Ecotoxicity of carbamazepine and its UV photolysis transformation products
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Ecotoxicity of carbamazepine and its UV photolysis transformation products
Carbamazepine, an anti-epileptic pharmaceutical agent commonly found in wastewater, is highly recalcitrant to standard wastewater treatment practices. This study investigated the mixture toxicity of carbamazepine transformation products formed during ultraviolet (UV) photolysis using three standard ecotoxicity assays (representing bacteria, algae and crustaceans). UV-treatment of 6 mg L−1 carbamazepine solution was carried out over a 120 min period and samples were removed periodically over the course of the experiment. Quantification results confirmed the degradation of carbamazepine throughout the treatment period, together with concurrent increases in acridine and acridone concentrations. Ecotoxicity was shown to increase in parallel with carbamazepine degradation indicating that the mixture of degradation products formed was more toxic than the parent compound, and all three ecotoxicity endpoints were still inhibited > 60% relative to control populations upon dosing with 90 + min UV-treated carbamazepine solution. Single compound toxicity testing also confirmed the higher toxicity of measured degradation products relative to the parent compound. These results show that transformation products considerably more toxic than carbamazepine itself may be produced during UV-treatment of wastewater effluents and/or photo-induced degradation of carbamazepine in natural waters. This study highlights the need to consider mixture toxicity and the formation and persistence of toxicologically relevant transformation products when assessing the environmental risks posed by pharmaceutical compounds.

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