

The Occurrence and Dietary Intake Related to the Presence of Microplastics in Drinking Water in Saudi Arabia

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Abstract

Microplastics have been detected in bottled and in tap drinking water around the world in varying levels. The implications and health effects of microplastics ingestion is still unclear. The objective of this study is to examine the levels of microplastics in drinking water from tap and bottled sources and estimate the dietary intake level from drinking water in Saudi Arabia. 30 drinking water samples have been analyzed for identification and classification of microplastics particles using Fourier-transform infrared micro spectroscopy (FTIR microspectroscopy). The results were used then to calculate the estimated intake of microplastics using recommended water intake by WHO and average body weight in Saudi Arabia

Introduction

Plastics have been manufactured on a large scale in the 1950s due to their economical uses and desirable features.

About 7800 million metric tons of plastics are produced yearly around the world and about 5000 million metric tons of which are deposited into the environment.

Humans are exposed to microplastics via water, air, and food. Evidence of human ingestion of microplastics in stool samples have been found. The implications and health effects of microplastics are not fully clear.

The sources of drinking water in Saudi Arabia are groundwater and desalinated drinking water. To our knowledge, this is the first study to analyze desalinated seawater samples.

In our study, we examined both sources to quantify and identify microplastics in drinking water.

Methods

30 drinking water samples have been collected. The samples included: 24 PET single-use bottled water, 2 glass bottles, 2 PC bottles, and two tap water samples. All samples were from the highly consumed brands.

All samples were pre-rinsed with ultra-pure Milli-Q water prior to any manipulations

Identification and classification of microplastics particles was done using Fourier-transform infrared micro spectroscopy (FTIR micro-spectroscopy).

The results were used then to calculate the estimated intake of microplastics using recommended water intake by WHO and average body weight in Saudi Arabia data according the following formula:

$$\text{Exposure} = (\text{consumption} \times \text{average particles/L}) / \text{bw}$$

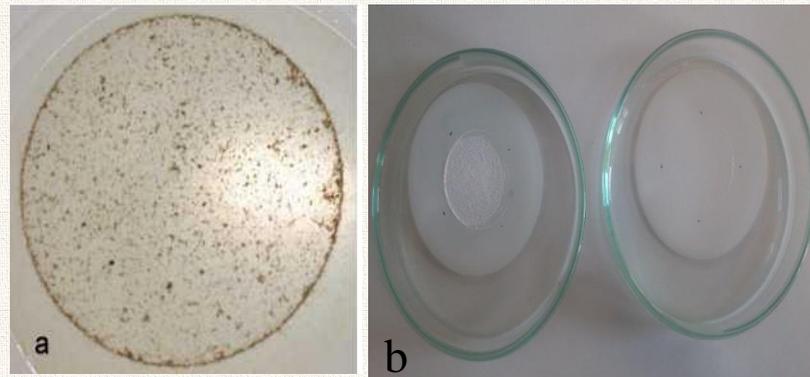


Figure 1: a) filter of 45 mm diameter covered with particles after pre-treatment of a water sample. b) 2 filters of sample BW-M (Lab. No. 1911 10980). Left: filter with usual sample aliquot and solid residues. Right: filter after reduction of sample aliquot (used for analysis).

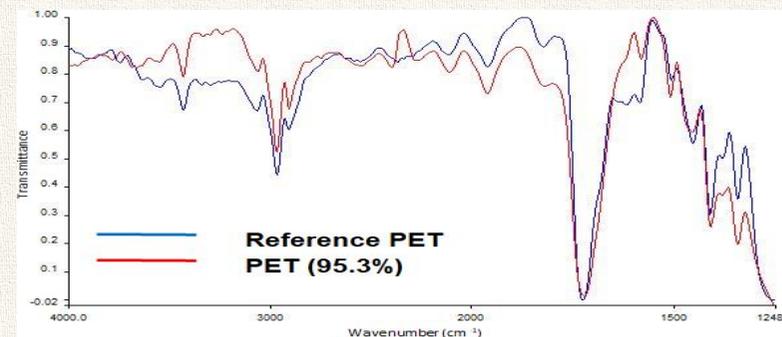


Figure 2: Measured IR spectrum in the sample (in red) and reference spectrum from in-house library (in blue) for PET

Results

- Microplastics in the size range 25-500 µm were found in 17 out of 30 (57%) samples.
- The most frequently identified polymers were: Polyethylene PE, Polystyrene PS, then Polyethylene terephthalate PET.

- The average particle number found 1.9 pcl/L and the range 0.99-26pcl/L.
- These values correspond to an annual intake of microplastics of 2,550-5,100

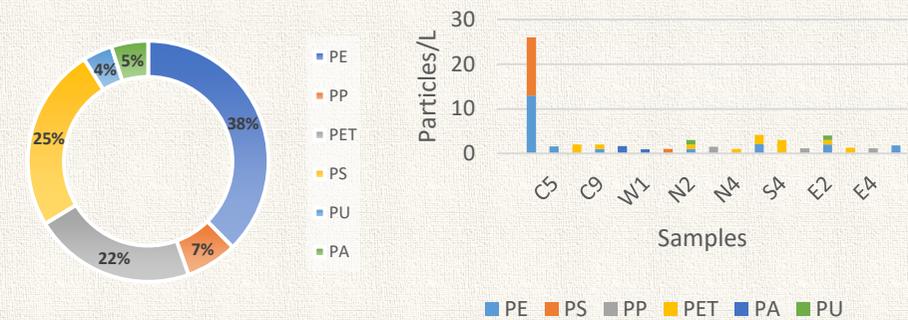


Figure 4: Relative contribution (in %) of each plastic type to the total amount of microplastics detected

Figure 5: Microplastic amount in pieces per liter (pcs/L) and plastic types detected in water samples

Conclusion and Limitations

- Analysis of drinking water in Saudi Arabia revealed low levels of microplastics in the size 25-500 µm similar to other studies analyzing the same size range.
- The sources of drinking water in Saudi Arabia are groundwater and desalinated seawater, and in this study there were no differences in the levels of contamination.
- The sample number in this study was sufficient to represent popular brands and tap water, however, increasing sample size would be beneficial to accurately estimate drinking water contribution to population intake of microplastics.
- Studies analyzing smaller sizes of microplastics in drinking water and other food commodities are needed to measure total exposure to microplastics and nanoplastics.

References

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