PEROXIDASE-CATALYZED OXIDATIVE POLYMERIZATION OF 1-NAPHTHOL IN SOILS AND AQUEOUS SOLUTIONS

[1]Fangxiang Xu, [1]Alok Bhandari, [2]David Koch, and [2]Robert P. Hunter
[1]Department of Civil Engineering, Fiedler Hall, Kansas State University, Manhattan, KS 66506; Phone: (785)532-5862; Fax: (785)532-7717.
[2]Department of Anatomy and Physiology, Coles Hall, Kansas State University, Manhattan, KS 66506; Phone: (785)532-5666; Fax: (785)532-4557.

Abstract

Oxidative coupling reactions catalyzed by the enzyme horseradish peroxidase (HRP) have been well studied for chemicals such as substituted phenols and anilines. Oxidative coupling generally results in production of high-molecular-weight oligomers that readily precipitate from solution or bind to soil surfaces. It is believed that these oligomers are more hydrophobic and less biodegradable than the parent phenols. Very few studies have looked at the oxidative polymerization phenomenon in the context of hydroxylated-polynuclear aromatic compounds (hPAHs). Our research explored HRP-catalyzed oxidative polymerization of 1-naphthol in both soils and aqueous solutions. Experimental results revealed that, unlike phenols, enzyme addition reduced the sorption and binding of naphthol to two sandy loam soils. Liquid chromatography-MS/MS analysis of naphthol-polymerization products, generated in aqueous solutions, illustrated that these products included naphthoquinones and dimers, trimers, tetramers, and higher oligomers of naphthol. Some products (tetramers and dimers) were more polar than the parent 1-naphthol. Size-exclusion chromatography and mass spectra results indicated that the molecular weight of the polymerization products ranged from 200 to 1700; the two most abundant products had molecular weights of 427 and 569.

Key words: naphthol, polymerization, oligomers, peroxidase, coupling