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A Lab Simulation of a Potential Egyptian Bacterial Ensemble for the Recovery of an Oil Spill

Lucky Yadav*

Department of Cancer Research, Autonomous University of San Luis Potosi, San Luis, Mexico

Abstract

The goal of the project was to develop an oil degrading bacteria that would be very effective when utilized alone or in a bacterial consortium to treat oil spills. By using GC-MS, the consortium influence on crude oil was investigated. After 7 days, the consortium had only decomposed 80% of the crude oil, compared to 99.2% for *Enterobacter* sp. ASH as an isolated culture. Based on 16S rRNA gene sequence analysis, morphological, physiological and biochemical characterization, this strain was identified. The results of an ANOVA study indicated that the significant variables are medium volume and crude oil concentration. According to the findings, the mixed consortium was more capable of biodegrading than *Enterobacter* sp. ASH.

Keywords: Oil spill treatment; Microbial degradation; Lab simulation; Bacterial consortium; GC-MS

Introduction

The petroleum business is one of Egypt's most significant and lucrative industries. Hydrocarbons are used in a variety of processes, such as power generation, transportation and heating systems. Egypt has eleven ports for petroleum. During the phases of exploration, production, transport and storage, accidents may occur. One of the riskiest mishaps is when petroleum hydrocarbons spill or leak. Oil stains spanned 150 meters at RAS GHARIB, the red sea governorate, in July 2019, spreading to additional locations and covering 1500 meters offshore. In June 2010, Jebel Al-Zayt oil spill catastrophe, known as the largest oil spill in Egyptian history, damaging about 160 km of north red sea shoreline. These spills and leaks may contain petroleum product contaminants that are neurotoxic, mutagenic, carcinogenic and immunotoxin, causing environmental and health risks. Finding efficient and affordable technology for the cleanup of oil spills and environmental protection should therefore receive increased focus. Recently, it was suggested that bioremediation technology for petroleum hydrocarbons be used instead of conventional physicochemical methods because it is more affordable and environmentally benign. Hence, it is important to assess a local microbial community's capacity, bioavailability and limiting constraints. Depending on their chemical makeup, petroleum hydrocarbons exhibit varying degrees of microbial breakdown. While N-alkanes with intermediate lengths are the preferred substrates for bacteria and typically breakdown the most readily, short chain compounds are typically dangerous. Longer chain alkanes are hydrophobic solids that are challenging to breakdown because of their poor bioavailability and water solubility.

Description

The strongest biodegradation resistance is seen in strongly packed aromatic and cycloparaffinic compounds, such as bitumen, tars and asphaltic materials. Cycloalkanes and branched chain alkanes disintegrate more slowly than their corresponding N-alkane counterparts. The most popular method for characterising and analysing the oils and determining the sources of spills is gas chromatography combined with mass spectrometry. You can use GC-MS to evaluate the fingerprints for the quantity of oil related substances and water tainted with oil.

In this work, oil degrading bacteria were potentially used to treat oil spills in a lab setting. A mixed culture of bacteria with the highest capacity for degradation was used in the experiment. In diverse experimental circumstances, this study also looked into the biodegradability of crude oil, including both aliphatic and aromatic components. Before and after oil content changes responses were measured in a full factorial experiment at all levels of the experimental factor combinations. Combinations of factor levels describe the circumstances under which responses will be evaluated. Using a 24 two levels, 4 factor full factorial design, distinct experimental conditions were produced. Each experiment had two replications, for a total of 16 runs. The four variables were: Inoculum size (number of cells), crude oil concentration, medium volume and incubation period (length of time active cells were exposed to oil. These varied on two different levels. Using gas chromatography mass spectrometry, the analysis was completed. Thermo mass spectrometer detectors were employed in conjunction with TRACE GC ultra-gas chromatographs. A TR-5 MS column was installed in the GC-MS system using the following temperature programme: 60°C for 1 minute; rising at 4.0°C/min to 240°C and held for 1 minute. At 210°C, the injector and detector were maintained. Typically, 1 L diluted samples of the combinations were injected. Using a spectral range of m/z 40-450 and electron ionization at 70 eV, mass spectra were produced. Using AMDIS software the chemical components of the essential oil were de-convoluted and recognized by their retention indices, mass spectra that matched genuine standards and Wiley spectral library collection.

***Corresponding author:** Lucky Yadav, Department of Cancer Research, Autonomous University of San Luis Potosi, San Luis, Mexico, E-mail: Luckyyadav43@gmail.com

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The Nawah scientific research center did the analysis. Twenty nine bacterial isolates were collected and their distribution was examined. 69% of all isolates came from the more diverse and richly varied WDCO sample.

Conclusion

Despite the large number of studies on oil biodegradation, nothing is known about the isolation of oil degrading bacteria. The severe conditions that prevent microbial activity make the petroleum ecosystem exceedingly complicated and distinctive.