Microplastic and Nanoplastic Exposure through New York City Tap Water: Method Development and Analysis

Olivia Grefenstette[1,2], Huiping Deng[2], Khue Nguyen[2], Beizhan Yan[2]

[1]Barnard College of Columbia University in the City of New York, [2]Lamont-Doherty Earth Observatory of Columbia University, Palisades New York

Plastics have become a ubiquitous part of modern life, with ingestion of contaminated water being one of the main pathways to exposure. Despite the potential health risks these plastics may pose, there is limited existing literature establishing effective methods for isolating and identifying microplastics and nanoplastics. Moreover, there is no existing literature looking at microplastic and nanoplastic contamination of tap water in New York City (NYC) specifically. NYC is the most populated city in the U.S., with a population of over 8.5 million people. This incredibly dense city is tasked with the crucial responsibility of providing enough resources to support its residents. One of these resources is tap water, which is mainly sourced from the Catskill water system. A city's tap water is a direct contributor to the city's health. This then raises concerns about the effects contaminated tap water can have on the country's largest city.

This study aims to bridge this knowledge gap by developing methods in order to assess New York City's plastic contamination exposure through tap water. Density separation was used to isolate plastics, and hydrogen peroxide (H2O2) was used to digest organics. Recovery experiments were conducted to determine the efficacy of the methods. Polymer identification, particle count, and particle size data were collected using advanced imaging techniques, including Scanning Electron Microscope (SEM), Stimulated Raman Scattering (SRS), and Optical PhotoThermal InfraRed (OPTIR). From SEM and OPTIR analysis, we found that our initial methods resulted in particle aggregation, leading us to add a sonication step after density separation. Preliminary results from a Manhattan sample found 1300 plastic particles spread across the five FOVs taken. From this count, plastic concentrations were estimated to be about 1.07×10^6 particles per liter of the Manhattan sample. Analysis of the sample also revealed that PMMA and PVC were the most dominant polymer types. More than 80% of the particles detected were identified as nanoplastics (<1 μm), while the remaining 20% were microplastics. The results from this study enable a more informed conversation about what water quality really means in an age dominated by plastics. The detection of plastics in the Manhattan sample, specifically the prevalence of nanoplastics, emphasizes the importance of continued high-resolution research into the threat of plastic exposure through tap water consumption, in New York City and beyond.