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MORALITY BEFORE KNOWLEDGE

Microplastic as an written composition in bottled water: Implications for waste management

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ABSTRACT

Background: Microplastics are the smallest particles of plastic measuring about 4.8 milliliters and are dangerous to the body due to the chemicals they contain, such as PCBs (Polychlorinated Biphenyls). Microplastics have been identified in various studies, both in aquatic and terrestrial environments, raising concerns about contamination in seafood, beverages (like beer), and more recently, bottled mineral water. **Methods:** This publication compiles and discusses currently available literature data on microplastic particles found in bottled mineral water. **Findings:** The discovery of microplastics in bottled mineral water highlights the widespread contamination of microplastics in consumable products, emphasizing the importance of water intake for supporting body metabolism. **Conclusion:** The identification of microplastics in bottled mineral water underscores the need for greater awareness of the dangers of microplastic contamination and its potential health risks. **Novelty/Originality of this article:** This article uniquely highlights the underexplored presence of microplastics in bottled mineral water, emphasizing the health risks associated with chemical contaminants like PCBs, and calls for increased awareness and regulatory measures to protect consumer safety.

KEYWORDS: microplastics; bottled water; pollutant; PCBs; metabolism.

1. Introduction

Drinking water is defined as any water, whether processed or not, that meets health regulations and is appropriate for direct ingestion (Peraturan Menteri Kesehatan Republik Indonesia, 2010). Everybody has different requirements for fluids. It is advised that individuals drink eight glasses of water (230 ml each) every day, or two liters in total. In addition to beverages, meals can supply roughly 20% of the body's fluid requirements (P2PTM Ministry of Health, Republic of Indonesia, 2018). People are encouraged to be able to meet their body's fluid needs, and one way to do so is by drinking bottled mineral water, given its importance. Hendrick Freerk Tillema, a man of Dutch descent, is credited for starting the history of bottled mineral water in Indonesia.

In the 1870s Hendrik launched a bottled water product under the name Hygeia. The city of Semarang became the place where the first bottled mineral water was made (Tjokro, 2021). Over time, until now there have been many companies that focus on the field of Bottled Drinking Water (AMDK), there are at least 10 major major brands, such as Aqua, Vit, Club, Prima, Sosro, 2 Tang, Ades, Oasis, Ron88, and Aires (Edgina, 2021).

The Ministry of Industry continues to press the food and beverage industry to offer competitive products that also adhere to consumer safety regulations. According to Rochim, bottled drinking water products circulating in the domestic market have met SNI 3553:

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2015, SNI 6241: 2015, SNI 6242: 2015, and SNI 7812: 2013; these meet the requirements for Product Certification Using the Indonesian National Standard Mark (SPPT SNI), which are contained in the Permenperin No. 26 of 2019 concerning Amendments to Permenperin No. 78 of 2016 concerning the Compulsory Enforcement of SNI for Mineral Water, Demineralized Water, Natural Mineral Water, and Dew Drinking Water (Kementrian Perindustrian, 2021).

It is undeniable that the increasing need for drinking water intake with the establishment of many companies that focus on Bottled Drinking Water has made many companies complacent in maintaining the quality of drinking water itself, not a few studies have also proven the existence of microplastic particles in drinking water packaging. According to the American Chemical Society's (ACS) Human Consumption of Microplastic Research Report, bottled water has the highest average daily consumption item concentration of microplastics (94.37 microplastic particles per gram/liter/cubic meter). This conclusion is drawn from a study of 3,600 research samples and 26 investigations that were dispersed among several nations (Cindy, 2022).

According to the findings of another study conducted on mineral water at the State University of New York, 242 out of the 259 AMDK (bottled drinking water) that was being consumed in nine different nations had microplastics in them. The Bottled Drinking Water (AMDK) that was tested was from brands like San Pellegrino that are freely sold in many countries, including Indonesia, Thailand, India, and the United States. According to Mason et al. (2018), there are 314.6 particles on average per liter worldwide.

2. Methods

The purpose of this essay is to shed more light on the significance of microplastics for a healthy lifestyle. The literature for this paper was gathered from books, journals, and websites through a literature study approach. A literary study involves several activities related to the processes of processing research materials, reading and taking notes, and obtaining library information. In a literature study, the researcher collects several books and journals that are relevant to the problem and the objectives of the study. Using this approach aims to provide a wealth of theories relevant to the problems being studied or challenges being faced as a resource for the discussion of research findings.

The research results are addressed in this study through the application of qualitative research methodologies drawn from a variety of literary works or literature studies. This study draws on a number of earlier investigations that include written materials or literature reviews supporting the claim that bottled drinking water contains microplastics. This study aims to examine microplastics in terms of their properties, makeup, presence in drinking water, and potential health effects.

3. Results and Discussion

3.1 Microplastics

Carpenter et al. (1972) in Dehaut et al. (2016) reported that the discovery of microplastics dates back to 1970 (Widianarko and Hantoro, 2018). Microplastics are plastic particles with a diameter of less than five millimeters. While the precise lower limit of particle size included in the category of microplastics is unknown, most research has employed particle objects with a minimum size of 300 m3. Microplastics fall into two sizes: large (1–5 mm) and small (<1 mm) (Victoria, 2017). Numerous studies have shown that marine organisms now prefer microplastics because of their higher abundance and close resemblance in size to plankton (Greeneration Foundation, 2021).

Microplastics come from two different sorts of sources: primary and secondary. Primary microplastics are pure plastic particles that, due to negligent treatment, wind up in the ocean. Meanwhile, tiny plastic particles Secondary microplastics are those produced as

a result of enhanced plastic fragmentation (Victoria, 2017). Many studies have found that marine animals currently favor stics (Greeneration Foundation, 2021).

3.2 Microplastics properties

The resistance of microplastics to biodegradation and their ability to linger in the environment for hundreds of years make them potentially harmful to ecosystems and biological systems (Yoshida et al., 2016). Microplastics can absorb hazardous compounds such as PBTs (persistent, bioaccumulative, and toxic substances) and POPs (persistent organic pollutants) (Barnes et al., 1009; Roy et al., 2019).

3.3 Microplastics characteristics

Figure 1 shows the distribution for the various samples. Figure 1 generally identified and displayed the three predominant morphologies (fragment, film, and pellet/granule) of MPs with the corresponding total quantities of 42.83 MP particles/0.75 L, 1.16 MP particles/0.75 L, and 10.82 particles/0.75 L. (Ibeto et al., 2021).

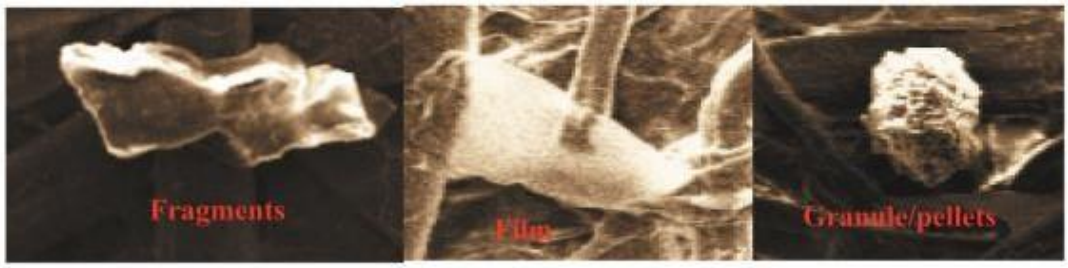

Fig. 1. Shapes of microplastic

Each and every microplastic that was studied has fiber and fragment forms. 99.2% of the microplastics in this study were fibrous. Typical microplastics are shown in Figure 3. Based on their diameters, microplastics were divided into four groups: less than 100 μm, 100 to 500 μm, 500 to 1000 μm, and 1000 to 5000 μm. Typical camera-captured pictures of microplastics in tap water and other water sources are displayed in Figure 4, where fibers are represented by (A–D) and pieces by (E and F). A scale bar is present in the lower right corner of every image (Zhang et al., 2020).

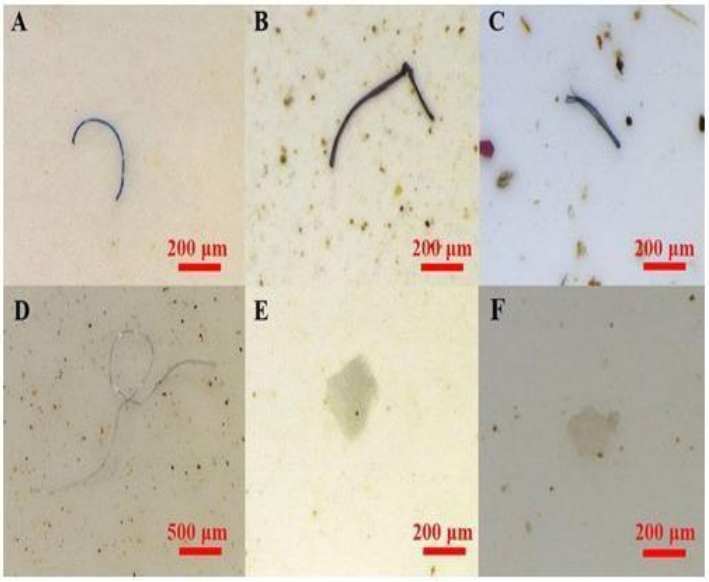

Fig. 2. Typical microplastic

3.4 Colors of microplastics

Microplastics are rarely used to pinpoint likely sources of microplastic contamination since their colors are malleable and susceptible to weathering and bleaching processes (Hartmann et al., 2019; Wu et al., 2017; Yuan et al., 2019). From the microplastics observed in this experiment, three varieties of colored microplastics were identified: colorless (white and transparent), colored (blue, red, yellow, green), and black.

Previous studies (Hartmann et al., 2019; Wu et al., 2017) have demonstrated that color information on microplastics is essential for assessing the likelihood of biological accumulation in aquatic species. The reason for this is that microplastics that mimic their prey may be mistaken for food by creatures. Color-related food preferences have been noted in a variety of aquatic species. For instance, it has been observed that organisms in the North Pacific tend to consume white and other light-colored plastic particles (Shaw & Day, 1994); zebrafish exhibit an innate preference for red-colored food (Spence & Smith, 2007); goldfish preferentially consume green and black-colored food over other colors (Xiong et al., 2019); and common fish that typically eat blue copepods have been observed to preferentially consume blue microplastics (Weis, 2020; Elkhatib and Oyanedel-Craver, 2020).

3.5 Polymer types

Polystyrene (PS), Polypropylene (PP), Polyethylene (PE), Polyethylene-terephthalate (PET), Polyvinyl Chloride (PVC), Polyamide or nylon (PA), Acrylonitrile Butadiene styrene (ABS), Polymethyl methacrylate (PMMA), and Polycarbonate (PC) are examples of microplastic polymers that are typically found in the environment (Faujiah and Wahyuni, 2022). Polypropylene is used to make ropes, bottle caps, gears, tools, anglers, and fasteners; Polyethylene is used to make plan astic baorganismsage contaiorganisms; and Polystyrene is frequently used to make furniture or wood coatings and storage boxes.Containers, pipes, and membranes are made of polyvinyl chloride; ropes and fishing nets are made of polyamide; and bottles, binders, and textiles are made of polyethylene-terephthalate (PET). (Lusher et al., 2017).

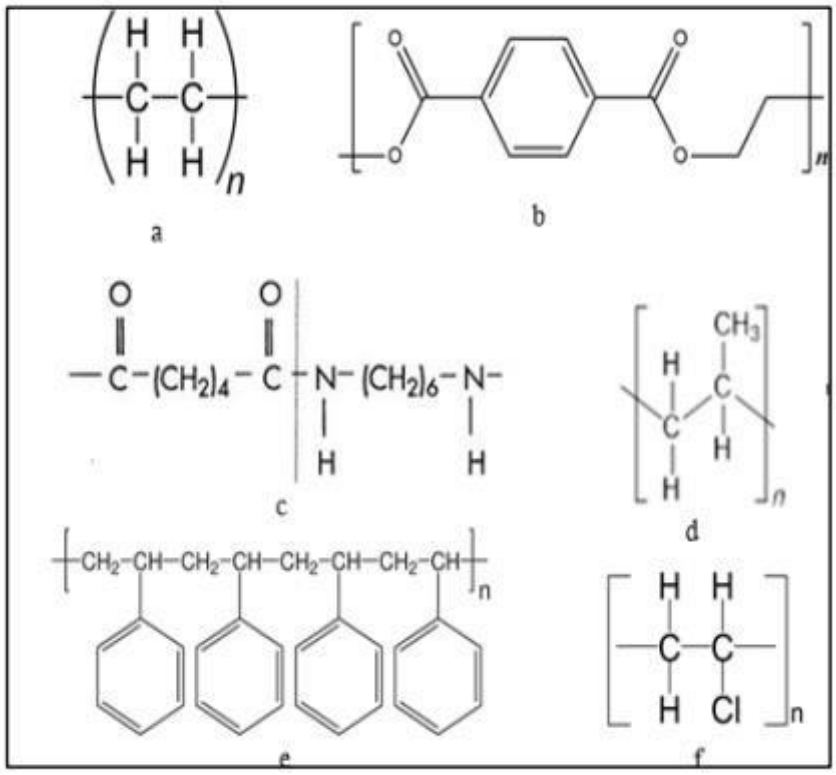

Fig. 3. Polymer structure (a) PE (b) PET (c) Nylon (d) PP (e) PS (f) PVC

3.6 Sorting MP varieties in bottled water

To find out which MP types were in the bottled water samples, an EDS analysis was performed on the particle that the SEM had identified. With the help of elemental mapping and concurrently acquired images, the technology makes it possible to distinguish MPs—which are high in carbon (C), silicon (Si), sulfur (S), and titanium (Ti)—from natural materials. The results of the EDS analysis are shown for each sample in Figure 5(I–IV). The EDS was compared to EDS spectral data of pure PET (plastic bottles including water samples) and those published in other papers in order to identify the kind of polymer (Figure S1).

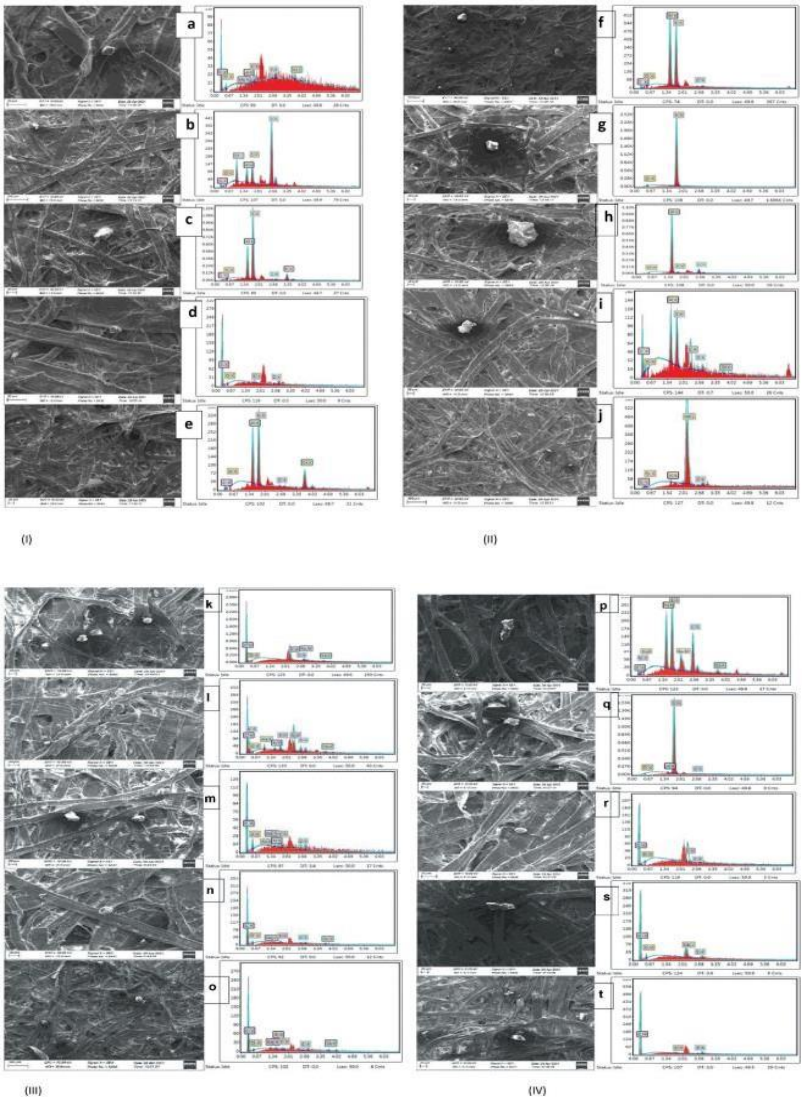

Fig. 4. Some SEM and EDS spectra of bottled water samples from (I) Anambra (II) Imo (III) Enugu (IV) Abia

3.7 Water containing microplastics

US researchers found that bottled drinking water from 259 bottles, representing 11 different brands and distributed in multiple countries, including Indonesia, had up to 93% of microplastics in it (AMDK). Microplastic particles varied in size from 6.5 to 100 m, with 335 fragments and the polymer Polypropylene (PP) (Mason et al., 2018). The average number of microplastic particles per liter was 10.4. Microplastics can enter the aquatic environment from a variety of sources, such as industrial waste, air deposition, wastewater, and degraded plastic debris. The microplastics included in bottled drinking water (AMDK)

may come from a number of places, such as raw water suppliers, packaging components, and the actual packaging. Microplastic can infect glass bottles, drink cartons, and single-use or reusable bottles. In the meantime, refilled drinking water may contain microplastic due to the management process utilizing several plastic pipes (PP, PVC, and other types of plastic) or pieces of equipment. PE (Faujiah and Wahyuni, 2022).

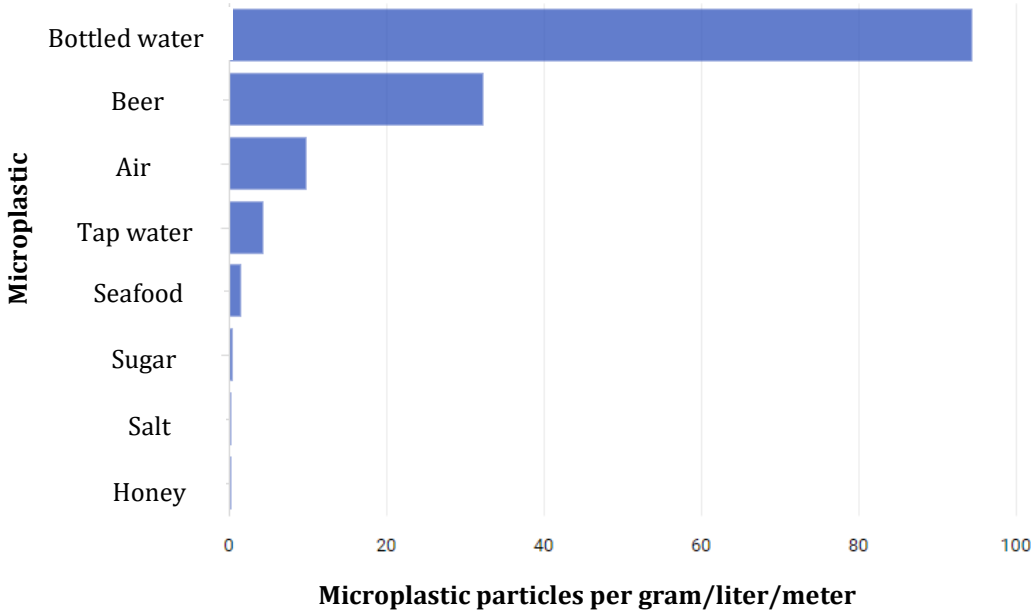

Fig. 5. Chart microplastic on drinking water

3.8 Health impact on healthy lifestyle

Microplastics can be readily ingested by marine life due to their small size, and if they build up in the human body or other biotas through the food chain, they may have detrimental effects. Microplastics less than 500 m have been shown to be able to pass through intestinal walls in fish and invertebrates (Lusher et al., 2020), and microplastics less than 20 m have been shown to accumulate in mice's liver, kidneys, and intestines [20]. Microplastic buildup in the body can have negative consequences like internal and external wounds, organ inflammation, changes in the chemical composition of plastics absorbed by the body, intestinal microbial disruptions that obstruct the digestive tract and create a false feeling of fullness, physiological stress, changed nutrition, growth retardation, and decreased fertility (Faujiah and Wahyuni, 2022).

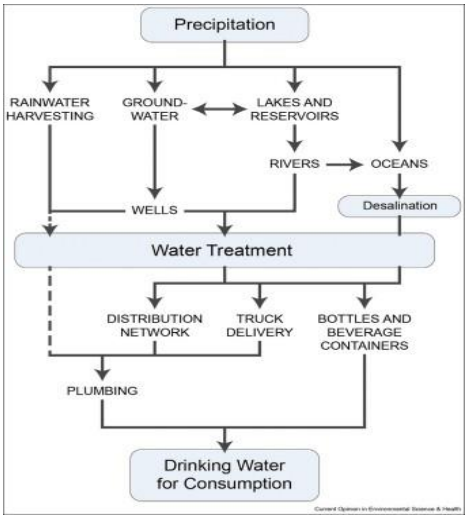

Fig. 6. The Process to become a drinking water

4. Conclusions

As far back as 1970, there have been reports of microplastics (Carpenter et al., 1972; dehaut et al., 2016). Microscopic plastic particles are those with a diameter of less than five millimeters. Both refilled and bottled water have been shown to contain microplastics. The polystyrene (PS), polyethylene-terephthalate (PET), and polyethylene (PE) types of microplastics were found to be present in bottled drinking water (AMDK) as fiber and fragments with sizes ranging from 0.025 to 5,000 mm; microparticles with sizes ranging from 12 to 58 particles/L to 40 to 723 m; polypropylene (PP) and PET types had 118±88 particles/L and PET and PET types had 14±14 particles/L.

Of course, when we consume Bottled Mineral Water (AMDK) that has been contaminated with microplastics, it will cause side effects on our bodies. Even though there has been no clear and straightforward research regarding the significant impact of microplastics on our health, at least we can better know and understand exactly what microplastic is, and also with this article, hopefully, it will be useful and become one of the additions to provide correct information. while at the same time awakening and encouraging companies that focus on providing drinking water, especially in bottles, so that they can continue to improve the quality of good drinking water in accordance with previous regulations.

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Author Contribution

Conceptualization, A.K.; Methodology, A.K.; Software, A.K.; Validation, A.K.; Formal Analysis, A.K.; Investigation, A.K.; Resources, A.K.; Data Curation, A.K.; Writing – Original Draft Preparation, A.K.; Writing – Review & Editing, A.K.; Visualization, A.K.; Supervision, A.K.; Project Administration, A.K.; and Funding Acquisition, A.K.

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Not available.

Conflicts of Interest

The authors declare no conflict of interest.

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