

Biomagnification potential of human pharmaceuticals in the Arctic food web

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Although human pharmaceuticals are increasingly reported in streams, effluents, seawater and sediments of the Arctic, accumulation of drugs in the resident biota and trophic transfer have not been yet examined. This study investigates behaviour of several pharmaceuticals in the rocky-bottom macrobenthic food web in the coastal zone of Isfjorden (western Spitsbergen) using stable isotope analyses coupled with liquid chromatography-mass spectrometry (LC/MS). Across 16 macroalgal and invertebrate species the highest average concentration of pharmaceuticals was measured for ciprofloxacin (CIP) (60.3 ng g⁻¹ dw) followed by paracetamol (PCT) (51.3 ng g⁻¹ dw) and nicotine (NIC) (37.8 ng g⁻¹ dw). Biomagnification potential was assessed for six (out of 14 detected) target compounds that were quantified with frequency > 50 % in biological samples. The trophic magnification factor (TMF) ranged from 0.221 to 1.324 and was significant only for NIC and CIP. TMF < 1.0 for NIC, DIC, carbamazepine (CBZ) and caffeine (CAF) indicated that neither compound accumulated with trophic position. Dilution of pharmaceutical residues in the food web might be a result of limited intake with dietary route, poor assimilation efficiency and biotransformation rates in benthic invertebrates. TMFs for CIP (2.768) and PCT (1.324) suggest trophic magnification, the phenomenon observed previously for several antibiotics in freshwater systems. Evidently, trophic transfer plays a major role in controlling CIP and PCT concentrations in the Arctic benthic communities and should be considered in the environmental risk assessment. This study provides the first evidence of the Arctic food web which indicates that behaviour of human pharmaceuticals varies among target compounds.