SPLICE: Dye Hard - Bioremediation of Heavy Metals and Dye Degradation in Wastewater Via Microbes

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The global increase in textile production has led to a proportional rise in industrial wastewater, contributing significantly to environmental pollution due to high concentrations of toxic metals present - innovative solutions are urgently required to mitigate its environmental impact. Previous studies have demonstrated the potential of microbes to reduce metal concentrations in wastewater yet challenges such as costs and inhibitory effects from harsh chemistries limit the efficiency and sustainability of these treatments. To address these challenges, we focused on enriching bacteria native to the wastewater to identify compounds from other waste streams (i.e., e-waste) to identify methods for scaling up.

Metagenomes were generated from DNA extracted from the wastewater of a textile factory in Leicester, with subsequent analyses to identify metabolic pathways. Enrichments were amended with KNO_3 and monitored for microbial growth using fluorescence microscopy. Metagenomic analysis identified *Pseudomonas* as a key microbe in the wastewater. The *Pseudomonas* genome contained genes encoding essential enzymes, including cytochrome p450, laccase, and phenol oxidases, and azo reductases, crucial for breaking down azo dyes, primarily used in textile industries [1]. The *Pseudomonas* genome also contained genes encoding zinc ATPases and iron siderophores, contributing to metal capture, while also using nitrate and nitrite in anaerobic respiration, which have been shown to alter the redox environment to favour metal ion precipitation [2].

This process of nitrate-mediated reduction has previously been shown to create conditions that increase metal concentration and promote precipitation of less soluble compounds, effectively trapping them within biofilm or associated with cells [3]. Additionally, *Pseudomonas* species have been shown to efficiently reduce COD (Chemical Oxygen Demand) through the breakdown of complex azo dyes, particularly under anaerobic conditions by using nitrates an electron acceptor [4]. The genomic analysis of the *Pseudomonas* therefore indicates a possible means of enhancing bioremediation of heavy metals and dye degradation.

Keywords: metagenome, bioremediation, wastewater

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