Experimental and modeling studies of the influence of ingestion of microplastics on bioaccumulation of hydrophobic organic chemicals by fish

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The potential for microplastic pollution to modulate the bioaccumulation of persistent hydrophobic chemicals is a topic of current scientific interest. There has been speculation that ingestion of plastics could increase bioaccumulation of chemicals. However modelling studies suggest that ingestion of plastic that has the same fugacity or activity of chemicals as its surrounding environment will have a negligible impact on bioaccumulation, and that plastic could even act as a pathway for depuration of chemicals from aquatic biota. Here we present results of an in-vivo fish experiment that examined the influence of ingesting clean microplastic particles on depuration rates of hydrophobic chemicals by fish. Experiments were conducted in two fish tanks containing 300L of aerated water, each containing sixteen rainbow trout weighing about 100 g each. Feed contaminated with PCB 18, PCB 40, PCB 128 and PCB 209 was given to the fish in both tanks, and allowed to pass through the digestive tract for five days. Then, fish in one tank were fed ordinary fish pellets while the fish in the other tank was fed pellets prepared with 40% by weight polyethylene microspheres (212-250µm). Four fish from each tank were sampled after one, three, six and nine weeks. Whole fish was homogenized, and aliquots of the homogenate were extracted, cleaned-up, and analyzed by GC/LRMS. After nine weeks of depuration, no significant decrease of the PCB concentrations in the fish could be measured in either of the two groups. The plastic content of ingested food used in this study is an extreme case that is unlikely to be approached in the real environment, and still no influence of plastic in the diet was evident on the depuration of PCBs. We discuss implications of our study using kinetic modeling scenarios that place boundaries on the potential influence of microplastic ingestion on the kinetics of uptake and depuration of hydrophobic organic contaminants with properties similar to PCBs.