



IDENTIFICATION OF MICROPLASTIC IN WATER, SEDIMENT, AND FISH IN LEMATANG RIVER, LAHAT

Rasyiq Fauzia*, Yuanita Windusari, Afifah Muntiah

Public Health Faculty, Universitas Sriwijaya, Indralaya Indah, Indralaya, Ogan Ilir, Sumatera Selatan 30662, Indonesia

*mendingidup@gmail.com

ABSTRACT

Microplastic is formed from plastic waste that enters water and decomposes over a certain period of time through chemical, physical, and biology processes that then change the plastic waste into plastic particles with micro sizing that is known as microplastics. This research is quantitative descriptive research that aims to determine the morphology, size, and color of microplastics on the samples that were collected from Lematang River then particles that are already trapped on the membrane filters are then observed under a microscope. Identification of microplastic forms in samples at the Lematang River using a trinocular microscope. The forms of microplastics found in the samples are categorized into 5 forms, which are film, fiber, foam, fragment, and pellet.

Keywords: debris; fish; microplastic; river; sediment; water

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INTRODUCTION

Plastic is a popular material because it is light, durable, cheap, and easy to produce. Plastic also has waterproof that the production rate is increasing every year. In the other hand, plastic has been a threat to our sustainable ecosystem because plastic take a long time to decompose. There are at least 8 million tons of plastic produce every year around the world. Plastic waste that get into our water system in small particle is called microplastic. In these couple of years, there has been a surge in the report regarding the abundance of microplastics in some freshwater environments (Wagner et al., 2014). Concern about microplastics threats to aquatic ecosystems as well as potable water supplies, considering where the water source that is often used by the community comes from river and ocean. Rapid increase in industry could increase freshwater microplastic contamination (Victoria, n.d.). along with poor waste treatment and poor waste management such as those in Lematang River, Lahat. Microplastic is defined as insoluble synthetic particles that are smaller than 5 mm in length (Petersen & Hubbart, 2020).

Microplastic is formed from plastic waste that enters water and decomposes over a certain period of time through chemical, physical, and biology processes that then change the plastic waste into plastic particles with micro sizing that is known as microplastics. Microplastic could get into water through processes that are categorized into 2, primary microplastics and secondary microplastics. Primary microplastics are kinds of microplastics that get into the aquatic environment directly in micro size for example glitters and polyethylene microbeads, while secondary microplastics is type of microplastics that comes from the fragmentation of larger plastic pieces that get into the water (Harpah et al., 2023)

Lematang River is a river in Lahat, South Sumatera, Indonesia that is approximately 244 km long making it one of the longest rivers in South Sumatera (Bahri et al., n.d.). Lematang river

flows through Dempo mountain, Lahat, Muara Enim, PALI, Musi Banyuasin, Pagar Alam, Prabumulih and empties in Musi River (Pasha et al., 2019). As a river with a wide basin area, Lematang River has a high average monthly debit water flow rate at 315.8 m³/second. This condition causes sedimentation at several points in the river (Sri Martini et al., n.d). Lematang River is utilized for irrigation, potable water supplies and transportation in the downstream area (Mas Tri Djoko Sunarno, n.d.). The number increases residents around the river as well can increase pollution production trash in the river out of necessity primary and secondary also increase (Rahayu et al., 2018). Nowadays, there are some people that live in the riverbank that use Lematang River for various purposes such as toilets, agriculture, and domestic. These various anthropogenic activities along the river make subsequent changes in water quality that will impact on the life of the aquatic biota in the river (Castro et al., 2021), for example the abundance of microplastic in the water, sediment, and biota in Lematang River.

METHOD

This research is quantitative descriptive research that aims to determine the morphology, size, and color of microplastics on the samples that were collected from Lematang River. The research was conducted in the Lematang River, South Sumatra from June to November 2023. Water, sediment, and biota sampling is collected and taken with 3 repetitions for the water and sediment samples. The tools that used in this research were laboratory glassware, cool box with dry ice, analytical balance 0.1, oven, plankton net (diameter 30 cm and Mesh 270), Ekman grab sampler, Niskin water sampler, stereo microscope, magnetic stirrer, Glass Filter Whatman GF/C 1.2 µm, GPS (global positioning system), filter (mesh 355 µm), MLXi -Plus Tr LED Trinocular with EPI-LED (Blue) The materials used in this research were water, sediment, and biota from the Lematang River, distilled water, saturated NaCl (Sodium Chloride), KOH (Potassium Hydroxide) 10%, H₂O₂ (hydrogen peroxide) 30%, and Milli-Q demineralized water.

Water sample from Lematang River is collected using Niskin Water Sampler (considering the depth and width of the river), sample then composited and filtered using plankton net (diameter 30 and mesh size 200 µm) as much as 200 ml water samples. For the sediment samples, sediment around 250-500 gr in the sampling point is taken from the river and then placed in a cool box for analysis that will be conducted in the laboratory. While for the biota samples, nekton (fish) is caught from the river and also getting identified on the spot through direct observation. Fish that have already been identified are then placed into a coolbox for analysis that will be conducted in the laboratory.

Identification of microplastics in water, sediment, and biota is carried out through several methods with some stages. The water sample was mixed with 10% KOH with 1:3 formula for 1x24 hours. Sediment samples dried in an oven at 50-70 C for 48 hours and filtered by using a 355 µm mesh. The 50 gr of dried sediment then mixed with saturated NaCl with formula 3:1 and stirred for 2 minutes then soaked for 24 hours. Biota samples mixed with 100 ml of 10% KOH and then incubated for 1x24 hours at 60 C to remove all the organic matter in biota. After all the process, samples are then diluted with 500 ml of milli-q water before being passed through glass microfiber membrane filter 0,45 µm Whatman GF/C 47 mm using the filtration system facilitated by a vacuum pump. Membrane filters are then placed inside clean petri dishes and dried at 50 C for 24 hours. Particles that are already trapped on the membrane filters are then observed under a microscope.

RESULT

Identification of microplastic forms in samples at the Lematang River using a trinocular microscope. The forms of microplastics found in the samples are categorized into 5 forms, which are film, fiber, foam, fragment, and pellet. Microplastic that found in the samples are found in 5 forms, pellet, foam, film, fiber, and fragment. The most common type that found in the samples are fragment, and the least common is pellet. The shape of microplastic could be different because they come from different types of macroplastic. These five forms of microplastic come from macroplastic that degrades until the size changes to micro. For example microplastics that are categorized as fiber usually come from the residue of clothing and fishing line that is used by fishermen. Plastic bags, plastic wrap, and bottles could form microplastic that are categorized as film-shaped microplastics. Foam-shaped microplastics with hollow structure could come from ship linings floating in the surface of the water (Yin et al., 2019).

The amount of microplastic particles that found in the sediment sample are 21 particles. The microplastic that commonly found are fiber, film, and fragment. The color of microplastic that mostly found in the sample is brown. On water sample, there are 10 microplastic particles that founded. Fiber is the most often encountered type of microplastic on water sample and brown in the most common color of microplastics. On the other hand, for biota sample, it is found that there are 13 microplastic particles on the sample. The most common color that found is brown. This result is the impact of domestic activity that performed by people that live along the river. It could be caused by trash and waste dumping, fishing, and laundry. Microplastics that are found in the samples vary in size, from 232,45 μm to 2225, 83 μm . Microplastic show a power law distribution because the fragmentation on the process cause the macroplastics break down in smaller pieces that we known as microplastic (Kooi & Koelmans, 2019). Microplastic color detection relies on human ability so it's most likely that the microplastic that have natural color (for example beige) are under-reported in most of the cases. Color identification in microplastics also may influence by the color of background substrate. Microplastics that are found have various colors such as brown, black, green, and red. Microplastics that are found in the samples are mostly brown in color. This could be caused by long sun exposure in microplastic that cause oxidation that changes the microplastic color.

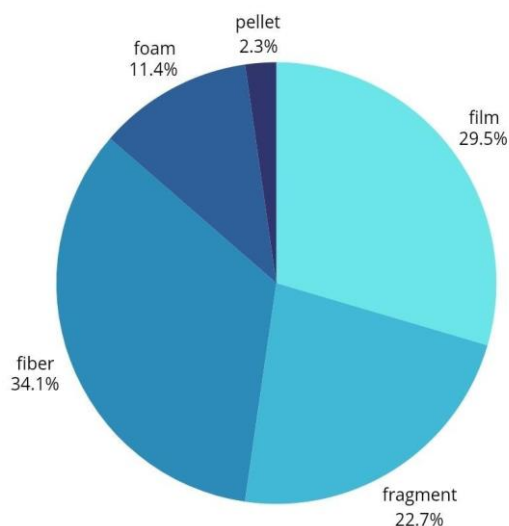


Figure 1. Type of Microplastic that found in Lematang River

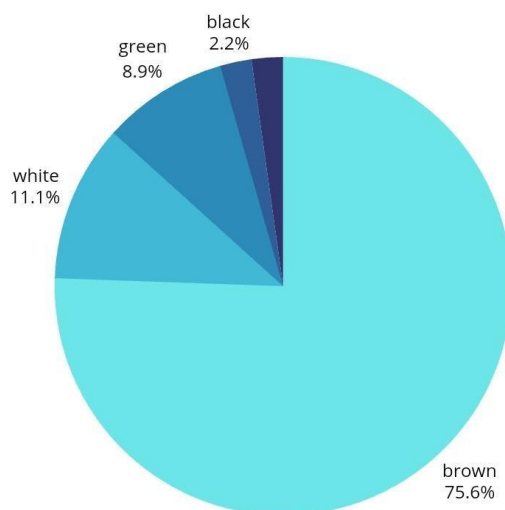


Figure 2. Color of microplastic that found in Lematang River

DISCUSSION

This study identified five main forms of microplastics in the Lematang River, namely film, fiber, foam, fragment, and pellet, with fragments being the most commonly found form, while pellets were the least. These variations in shape are attributed to the different origins of microplastics, which are the result of macroplastic degradation into smaller pieces. For example, fibers typically originate from clothing residues or fishing lines, while film-shaped microplastics may come from plastic bags, wraps, or bottles. Foam with a hollow structure is likely derived from ship linings or packaging materials exposed to the aquatic environment (Yin et al., 2019). The study found 21 microplastic particles in sediment samples, 10 particles in water samples, and 13 particles in biota samples. Fiber was the most frequently encountered type of microplastic in water and biota samples, while brown was the dominant color in all three sample types, likely due to oxidation caused by prolonged sun exposure. Additionally, lighter-colored microplastics, such as beige, tend to be underreported as the identification process still relies on human perception.

These findings are supported by various other studies. Research by (Ding et al., 2019) in rivers in China showed that fiber is the dominant form of microplastic, primarily originating from domestic activities like washing clothes. A study by (Liu et al., 2020) also highlighted that UV exposure influences the color change in microplastics, with brown often resulting from oxidation. In the context of ecosystems, research by (Setyaningsih et al., 2023) revealed that microplastics can be ingested by aquatic organisms, impacting their digestive systems. In the Lematang River, the discovery of 13 microplastic particles in biota supports this finding, especially with the dominance of fibers, which are difficult to digest. The size of microplastics found ranged from 232.45 μm to 2225.83 μm , with a power-law distribution pattern consistent with the study (Cahya Alam & Rachmawati, 2020), indicating that the fragmentation of macroplastics results in an exponential distribution of particle sizes.

The presence of microplastics in the Lematang River is closely related to domestic activities such as waste disposal, fishing, and laundry. This aligns (Vriend et al., 2021), who reported that 80% of global plastic waste originates from domestic activities and enters aquatic environments through river systems. Plastic waste such as bags, bottles, and food wrappers are the primary sources of film- and fragment-shaped microplastics. The identification of microplastic colors, predominantly brown, black, green, and red, is also (Cahya Alam &

Rachmawati, 2020), who noted that background substrates influence the accuracy of color detection, particularly for natural colors like white or beige. These findings provide valuable insights into the distribution of microplastics in the Lematang River and reinforce previous research on the impact of human activities on microplastic pollution. It is hoped that this study will encourage better plastic waste management to reduce its effects on ecosystems and human health.

CONCLUSION

In Lematang River, 5 forms of microplastic were found, which are film, fiber, foam, fragment and pellet. The size of microplastics vary from 232,45 μm to 2225, 83 μm . The color of microplastics that are found on the samples are brown, black, green, and red. Plastic debris that cause microplastic in the Lematang River is caused by human activity in the area such as fishing and domestic activity.

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