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# Characterization and Application of *Serratia marcescens* and *Sporosarcina luteola* in the Biodegradation of Soil Polycyclic Aromatic Hydrocarbons for Sustainable Soil Management

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## Abstract

Polycyclic aromatic hydrocarbons (PAHs) are prominent soil pollutants found at waste disposal sites and pose significant environmental and health challenges due to their persistent toxicity and potential carcinogenic effects. This study investigates the biodegradation potential of *Serratia marcescens* and *Sporosarcina luteola,* with the accession number PQ082967 and PQ002182, which were isolated from contaminated soil, in effectively degrading PAHs, specifically anthracene and pyrene, without releasing harmful intermediates into the environment. High-performance liquid chromatography (HPLC) analysis confirmed the levels of PAHs in the environment, emphasizing the urgent need for immediate remediation strategies to mitigate the risks associated with these pollutants. To promote the utilization of PAHs as the sole carbon source, bacterial starvation was conducted using Bacto-Bushnell Haas (BBH) agar, which lacks carbon sources. This method encouraged the bacteria to adapt and utilize the PAHs present in the environment effectively. The bacterial growth observed on the agar plates indicated efficient degradation of PAHs, further confirmed by spectrometric analysis. The results showed a significant reduction in absorbance, which was measured at a wavelength of 609nm, indicating successful decomposition, as the redox indicator methylene blue transitioned from blue to colorless, reflecting the metabolic activity of the bacteria in breaking down the contaminants. Antagonistic activity assays validated the compatibility of the bacterial strains, establishing a healthy foundation for their potential consortium application in compost-based bioremediation strategies. Additionally, antibiotic susceptibility tests demonstrated that the strains were inhibited by various antibiotics, enhancing safety and efficacy in their selection for environmental applications. Subsequent molecular analyses, including PCR, agarose gel electrophoresis, and Sanger sequencing, successfully identified *Serratia marcescens* strain MV21428 and *Sporosarcina luteola* strain MV7677 as promising PAH degraders. Gram staining characterized these strains as gram-negative cocci and gram-positive rods, respectively, further informing their classification. Phylogenetic analysis revealed close evolutionary relationships with known PAH-degrading strains, underscoring their relevance in bioremediation efforts. Toxicity assessments, employing brine shrimp (*Artemia salina*) and mung seeds (*V. radiata)*, indicated that both strains are non-toxic to aquatic and terrestrial organisms. Remarkably, mung seedlings grown in compost containing the bacterial consortia reached an average length of 18.2 cm, denoting a significant improvement in soil quality. These findings affirm that *Serratia marcescens* strain MV21428 and *Sporosarcina luteola* strain MV7677 can serve as environmentally safe agents for the bioremediation of PAH pollution, enhancing soil health and promoting plant growth. The study concluded their potential application in sustainable environmental management practices, aiming for a cleaner and healthier ecosystem.

**Keywords**: *Polycyclic aromatic hydrocarbons, Serratia marcescens, Sporosarcina luteola, Biodegradation, HPLC*