

Reduction of lag in crude oil degradation by *Aspergillus* when it is in synergy with *Bacillus* in biofilm mode

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Abstract

A major hindrance to the effective use of fungi in bioremediation is their inherent slow growth. Despite this, *Aspergillus* spp. may be used effectively. Our experiments demonstrate that bacteria, although inefficient in hydrocarbon degradation, may be effectively used in a consortium to overcome the lag in fungal utilization of petroleum hydrocarbons. Crude petroleum oil (160 mg; at 8 g/L) in minimal medium was inoculated with a previously isolated biofilm-forming consortium (*Aspergillus* sp. MM1 and *Bacillus* sp. MM1) as well as monocultures of each organism and incubated at 30 °C under static conditions. Residual oil was analyzed by GC–MS. Crude oil utilization of *Aspergillus*–*Bacillus* biofilm was $24 \pm 1.4\%$ in 3 days, increased to $66 \pm 7\%$ by day 5 and reached $99 \pm 0.2\%$ in 7 days. *Aspergillus* sp. MM1 monoculture degraded only $14 \pm 6\%$ in 5 days. However, at the end of 7 days, it was able to utilize $98 \pm 2\%$. *Bacillus* sp. MM1 monoculture utilized $20 \pm 4\%$ in 7 days. This study indicates that there is a reduction of the fungal lag in bioremediation when it is in association with the bacterium. Although in monoculture, *Bacillus* sp. MM1 is inefficient in crude oil degradation, it synergistically enhances the initial rate of crude petroleum oil degradation of the fungus in the consortium. The rapid initial removal of as much crude oil as possible from contaminated sites is vital to minimize detrimental impacts on biodiversity.

Keywords: *Aspergillus*–*Bacillus* biofilm, Lag time, Crude oil biodegradation, Synergism, GC–MS

Citation

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