e-ISSN: 3030-878X

The 5th International Conference on Environmental Health (ICoEH)

Microplastic Analysis in Human Feces: A Case Study in Palembang City, Indonesia

Diah Navianti[1], Khairil Anwar[2*]

[1,2] Environmental Health Department, Poltekkes Kemenkes Palembang, Indonesia
**Corresponding author: khairil@poltekkespalembang.ac.id*

ABSTRACT

Background: Microplastic pollution has become an increasingly serious environmental and public health concern. Microplastics, defined as plastic particles smaller than 5 mm, can enter the human body through contaminated food, drinking water, and air. Fecal analysis serves as a direct indicator of human exposure to microplastics. **Object:** This study aimed to analyze the presence and abundance of microplastics in human feces among residents of Palembang City, Indonesia. **Methods:** A descriptive laboratory study was conducted using fecal samples collected from 30 purposively selected respondents based on their daily consumption patterns and sources of drinking water. Microplastics were separated using a density separation method and identified through stereomicroscopy and Fourier Transform Infrared (FTIR) spectroscopy. **Results**. The results showed that microplastics were detected in all fecal samples, with concentrations ranging from 13 to 35 particles per gram and an average of 23 particles per gram. The dominant polymer types identified were polyethylene (PE), polypropylene (PP), polystyrene (PS), and polyethylene terephthalate (PET). Microplastic exposure was associated with dietary and environmental factors, particularly among individuals who consumed fish and used refill or river water. **Conclusion:** Conclusion, residents of Palembang City are significantly exposed to microplastics through daily consumption and environmental contact, indicating the need for further research and preventive efforts in urban food and water safety management.

Keywords: Microplastics, Human Feces, Residents of Palembang City

BACKGROUND

Worldwide plastic production has increased exponentially over the last century to over 350 million tons per year. However, much of this increase contributes to environmental pollution (Kershaw et al., 2011). Microplastics are plastic particles <5 mm in size that are divided into 2 categories, large size (1-5 mm) and small (<1 mm) (N.O.A.A., 2013). They are made in these dimensions or as a result of the division of larger dimensions of the plastic structure (N.O.A.A., 2013).

Microplastics are worrying because they are increasingly polluting the aquatic environment land , air (Budiarti, 2021; Hurley et al., 2018; Prata, 2018; Souza Machado et al., 2017). In addition, there are several reports of microplastic content in food , especially seafood, sea salt, and drinking water (Barboza et al., 2018; Cauwenberghe & Janssen, 2014; Cho et al., 2019; Karami et al., 2017; Kosuth et al., 2018). Microplastics are also found mainly in the digestive tract of marine fish (Schymanski et al., 2018). Plastic particles are considered as foreign bodies in the body in the tissue and have the ability to trigger local immune reactions (Sá et al., 2018).

Microplastics can also serve as a cause of disease due to other chemicals, such as environmental pollutants or plastic additives, which can leach and cause exposure to harmful substances (MacNee et al., 2001). There are few reports of microplastic inhalation in humans, but there are concerns about microplastics in food, potential human consumption, and their health impacts (Asrul, 2022; Rochman et al., 2013). However, the findings of microplastics in food and the digestive tract of animals have not been studied.

RESEARCH METHODS

This study used a descriptive design with laboratory analysis. Fecal samples from 50 respondents domiciled in Palembang City were collected through a *purposive sampling technique* , by selecting individuals based on certain consumption patterns, especially consumption of fish, tea bags, and tap water. Fecal samples were collected from 50 respondents, each with 10 grams of feces. The collected fecal samples were labeled on each container.

Each sample was processed using the Liebmann method with several modifications. 10 grams of feces were dissolved in 20 ml of a mixture of 30% H2SO4, 30% H2O2 with a ratio of 3:1 (Food Chain, 2016). 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 then filtered using a 400 mesh (37 micron) filter cloth. Samples that settled on the filter cloth and on the walls of the bottle were rinsed using a 1% NaCl solution.

The microplastic material floating in the sample supernatant was then filtered using *Whatmann* 01 filter paper. After filtering, the *Whatmann filter paper* was at room temperature. The microplastic material dried for 24 hours was observed using a stereo binocular microscope. *A Digital Wais* equipped with a *Sanqtid* DX-300 camera was used in this study. The microplastic particles observed using a microscope were grouped into several types such as fibers, fragments, filaments, granules and other forms (Liebmann et al., 2018).

The type of polymer used Fourier-transform infrared (FTIR) spectroscopy. The microplastic concentration was expressed as the number of particles per gram of feces. Ethical approval was obtained, and the participants gave their consent to participate in this study. Data analysis was carried out univariately to describe each variable and bivariately using the chi-square test.

RESULTS AND DISCUSSION

This interview was conducted to obtain accurate information from reliable respondents. The interviews involved 30 residents of Palembang City. The following is a frequency distribution of the characteristics of the research respondents, presented in Table 1 below.

Table 1.

Frequency Distribution of Research Respondent Characteristics

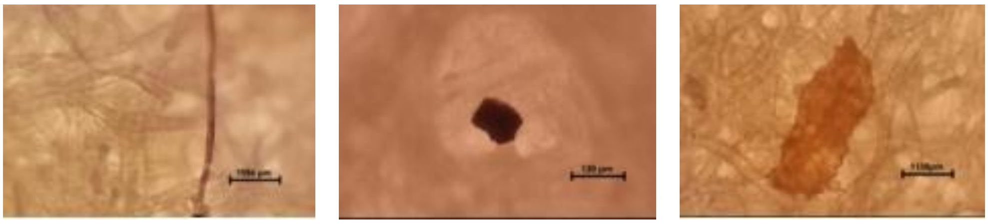
Variables	n (frequency)	Percentage (%)
Gender		
- Man	10	20
- Woman	20	80
Age		
- < 46 Years	13	46
- ≥ 46 Years	17	54
Length of Stay		
- < 33 years	17	54

Variables	n (frequency)	Percentage (%)
- ≥ 33 years old	13	46
Education		
- < High School	16	52
- ≥ High School	14	48

Based on Table 1. above, it shows that the majority of respondents are female, the majority are aged 46 years and above, and the length of residence of respondents is less than 33 years, and the level of education of respondents is below high school.

Identification of Microplastics in Feces

Fecal samples were collected from 30 respondents in Palembang City . The results of microplastic identification in the fecal samples are shown in Figure 1 below:



(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 found in fecal samples from 30 respondents in Palembang City. Three types of microplastics were found, namely fibers, fragments and films.

Types of Microplastics in Fecal Samples

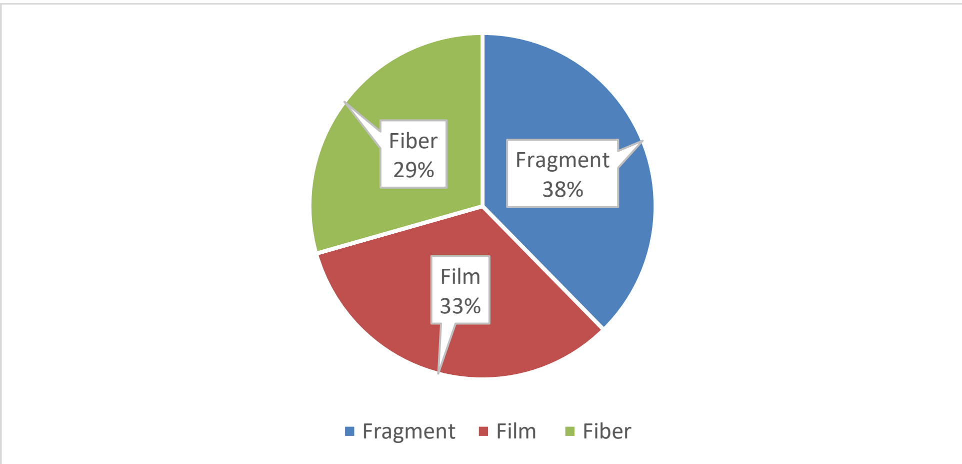


Figure 2. The Percentage of Microplastic Types Found in Respondents' Fecal Samples.

Figure 2 above shows the distribution of microplastic types in feces based on the categories of Fragments, Films, and Fibers . The Film type accounts for 38%, which is the type with the largest percentage of microplastics, while the Fragment type accounts for 33%, which is close to the Film type . Furthermore, the type of microplastic with the lowest concentration in fecal samples is Fiber at 29%.

Microplastic Color in Fecal Samples

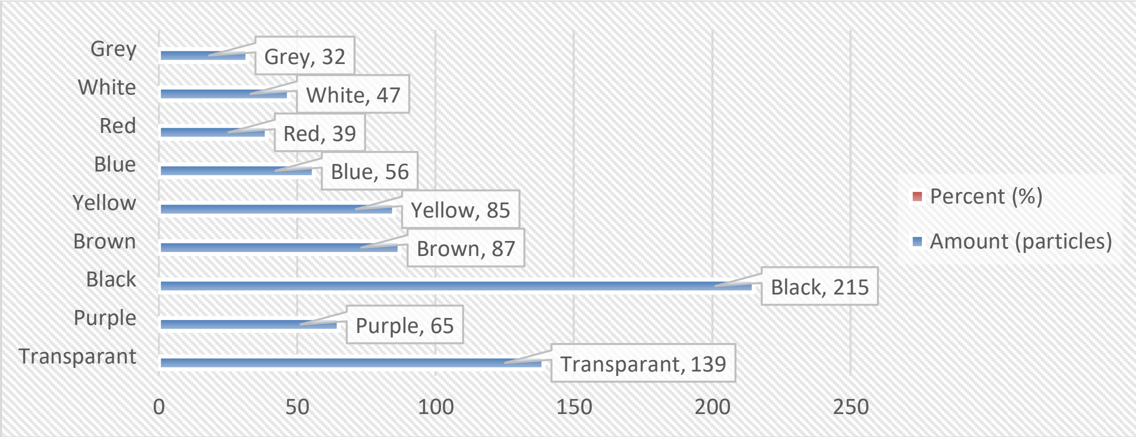
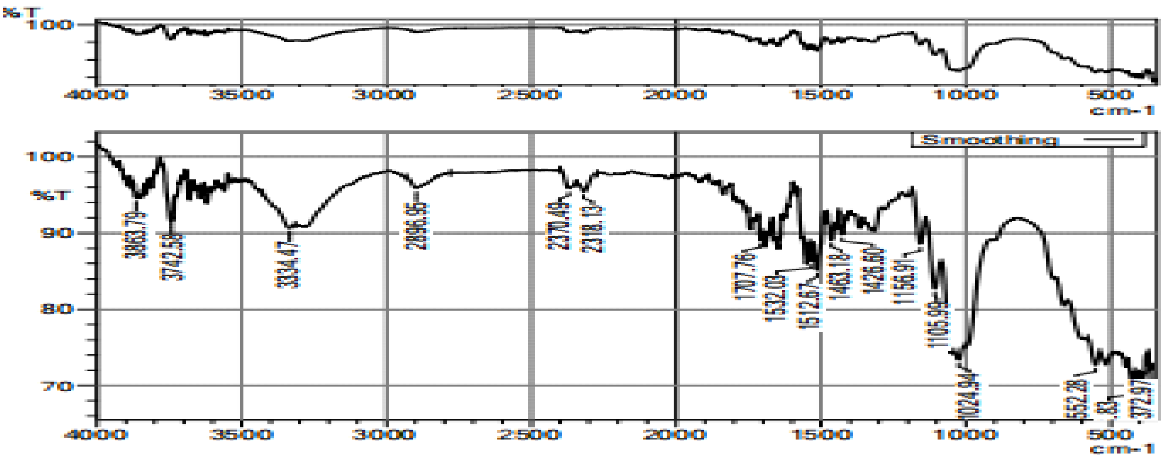


Figure 3. The Color of Microplastics in The Respondents' Feces Samples

Figure 3 above shows the distribution of microplastic colors in the respondents' feces. The colors of microplastics in the respondents' feces include black at 28% which has the highest percentage, transparent at 18%, purple at 9%, brown at 12%, yellow at 11% , blue at 7% , red and white at 6% and the lowest microplastic color, namely gray at 4%.

Microplastic Polymer Testing on Fecal Samples



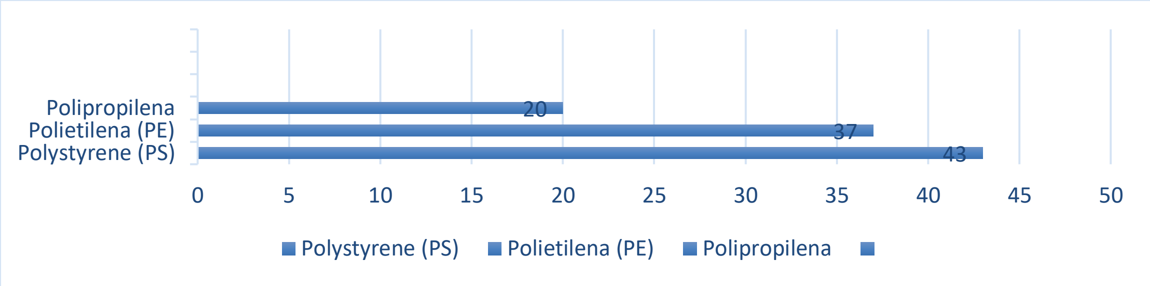


Figure 4. The Results of The Microplastic Polymer Test on Respondents' Feces Samples

Figure 4 above shows that using the FT-IR test to identify polymers in microplastics in fecal samples, 3 out of 10 selected items were identified as plastic. This resulted in 50% of the polymers being identified, meaning four types of microplastic polymers were found in the fecal samples. The most common polymers were *polystyrene (PS), polyethylene (PE), and polypropylene.* The selected particles represent the most common types of particles identified visually.

DISSCUSION

Microplastics in the form of fragments obtained from beverage waste thrown into the sea, because along the way to the sea many waste in the form of plastic bottles are found, the source of microplastic fragments 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 the largest microplastic fragments (Liebmann et al., 2018). It can be assumed that the type of microplastic fragments from community *fecal samples* comes from bottles and plastic bags used by people every day, due to the habit of people who often use plastic bottles for drinking and use plastic bags to wrap food.

The highest microplastic color found in feces samples from 30 respondents was black 28%, transparent 18%, purple 9%, brown 12%, yellow 11%. These colors indicate the origin of the microplastics (Ayuningtyas et al., 2019). Black color dominated the particle results found in 30 feces samples. This 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 the degradation results can be black. This is in accordance with the statement that PSM (*Particle Suspected as Microplastic*) in the form of fibers and fragments were found to be mostly black (Azizah et al., 2020). While microplastics in film form tend to have a transparent color. The dominant black color in the results found 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 digestive process so that they are more difficult to degrade abiotically due to low temperatures and ultraviolet radiation. It is known that temperature and ultraviolet radiation are factors that greatly influence the process of plastic photodegradation (Widianarko & Hantoro, 2018).

Figure 4 above shows the results of the identification of the types of microplastic polymers found in the fecal 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 types detected, *Polystyrene* used in materials for food packaging, craft materials, decorations and other craft materials , While other polymers detected in Musi River water are PVC *(Polyvinyl chloride)* which has rigid, hard, non-flammable properties, usually often used in raw materials for making plastics and also insulation on electrical cables, the level of microplastic pollution is higher (Fadhilah et al., 2023; Putra et al., 2023).

The varying polymer composition in fecal samples is influenced by human food and drink consumption patterns or different sources of pollution. PET *(Polyethylene terephthalate)* which is a type of microplastic polymer that can come from disposable plastic bottles, and PE *(Polyethylene) polymers* the source of this plastic polymer material can be sourced from plastic bags and storage containers (Qodriati et al., 2023; Seftianingrum et al., 2023).

CONCLUSION

The findings indicate that microplastics detected in human fecal samples are predominantly derived from anthropogenic sources, particularly daily-use plastic products such as beverage bottles, plastic bags, and food packaging. Fragment-type microplastics are associated with the degradation of plastic waste entering aquatic environments, while the dominant black coloration suggests that most particles originate from secondary microplastics, especially fibers and fragments.

Limited exposure to ultraviolet radiation and temperature fluctuations during the digestive process may reduce abiotic degradation, thereby preserving the original color of the particles. Polymer identification using FT-IR analysis revealed several common plastic polymers, including PTFE, polystyrene, PVC, PET, and polyethylene, which are widely used in packaging and household materials. The diversity of polymer types found in fecal samples reflects variations in human consumption patterns and environmental exposure to plastic pollutants. Overall, these results demonstrate that everyday plastic usage and environmental contamination contribute to the presence of microplastics within the human digestive system.

REFERENCES

Asrul, N. A. M. (2022). *Fundamentals of Microplastics*. CV Jejak (Jejak Publisher.

Ayuningtyas, W. C., Yona, D., Iranawati, J. S. H., & F. (2019). Abundance of microplastics in the waters of Banyuurip, Gresik, East Java. *Journal of Fisheries and Marine Research*, *3*(1), 41–45.

Azizah, P., Ridlo, A., & Suryono, C. A. (2020). Microplastics in sediments on Kartini Beach, Jepara Regency, Central Java. *Journal of Marine Research*, *9*(3), 326–332.

Barboza, L. G. A., Vethaak, A. D., & Lavorante, B. R. B. O. (2018). Marine microplastic debris: An emerging issue for food security, food safety, and human health. *Marine Pollution Bulletin*, *133*, 336–348. https://doi.org/10.1016/j.marpolbul.2018.05.047

Budiarti, E. C. (2021). Identification of Microplastics in Human Feces. *Approximately. Pollute. J*, *1*, 87–88. https://journalecoton.id/index.php/epj

Cauwenberghe, L., & Janssen, C. R. (2014). Microplastics in bivalves cultured for human consumption. *Environmental Pollution*, *193*, 65–70. https://doi.org/10.1016/j.envpol.2014.06.010

Cho, Y., Shim, W. J., & Jang, M. (2019). Abundance and characteristics of microplastics in market bivalves from South Korea. *Environmental Pollution*, *245*, 1107–1116. https://doi.org/10.1016/j.envpol.2018.11.091

Fadhilah, W., Sofiana, M. S. J., Safitri, I., & Kushadiwijayanto, A. A. (2023). Abundance of microplastics in the waters of Temajo Island, Mempawah, West Kalimantan. *Equatorial Sea*, *6*(3), 134–144.

Food Chain, E. F. S. A. P. (2016). Presence of microplastics and nanoplastics in food, with particular focus on seafood. *Efsa Journal*, *14*(6), 4501. https://doi.org/https://doi.org/10.2903/j.efsa.2016.4501

Hurley, R., Woodward, J., & Rothwell, J. J. (2018). Microplastic contamination of river beds significantly reduced by catchment-wide flooding. *Nature Geoscience*, *11*(4), 251 2013257. https://doi.org/10.1038/s41561-018-0080-1

Karami, A., Golieskardi, A., & Choo, C. K. (2017). The presence of microplastics in commercial salts from different countries. *Scientific Reports*, *7*(46173). https://doi.org/10.1038/srep46173

Kershaw, P., Katsuhiko, S., Lee, S., & Woodring, D. (2011). *Plastic debris in the ocean*. United Nations Environment Programme.

Kosuth, M., Mason, S. A., & Wattenberg, E. V. (2018). Anthropogenic contamination of tap water, beer, and sea salt. *PLOS ONE*, *13*(4), 194970. https://doi.org/10.1371/journal.pone.0194970

Liebmann, B., Köppel, S., Königshofer, P., Bucsics, T., Reiberger, T., & Schwabl, P. (2018). Assessment of microplastic concentrations in human stool: Final results of a prospective study. *Conference on Nano and Microplastics in Technical and Freshwater Systems*, *2018*, 28–31.

MacNee, W., Stone, V., & Donaldson, K. (2001). Size-dependent proinflammatory effects of ultrafine polystyrene particles: a role for surface area and oxidative stress in the enhanced activity of ultrafines. *Toxicology and Applied Pharmacology*, *175*(3), 191–199.

N.O.A.A. (2013). *Programmatic Environmental Assessment (PEA) for the NOAA Marine Debris Program (MDP* (p. 168).

Prata, J. C. (2018). Airborne microplastics: Consequences to human health? *Environmental Pollution*, *234*, 115–126. https://doi.org/10.1016/j.envpol.2017.11.043

Putra, M. P., Widarto, H., & Hamka. (2023). Analysis of the use of polystyrene (PS) plastic as an additive for AC-WC and AC-BC asphalt as a marshall method. *Journal of Jakarta Engineering*, *3*(20), 91–95.

Qodriati, T., Safitri, I., & Sofiana, M. S. J. (2023). Abundance of Microplastic in Water of Terus River, Sungai Nibung Village, West Kalimantan. *PLATAX Scientific Journal*, *11*(2). https://doi.org/https://doi.org/10.35800/jip.v11i2.49317

Rochman, C. M., Hoh, E., Kurobe, T., Teh, S. J., & Gu, M. B. (2013). Ingested plastic transfers hazardous chemicals to fish and induces hepatic stress. *Scientific Reports*, *3*, 3263. https://doi.org/https://doi.org/10.1038/srep03263

Sá, L. C., Oliveira, M., Ribeiro, F., Rocha, T. L., & Futter, M. N. (2018). Studies of the effects of microplastics on aquatic organisms: what do we know and where should we focus our efforts in the future? *Science of the Total Environment*, *645*, 1029–1039.

Schymanski, D., Goldbeck, C., & Humpf, H. U. (2018). Analysis of microplastics in water by micro-Raman spectroscopy: Release of plastic particles from different packaging into mineral water. *Water*

Research, *129*, 154 2013162. https://doi.org/10.1016/j.watres.2017.11.011

Seftianingrum, B., Hidayati, I., & Zummah, A. (2023). Identification of Microplastics in Water, Sediment, and Tilapia (Oreochromis niloticus) in the Porong River, Sidoarjo Regency, East Java. *Jurnal Jeumpa*, *10*(1), 68–82.

Souza Machado, A. A., Kloas, W., & Zarfl, C. (2017). Microplastics as an emerging threat to terrestrial ecosystems. *Global Change Biology*, *24*(4), 1405 20131416. https://doi.org/10.1111/gcb.14020

Widianarko, Y. B., & Hantoro, I. (2018). *Microplastics in Seafood from the North Coast of Java*.