Microplastic Contents in Kijing Shells (Pilsbryoconchaexilis) in Tallo Makassarriver, Indonesia

Yuliati[1], Anwar Daud[2], Anwar Mallongi[2], Burhanuddin Bahar[2], Mukono[3], Mahatma Lamuru[4], Maming[5]

[1]Faculty of Public Health, Universitas Muslim Indonesia, Indonesia, [2]Faculty of Public Health, Hasanuddin University, Indonesia, [3]Faculty of Public Health, Airlangga University, Indonesia, [4]Faculty of Marine Science and Fisheries, Hasanuddin University, Indonesia, [5]Faculty of Mathematics and Natural Sciences, Hasanuddin University, Indonesia

Abstract

Background : Plastic pollution in the aquatic environment has become a global concern because of its detrimental impact on river and marine ecosystems. Plastic waste that breaks down into plastic particles of microplastic size (less than 5 mm), allows fine particles to enter the food chain and leads to humans as top predators in the food chain.

The purpose of this study was to determine the microplastic content of Kijing Shells (Pilsbryoconchaexilis) 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 Kijing Shell (Pilsbryoconchaexilis) in the Tallo Makassar River.

Results: The results of this study indicate that the abundance of microplastics in Kijing Shells (Pilsbryoconchaexilis) at station I is 5.6 Mps/Ind, station II is 2.2 Mps/Ind and station III is 1.8 Mps/Ind. For contaminants, station I was 100%, station II was 80% and station III was 60%. The most types of microplastics were line and fragment types, while the most common microplastics found were red, blue and gray.

Conclutions: Kijing Shells (Pilsbryoconchaexilis) originating from the Tallo River, Makassar contain microplastics. The highest abundance of microplastics was at station I at 5.6 Mps/Ind, station II at 2.2 Mps/Ind and station III at 1.8 Mps/Ind. For contaminants, station I was 100%, station II was 80% and station III was 60%.

***Keywords:** Microplastics, Kijing Shells (Pilsbryoconchaexilis), abundance, contamination*

Introduction

EPA (Environmental Protection Agency) 2016, states that waste originating from land enters the waters through waterways (run-off) so that it eventually becomes marine debris and causes water or sea pollution, and has the potential to threaten the health of plants and wildlife in the sea[1]. Environmental plastics come in a variety of sizes, from meters to micrometers. The smallest form of plastic waste is called microplastic[2].

Based on news released by UNEP (United Nations Environment Program) in November 2012, citing the latest World Bank report entitled "What a Waste: A Global Review of Solid Waste Management" states that the volume of world waste reaches 1.3 billion tons per year, with the amount of solid waste in big cities which will continue to increase by 70%, this volume is estimated to reach 2.2 billion tonnes by 2025[3]. Researchers at the University of Georgia, United States

Correspondence Author :
Yuliati
akibyuliati@gmail.com

led by Jenna Jambeck, in 2015 launched a ranking of countries that dump plastic waste into the sea. Estimated total 275 million Metric Tons (MT) of plastic waste produced from 192 countries around the world in 2010, it is estimated that there is between 4.8-12.7 million MT entering the open seas. Indonesia in the study is in the second position behind China and one rank above the Philippines. The three countries have something in common, namely that they are both densely populated with urban areas, and have territorial boundaries directly adjacent to the sea[4].

Microplastic pollution of the marine environment is a global problem of increasing concern. Many of these effects have not been studied and the long-term consequences remain largely unknown[5]. Additionally, the amount of plastic in the ocean is probably underestimated by a considerable amount; it is estimated that there may be 2.5 times the surface volume of plastic in the oceans, because it is mixed in the bottom of the water[6]. Research conducted by Van Cauwenberghe et al on microplastics in cultured shellfish for human consumption, identified microplastics in two shellfish species, Mytilusedulis and Crassostreagigas, found that M. edulis contained an average plastic content of 0.36 ± 0.07. particles (wet weight), while a plastic charge of 0.47 ± 0.16 particles was detected in C. Gigas[7].

Microplastic pollution also occurs in Indonesia. Research conducted by FitriIchlasiaAinulon Blood Shells (Anadaragranosa) taken from TambakLorok Semarang, the results obtained were Blood Shells (Anadaragranosa) containing microplastics of 5.1 ± 3.5 5.1 ± 3.5 particles/samples [8]. This is what inspires researchers to conduct research on the microplastic content of Kijing Shells (Pilsbryoconchaexilis) in the Tallo Makassar River because Makassar is the largest producer of shellfish and fish in South Sulawesi [9]. Based on preliminary observations, the environment around the Tallo Makassar River is partly utilized for industrial activities and residential areas. Kijing Shells (Pilsbryoconchaexilis) are one of the staple foods favored by the people around the Tallo MakassarRiver.

The purpose of this study was to determine the microplastic content of Kijing Shells (Pilsbryoconchaexilis) in the Tallo Makassar River.

Materials and Methods

Location and Time of Research

This type of research is observational with a laboratory approach using Minitab 16 software to determine the microplastic content of mussel shells (Pilsbryoconchaexilis). The location of this research is on the Tallo Makassar River. This research was conducted from August - November 2020

Sampling

Sampling using grab sampling where the clam samples are put into a bucket and then closed. In addition, interviews were also conducted with local fishermen to find out the fishing location and types of shellfish that are often consumed.

Identification of Microplastics in Shells

All equipment is sterilized with acetone and distilled water. Shell samples were identified using shellbase. First, dilution water one and KOH by 20%. The clams are cleaned from the attached mud and then the length and height of the shells are measured, after which the shells are 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 were left to stand for 14 days (2 weeks) so that the shellfish was 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 were observed by type (fiber, films, fragments, pellets) and their colors using a stereo microscope. Furthermore, the microplastics obtained were counted, photographed with optilab, and then measured with image raster software [10].The classification of Kijing Shells as follows:

Kingdom : Animalia

Phylum : Mollusca

Classis : Pelecypoda

SubClassis : Lamellibranchia

Ordo : Schizodontia

Familia : Unionidae

Genus : Pilsbryoconcha

Species : Pilsbryoconchaexilis

Picture: Kijing Shells (Pilsbryoconchaexilis)

Data Analysis Processing

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

Results

Microplastics in Shells

The microplastic content found in Kijing Shells (Pilsbryoconchaexilis)in the Tallo Makassar River.

a. Amount of Microplastics

Table 1: Distribution of Microplastics in Kijing Shells (Pilsbryoconchaexilis)Based on the Amount in the Tallo Makassar River

Station	Sample Code	(Mps/Ind)
Stasiun I	1	13
	2	6
	3	2
	4	4
	5	3
Stasiun II	6	2
	7	0
	8	2
	9	4
	10	2
Stasiun III	11	3
	12	2
	13	0
	14	3
	15	0
Total		46

Source: Primary Data, 2020

b. Abundance of Microplastics

Table 2: Distribution of Microplastics inKijing Shells (Pilsbryoconchaexilis)Based on Abundance in the Tallo Makassar River

Station	Abundance (Mps/Ind)
I	5,6
II	2,2
III	1,8

Source: Primary Data, 2020

c. Microplastic Contamination

Table 3: Distribution of Microplastics in Kijing Shells (Pilsbryoconchaexilis)Based on Contaminants in the Tallo Makassar River

Station	% Contamination
1	100
2	80
3	60
Contamination of all samples	240

Source: Primary Data, 2020

d. Types of Microplastics

Table 4: Distribution of Microplastics in Kijing Shells (Pilsbryoconchaexilis) by Type in the Tallo Makassar River

Type MP	Station I	Station II	Station III	Amount
Fragmen	6	2	2	27
Line	17	6	4	10
Foam	4	0	0	4
Film	1	2	1	4
Total				45

Source: Primary Data, 2020

e. Microplastic Size

Table 5: Distribution of Microplastics in Kijing Shells (Pilsbryoconchaexilis)Based on Size in the Tallo Makassar River

Station	Sample Code	Size (mm)	Amount
Station 1	1	0.957	16
		0.534	
		0.645	
		0.745	
		1.674	
		6.053	
		2.544	
		1.346	
		2.216	
		3.363	
		1.266	
		3.654	
		4.645	
	2	0.853	6
		0.425	
		0.357	
		1.629	
		3.463	
		5,432	
	3	6.186	2
		3.198	
	4	6.158	4
		3.154	
		2.645	
		7.321	
	5	4.321	3
		2.467	
		1.769	
StationII	6	1.051	2
		2,375	
	7	-	-
	8	3.161	2
		3.246	
	9	1.235	4
		4.345	
		1.307	
		0.329	
	10	5.385	2
		3.558	
Station 3	11	3.268	3
		2.645	
		1,467	
	12	0,234	2
		2,435	
	13	-	0
	14	4,35t	3
		2,358	
		2,085	
	15	-	0

Source: Primary Data, 2020

f. Microplastic Color

Table 6: Distribution of Microplastics in Kijing Shells (Pilsbryoconchaexilis)Based on Color in the Tallo Makassar River

Color	Station I	Station II	Station III	Amount
Blue	5	2	2	9
Red	7	2	2	11
Transparent	2	3	2	7
Black	2	1	0	3
Chocolate	3	2	1	6
Green	3	0	1	4
Gray	5	1	0	6
Total				46

Based on table 1, it shows that the highest number of microplastics is at code 1 as much as 13 Mps/Ind, while sample codes 7 and 13 are not detected.

Based on table 2, it shows that the highest abundance of microplastics is at station I as much as 5.6 MPs/Ind, station II as much as 2.2 MPs/Ind and station III as much as 1.8 MPs/Ind.

Based on table 3, it shows that the most microplastic contaminants are at station I as much as 100%, station II as much as 80% and station III as much as 60%.

Based on table 4, it shows that, the most types of microplastic fragments were at station I, namely 6, while stations II and III were not detected. For line microplastics, the highest number was at station I as many as 17, while for station III there were 4. The most types of foam microplastics were at station I, namely 4, while at stations II and III, it was not detected. The most types of microplastic films were at station II, namely 2, while at stations I and III were 1.

Based on table 5, it shows that the longest microplastic size in sample code 3 is 6.186 mm, while sample codes 7 and 13 are not detected.

Based on table 6, it shows that 5 microplastics that are blue in color are found at station I while stations II and III are found 2. For red microplastics, 7 are found at station I while stations II and III are 2. For transparent microplastics, 3 are found. at station II while stations II and III were found 2. For black microplastics, 2 were found at station I while station III was not detected. For brown microplastics, we found 3 at station I while station III found 1. For green microplastics, we found 3 at station I while station II was not detected. For gray microplastics, 5 were found at station I while station III was not detected.

Discussion

Besides being harmful to marine life, microplastics are also dangerous if they are continuously consumed by humans[11]. The number of biota does not have an influence on the large or small potential for microplastic contamination, because each biota has a susceptible response to absorption, different types of environment, and depends on different waste polymer waste[12].

The results of this study indicate that the Kijing Shells (Pilsbryoconchaexilis) taken from three stations contain microplastics even though there are 2 undetected sample codes. This was due to the location of the Kijing Shells (Pilsbryoconchaexilis) sampling location in the vicinity of residential areas, shrimp ponds and industrial activities. Station I has a higher abundance of 5.6 MPs/

Ind, station II is 2.2 MPs/Ind and station III is 1.8 MPs/Ind. This happens because Station I is close to the residential area where the amount of plastic waste is very large compared to stations II and III. This is in line with research conducted by Li et al. which was taken in the vicinity of human settlements in the estuary of China's Estuary River, the results obtained from the five mollusc species examined, the results obtained were 1.4-7.0 particles/sample and 1.5-7.2 particles/g dry weight [13].

The types of microplastics vary depending on the fiber they come from. Line and fragment microplastics were mostly found at each station in this study, while the dominant colors were red and blue. These results are in line with research conducted by Ballent et al., On shellfish, the results obtained by the average types of microplastics found in shells are line, foam and fragments [14]. Microplastics that enter the body's biota can damage the digestive tract, reduce growth rates, inhibit enzyme production, reduce steroid hormone levels, affect reproduction and can cause greater exposure to toxic plastic additives[10].Microplastics can affect ecosystems because some microplastics contain opposite to microbes components. These components are toxic to organisms such as bacteria or fungi that have an important role in the ecosystem [15].

Microplastics can also enter the human body through the food chain. Humans often consume seafood such as shellfish, fish, crab, squid and shrimp, which indirectly causes microplastics to enter the human body through these marine biota(16). Microplastic exposure can affect human health, especially in the human digestive system. Microplastics can accumulate into organisms causing physical harm, such as internal abrasions and blockages[17]. With regard to its impact, toxicity effects can arise from the release of contaminants such as addictive compounds from plastics and their monomers which can cause carcinogenesis and endocrine disorders[6].

Conclusion

Kijing Shells (Pilsbryoconchaexilis) originating from the Tallo Makassar River containmicroplastics. The highest abundance of microplastics was at station I at 5.6 Mps/Ind, station II at 2.2 Mps/Ind and station III at 1.8 Mps/Ind. For contaminants, station I was 100%, station II was 80% and station III was 60%.

Conflict of Interest: None

Source of Funding: Self

Ethical Clearance: Taken from Ethics Committee of Public Health Faculty, Hasanuddin University with Protocol Number 192193009.

References

1. Anne Murie, Mahon. Rick Officer RN and IO. Scope, Fate, Risk and Impact of Microplastic Pollution in Irish Fresshwater Systems. In: 219th ed. Wexford, Ireland;
2. SAPEA. A Scientific Perspective on Microplastics in Nature and Society. In: II. 2019.
3. 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.
4. Jambeck J, Geyer R, Wilcox C, Siegler TR, Perryman M, Andrady A, et al. the Ocean : the Ocean : 2015;347(6223):3–6. Available from: https://science.sciencemag.org/CONTENT/347/6223/768.abstract
5. Horton AA, Dixon SJ. Microplastics: An introduction to environmental transport processes. Wiley Interdiscip Rev Water. 2018;5(2):e1268.
6. Wright SL, Kelly FJ. Plastic and Human Health: A Micro Issue? Environ Sci Technol. 2017;51(12):6634–47.
7. Van Cauwenberghe L, Vanreusel A, Mees J, Janssen CR. Microplastic pollution in deep-sea sediments. Environ Pollut [Internet]. 2013;182:495–9. Available from: http://dx.doi.org/10.1016/j.envpol.2013.08.013
8. Fitri. Studi Awal Mikroplastik Pada Kerang Darah (Anadara granosa) dari Tambak Lorok Semarang. 2017;
9. Sekretariat Jenderal Kementerian Kelautan dan Perikanan. Laporan tahunan 2018. Indonesia; 2018.
10. Masura J, Baker J, Foster G, Arthur C. Laboratory Methods for the Analysis of Microplastics in the Marine Environment. NOAA Mar Debris Progr Natl [Internet]. 2015;(July):1–39. Available from: https://marinedebris.noaa.gov/sites/default/files/publications-files/noaa_microplastics_methods_

manual.pdf

11. Cox AKD, Covernton GA, Davies HL, Dower JF. Supplementary Materials for Human Consumption of Microplastics Affiliations :
12. Hall NM, Berry KLE, Rintoul L, Hoogenboom MO. Microplastic ingestion by scleractinian corals. Mar Biol. 2015;162(3):725–32.
13. Li HX, Ma LS, Lin L, Ni ZX, Xu XR, Shi HH, et al. Microplastics in oysters Saccostrea cucullata along the Pearl River Estuary, China. Environ Pollut. 2018;
14. Ballent A, Pando S, Purser A, Juliano MF, Thomsen L. Modelled transport of benthic marine microplastic pollution in the Nazaré Canyon. Biogeosciences. 2013;10(12):7957–70.
15. Barrows A. National Microplastics Field Methodology Review. 2017;(April):28.
16. Van Cauwenberghe L, Janssen CR. Microplastics in bivalves cultured for human consumption. Environ Pollut. 2014;
17. Auta HS, Emenike CU, Fauziah SH. Distribution and importance of microplastics in the marine environmentA review of the sources, fate, effects, and potential solutions. Environment International. 2017.