Halophenols bioremediation catalyzed by an artificial peroxidase

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Halophenols (HPs) have been widely used as pesticides, herbicides and wood-preserving agents. Once released into the environment, they exert toxic effects onto living systems such as plants, animals and humans.[1]

Among bioremediation strategies targeting HPs, oxidative degradation is efficiently catalyzed by natural heme-enzymes, such as Horseradish Peroxidase (HRP),[2,3] in the presence of hydrogen peroxide as an oxidant. Peroxidases activate the phenol ring, by generating both phenoxy radical and carbocationic species, which further react to give coupling and/or oxidative dehalogenation products, such as chlorinated benzo-*p*-dioxins and quinones.

The ability of these enzymes to cause phenolic coupling may allow the immobilization of toxic phenolic substances, such as HPs, limiting their bioavailability and suppressing their toxic effects. Humic acids (HA) are ubiquitous organic materials in terrestrial and aquatic ecosystems to which HPs can covalenty bind upon activation.

In order to improve the chemical stability of natural peroxidases along with their catalytic efficiency, in recent years a variety of artificial biomimetic systems has been developed and evaluated to this purpose.[4] In this area, our ongoing project, focused on the design and synthesis of artificial enzymes led us to explore the activity of an artificial peroxidase, Fe^{III}-Mimochrome VI*a (FeMC6*a) (Fig. 1), towards HPs.[5] Herein, the oxidative degradation of HPs catalyzed by FeMC6*a and its use in bioremediation strategies are reported. FeMC6*a is able to convert a variety of HPs, including 2,4,6-trichlorophenol (TCP) (Fig. 2) with 840-fold higher catalytic efficiency than natural HRP.

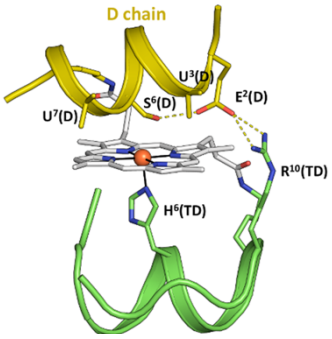

Fig. 1 Structure of FeMC6*a

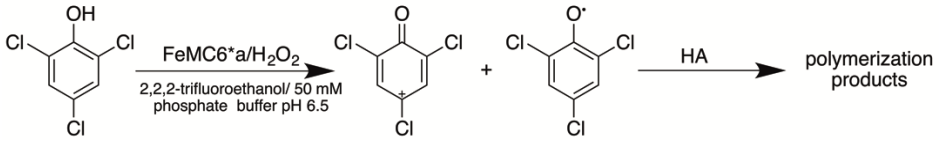

Fig. 2 Degradation reation catalyzed by FeMC6*a

Furthermore, used in combination with HA, FeMC6*a is able to remove TCP from aqueous media, even at nanomolar catalyst concentration.

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