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Impact of the dissolved organic matter molecular composition on dichlorobenzene phototransformation mechanisms

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Dissolved organic matter (DOM) is a photosensitizer that transforms organic contaminants through indirect photolysis. DOM facilitates the indirect phototransformation of organic micropollutants by forming reactive intermediates, leading to the formation of daughter products. Dichlorobenzenes (DCBs) are chemical intermediates used in the production of pesticides, pharmaceuticals, and dyes. DCBs primarily enter the environment through industrial discharges or non-point use of DCB-containing chemicals, posing risks to human and aquatic ecosystem health. This research links the profile of the daughter photoproducts of DCBs with the molecular composition of different DOM types.

The photodegradation of DCB was conducted in a custom-built reactor equipped with the LED lamp, encompassing a broad spectrum of wavelengths ranging from 360 to 800 nm. We varied the DOM molecular composition by using the end-member DOMs: Suwannee River DOM (SRNOM) as terrestrial DOM, and a microbial origin DOM produced in a lab setting. We incubated the algae *Arthrospira platensis* in Allen Medium under a 12-hour light/dark cycle to produce purely microbial DOM. We also sampled predominantly algae-derived DOM from a eutrophic lake in Auburn, Alabama, USA. The SRNOM and eutrophic lake DOMs showed distinct structural compositions, assessed through spectroscopic properties like aromatic content ($SUVA_{254}$) and the fluorescence index. SRNOM had higher aromaticity and a humic-like nature, while eutrophic lake DOM exhibited more pronounced microbial signatures. In photolysis experiments, we found that the profile of the daughter products varied between the different types of tested DOM under the same experimental conditions. The dechlorination to monochlorobenzene (MCB) was observed in the microbial DOM, while the SRNOM did not lead to MCB formation.

Future research will focus on identifying the suite of degradation products in the SRNOM sample and determining the DOM type's molecular composition by high-resolution mass spectrometry. We will also determine the carbon and chlorine isotope fractionation of the parent compound to distinguish between the degradation mechanisms of DCB.