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Biotransformation of Emerging Pollutants in Groundwater by Laccase from *P. sanguineus CS43* Immobilized onto Titania Nanoparticles

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ABSTRACT

Biotransformation of organic compounds by using biocatalysts such as laccases provides an environmentally attractive alternative to supplement conventional wastewater treatment. However, loss and inactivation of enzymes are challenges to solve for their potential use in water treatment applications. Titania presents a high chemical stability and easy functionalization, which are important characteristics in a support used for immobilization processes. Therefore, in this study, the immobilization of laccase enzymes produced by *Pycnoporus sanguineus* CS43 onto titania nanoparticles (~21 nm) was optimized. Surface modification of the support was carried out by using different weight % (wt%) of 3-aminopropyltriethoxysilane (APTES) as a coupling agent and the cross-linker glutaraldehyde (GLU) as a laccase binder. Free and immobilized enzymatic activity were measured based on 2,2′-azino-bis-(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS) assays and were compared regarding apparent activity and activity recovery. In addition, the effect of ionic strength on the immobilization process was studied, finding that low ionic strength (25 mM phosphate buffer) promote a high activity recovery, greater than 90% and even higher than previous reports. Immobilized laccases showed high thermostability at 50 and 60 ºC (half-lives of 45.7 and 3.7h, respectively), and high stability at low pH values of 2 and 3 (half-lives of 31.8 and 107.1h respectively). Furthermore, the biocatalyst was assessed in the biodegradation of emerging pollutants such as acetaminophen and diclofenac by using 100 UL^{-1} of immobilized laccase at pH 4; the maximum biotransformation percentage of DCF was 68% after 8h, and more than 90% biotransformation of ACE was reached after 2h of treatment.

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