"Effectiveness study of three selected bacterial strains: *Pseudomonas stutzeri*, *Bacillus pumilus* and *Bacillus simplex* for degrading fluorene and phenanthrene in PAHs-contaminated soil"

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Abstract

Polycyclic aromatic hydrocarbons (PAHs) are organic contaminants among the most toxic, persistent and the most commonly detected in all the compartment of the environment (air, water, sediment, soil) and can cause adverse affect on human and wildlife. To date, their fate and behavior in soil, particularly located in industrial areas, also remain one of the global concerns. In natural way, such organic pollutants are generally hardly degradable because of the complexity of their chemical structure and their characteristics (low water solubility, hydrophobic). However, biological techniques have been commonly recommended as a clean-up technique from soil. The present study focuses on this purpose. In our case, bacterial species were used during the bioremediation experiment. Several bacterial strains were firstly subjected to a biostimulation step in order to increase the scant activity of indigenous microbial populations. Three species (*Pseudomonas stutzeri, Bacillus pumilus and Bacillus simplex*) were then selected to perform the bioremediation experiment because of their potential to be resistant in a high level of PAHs contamination. Four PAHs model were treated including two low molecular weight PAHs (fluorene, phenanthrene) and two others classified as the high molecular weight-PAHs (pyrene and benzo[a]anthracene). The degradation of 500mg Σ_4PAHs kg^{-1} dry soil was studied in aerobically incubated microcosms for 72 days. The kinetic of PAHs degradation was investigated. Therefore, individual PAHs namely "fluorene" and "phenanthrene" were observed rapidly degraded using these bacteria. The removal rate was all observed higher than 70%. *Bacillus Simplex* and *Pseudomonas Stutzeri* strains were observed more effective compared to the *Bacillus pumilus* one. In all cases, these three bacterial species were demonstrated as effective to degrade preferentially the low molecular weight PAHs (< 4-aromatic rings). The results showed also that fluorene and phenanthrene half-lives were ranged from 3.52 to 5.35 days and 2.40 to 2.98 days respectively. Based on these results, the potential applications of these bacterial species set in consortium could produce a higher PAH dissipation rates especially for the high molecular weight PAHs concern.

Keywords: PAHs, bioremediation, *Pseudomonas stutzeri, Bacillus pumilus, Bacillus simplex*