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Studies on the microbial halogen cycle: reactions of fungal peroxidases and bacterial reductive dehalogenases

Halogenated metabolites are produced e. g. by lignin degrading fungi and may be available to organohalide respiring anaerobes in natural environments. However, it is unclear if there is any connection between aerobic biological halogenation and anaerobic dehalogenation. The aims of this study were to answer this question and to shed some light on microbial halogenation and dehalogenation involving halide ions other than the well studied chloride (e. g. bromide, fluoride).

Using *Sulfurospirillum multivorans* and *Desulfitobacterium hafniense* strain PCE-S and their purified tetrachloroethene (PCE) reductive dehalogenases as a model system, dehalogenation of brominated alkenes was investigated and compared with that of their chlorinated analogues. A lower stereospecificity as well as a similar reaction mechanism of the debromination as compared with the dechlorination was found.

As a model for halogenating fungi, *Bjerkandera adusta* strain Ud1 was studied for halogenating enzyme production. The versatile peroxidases of this fungus were found to possess brominating activity. For the first time, a fluoride-dependent activity was observed with the versatile peroxidases as well as manganese peroxidases from *B. adusta*. A hypothesis of fluoride activation of long-range electron transfer pathway(s) in manganese peroxidase was brought up.

Halogenated metabolites were produced by *B. adusta* strain Ud1, identified as 3-Cl-*p*-anisaldehyde and 3,5-dichloro-4-methoxybenzaldehyde, and were *O*-demethylated and dehalogenated by the anaerobe *D. hafniense* strain DCB-2.

Furthermore, an anaerobic mixed culture with *O*-demethylating and dehalogenating activity was enriched from forest soil, where ligninolytic enzyme activities were detected. These experiments point to an interaction between aerobic halogenating fungi and anaerobic dehalogenating bacteria.

Publications

Ye L, Schilhabel A, Bartram S, Boland W, Diekert G (2010) Reductive dehalogenation of brominated ethenes by *Sulfurospirillum multivorans* and *Desulfitobacterium hafniense* PCE-S. *Environ Microbiol* 12(2), 501-509. Details PubMed

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