Habib *et al. Microb Cell Fact (2018) 17:44*
https://doi.org/10.1186/s12934-018-0889-8

Microbial Cell Factories

RESEARCH

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Evaluation of conventional and response surface level optimisation of *n*-dodecane (*n*-C12) mineralisation by psychrotolerant strains isolated from pristine soil at Southern Victoria Island, Antarctica

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Abstract

Background: Biodegradation of hydrocarbons in Antarctic soil has been reported to be achieved through the utilisation of indigenous cold-adapted microorganisms. Although numerous bacteria isolated from hydrocarbon-contaminated sites in Antarctica were able to demonstrate promising outcomes in utilising hydrocarbon components as their energy source, reports on the utilisation of hydrocarbons by strains isolated from pristine Antarctic soil are scarce. In the present work, two psychrotolerant strains isolated from Antarctic pristine soil with the competency to utilise diesel fuel as the sole carbon source were identified and optimised through conventional and response surface method.

Results: Two potent hydrocarbon-degraders (ADL15 and ADL36) were identified via partial 16S rRNA gene sequence analysis, and revealed to be closely related to the genus *Pseudomonas* and *Rhodococcus* sp., respectively. Factors affecting diesel degradation such as temperature, hydrocarbon concentration, pH and salt tolerance were studied. Although strain ADL36 was able to withstand a higher concentration of diesel than strain ADL15, both strains showed similar optimal condition for the cell's growth at pH 7.0 and 1.0% (w/v) NaCl at the conventional 'one-factor-at-a-time' level. Both strains were observed to be psychrotrophs with optimal temperatures of 20 °C. Qualitative and quantitative analysis were performed with a gas chromatograph equipped with a flame ionisation detector to measure the reduction of *n*-alkane components in diesel. In the pre-screening medium, strain ADL36 showed 83.75% of *n*-dodecane mineralisation while the reduction of *n*-dodecane by strain ADL15 was merely at 22.39%. The optimised condition for *n*-dodecane mineralisation predicted through response surface methodology enhanced the reduction of *n*-dodecane to 99.89 and 38.32% for strain ADL36 and strain ADL15, respectively.

Conclusions: Strain ADL36 proves to be a better candidate for bioaugmentation operations on sites contaminated with aliphatic hydrocarbons especially in the Antarctic and other cold regions. The results obtained throughout strongly supports the use of RSM for medium optimisation.

Keywords: Biodegradation, Diesel fuel, Psychrotroph, Response surface methodology, GC-FID analysis

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