

# Stability and Degradation of Opioids in Riverine Systems

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Opioids are psychoactive compounds whose high consumption and environmental persistence may pose risks to organisms in streams that receive effluent discharges. In this study, we examined the degradation kinetics of four common opioids – tramadol, fentanyl, codeine, and buprenorphine – in bench-top riverine microcosms. The experiments were conducted at room temperature over two weeks in the dark using river water from a conservation site and seeded with pre-grown biomass. They were set-up to distinguish among hydrolysis, aerobic biodegradation, and sorption (to particulates and biofilm). Labeled opioids were spiked in at environmentally relevant concentrations. For all opioids, degradation followed first-order kinetics, with tramadol as the most stable (15 % removal) and buprenorphine (26% removal) as the least stable. Biodegradation was the most significant attenuation pathway for all four opioids. This study is the first to report on the contribution of biodegradation to the attenuation of fentanyl and buprenorphine in riverine systems, as well as the effects of sorption for the four opioids. Findings provide some insights regarding the stability of opioids in streams and raise questions regarding the effects of their pseudo-constant presence to aquatic organisms.

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