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Original Article

Risk Analysis of Microplastic Exposure Through Consumption of *Anadara Granosa* at Coastal Area

Nurhayati Namira, Anwar Daud*, Anwar Mallongi, Hasnawati Amqam, Atjo Wahyu, Irwandy

ABSTRACT

Plastic waste is starting to threaten marine waters, especially microplastics. This micro-sized plastic can be consumed by marine biota. The accumulation of microplastics in the bodies of marine biota can threaten humans who consume them. The purpose of this study was to analyze the risk level of microplastic (polystyrene) exposure through the consumption of blood clams in the coastal area of Pao Village, Tarowang District, Jeneponto Regency. This type of research is a descriptive analysis with the Environmental Health Risk Analysis (EHRA) approach. The samples in this study were 30 respondents and 125 blood clams (*anadara granosa*). Data were obtained by interview using a questionnaire, identifying MPs in shells in the laboratory, and identifying polymer types using FTIR-spectroscopy. The results showed that 68 MPs of microplastics were found in blood clams (*anadara granosa*) samples. The dominant shapes were lines and blue. The types of polymers from the FTIR results are Polystyrene (PS), Low-density polyethylene (LDPE), Polyvinyl chloride (PVC), and Polyethylene (PE). The average non-carcinogenic daily intake (Intake) is 0.00012 mg/kg/day, the average risk level (RQ) is 0.0006, and the daily intake value is ≤0.2 (RfD Styrene), so it is said to be safe and the risk level value (RQ) ≤ 1, then categorized as the risk of exposure to MPs in humans through consumption of blood clams is still categorized as safe. The route of exposure to MPs in humans is not only through blood clams, so efforts to control the risk of exposure to MPs in humans are still needed.

Key words: Risk analysis, Microplastic, Polystyrene, Blood clams, *Anadara Granosa.*

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INTRODUCTION

Today plastic has penetrated all aspects of daily life like clothing, upholstery, transport vehicles, and cleaning products.[1] The high use of plastic will result in high waste disposal which will then end up in the ocean if not managed. Plastic waste includes all size residues, from large visible and easily removed items to small, invisible particles. Where the primary source of microplastics is microplastics which are immediately released into the environment as small plastic particles (<5 mm in size). whereas secondary microplastics mostly come from the degradation of large plastic waste which becomes smaller plastic fragments after exposure to the marine environment.[2]

Microplastics have the potential for contamination because microplastic particles can undergo biomagnification, where pollutant transfer occurs in the food chain. Microplastic biomagnification has been found in fish and shellfish that live in contaminated aquatic environments[3] and in the air.[4] Microplastic biomagnification is also found in human feces[1] and human placenta,[5] in sediments and filter-fed animals,[6] Lemuru Pretolan fish (Sardinella Lamuru) caught in the Straits Bali,[7] digestion of anodontostoma chacunda fish in Jakarta Bay.[8]

As a maritime country, Indonesia is vulnerable to exposure to microplastics found in marine biota which are then consumed and can accumulate in the human body. Jeneponto Regency is one of the areas in South Sulawesi with potential marine resources, namely various types of fish and shellfish as a source of animal protein. One of them is in Tarowang District. The majority of residents around the coast work as seaweed farmers and fishermen. Where the catch from the sea is used by residents to be sold as added economic value as well as for consumption.

Based on the initial survey at the research location, it was found that there was a lot of plastic waste disposed of by the community in the coastal area of Pao Village, Tarowang District, Jeneponto Regency. The abundance of microplastics in marine biota can be classified as a contaminant that has the potential to endanger public health. Because it does not meet food safety standards it raises concerns about the level of risk of microplastics, especially polystyrene, to human health. Therefore, it is important in this study to review the evidence that seafood (blood clams) is contaminated with microplastics, especially polystyrene, and the level of risk from the presence of microplastics in the marine environment to human health.

METHOD AND MATERIALS

This type of research is a descriptive analysis with the Environmental Health Risk Analysis (EHRA) approach to determine the level of public health risk based on the concentration of the risk agent, intake rate, frequency of exposure, duration of exposure, and body weight.

This research was conducted in the coastal area of Pao Village, Tarowang District, Jeneponto Regency. The sampling locations for blood clams (*anadara granosa*) were carried out at 5 location points, the coast (location 1), near settlements (location 2), mangrove ecosystems (location 3), rivers (location

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4), river estuaries (location 5).[9,10] This research was conducted in September - December 2022. The sample in this study was the coastal area of Pao Village, Tarowang District, Jeneponto Regency, who were interviewed as many as 30 people. Determination of the sample using purposive sampling technique with inclusion criteria.

Primary data were obtained directly through observation, interviews, questionnaires, identification of microplastics and polymer analysis with FT-IR in the laboratory, results of exposure analysis calculations, and health risk levels.

RESULTS

Respondent characteristics

There were more female respondents than male respondents. Where there were 19 female respondents or 63.33%, while the most vulnerable respondents were in the age group >40 years, 16 people, or 53.33%. The education level of the majority of respondents was at the SMP/MTS level equivalent with a total of 11 respondents or 36.67%. While the majority of the length of stay/sedentary respondents were in the group > 40 years.

Table 1: Characteristics of respondents.

Variable	Amount (n)	Percentage (%)
Gender		
Man	11	36,67
Woman	19	63,33
Age		
< 30 years	1	3,33
30-40 years	13	43,33
> 40 years	16	53,33
Level of education		
TTSD	4	13,33
SD / MI equivalent	6	20.00
SMP / MTs equivalent	11	36,67
SMA/MA/SLTA equivalent	9	30.00
Length of stay/stay		
< 30 years	1	3,33
30-40 years	13	43,33
> 40 years	16	53,33

Table 2: Forms of microplastics in blood clams (*Anadara Granosa*).

No	Location of Blood Clams Sampling	Microplastic form	
		line	Fragments
1	Coast	13	0
2	Near Residential	21	0
3	Mangrove Ecosystem	15	4
4	River	5	0
5	Estuary	6	4
Total		60	8

Table 3: Interpretation of the results of the calculation of the intake indicator for polystyrene polymer microplastics.

Intake indicator	Average	Min	Max
The concentration of Microplastic (Polystyrene) (mg/kg)	0.0355	0.017	0.042
Rate (kg/day)	0.349	0.157	0.705
Frequency of Exposure (day/year)	150.4	96	192
Duration time (years)	40,36	26	60
Weight of Body (kg)	56	38	71

Table 4: Interpretation of the results of calculating the intake of microplastics (polystyrene).

Daily Intake (mg/kg/day)	Average	Min	Max
Non-carcinogenic intake	0.00012	0.00003	0.00029
carcinogenic intake	0.00005	0.00001	0.00012

Table 5: Interpretation of the results of the calculation of the risk level of microplastic (polystyrene) exposure.

Risk Level (RQ)	Average	Min	Max
Microplastic (Polystyrene) Exposure Risk Level	0.0006	0.0001	0.0014

The risk level is not risky, if RQ≤1. The level of risk is risky if RQ> 1. The RQ value is 0.0006 ≤ 1 so that is not a risk.

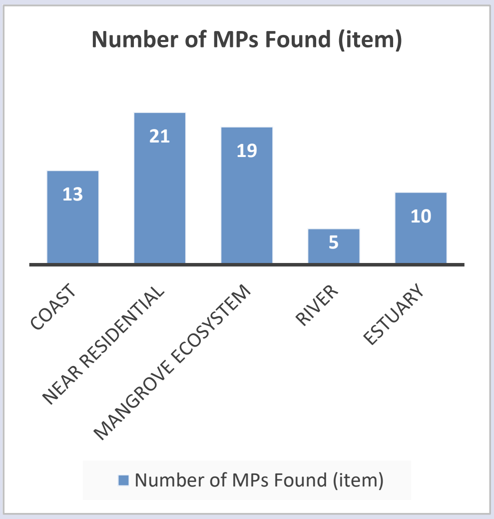

Figure 1: Number of microplastics in blood clams (*Anadara Granosa*)

Microplastic in blood clams

The total of Microplastics in blood clams (*Anadara granosa*) are 68 MPs items and most of them were found near settlements. Meanwhile, the least found at river locations.

Wave spectrum the shows the absorption band sharp and strong on numbers wave 3442.94 cm-1 indicating group NH function. Number wave 1743.65 cm-1 originates group carbonyl (C=O) with an absorption band sharp. Number the show ester group. this is supported by the existence CO group with an absorption band at 1039.63 cm-1 (CO functional group at absorption 1300 to 1000 cm-1).

Identification results group function when connected with polymer, probably sample contain polystyrene polymer.

Intake and Risk Quotient (RQ)

The following is the result of calculating intake through ingested exposure (ingestion):

The RfD value of the Polystyrene (PS) polymer which is composed of Styrene polymer is 0.2 mg/kg/day based on www.epa.gov/iris. Referring to the RfD value of the styrene polymer, the non-carcinogenic daily intake value is 0.00012 ≤ 0.2, so it is still safe. The carcinogenic daily intake value of 0.00005 ≤ 0.2 is still safe.

DISCUSSION

The line shape found in shells generally originates from the activities of fishing communities and seaweed farmers along the coastal area of

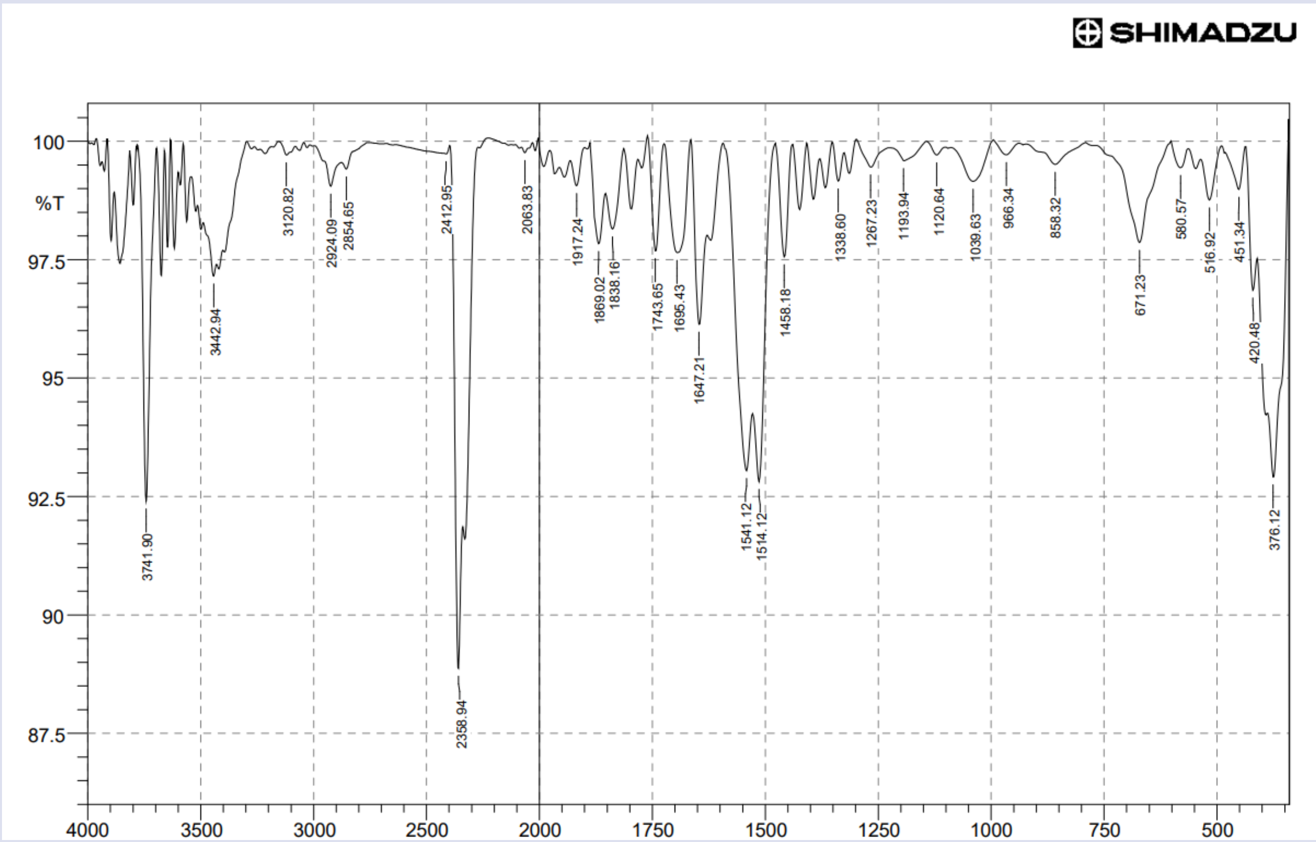

Figure 2: Results of FTIR analysis of microplastics in shellfish blood (*anadara granosa*)

Pao Village, Tarowang District, Jeneponto Regency. The shape of the line generally comes from high human activities around the sea.[11,12] The shape of the line comes from the fragmentation of fishing gear such as nets, and fishing line, or comes from waste clothing fibers (yarn), or degradation of ship ropes and seaweed straps found in sea waters.[13]

Aquatic organisms may become contaminated by microplastics through loaded water or food from other organisms containing microplastics.[14] The abundance of microplastics in blood clams in this study showed an average of 0.0144 items/gram. Where the highest abundance is found in clams that live in areas near settlements. This can be influenced by population density.[15] The presence of domestic disposal can be identified as a contributor to microplastic pollution.[16]

Several types of polymers found in this study were Polystyrene (PS), Low-density polyethylene (LDPE), Polyvinyl chloride (PVC), and Polyethylene (PE).

Generally, polystyrene is used in household products such as basins, brooms, combs, clothes hangers, buckets, bristle brushes,[11] foamed food utensils, and foamed food containers.[17] Therefore, based on this, it is strongly suspected that the polystyrene polymer found in microplastics originates from the degradation of plastic waste from household products that are wasted into the sea.

The results of observations at the research location found a lot of plastic waste scattered along the coastal area of Pao Village, Tarowang District, Jeneponto Regency. This is due to the absence of proper household waste management, where the waste generated by households is simply thrown into ditches that flow directly to the beach or the waste is carried to the coast because it is blown by the wind. This is exacerbated by the absence of a fleet transporting household waste to temporary or final landfills.

Apart from household waste that is simply thrown away or not managed properly, fishermen's activities with fishing equipment sourced from plastic materials such as fishing nets, buckets, and tarpaulins and the activities of seaweed farmers who use a rope to tie seaweed can be a source of accumulation. Polystyrene polymer microplastics are found in shell samples. Polystyrene is found in microplastic samples in seawater,[18] and fish.[13] This is because the polystyrene beads contained in polystyrene products can easily be detached due to weathering and occur in a size range (1-5 mm).[19]

Analysis of daily intake (intake) shows that the people of Pao Village are still categorized as safe to consume shellfish containing microplastics. This is because the amount of microplastics found in the body of the clam is not too much, in fact, it was found that some shellfish did not contain microplastics. It's just that it needs to be known that microplastics enter the human body not only through the ingestion route or consuming shellfish, but through several other routes such as inhalation and through the skin.

The risk level indicates the level of danger of exposure to microplastic contaminants in humans. The calculation results show that there is no risk if humans consume shellfish containing microplastics, even though the value is far below the standard. Even so, it cannot be concluded that microplastic contamination in the human body is considered harmless because the accumulation of microplastics in the human body does not only originate from shellfish. The magnitude of the risk is stated in numbers without units which is a calculation of the comparison between intake and reference doses/concentrations of a non-carcinogenic risk agent and can also be interpreted as safe/unsafe for a risk agent for organisms, systems, or sub/populations.[20-24]

Microplastics can enter the human body through two main routes: air through the nose to the lungs and ingestion through the mouth into the stomach. Ingestion of microplastics through food consumption increases health concerns because of the potential for translocation of particles from the digestive tract to other organs or tissues and as a delivery mechanism for toxic chemicals.

Microplastics can act as a transport medium for other toxic elements such as DDT (Dichloro-Diphenl-Trchloroethane) and hexachlorobenzene and end up in the bodies of living organisms that consume them. The absorption and transfer of ingested toxic contaminants with microplastics can impact human health in the long term.[17]

CONCLUSION

Microplastics were found in samples of blood clams (*anadara granosa*) taken from 5 location points in the coastal area of Pao Village, Tarowang District, Jeneponto Regency, including the coast, near settlements, mangrove forests, rivers, and river estuaries, namely 68 MPs items with the highest abundance being in the coastal area near settlements. The dominant shape is a line with 60 MPs and the dominant color is blue with 36 MPs.

The FTIR results show that the types of polymers contained in microplastic shells are Polystyrene (PS), Low-density polyethylene (LDPE), and Polyvinyl chloride (PVC) and Polyethylene (PE). The average concentration (C) of microplastic (polystyrene) was 0.0355 mg/kg, the average intake rate (R) was 0.349 kg/day, the average exposure frequency (FE) was 150.4 days/year, the average exposure duration (Dt) was 40.36 years the average body weight (Wb) is 56 kg. The average non-carcinogenic daily intake is 0.00012 mg/kg/day, the average carcinogenic intake is 0.00005 mg/kg/day. The average risk level (RQ) is 0.0006, the daily intake value is ≤0.2 (RfD Styrene), so it is said to be safe and the risk level value (RQ) is ≤ 1, so it can be said to be Not at Risk.

With the findings of microplastics in shellfish, efforts are needed for risk management even though the results of the risk level are still declared safe. Some of the risk management steps include: reducing the concentration of microplastics in the environment by managing plastic waste so it doesn't get dumped into the sea. Also, the depuration process can be carried out on the shellfish that will be consumed.

ETHICS

The study was conducted in accordance with the Health Ethics Committee of The Faculty of Public Health at Hasanuddin University. The approval number is 11967/UN4.14.1/TP.01.02/2022. All participants provided written informed consent.

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