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Biosurfactant and bioemulsifier production by hydrocarbonoclastic bacteria isolated from petroleum sludge as potential biodispersant for oil spill remediation

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Abstract

The elevation of environmental pollution caused by the production and spillage of petroleum hydro-carbons is disastrous. Major compounds in petroleum hydrocarbon such as polycyclic aromatic hydro-carbons (PAHs) are of special concern since their molecules are persistent for a and highly toxic and carcinogenic to the ecosystems and humans. Although a lot of effort had been spent to treat these pollutants, the left-over products are still ubiquitous in the environment although they could be naturally degraded by indigenous microorganisms aided by biosurfactants or bioemulsifiers that they produce during hydrocarbon biodegradation process. Hydrocarbonoclastic bacteria were isolated from petroleum sludge obtained from a waste disposal company in Malaysia and investigated for their potential to produce biosurfactants (i.e., surface tension measurement) and bioemulsifiers (i.e., emulsification assay) together with their ability in total petroleum hydrocarbon (TPH) biodegradation (i.e., gas chromatography-mass spectrometry (GC-MS)). One isolate of potential bioemulsifier producing bacteria (BEP) exhibited emulsification index as high as 72.81% while the rest were between the range of 64%–68%. In addition, one isolate of potential biosurfactant producing bacteria (BSP) recorded a surface tension measurement as low as 18.92 mN/m while the rest were between the range of 45–28 mN/m. Further identification of selected potential isolates by 16s rRNA gene amplification and sequencing revealed their identity as from several genera such as *Achromobacter* sp., *Pseudomonas* sp. and *Serratia* sp. Isolate P15 was found as the best candidate for potential BSP identified as closely related to *Pseudomonas stutzeri* while isolate P18 which was the best candidate for potential BEP identified as closely related to *Serratia marcescens*. Biodegradation study conducted for both isolates showed the percentage of TPH loss of approximately 85% by BSP P15 and approximately 78% by BEP P18. Production of biosurfactant and bioemulsifier by both isolates supported by their ability to degrade total petroleum hydrocarbons validate the advantageous features of biosurfactants and bioemulsifiers in hydrocarbon biodegradation and this can be further exploited in designing bioremediation strategies for contaminated environment. © 2023 Elsevier Inc.

Author Keywords

Bioemulsifier; Biosurfactant; Emulsification index; Petroleum hydrocarbon-degrading bacteria; Surface tension

Index Keywords

bacterium, biodegradation, bioremediation, emulsion, oil spill, oil spill response, sludge, surface tension, surfactant, waste disposal; Malaysia

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