Exploring the fungal potential for natural and synthetic polymer degradation

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Fungi are versatile microorganisms with a crucial role in organic carbon mineralization and dead matter degradation in nature, due to their ability to break down complex natural polymeric structures. Many fungal strains are also very efficient in degradation of recalcitrant organic compounds, making them promising candidates for the bioremediation of various environmental pollutants with similar structure, including synthetic polymers [1,2]. In this work, four fungal strains, one belonging to Ascomycota and three to Basidiomycota, were selected based on preliminary screening results on agar plates and evaluated for their ability to grow with complex polymers as sole carbon sources in submerged fermentations. Anionic aliphatic polyester-polyurethane and long-chain alkanes dispersions were used to probe the fungal degradation potential towards polyurethane and polyolefins, respectively, while corn bran was used to check for the delignification capacity of the selected strains. During fermentation, culture supernatants were regularly screened for their protein content, and selected enzymatic oxidative and hydrolytic activities were quantified via spectrophotometric assays. Upon termination of fermentation, substrate degradation was evaluated through compositional analysis of corn bran and gel permeation chromatography of synthetic compounds. Culture supernatants were sent for shotgun proteomics analyses, targeting at sequences homologous to known Carbohydrate Active Enzymes (CAZymes) [3] and activities related to synthetic polymers degradation [4]. This study highlights the potential of fungi and their enzymatic machinery as powerful tools for the degradation of these recalcitrant compounds.

Keywords: biocatalysis; fungi; plastic depolymerization; lignocellulosic biomass delignification; omics-based techniques; oxidative enzymes

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