Mussel Fish (Polymesoda Erosa) and Microplastics inTallo River, Makassar, Indonesia

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Abstract

Background: Microplastics are plastic particles whose diameter is less than 5 mm, which can be a problem for the environment and public health.

This study aimed to determine the Mussel Shellfish's microplastic content (Polymesodaerosa) in the Tallo Makassar River.

Methods: This type of research is observational with a laboratory approach using Minitab 16 software to determine the microplastic content of Mussel Shellfish(Polymesoda erosa) in the Tallo Makassar River.

Results: The results of this study indicated that the abundance of microplastics in the Mussel Shellfish (Polymesodaerosa) at station 1 was 3.8 Mps/Ind, while at station II and station III was 0.8 Mps/Ind. For contaminants, station 1 was 80%, station II was 60%, and station III was 40%. The most types of microplastics were line and fragment types, while the most common microplastics found were blue, red and transparent.

Conclutions: Mussel Shellfish (Polymesodaerosa) originating from the Tallo Makassar River contain microplastics. The highest abundance of microplastics was at station I of 3.8 Mps/Ind, while stations II and III were at 0.8 MPs/Ind. Station I is 80% for contaminants, Station II is 60%, and Station III is 40%.

***Keywords**: Microplastic, Mussel Shellfish(Polymesoda erosa), abundance, contamination*

Introduction

Garbage is the biggest problem in the world because until now, it has not appropriately resolved. Garbage causes environmental pollution both on land and at sea, for example, plastic waste that damages marine waters because it can threaten marine life's living conditions to become extinct. [1]. Plastic waste, which is generally only used once, has become a global environmental problem. Plastic waste in nature can decompose into microplastics.[2]

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Microplastics are plastic particles with a diameter of less than 5 mm [3].Microplastics are plastic particles with a diameter of less than 5 mm. The limit that the particle size included in the microplastic group has not defined with certainty, but most studies have taken objects of at least 300 μm[4]. Microplastics divided into two categories, namely large (1-5 mm) and small (<1 mm) sizes. Microplastics weigh 0.1-8.8 mg with dominant blue angular particles and have a length of less than 5 mm[5].Research conducted by Bai and Li on China's coast, the results obtained from 263 shells examined, there were 26 species of commercial shellfish. 32.7% identified to ingest more than one type of microplastic. Of all the shellfish types discussed, 63.5% were Blood Shells, and 36.5% were Feather Shells. A total of 73 types of microplastics identified, 48 (65.8%) were fibres, and 25 (34.2%) were fragmented, the rest were polymers (polypropylene, polyethene, alkyd resin, rayon, polyester, nylon and acrylic)[6].

Microplastics can be a more severe threat than large plastic materials as organisms that inhabit lower trophic levels, such as plankton. Which have particles susceptible to the digestion process of microplastics as a result of which they can affect high-level tropical organisms through the bioaccumulation process[7]. Laboratory test results show that marine organisms can dig microplastics when one of the microplastic particles can resemble food[8].

Microplastic pollution also occurs in Indonesia. Research conducted by Hardianti Dian in Jakarta Bay on Green Shells, the results obtained by microplastics in shellfish are 15.5-75 particles/gr [9]. Inspires researchers to research the microplastic content of Mussel Shellfish (Polymesodaerosa) in the Tallo Makassar River because Makassar is the largest producer of shellfish and fish in South Sulawesi.[10]

This study aimed to determine the microplastic content of the Mussel Shellfish (Polymesodaerosa) in the Tallo Makassar River.

Materials ad Methods

Location and Time of Research

This type of research was an observational study with a laboratory approach using Minitab 16 software to determine the Mussel Shellfish's microplastic content (Polymesodaerosa). The location of this research is on the Tallo Makassar River. This research conducted from August-November 2020.

Sampling

Sampling using grab sampling where the shellfish samples are put into a bucket and then closed. Besides, interviews were also conducted with local fishers to determine the fishing location and types of consumed shellfish.

Identification of Microplastics in Shells

All equipment sterilized with acetone and distilled water, Shell samples identified using shell base. First, dilution water one and KOH by 20%. The clams cleaned from the attached mud, and then the shells' length and height are measured, after which the shells weighed using an electric scale to determine the weight of the shells, using the shell and without the shell (shellfish).

The identified shells were then put into a sample bottle and diluted by adding a mixture of water one and KOH, after which the shells left to stand for 14 days (2 weeks) so that the shellfish crushed. After 14 days (2 weeks), the shells that had been crushed and mixed with a solution of water one and KOH were then observed under a microscope using a stained plate. The visible particles were pricked with a needle to ensure that they were microplastic, and observed by type (fibre, films, fragments, pellets) and their colours using a stereomicroscope. Furthermore, the microplastics obtained were counted, photographed with optic lab, and then measured with image raster software[11].

Kingdom : Animalia

Phylum : Mollusca

Classis : Bivalvia

Sub Classis : Euheterodonta

Ordo : Veneroida

Picture: Mussel Shellfish(Polymesodaerosa)

Data Analysis Processing

Data analysis used descriptive statistical analysis to determine the number of microplastics between stations. Data analysis carried out, namely a laboratory approach using Minitab 16 software.

Results

Microplastics in Shells

The microplastic content found in Mussel Shellfish (Polymesoda erosa)in the Tallo Makassar River.

e. Amount of Microplastics

Table 1: Distribution of Microplastics in Mussel Shellfish (Polymesoda erosa)Based on the Amount in the Tallo Makassar River

Station	Sample Code	(Mps/Ind)
Station I	1	11
	2	4
	3	2
	4	2
	5	0
Station II	6	1
	7	0
	8	2
	9	1
	10	0
Station III	11	0
	12	0
	13	0
	14	1
	15	3
Total		27

Source: Primary Data, 2020

b. Abundance of Microplastics

Table 2: Distribution of Microplastics inMussel Shellfish(Polymesoda erosa)Based on Abundance in the Tallo Makassar River

Station	Abundance (Mps/Ind)
I	3,8
II	0,8
III	0,8

Source: Primary Data, 2020

c. Microplastic Contamination

Table 3: Distribution of Microplastics in Mussel Shellfish(Polymesoda erosa)Based on Contaminants in the Tallo Makassar River

Station	% Contamination
1	80
2	60
3	40
Contamination of all samples	60

Source: Primary Data, 2020

d. Types of Microplastics

Table 4: Distribution of Microplastics in Mussel Shellfish(Polymesoda erosa) by Type in the Tallo Makassar River

Type MP	Station I	Station II	Station III	Amount
Fragmen	1	4	0	5
Line	14	0	2	16
Foam	2	0	1	3
Film	2	0	1	3
Total				27

Source: Primary Data, 202

e. Microplastic Size

Table 5: Distribution of Microplastics in Mussel Shellfish(Polymesoda erosa)Based on Size in the Tallo Makassar River

Station	Sample Code	Size (mm)	Amount
StationI	1	0,846	11
		0,615	
		0,36	
		0,576	
		1,503	
		4,153	
		1,594	
		1,227	
		0,26	
		0,347	
		0,364	
	2	0,85	4
		0,425	
		0,357	
		1,629	
	3	4,089	2
		1,158	
	4	4,258	2
		3,64	
	5	-	-
Station II	6	0,547	1
	7	-	-
	8	4,696	2
		1,769	
	9	1,051	1
	10	-	-
Station III	11	-	-
	12	-	-
	13	-	-
	14	0,799	1
	15	3,161	3
		3,463	
		0,908	

Source: Primary Data, 2020

f. Microplastic Color

Table 6: Distribution of Microplastics in Mussel Shellfish(Polymesoda erosa) Based on Color in the Tallo Makassar River

Color	Station I	Station II	Station III	Amount
Blue	5	0	1	6
Red	4	0	1	5
Transparent	2	4	0	6
Black	2	0	0	2
Chocolate	3	0	1	4
Green	1	0	0	1
Gray	2	0	1	3
Total				27

Source: Primary Data, 2020

Table 1 shows that the highest number of microplastics is at code 1 as much as 11 Mps/Ind, while the sample codes 5,7,10,11,12 and 13 are not detected.

Table 2 shows that the highest abundance of microplastics is at station I as much as 3.8 MPs/Ind, while the lowest at stations II and III is 0.8 MPs/Ind.

Table 3 shows that most microplastic contaminants are at station I as much as 80% while the smallest is at station III as much as 40%.

Table 4 shows that the most types of microplastic fragments were at station II, namely 4, while station III was not detected. For the microplastic line type, the highest number was at station I as many as 14, while station II was not detected. The most types of foam microplastics were at station I, namely 2, while at station II, it was undetectable. The most types of microplastic films were at station I, namely 2, while at station II, it not detected.

Table 5 shows that the most extended microplastic size in sample code 8 is 4.698 mm, while sample codes 5,7,10,11,12 and 13 are not detected.

Table 6 shows that blue microplastics are mostly found at station I as many as 5, while station II is undetectable. For red microplastics, mostly found at station I as many as 4, station II was undetectable. For transparent microplastics, the most found at station II was 4, while station III was undetectable. The most found at station I were 2, while stations II and III not detected for black microplastics. The most found was at station I as many as 3, while station II was undetectable for brown microplastics. For green microplastics, only 1 station found while stations II and III were not detected. For grey microplastics, the most found at station I is 2, while station II is undetectable.

Discussion

Microplastics that enter the body of biota such as shellfish can damage the digestive tract, reduce growth rates, inhibit enzyme production, reduce steroid hormone levels, affect reproduction, and cause exposure to plastic additives with more significant toxicity properties.[12]. Microplastics can also function as pathogenic factors, potentially bringing microbial species into the waters, microplastics that have contaminated biota at various trophic levels. There is concern that debris from the adopted plastics or chemicals can accumulate at lower trophic levels. Furthermore, the lower trophic level organisms consumed, biomagnification can occur at a higher trophic level; this will affect human health.[13]

The research results from the three stations showed that the Mussel Shellfish (Polymesodaerosa) contained microplastics. However, there were some undetected codes. This research was because the sampling locations for Mussel Shellfish (Polymesodaerosa) were around residential areas, shrimp ponds and industrial activities. Station I, has a higher abundance of 3.8 MPs/Ind than stations II and III, namely 0.8 MPs/Ind. This research happens because Station 1 is close to a residential area where the amount of plastic waste is enormous compared to stations II and III. This research is in line with Garth A. Covernton at all in Columbia, namely, on shells (oysters) taken around residential areas, the results obtained by an average of 0.05 vs. 0.03 Mps more than other locations[14].

The small microplastics (≤ 5 mm) allows high potential microplastics to digested by various marine organisms[15]. Microplastics ingested by shellfish or marine organisms will impact these marine organisms, both physically and chemically. If ingested, microplastics can pass through the intestines or can be retained in the digestive tract [13].

Line and fragment microplastics were mostly found in each station, while the dominant colours were blue, red and transparent. These results align with Li Jiana et al. in China, which examined microplastics in commercial shellfish. The results obtained were the average types of microplastics found in shellfish, namely line, fibre, fragments, and pellets. This microplastic type can form knots or clots and can be dangerous because the fibre can block the digestive tract and block food entry[16]. If plastic particles accumulate in large numbers in small animals' intestines, it will have the same effect as large plastic waste and clog the digestive system[1]. Accumulated waste in the digestive tract can cause a false sense of fullness. This causes shellfish to experience a decrease in appetite [17]. There is also concern that if ingested by organisms, small objects from plastic waste might facilitate the transportation of chemical contaminants [18].

Microplastics found in marine life such as shellfish, of course, will have an impact when consumed by humans [19].Health impacts that can arise are intestinal, stomach disorders (irritation), and plastics' chemicals can trigger cancer cells' growth[20].

Conclusion

Mussel Shellfish (Polymesodaerosa) originating from the Tallo Makassar River contain microplastics. The highest abundance of microplastics was at station I of 3.8 Mps/Ind, while stations II and III were at 0.8 MPs/Ind. Station I is 80% for contaminants, Station II is 60%, and Station III is 40%.

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References

1. Kershaw P, Katsuhiko S, Lee S, Samseth J, Woodring D, Smith J. Plastic Debris in the Ocean. UNEP Year Book 2011. 2011. 20–33 p.
2. Wright SL, Kelly FJ. Plastic and Human Health: A Micro Issue? Environ Sci Technol. 2017;51(12):6634–47.
3. Crawford CB, Quinn B. Microplastic collection techniques. In: Microplastic Pollutants. 2017.
4. Peng G, Zhu B, Yang D, Su L, Shi H, Li D. Microplastics in sediments of the Changjiang Estuary, China. Environ Pollut. 2017;
5. Horton A. Microplastics in the Freshwater Environment. Found water Res. 2017;44.
6. Bai M, Li D. Quantity of plastic waste input into the ocean from China based on a material flow analysis model. Anthr Coasts. 2020;3(1):1–5.
7. Maes T, Van der Meulen MD, Devriese LI, Leslie HA, Huvet A, Frère L, et al. Microplastics baseline

surveys at the water surface and in sediments of the North-East Atlantic. Front Mar Sci. 2017;

8. Kaberi H, Zeri C, Mousdis G, Papadopoulos A, Streftaris N. Microplastics along the shoreline of a Greek island (Kea isl., Aegean Sea): types and densities in relation to beach orientation, characteristics and proximity to sources. Proc 4th Int Conf Environ Manag Eng Plan Econ SECOTOX Conf Mykonos island, Greece June 24-28, 2013. 2013;
9. Hardianti D. Mikroplastik pada Kerang Hijau di Teluk Jakarta [Internet]. 2019. Available from: http://repository.unsri.ac.id/id/eprint/10733
10. Sekretariat Jenderal Kementerian Kelautan dan Perikanan. Laporan tahunan 2018. Indonesia; 2018.
11. Oceanic N. Laboratory Methods for the Analysis of Microplastics in the Marine Environment : Recommendations for quantifying synthetic particles in waters and sediments. 2015;(July).
12. Lenz R, Labrenz M. Small microplastic sampling in water: Development of an encapsulated filtration device. Water (Switzerland). 2018;10(8).
13. Clunies-Ross PJ, Smith GPS, Gordon KC, Gaw S. Synthetic shorelines in New Zealand? Quantification and characterisation of microplastic pollution on Canterbury's coastlines. New Zeal J Mar Freshw Res. 2016;50(2):317–25.
14. Covernton GA, Collicutt B, Gurney-smith HJ, Pearce CM, Dower JF, Ross PS, et al. Microplastics in bivalves and their habitat in relation to shellfish aquaculture proximity in coastal British Columbia , Canada. 2019;11:357–74.
15. Carbery M, O'Connor W, Palanisami T. Trophic transfer of microplastics and mixed contaminants in the marine food web and implications for human health. Environ Int. 2018;115(December 2017):400–9.
16. Li J, Yang D, Li L, Jabeen K, Shi H. Microplastics in commercial bivalves from China. Environ Pollut. 2015;
17. Arthur C, Baker J, Bamford H. Proceedings of the International Research Workshop on the Occurrence , Effects , and Fate of Microplastic Marine Debris. Group. 2009;(January):530.
18. Kooi M, Reisser J, Slat B, Ferrari FF, Schmid MS, Cunsolo S, et al. The effect of particle properties on the depth profile of buoyant plastics in the ocean. Sci Rep. 2016;
19. Kleinteich J, Seidensticker S, Marggrander N, Zarf C. Microplastics reduce short-term effects of environmental contaminants. part II: Polyethylene particles decrease the effect of polycyclic aromatic hydrocarbons on microorganisms. Int J Environ Res Public Health. 2018;
20. SAPEA. A Scientific Perspective on Microplastics in Nature and Society. In: II. 2019.