Bromoform production from seawater treated with bromoperoxidase

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ABSTRACT: Bromoform ($CHBr_3$; 11 – 486 fmol L^{-1} h^{-1}), dibromomethane (CH_2Br_2; 0 – 9.4 fmol L^{-1} h^{-1}), and low amounts of chloride-substituted chlorobromomethanes were produced from southern California coastal surface seawater upon the addition of algal bromoperoxidase (BrPO) and hydrogen peroxide. Production was greater from water collected near shore than 16 km offshore, presumably reflecting the difference in the reactive dissolved organic matter (DOM_{reac}) concentrations. In the spring, there was an increase in phytoplankton abundance, and $CHBr_3$ production from BrPO incubations was greater, presumably due to increased DOM_{reac}. In the winter, CH_2Br_2 production was enhanced, although still lower than $CHBr_3$, suggesting a qualitative change in DOM composition due to terrestrial runoff. During the month of the highest precipitation, $CHBr_3$ and CH_2Br_2 production was enhanced in samples obtained from the mouth of an urban river, suggesting a higher concentration of DOM_{reac} of terrestrial origins. DOM was fractionated by ultrafiltration and subject to the BrPO incubation. The higher molecular weight fractions contained a higher concentration of DOM that was susceptible to BrPO bromination, yielding polybromomethanes. Polybromomethane and iodomethane production associated with phytoplankton blooms results from the reaction between the surrounding DOM, and hypobromous acid (HOBr) and hypoiodous acid released from extracellular (apoplastic) BrPO. The reaction of HOBr and DOM (biological bleaching) could represent a significant DOM degradation pathway. Cell-free BrPO, derived from dead cells, could remain catalytically active in seawater and produce low amounts of polyhalomethanes prior to biological degradation.

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