The Presence of Microfibers in the City of Phoenix Public Drinking Water

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Microfibers in Tap Water

Abstract

Phoenix is the 5th largest city in the country and the eighth fastest growing city in the United States and provides drinking water to approximately 1.5 million people. An estimated 95% of the drinking water provided by the City of Phoenix comes from rivers and lakes, which are water sources known to contain microplastics and microfibers. Furthermore, microfibers and microplastics may enter water sources through the treatment or delivery process. It is imperative to research drinking water for microplastics and microfibers because there is currently no publicly available research on these materials in the city’s drinking water. Only one other known study has tested for microplastics in drinking water throughout the world, including some parts of the United States. However, this research contained no information on Phoenix drinking water or the Southwestern part of the United States. The purpose of this experiment was to identify if microplastics and microfibers are present in the drinking water throughout the City of Phoenix and to contribute to the emerging field of microplastic pollution. Water samples from villages located within the City of Phoenix limits were collected; a vacuum filtration system was used to remove microfibers, and filtered samples were stained and analyzed by a dissection microscope and Fourier-transform infrared spectroscopy (FTIR). Preliminary results have demonstrated that microfibers may be present in drinking water.

Keywords:

Microplastics: Microplastics are small plastic pieces less than five millimeters long which can be harmful

Microfibers: synthetic yarn that is smaller than 1mm
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Background

Over the past decade several research experiments have indicated that society is now in the “Age of Plastic” and traces of plastic can be found virtually everywhere (Kosuth et. al., 2017). Even when plastic seems to be broken down, not visible to the naked eye, it is still present on the microscopic level and polluting air, surface water, oceans, sediments, and marine life including types of seafood (Rochman et. al., 2015). Microplastics are also found in personal care products and machine-washed clothing (Wright and Kelly, 2017). However, the question remains as to whether microplastics have polluted public drinking water. It is imperative to test Phoenix public drinking water for a number of reasons: Phoenix is one of the fastest growing cities; research on microplastics in tap water for the City of Phoenix is not publicly available and possibly has not been researched to date; and to contribute data to the emerging field of microplastics and its effect on human health.

Literature Review

Information from the National Oceanic and Atmospheric Administration (NOAA) reveals some general problems with using microbeads in personal care products such as toothpaste and facial exfoliators. Problems include the microplastics and microbeads being washed down the drain and not captured by wastewater treatment processes. After passing through the wastewater treatment process, these tiny plastics can enter ocean and lake water. Two negative effects of microplastics in the ocean and lake water are that they absorb toxic chemicals and the microplastics can be consumed by marine life (NOAA, 2015). In response to the growing body of research on microplastics, one piece of legislation was passed in 2015 known as the “Microbead-Free Waters Act of 2015.” The Act bans microbeads in cosmetics and personal care products. A preliminary study conducted in St. Petersburg on synthetic microfibers at a
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wastewater treatment plant identified that microfibers were present before and after the wastewater purification process and that wastewater could be a potential source for marine environmental contamination (Helcom, 2014). Additionally, a study conducted on microplastic contamination in the Great Lakes area revealed that microplastics also affect local habitat areas by altering physical properties of the environment (Kammin, 2015). It appears as though only one public observational experiment surveying tap water has ever been performed. Research conducted by Kosuth et. al. (2017) collected 150 water samples from six regions on five continents, including parts of the US and found that 83% of tap water around the world contained microplastics, and of the samples taken in the United States, 94% of water contained microplastics. The researchers of the experiment expressed the need to further test geographical regions and include more information about water sources and ground filtration methods prior to human use to better understand potential pathways of contamination.

Experiment

The purpose of this experiment is to identify if microplastics and microfibers are present in the drinking water throughout the City of Phoenix and to contribute to the emerging field of microplastic pollution. A total of 17 samples from 12 of the 15 villages located within the City of Phoenix limits were collected (See Figures 1 and 2).
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Figure 1. A geographical map of the 15 villages located within the city of Phoenix.

Figure 2. A map of the 12 villages within the City of Phoenix where samples were collected.

Research Question:
Are microscopic plastic materials and fibers present in public drinking water throughout the City of Phoenix?

Hypothesis:
Samples of tap water taken from within the City of Phoenix villages will be positive for microfibers and/or microplastics.

Null Hypothesis:
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Samples of tap water taken from within the City of Phoenix villages will be negative for microfibers and/or microplastics.

*Independent variable:* Location of water sample

*Dependent variable:* Number of microfibers and/or microplastics in water sample

**Methods**

This experiment attempted to follow the general methods outlined in the previous research study completed by Kosuth et. al. (2017) for the purposes of consistency. Each sample was collected by running the tap water source for 1 minute prior to filling a 500mL glass jar to the point of overflowing. While leaving the tap water running, each sample jar was dumped out and filled twice before being filled a third time and capped with a metal lid. A vacuum filtration system (see Figure 3) was used to remove microfibers, filtered samples were placed in glass petri dishes, stained with Rose Bengal dye, and analyzed with a dissection microscope. To minimize the risk of contamination, the experiment was performed in a laminar airflow cabinet. At the start of each day when samples were processed, 2 Liters of deionized water (referred to as the control blank) was filtered to account for polymer contamination within the testing environment. In contrast to the referenced protocol, a higher volume of the control blank was used because extra water was used to rinse the Buchner funnel and Buchner flask at the start of each session and in between each sample. Additionally, a filter was inspected under a microscope to control for any contamination of the filters.
Figure 3. Schematic of the vacuum filtration system.

https://chem.libretexts.org/Demos%2C_Techniques%2C_and_Experiments/General_Lab_Techniques/VacuumFiltration
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Results

![Number of Microfibers Found in Phoenix Drinking Water](image)

**Figure 4.** Raw count of microfibers present in each Phoenix Village

Discussion

The experiment shows that microfibers are present in drinking water throughout all 11 villages sampled in the City of Phoenix. Additionally, unknown particulates were identified on almost all dyed filters. More research is needed to expand on the significance of microfibers and the unknown particulates in drinking water within the City of Phoenix. It is imperative that more research is done with the goal of understanding how the presence of microfibers in drinking water will affect human health as it already affects the health of marine organisms. Next steps include: exploring alternative methods for developing a control to account for baseline microfibers in the water, gathering more samples to test for the presence of microfibers, and analyzing dyed water...
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sample filters with Fourier-transform infrared spectroscopy to identify the foreign particulates found on the filters.

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