Interactions between fungi and bacteria associated with degradation of persistent organic pollutants

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Key Word: fungi, bacteria, interaction, degradation

The fungal ability to degrade xenobiotics had attracted attention due to their predominance and multiplex pathways. Diverse ligninolytic fungi had been confirmed as an effective strategy to remove pollutants from environment by bioremediation. On the other hand, bacterial degradation studies have shown that it is much more difficult to remove high-molecular-weight (HMW) pollutants since which are thermodynamically stable, hydrophobic and being always absorbed to solid particles. Therefore, we are searching for a new biodegradation strategy which could use the cooperation between fungi and bacteria. This study investigated the interactions between fungi and bacteria which are associated with degradation of polycyclic aromatic hydrocarbons (PAHs). Seven soil fungi were screened for their ability to metabolize phenanthrene, fluoranthene and pyrene when used as sole source of carbon and energy. Meanwhile, five soil bacteria were also screened for which could degrade PAHs as co-workers with those of fungi. High performance liquid chromatography (HPLC) analyses showed the maximal pyrene degradation rate (60%, 28d) was obtained when fungi and bacteria were co-cultured at soil condition, as compared to a degradation rate of 28% for fungi group and 47% for bacteria group respectively. Meanwhile, we conducted a metabolites analysis of cells exposed to pyrene using one strain of fungi combining with one strain of bacteria. Gas chromatography–mass spectrometry (GC–MS) was used to analyze composition of PAH-metabolites to which identify the mechanism of synergistic function between fungi and bacteria. At present, the data analysis is under processing.

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Salicylic acid stimulates the cometabolic biotransformation of the 3-ring PAH fluorene by a phenanthrene-degrading bacterium

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Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental contaminants that often occur in complex hydrocarbon pollutant mixtures. Little is known about their biodegradation in mixtures but it appears that cometabolism plays a significant role in facilitating their biodegradation in the natural environment. Fluorene, a 3-ring PAH classified as a priority pollutant by the US EPA was found to be biotransformed by a soil bacterium after it was grown on phenanthrene as a sole source of carbon and energy. Further experimentation revealed that phenanthrene stimulated fluorene biotransformation in a concentration-dependent manner. Considering this, the effects of a downstream metabolite of phenanthrene utilization by this organism, salicylic acid, were investigated and shown to stimulate fluorene biotransformation in a 23-hour timecourse study. Fluorene biodegradation was monitored in triplicate microcosms that consisted of whole tube extraction at pH 7 and pH 2 at multiple timepoints followed by HPLC analyses. Analyses of microcosms extracts revealed that phenanthrene-grown, harvested and washed cells biotransformed 30% of 250 mg/L fluorene in 23 hours but when the same cells were treated with 125 mg/L salicylic acid, 65% biodegradation of fluorene was stimulated. Additionally, UV-detection of multiple peaks that were not detected in abiotic controls indicated the presence of metabolites. Negative ionization full-scan, precursor ion scan and product ion scan modes were employed in liquid chromatography electrospray ionization tandem mass spectrometry (LC/ESI-MS/MS) and allowed for the tentative identification of fluorene biotransformation products. Biodegradation of fluorene via lateral dioxygenation occurred and a pathway for its biodegradation by this bacterium was proposed.

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