The potential of biological treatment for Lead (Pb) and Cadmium (Cd) polluted soil

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Abstract

The persistence of heavy metals (HMs) such as Lead (Pb), Arsenic (As), and Cadmium (Cd) contamination in soil and aquatic systems remains a critical global environmental and health challenge, underscoring the need for eco-friendly, sustainable mitigation strategies. Fungal mycoremediation, utilizing the natural metabolic capabilities of fungi, offers a promising solution for rehabilitating these degraded habitats. In this study, we investigated the HMs remediation potential of an endophytic fungi isolate from *Oncosperma* sp. and *Litsea cubeba* Pers. Among the tested endophytic fungi, the *Diaporthe* spp. LCL09 is a promising strain with a high tolerance index (TI) for 1,000 ppm of Pb (TI = 0.96), 500 ppm of As (TI = 0.97) and moderate TI for 500 ppm of Cd (TI = 0.41). This strain demonstrated adaptability with consistent growth between 20-30°C and across a pH range of 4-10. The quantitative bioleaching assays confirmed the efficiency of *D. subclavata* LCL09, achieving a 63.77%-70.99% and 59.58%-81.4% reduction of all three HMs in culture media and soil, respectively. These data suggested that *D. subclavata* LCL09 employs bioaccumulation for HMs removal. SEM analysis revealed absorption efficiency of this fungal strain on Cd and Pb. Indicating a synergistic dual mechanism of bioaccumulation and biosorption for Pb and Cd. Additionally, the significant induction of laccase activity in *D. subclavata* LCL09 (up to 15.735 U/L) under Cd and Pb stress underscores the role of lignolytic enzymes in detoxification. These results demonstrate that *D. subclavata* LCL09 its effectiveness as a biological agent for multi-metal treatment of contaminated environments.

Keywords: Mycoremediation, Heavy metals, *Diaporthe subclavata*, Bioleaching, Laccase activity, Environmental sustainability.