics on mussels tissue (B), green mussels not associated with epibionts and contain microplastics (C) respectively 3,629 items/g, 0, 7160 items/g, 1,032 items/g. The results of statistical tests showed that the concentration of microplastics in groups A, B, and C showed significant differences ($p < 0.005$). Group A was different from B and C. However, there was no statistically significant difference between B and C. This showed that epibionts have a major role in reducing microplastics that will enter or expose green mussels.

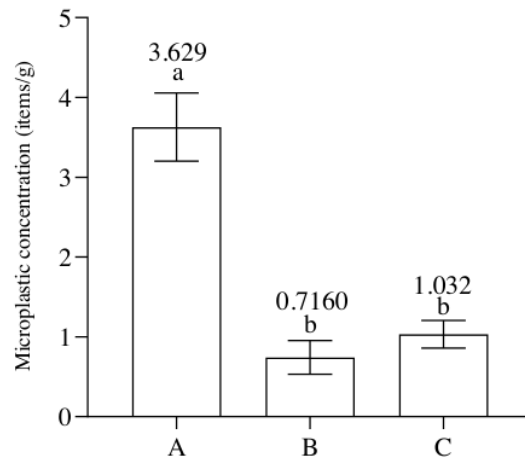


Figure 5. Comparison of microplastic concentrations in various groups of green mussel-epibiont association. Green mussels associated with epibionts with microplastics in epibionts (A); Green mussels associated with epibionts with microplastics on mussels tissue (B); Green mussels not associated with epibionts and contain microplastics (C). Different letters indicate significant differences ($p < 0.05$).

4.3.1. Shape of microplastic.

Based on the observations of all samples, it was found that there were two forms of microplastic particles, namely fiber, and fragments. The average value of the concentration of the microplastic form in the green mussels group associated with epibionts with microplastics in epibionts (A) in the fiber was 1,845 items/g and the fragments were 4,435 items / g, green mussels associated with epibionts with microplastics on mussels tissue (B) the fiber of 0.7833 items/g and fragments of 0.232 items/g, and green mussels not associated with epibionts and contain microplastics (C) in the fiber of 1.2012 items/g and fragments of 0.9772 items/g.

In group the fragment concentration was greater than the fiber concentration statistically ($p < 0.005$). In group B the data could not be analyzed statistically because the data did not meet the requirements in terms of the amount of data. Descriptively it appears that there were more fibers than fragments. This depicted that green mussels filter the fibers more than fragments because the fragments have been filtered by epibiont. This analysis was supported by data on group C, which in group C microplastics were counted on green mussel only. The results showed that there were no significant differences between fiber and fragment concentrations. This means that the presence of epibionts in green mussels affected the type of microplastic that was filtered by green mussels. In addition, if we looked closely at the data for group A, the data also supported the data for group B that showed epibionts reduce green mussel filtration of microplastics in the form of fragments. Therefore, it could be emphasized that the existence of epibiont affected the filtration activity of green mussels on microplastics, which ultimately reduced the concentration of microplastics in green mussels.

The research of Wahdani and co-workers found microplastics in the form of fibers and fragments in the bivalve body, *Venerupis philippinarum* which was found in Maccini Baji Waters [7]. Fiber that has a long and thin form can come from ropes, clothing fibers, fishing gears such as fishing gears, and fishing rods [5]. Fragments are hard particles with irregular shapes [23]. Fragments come from plastic waste, such as in plastic packaging materials, plastic bags, and agricultural tools.

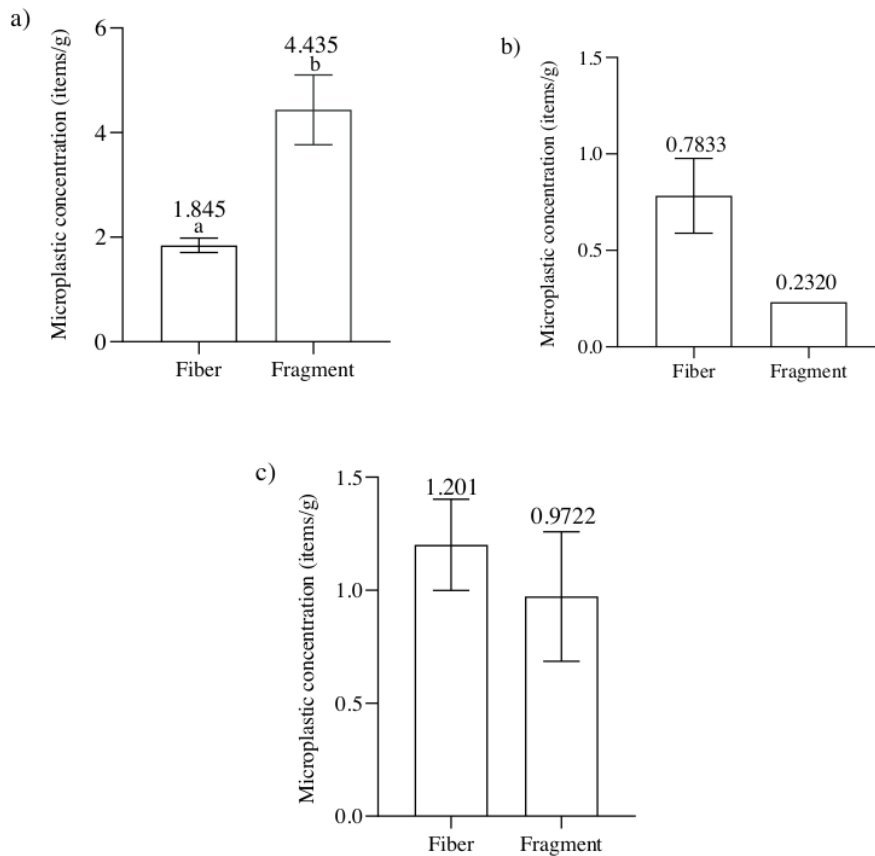


Figure 6. The concentration of microplastics is based on the shape of the microplastic. Green mussels associated with epibionts with microplastics in epibionts (A); Green mussels associated with epibionts with microplastics on mussels tissue (B). Statistical analysis was not performed on data B, because the data were not sufficient for statistical analysis; Green mussels are not associated with epibionts and contain microplastics (C). Different letters indicate significant differences ($p < 0.05$).

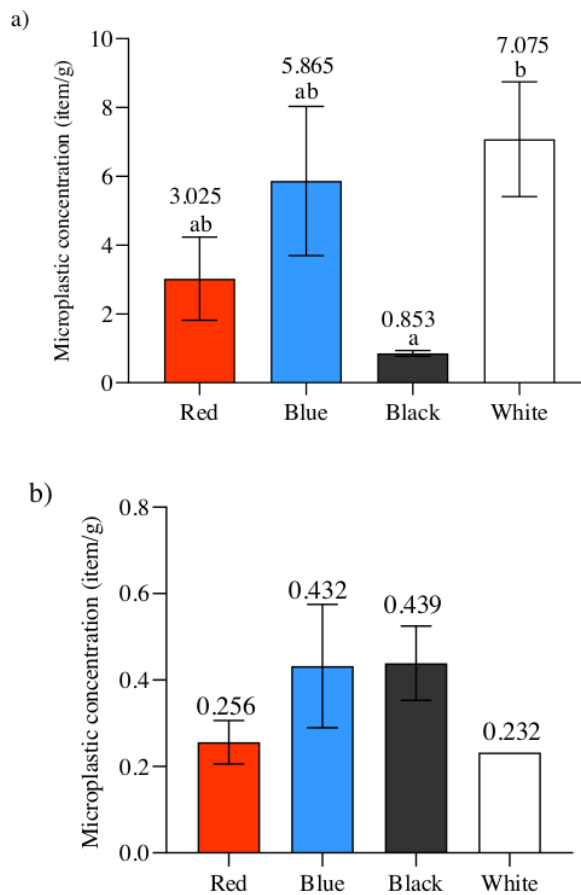
4.3.2. Microplastic Color.

The color of microplastic particles found in the green mussels group associated with epibionts with microplastics in epibionts (A) was red, blue, black, and white, with an average value of microplastic concentrations respectively 3.025 items/g, 5.865 items/g, 0.853 items/g, and 7.075 items/g. From the results of statistical analysis, there was only a significant difference between white and black. This was consistent with the research of Jiang and co-workers who found that white microplastic is the color more than black, red, and blue [24].

The average value of the concentration of color-based microplastics in the green mussels associated with epibionts with microplastics on mussels tissue (B) group was 0.256, 0.432, 0.439, and 232 items/g, respectively for red, blue, black, and white. In group B, no statistical analysis was carried out because the data did not meet the requirements for statistical analysis in terms of the amount of data

on the white color of microplastics. Then the average values of green mussels are not associated with epibionts and contain microplastics (C), namely 0.761, 1063, 0.811, and 0.729 items/g respectively for red, blue, black, and white. The results of statistical analysis depicted that there were no significant differences between the colors of the microplastics. The absence of a significant difference in the concentration of color-based microplastics was not related to the preference of green mussels and epibionts on the color of the microplastics, because the two types of organisms carried out the filtration activity on whatever was in front of their inhalant.

The color of the microplastic can provide information about the source of plastic waste or the condition of the microplastic [23]. The difference in the color of the microplastics that was found was influenced by the plastic waste around the sampling location. The blue and red colors are artificial colors that are produced from the production of plastic factories [25]. The results of Manalu's research indicate that the microplastic color found in the study could be the original color of the microplastic or the color of the degradation that occurs due to the release of the original color caused by photochemical processes and other processes that occur in the water [26].



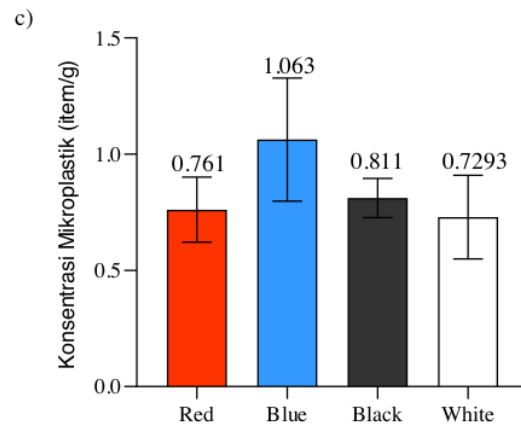


Figure 7. Microplastic concentration based on color. Green mussels associated with epibionts with microplastics in epibionts (A); Green mussels associated with epibionts with microplastics on mussels tissue (B). Data B was not subjected to statistical analysis, because the data did not meet the requirements for statistical analysis; Green mussels are not associated with epibionts and contain microplastics (C). Different letters indicate significant differences ($p < 0.05$).

4.4. Microplastics in water

The results of observing water samples from four different points indicated that the waters of the research location contained microplastics. Figure 8 shows examples of microplastics found in water samples. The forms of microplastic particles found in water samples were fibers and fragments in blue, red, white, and black. The average value of the concentration of microplastics in the water sample is 1.0848 items/m³. The microplastic particles found in the water samples showed similarities to the microplastic particles found in epibiont and green mussel, both in terms of shape and color.

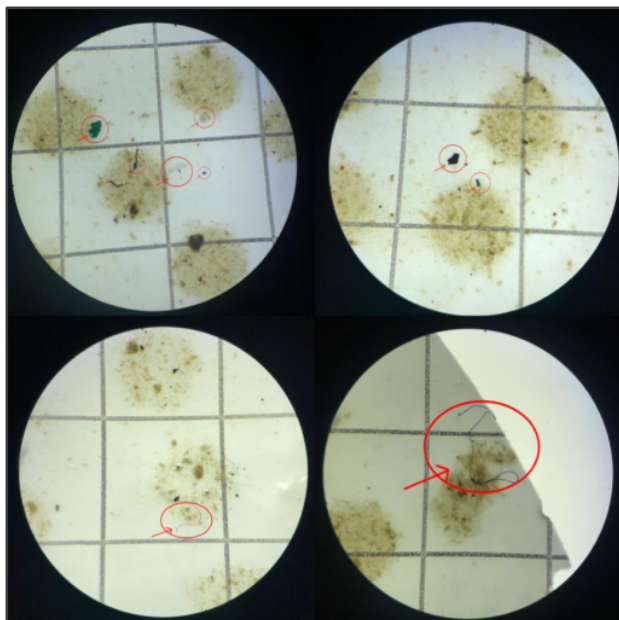


Figure 8. Microplastics in water samples.

5. Conclusion

Based on the research results, it could be concluded that:

- (1) Epibionts associated with green mussels in Maccini Baji Waters, Labakkang District, Pangkajene Archipelago Regency were contaminated with microplastics. Microplastic particles found in water, epibionts, and green mussels were fibers and fragments in red, blue, black, and white colors. The microplastics found ranged from 0.1 mm to 4.9 mm in size.
- (2) The frequency of occurrence of microplastics in the group of green mussels associated with epibionts with microplastics in epibionts (A); green mussels associated with epibionts with microplastics on mussels tissue (B), green mussels not associated with epibionts and contain microplastics (C) were 55.42, 8.43, and 68.75% respectively.
- (3) The presence of epibiont in green mussel shells is ecologically a competitor for green mussel, but ecotoxicologically it can reduce exposure to green mussel microplastics.

Acknowledgment

The authors would like to thank Prof. Nanit (Joeharnani Tresnati), and Dr. Hasni Aziz for permitting us to do sample analysis in their laboratories.

References

- [1] Nasution R S 2015 Berbagai cara penanggulangan limbah plastik *Elkawnie J. Islam. Sci. Technol.* **1** 97–104
- [2] Thompson R C 2006 Plastic debris in the marine environment: consequences and solutions *Mar. Nat. Conserv. Eur.* **193** 107–15
- [3] Storck F R, Kools S A E and Rinck-Pfeiffer S 2015 Microplastics in fresh water resources *Glob. Water Res. Coalition, Stirling, South Aust. Aust.*
- [4] Ayuinytyas W C, Yona D, Julinda S H and Iranawati F 2019 Kelimpahan mikroplastik pada perairan di Banyuurip, Gresik, Jawa Timur *JFMR (Journal Fish. Mar. Res.* **3** 41–5
- [5] Claessens M, Van Cauwenberghel L, Vandegehuchte M B and Janssen C R 2013 New techniques

- for the detection of microplastics in sediments and field collected organisms *Mar. Pollut. Bull.* **70** 227–33
- [6] Sun X, Li Q, Zhu M, Liang J, Zheng S and Zhao Y 2017 Ingestion of microplastics by natural zooplankton groups in the northern South China Sea *Mar. Pollut. Bull.* **115** 217–24
- [7] Wahdani A, Yaqin K, Rukminasari N, Inaku D F and Fachruddin L 2020 Konsentrasi Mikroplastik pada Kerang Manila *Venerupis philippinarum* di Perairan Maccini Baji, Kecamatan Labakkang, Kabupaten Pangkajene Kepulauan, Sulawesi selatan *Maspari J. Mar. Sci. Res.* **12** 1–14
- [8] Railkin A I 2004 *Marine biofouling: colonization processes and defenses* (Florida: CRC Press)
- [9] Hamzah M S and Nababan B 2009 Studi pertumbuhan dan kelangsungan hidup anakan kerang mutiara (*Pinctada maxima*) pada kedalaman beberapa di teluk Kapontori, pulau Buton *E-Jurnal Ilmu dan Teknol. Kelaut. Trop.* **1** 22–3
- [10] Sulistiawan N Asosiasi Teritip (*Balarus* spp.) pada Komunitas Kerang Hijau yang Dipelihara di Muara Kamal, Jakarta
- [11] Khoironi A and Anggoro S 2018 The existence of microplastic in Asian green mussels *IOP Conference Series: Earth and Environmental Science* vol 131 (IOP Publishing) p 12050
- [12] Ramli R, Yaqin K and Rukminasari N 2021 Microplastics contamination in green mussels *Perna viridis* in Pangkajene Kepulauan Waters, South Sulawesi, Indonesia *Akuatikisle J. Akuakultur, Pesisir dan Pulau-Pulau Kecil* **5** 1–5
- [13] Lemeshow S, Hosmer D W, Klar J and Lwanga S K 1997 Besar sampel dalam penelitian kesehatan *Yogyakarta Gajah Mada Univ.*
- [14] Ogunola O S and Palanisami T 2016 Microplastics in the marine environment: current status, assessment methodologies, impacts and solutions *J Pollut Eff Cont* **4** 2
- [15] Wischart G D, Rempala E C and Leboffe M J 2012 *A photographic atlas of marine biology* (Morton Publishing Company)
- [16] Rochman C M, Tahir A, Williams S L, Baxa D V., Lam R, Miller J T, Teh F C, Werorilangi S and Teh S J 2015 Anthropogenic debris in seafood: Plastic debris and fibers from textiles in fish and bivalves sold for human consumption *Sci. Rep.* **5** 1–10
- [17] Krebs C J 1989 *Ecology: The experimental analysis of distribution and abundance* (New York: Harper and Row, Publisher. New York)
- [18] Ruslan A F 2014 Kepadatan dan keragaman macrobiofouling pada dermaga beton dan dermaga kayu di Pulau Balanglombo *Kec. Mattiro Sompe. Kabupaten Pangkep. Skripsi. Makassar Fak. Ilmu Kelaut. dan Perikanan. Univ. Hasanuddin*
- [19] Yu S-P and Chan B K K 2020 Intergenerational microplastics impact the intertidal barnacle *Amphibalanus amphitrite* during the planktonic larval and benthic adult stages *Environ. Pollut.* **267** 115560
- [20] Li Q, Feng Z, Zhang T, Ma C and Shi H 2020 Microplastics in the commercial seaweed nori *J. Hazard. Mater.* **388** 122060
- [21] Lesser M P, Shumway S E, Cucci T and Smith J 1992 Impact of fouling organisms on mussel rope culture: interspecific competition for food among suspension-feeding invertebrates *J. Exp. Mar. Bio. Ecol.* **165** 91–102
- [22] Laihonen P and Furman E R 1986 The site of settlement indicates commensalism between blue mussel and its epibiont *Oecologia* **71** 38–40
- [23] GESAMP 2019 *Guidelines for the monitoring and assessment of plastic litter in the ocean* (United Nations Environment Programme (UNEP))
- [24] Jiang C, Yin L, Li Z, Wen X, Luo X, Hu S, Yang H, Long Y, Deng B and Huang L 2019 Microplastic pollution in the rivers of the Tibet Plateau *Environ. Pollut.* **249** 91–8
- [25] Azizah P, Ridlo A and Suryono C A 2020 Mikroplastik pada Sedimen di Pantai Kartini Kabupaten Jepara Jawa Tengah *J. Mar. Res.* **9** 326–32
- [26] Manalu A A 2017 *Kelimpahan Mikroplastik di Teluk Jakarta* (Tesis. Sekolah Pascasarjana)

The concentration of microplastics in epibiont of green mussel (Perna viridis) from Maccini Baji waters, Pangkajene Kepulauan

ORIGINALITY REPORT

8%

SIMILARITY INDEX

5%

INTERNET SOURCES

6%

PUBLICATIONS

%

STUDENT PAPERS

PRIMARY SOURCES

- 1** Dede Falahudin, Muhammad Reza Cordova, Xiaoxia Sun, Deny Yogaswara, Ita Wulandari, Dwi Hindarti, Zainal Arifin. "The first occurrence, spatial distribution and characteristics of microplastic particles in sediments from Banten Bay, Indonesia", *Science of The Total Environment*, 2020
Publication 2%
- 2** dk.um.si
Internet Source 1%
- 3** www.semanticscholar.org
Internet Source 1%
- 4** centaur.reading.ac.uk
Internet Source 1%
- 5** Hawu Yogia Pradana Uly, Djoko Budiyanto Setyohadi. "A Usability Testing Approach on A Boarding House Search Website in Kupang City Using The Nielsen Heuristic Method", 2021 7th International Conference on 1%

Electrical, Electronics and Information Engineering (ICEEIE), 2021

Publication

6	garuda.kemdikbud.go.id Internet Source	1 %
7	scholar.ufs.ac.za:8080 Internet Source	1 %
8	Kyungsik Choi. "Pedogenesis of late Quaternary deposits, northern Kyonggi Bay, Korea: Implications for relative sea-level change and regional stratigraphic correlation", <i>Palaeogeography, Palaeoclimatology, Palaeoecology</i> , 2005 Publication	1 %

Exclude quotes On

Exclude matches < 20 words

Exclude bibliography On