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Research Article

Evaluating the ability of *Rodococcus erythropolis* bacterial cells to remove lead from aquatic environments with a comparative approach between biosorption and bioaccumulation

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Extended Abstract

Introduction
The removal of heavy metals, such as lead (II), from aqueous environments is a critical environmental challenge due to their toxicity and persistence. This study investigates the comparative efficiency of biosorption and bioaccumulation using *Rhodococcus erythropolis* for lead (II) removal. Biosorption involves the use of non-living biomass to adsorb metals, while bioaccumulation utilizes living cells to uptake and store metals. The study aims to evaluate the effectiveness of these methods under varying conditions, including contact time, initial metal concentration, and biomass dosage, to optimize lead removal from contaminated water.

Materials and Method
The study employed *Rhodococcus erythropolis* in both living (bioaccumulation) and non-living (biosorption) states. The biomass was prepared by culturing the bacteria in a nutrient-rich medium, followed by inactivation using autoclaving or chemical treatment with potassium hexacyanoferrate (III). The surface morphology and functional groups of the biomass were analyzed using Scanning Electron Microscopy (SEM) and Fourier Transform Infrared Spectroscopy (FT-IR). Batch experiments were conducted to assess the impact of contact time, initial lead concentration, and biomass dosage on removal efficiency. Lead concentrations were measured using UV-Vis spectrophotometry.

Results and Discussion
The results demonstrated that biosorption using non-living biomass achieved equilibrium within 15 minutes, with a maximum removal efficiency of 97.55% at an initial lead concentration of 20 mg/L and a biomass dosage of 0.1 g. In contrast, bioaccumulation using living cells required 60 minutes to reach equilibrium, with a maximum efficiency of 93.06% at a higher biomass dosage of 0.4 g. The biosorption process was significantly influenced by the initial metal concentration and biomass dosage, with higher concentrations leading to reduced efficiency due to saturation of active sites. FT-IR analysis revealed the presence of functional groups such as carboxyl, hydroxyl, and amine groups on the biomass surface, which facilitated metal binding. SEM images confirmed the structural integrity of the biomass before and after metal adsorption.

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Conclusion

The study concludes that biosorption using non-living *Rhodococcus erythropolis* biomass is more efficient and practical for lead (II) removal compared to bioaccumulation. The rapid equilibrium time, higher removal efficiency, and ease of metal recovery make biosorption a superior method for industrial wastewater treatment. The findings highlight the potential of *Rhodococcus erythropolis* as a cost-effective and environmentally friendly biosorbent for heavy metal remediation. Future research should focus on scaling up the process and exploring its application in real-world industrial effluents.

Keywords: Aquatic environments, Bioaccumulation, Biosorption, Lead, *Rhodococcus erythropolis*