Robust laboratory procedures for the determination of microplastics and nanoplastics in tissues of humans and animals

Varun Kelkar[1], Sangeet Adhikari[1], Rolf U. Halden[1]

1. Environmental health engineering , Arizona State University, Tempe , AZ, United States.

The presence of microplastics (MPs) and nanoplastics (NPs) in commodities of daily use and is a human health concern. Polyethylene terephthalate (PET) and polycarbonate (PC) are among the most widely used plastics, made from monomers of terephthalic acid (TPA) and bisphenol A (BPA), respectively. The present work aimed to perform a literature analysis of PET and PC exposures in humans and to assess the potential for analytically demonstrating potential human exposures to MPs and NPs against a potentially significant background of environmental plastics that may cross-contaminate samples during sample acquisition, handling, storage, processing and analysis. For the literature review, peer-reviewed data on the presence of plastic monomers and polymers in human tissues were obtained and analyzed from scientific databases. To assess the feasibility and limits of plastic exposure determination in human tissues, a multi-step analytical approach was outlined, (1) solubilization of tissue using an alkaline agent, (2) determination of BPA/TPA in tissue extracts using liquid chromatography tandem mass spectrometry (LC-MS/MS), (3) depolymerization of MPs and NPs putatively present in the form of PET and PC polymers, (4) concentration and analysis by LC/MS-MS of monomers liberated by the depolymerization step, and (5) comparison of the mass of plastic monomers determined to be present before and after the tissue solubilization and plastic depolymerization. Study results demonstrate that a significant body of literature on human exposure to plastic monomers exist, whereas authoritative reports of the presence of plastic polymers in human tissues are still scarce. Overall, this study highlights the significant challenges associated with the qualitative and quantitative determination of plastics that are ubiquitous and thus pose a high risk of unwanted cross-contamination during analysis. Recommendations are provided on how to minimize the risk of erroneous conclusions about the type and extent of polymers present in animals and human study subjects. Opportunities for interpreting obtained results in the context of lifetime exposure metadata also are discussed.