Survival of human pathogens bound to microplastics during transfer through the freshwater-marine continuum: from wastewater discharge to the beach

Rebecca Metcalf*[1], Hannah White[1], Michael Ormsby[1], David Oliver[1], and Richard Quilliam[1]

[1]University of Stirling – Stirling, United Kingdom

Abstract

Large quantities of microplastics are regularly discharged from wastewater treatment plants (WWTPs) into the aquatic environment. Once released, these plastics can rapidly become colonised by microbial biofilm, forming distinct plastisphere communities which may include potential pathogens. However, it is unclear how long potential pathogens can persist in the plastisphere following their release from WWTPs and the impact that transitioning between different environmental matrices, with changing biotic and abiotic conditions, has on their survival. We hypothesised that the protective environment afforded by the plastisphere would facilitate the survival of potential pathogens during such transitions and increase their persistence in the environment. In this study, 2 mm polyethylene and glass particles were added to either freshwater or seawater mesocosms, or moved through a series of effluent-freshwater-estuary-seawater-sand mesocosms to simulate downstream transport following discharge from a WWTP. We found that viable *E. coli, E. faecalis* and *P. aeruginosa* can successfully survive in the plastisphere, either in freshwater or seawater, or as the particles transition between different environmental matrices. Higher concentrations of bacteria were detected on microplastic compared to glass particles; however, there were no differences in die-off rates of bacteria colonising the two materials. Despite concentrations decreasing over time, viable bacteria were still detected on microplastic and glass particles after 25 days in both freshwater and seawater, and after passing through the river-estuary-marine-beach continuum. This enables potential pathogens to transition into environments where human exposure is greater (e.g., bathing waters and beach environments), increasing the likelihood of pathogen transfer and potential impact on human health.

Keywords: Microplastics, Human health, Environmental pathogens, Plastisphere

*Speaker