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Characteristics and Abundance of Microplastics in the Feces of Communities on the Banks of the Musi River, Palembang

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Abstract: Microplastic pollution has become an increasingly worrying global environmental issue. Microplastics are plastic particles measuring less than 5 mm from the degradation of large plastics or using products containing microplastics. Microplastics can enter the human body through contaminated food, water, and air, with feces being one of the indicators of exposure. This study aims to analyze the characteristics and abundance of microplastics in feces in communities on the banks of the Musi River in Palembang City. This study used a descriptive design with laboratory analysis. Fecal samples were collected from 50 respondents selected by purposive sampling based on fish consumption patterns and water sourced from the Musi River. The study was carried out using the microplastic separation method using a solution and particle identification using a stereo microscope and FTIR spectroscopy. The results showed that microplastics were found in all respondents' feces samples, with concentrations ranging from 9-27 particles per gram and an average of 18 particles per gram. The dominant types of microplastic polymers found were Polystyrene (PS), Nylon, Polyvinyl chloride (PVC), Polypropylene (PP), Polyethylene Terephthalate (PET), and Polyethylene (PE). It was concluded that the presence of microplastics in feces indicates significant exposure. Microplastics, such as fragments, fibers, and other particles, were found in people's feces with various shapes, sizes, and colors. The abundance of microplastics in feces indicates contamination, which most likely comes from consuming food and drinks exposed to microplastics. It is recommended that a campaign be carried out to reduce single-use plastic or increase waste processing in riverbank areas.
Keywords: Human waste; microplastics; musi riverbank communities.

INTRODUCTION

Worldwide plastic production has increased exponentially over the last century to more than 350 million tons annually. However, much of this increase contributes to environmental pollution[1]. Microplastics are plastic particles measuring <5 mm that are divided into two categories: large size (1-5 mm) and small (<1 mm)[2] They are made in these dimensions or as a result of the larger dimension subdivision of plastic structures[2]. Microplastics are of concern because they are increasingly polluting the aquatic environment[3,4] land[5], air[6]. In addition, several reports of microplastic content in food[7],

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especially seafood[8], sea salt [9,10], and drinking water[10,11]. Microplastics are also found mainly in the digestive tract of marine fish[12]. Plastic particles are considered foreign bodies in the body in tissues and can trigger local immune reactions[13]. Microplastics can also cause diseases due to other chemicals, such as environmental pollutants or plastic additives, which can leach and cause exposure to hazardous substances[14].

There are few reports of microplastic inhalation in humans[15]. Still, there are concerns about microplastics in food, their potential for human consumption, and their health impacts[16]. The novelty of this research is that the discovery of feces from people on the banks of the Musi River provides an overview of the sanitation conditions and environmental pollution caused by plastic waste which can affect the health of people on the banks of the Musi River. The objective of the research is to analyze the microplastic content in feces in communities on the banks of the Musi River, Palembang City.

MATERIALS AND METHODS

This study used a descriptive design with laboratory analysis. Fecal samples from 50 respondents domiciled on the banks of the Musi River in Palembang City were collected through purposive sampling techniques by selecting individuals based on specific consumption patterns, especially fish consumption and river water used. Fecal samples were collected from 50 respondents, each with as much as 10 grams of feces. The collected fecal samples were labeled on each container. Each sample was processed using the Liebmann method[17] with some modifications. Ten grams of feces were dissolved in 20 ml of a mixture of 30% H_2S0_4 and 30% H_2O_2 with a ratio of 3:1. Stirring was carried out for 2 minutes and then incubated for 24 hours at room temperature. After incubation, the samples were heated for 2 hours with a water bath system. The samples were cooled and filtered using a 400-mesh cloth (37 microns). Samples that settled on the filter cloth and the walls of the bottle were rinsed using 1% NaCl solution. The microplastic material floating in the sample supernatant was filtered using the Whatman 01 filter paper.

After being filtered, the Whatman filter paper was at room temperature. The microplastic material dried for 24 hours was observed using a stereo binocular microscope. Digital Wais equipped with a Sanqtid DX-300 camera was used in this study. Microplastic particles observed using a microscope were grouped into several types such as fibers, fragments, filaments, granules, and other forms[18]. types of polymers using Fourier-transform infrared (FTIR) spectroscopy. The concentration of microplastics was expressed as the number of particles per gram of feces. Ethics approval was obtained based on ethics committee number 0746/KEPK/Adm2/V/2024, and participants consented to participate in this study. Analysis Data was analyzed univariately to describe each variable.

RESULTS AND DISCUSSION

Identification of Microplastics in Feces

Fecal sampling in the community on the banks of the Musi River in Palembang City was carried out on 50 respondents. The results of microplastic identification in fecal samples can be seen in Figure 1.

(a) (b) (c)

Figure 1. Results of Identification of Microplastic Types (a) Film; (b) Fragment; and (c) Fiber

Figure 1 above shows the results of microplastic identification in feces samples from 50 respondents in Palembang City. Three types of microplastics were found: fibers, fragments, and films.

Types of Microplastics in Fecal Samples

In Figure 2. The following is the percentage of microplastic types found in respondents' feces samples.

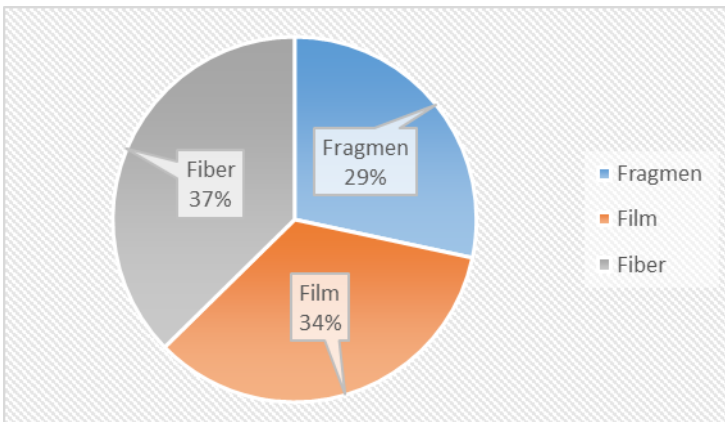

Figure 2. Types of Microplastics in Fecal Samples

Figure 2. above shows the distribution of microplastic types in the feces of people on the banks of the Musi River in Palembang City based on the categories of Fragments, Films, and Fibers. The fiber type is 37%, which is the type of microplastic with the most significant percentage, while the film type is 34%, and the lowest kind of microplastic in the feces sample is fragments of 29%.

Microplastic Color in Fecal Samples

Figure 3. above shows the distribution of microplastic colors in respondents' feces. The colors of microplastics in respondents' feces include black, which has the highest percentage of 23%, transparent at 18%, purple at 15%, brown at 11%, yellow at 10%, blue at 8%, and red, white, and gray at 5%.

Microplastic Polymer Test on Fecal Samples

Figure 4. below shows the results of microplastic polymer tests on feces samples from people on the banks of the Musi River in Palembang City.

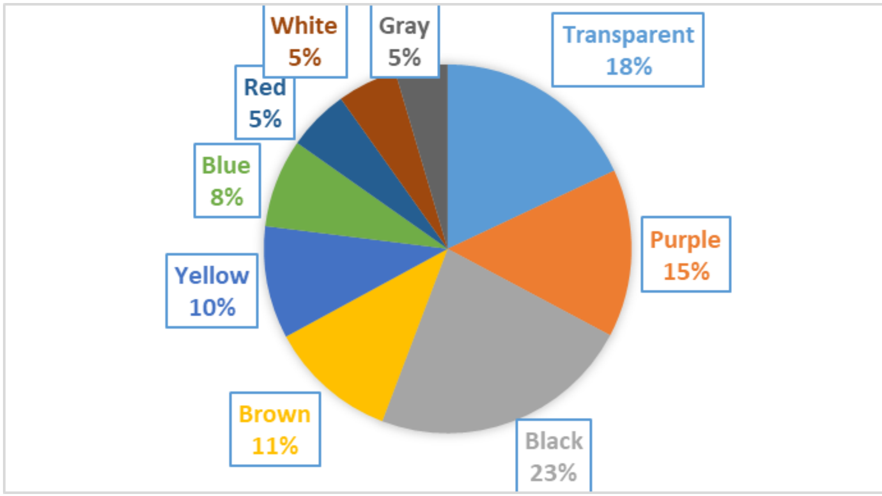

Figure 3. Color of Microplastics in Fecal Samples

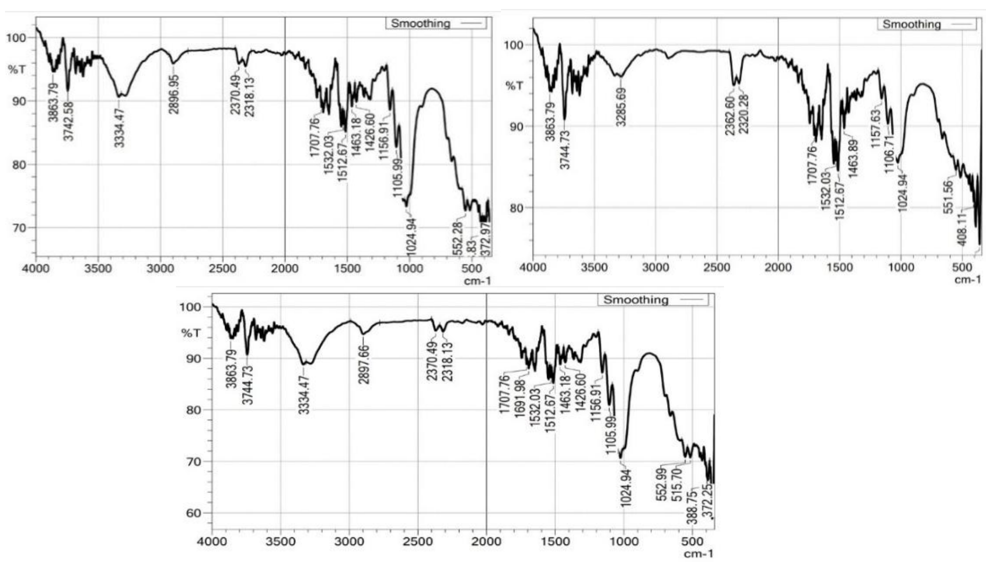

Figure 4. FT-IR Test Result Graph

In Figure 5. above, it can be explained that using the FT-IR test to identify polymers in microplastics in feces samples, 6 out of 12 selected items were identified as plastic. As a result, 50% of the polymers were successfully identified, and six microplastic polymers were found in feces samples. The most common polymers are Polystyrene (PS), Nylon, Polyvinyl chloride (PVC), Polypropylene (PP), Polyethylene Terephthalate (PET), and Polyethylene (PE). The selected particles represent the most common particle types identified visually.

Microplastics in the form of fragments are obtained from beverage waste thrown into the sea because, along the way to the sea, much waste in the form of plastic bottles is found; the source of microplastics of the fragment type can come from human activities; one of which is the disposal of waste around the waters. Microplastic pollution from anthropogenic sources such as household waste contributes to the largest microplastic in fragments[18]. It can be assumed that the microplastic fragments from community feces samples come from the community's bottles and plastic bags daily due to the habit of people who often use plastic bottles for drinking and plastic bags to wrap food.

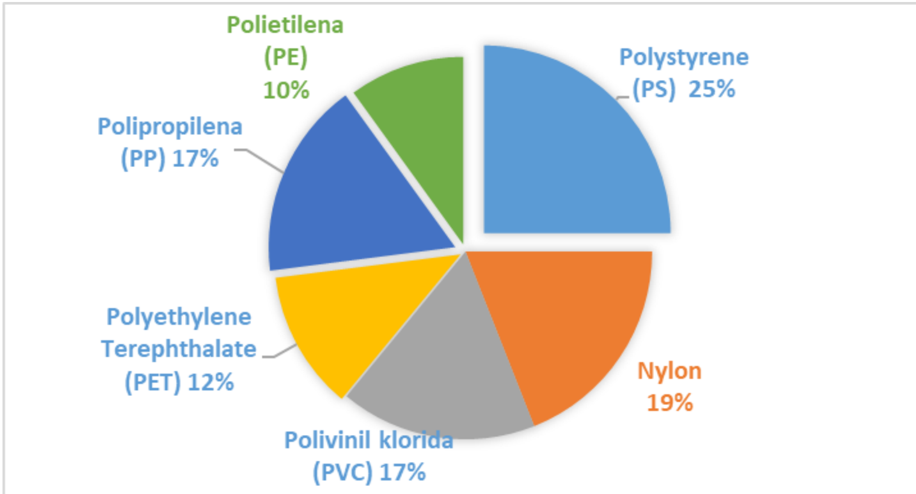

Figure 5. Microplastic Polymers in Fecal Samples

The highest microplastic color found in feces samples from 50 respondents was black at 26%, transparent at 19%, purple at 13%, brown at 10%, and yellow at 9%. These colors indicate the origin of the microplastics[19]**.** Black color dominates the particle results found in 50 feces samples (Figure 3). The dominance of black color is thought to be because the shape of the microplastics found in feces samples is dominated by fiber forms, which generally come from secondary microplastics so that the degradation results can be black. This is in line with the statement Azizah[20] that PSM (Particle suspected as microplastic) is in the form of fibers and fragments found to be black.

Meanwhile, microplastics in the form of films tend to have transparent colors. The dominant black color in the results also indicates that the color of the microplastics is still thick and has not experienced significant color changes. This is thought to occur because microplastics follow the digestion process, making it more difficult to degrade abiotically due to low temperatures and ultraviolet radiation. It is known that temperature and ultraviolet radiation greatly influence the plastic photodegradation process[21]**.**

Figure 4 above shows the results of identifying the types of microplastic polymers found in the feces samples of respondents in Palembang City. Identification was carried out using the FT-IR (Fourier Transform Infrared Spectroscopy) technique. The dominant type of polymer is PTFE, with two kinds detected Polystyrene, which is used in materials for food packaging, craft materials, decorations, and other craft materials[22]. In contrast, other polymers detected in the Musi River water are PVC (Polyvinyl chloride), which has rigid, complex, non-flammable properties, usually often used in raw materials for making plastic and also insulation on electrical cables[23], PTFE polymer (Polytetrafluoroethylene) was found in the waters as an activity of the community who carried out the results of washing activities in the seas 24**.** At the same time**,** nylon polymers generally come from raw textile materials and materials for making toothbrush bristles[24]. In fecal samples, the most significant number of identified polymer types (6 types) reflects a higher level of microplastic pollution. The varying polymer composition in fecal samples is influenced by human food and beverage consumption patterns or different sources of pollution. Feces contain PET (Polyethylene terephthalate), which is a type of microplastic polymer that can come from disposable plastic bottles[25], and PE (Polyethylene) polymers, the source of this plastic polymer material can be sourced from plastic bags and storage containers[26]. This study is conducted exclusively in the riverbank area of the Musi River, Palembang, and does not include any other regions beyond this area. The analyzed samples are limited to human feces collected from individuals residing or engaging in activities around the Musi Riverbank. Microplastic identification is carried out using microscopy and FTIR spectroscopy methods.

Additionally, this study focuses only on the characteristics of microplastics (shape, size, color, and polymer type) and their abundance in the feces of the local population within the study area. The accumulation of microplastics in the body can cause various adverse effects, such as organ inflammation, internal and external injuries, and the transfer of chemical substances from plastics into the body's system. Additionally, microplastics can disrupt the balance of gut microbiota, potentially leading to intestinal blockage and a false sense of satiety. Other impacts include physiological stress, changes in eating patterns, growth inhibition, and reduced fertility[27-30].

CONCLUSION

The results showed that microplastics were found in all respondents' feces samples, with concentrations ranging from 9-27 particles per gram and an average of 18 particles per gram. The dominant types of microplastic polymers found were Polystyrene (PS), Nylon, Polyvinyl chloride (PVC), Polypropylene (PP), Polyethylene Terephthalate (PET), and Polyethylene (PE). The study concluded that the community on the banks of the Musi River in Palembang City was significantly exposed to microplastics. It is recommended that a campaign be carried out to reduce single-use plastic or increase waste processing in riverbank areas.

CONFLICT OF INTEREST

In this study there is no conflict of interest.

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