Anthropogenic microparticle contamination in bottled water for human consumption

In December 2017, 19 different bottled water brands were analyzed for microparticle contamination by Abigail Barrows of Ocean Analytics. A total of 19.85 L were analyzed with samples averaging 0.99 L. Samples contained an average 8 particles per liter of water with 161 particles enumerated in total (table. 1.). Particles were categorized as fibers (n = 90) or fragments (n = 71). 96% of the particles were between 0.1-1.5 mm in size.

Samples were processed following strict QA/QCC protocols as outlined in Barrows et al., 2017; Hidalgo-Ruz et al., 2012; Miller et al., 2017. Before sample processing, all surfaces were wiped down with a brightly colored cellulose sponge. A 100% white cotton laboratory coat was worn at all times during sample handling. All laboratory equipment was triple-rinsed immediately before contact with the sample water. Each sample was vacuum pumped over a 0.45 μm filter (Whatman mixed cellulose nitrate, 47 mm diameter, GE Life Sciences). Sample filtrated was measured in a graduated cylinder and volume recorded. Filters were placed in a triple-rinsed glass petri dish until enumeration.

Using a stereo microscope at 45x magnification the filter was systematically viewed using the 3.2 mm grid as a guideline. Particles were identified based on a lack of cellular structures and, in the case of microfibers a uniform shape (Hidalgo-Ruz et al., 2012). Each plastic piece was categorized based on shape (round, fiber, fragment) and color (blue, red, black, transparent/clear, other) and size (100 μm – 1.5 mm, 1.6-3.1 mm, 3.2-5 mm, and 5.1-9.6 mm) (Miller et al., 2017). The size classes were based on the filter grid. The final count for the sample was divided by the sample volume. This calculation standardizes the results, as the water samples were not exactly one liter. Particles were photographed on each filter using an AMscope microscope camera. Scale bars were applied to the photographs after calibration with ImageJ software (Barrows et al., 2017).

To control for potential laboratory contamination, lab water and air blanks were conducted during sample processing. Water blanks were run to determine if the filtered tap water used to rinse the glassware and forceps were contributing to microparticle contamination in the samples. During the two days of filtration we processed a total of 2.71 L. No particles were enumerated from the

water blank samples. During filtration and counting an air blank (0.45 μm dampened filter in a glass petri dish) was continuously exposed to the air. Additionally, an air blank was exposed intermittently for the duration of 1 to 3 samples with time recorded for both types of air blanks. Samples were exposed for a total of 186.6 minutes. There was contamination of 0.09 particles per 8.5 minutes exposure. Since contamination was minimal we did not subtract from the bottled water totals.

In conclusion, microparticle contamination appears to be present in bottled water destined for human consumption. We recommend further analysis of microparticle material types and associated toxicants to better understand potential human health effects.

Table 1. Bottled water brand names and particle contamination.

Brand	Sum of Total Particles	Sum of Total Particles per Liter
Aquafina	0	0.0
Arrowhead	6	3.9
Boxed Water	56	58.6
Crystal Geyser	8	7.7
Dasani	2	2.1
Deer Park	5	4.8
Eternal water	1	1.0
Evian	10	9.5
Fiji	19	12.3
Glaceau Smart	6	5.8
Ice Mountain	6	11.3
Icelandic Glacial	8	7.8
Ozarka	11	15.1
Penta	5	4.9
Poland Spring	2	1.9
Texas Spring Water	5	7.9
Trader Joes Mountain Spring	2	1.9
True Zealand	6	5.9
Zephyrhills	3	2.9
Grand Total	**161**	**165**

About the researcher

Abigail Barrows has worked for the past 5 years studying microplastics in marine and freshwater environments. She has processed over 3,000 global water samples. She has published three peer-reviewed papers (one *in review*) using this rigorous laboratory method. Abigail has presented nationally and internationally on her microplastic research and sits on a variety of scientific advisory boards. She is currently completing her Master's Degree at College of the Atlantic.

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