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Environmental Chemistry 2020-Title: Biosurfactant Production and Hydrocarbon Degradation Potential of Bacteria Strains From A Crude-Oil Polluted Soil In Ogoniland Nigeria- Ekeoma- University of Calabar

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Abstract

There has been significant attention to the use of biosurfactants because of their potential industrial and environmental applications and ecological friendliness. With hydrocarbon polluted soil being the major source of biosurfactant producing bacteria, thus, biosurfactant production and hydrocarbon degradation potential of bacteria strains from hydrocarbon polluted soil in Ogoniland Nigeria were investigated. The bacterial strain Proteus cibarius- E1 was isolated as it was found to be a potent producer of biosurfactant on mineral salt medium at 30°C for 5 days. The production process was optimized using response surface methodology (RSM) by varying the pH level, Temperature, salinity, and Glycerol concentration. The produced biosurfactant was characterized using the ninhydrin biochemical test, Fourier transform infrared spectroscopy(FTIR), and mass spectral (GC-MS) analysis. The degradative potential of the isolate on Total Petroleum Hydrocarbon was also investigated. The optimal and stable conditions for the biosurfactant production were found to be pH 7.0, temperature 37°C, Salinity 10%, and glycerol concentration 10% producing 1.8g/l was produced by Proteus cibarius. The biosurfactants produced were characterized as a lipopeptide having shown a purple complex in the presence of ninhydrin confirming the presence of free amino acid. The FT-IR chromatogram showed the presence of N-H and C-N Amine bond peaks and the GC–MS analysis identified the lipopeptide based biosurfactant as 11-Hexadecenoic acid methyl ester and trans-13-octadecenoic methyl ester fatty acids. The degradative efficiency at optimum temperature and pH for 14days was 81.5percent. These were compared to Sodium dodecyl sulphate (SDS) the positive control and dH2O the negative control having 54.85% and 3.86% degradation respectively. The ability to produce biosurfactants makes the strain promising for enhanced oil recovery. A low-cost raw material substrate is a great economic attraction of the biosurfactant and offers countless opportunities in future development. The development of a polynomial model to be used in making predictions on the response for given levels of varying factors is a major contribution to knowledge. Its application will be of immense value to the industry.

Introduction:

Hydrocarbons are significant constituents of unrefined petroleum and oil. They can be biodegraded by normally happening microorganisms in freshwater and marine situations under an assortment of vigorous and anaerobic conditions. The capacity of microorganisms - microbes, archaea, organisms, or green growth - to separate hydrocarbons is the reason for normal and improved bioremediation. To advance biodegradation, changes, for example, nitrogen and phosphorous compost are frequently added to animate microbial development and digestion. Oxygen, nitrate, or sulfates are once in a while added as electron acceptors to upgrade biodegradation rates. The expansion of hydrocarbon-corrupting microbial societies to defiled locales may likewise be thought of, in spite of the fact that the act of bioaugmentation is remarkable for hydrocarbons attributable to the characteristic wealth of hydrocarbon-debasing organisms. Beside unearthing, different types of bioremediation from basic plowing of soils and landfarming to in situ biostimulation are normal types of remediation for hydrocarbon sullying. Contrasted with different advances, bioremediation is lower cost, ecologically amicable, and frequently non-invasive. In any case, the time required for full site cleanup can be longer and less unsurprising than for different strategies, and fruitful results may not be ensured because of fluctuation in site conditions. In any case, it is the most widely recognized methodology for remediation of hydrocarbon-defiled conditions.

Hydrocarbons are mixes made altogether out of carbon and hydrogen. Sweet-smelling hydrocarbons, alkanes, alkenes, cycloalkanes, alkynes, and mixes of these mixes involve various sorts of hydrocarbons. Complex blends of hydrocarbons happen normally in raw petroleum and gas. Most can be utilized as substrates in digestion by microscopic organisms, archaea, growths, and algae. While organisms and green growth debase hydrocarbons vigorously, microorganisms and archaea are equipped for both oxygen consuming and anaerobic degradation. Attributable to the generally diminished nature of most hydrocarbons, they are commonly the vitality source or electron givers for microbial digestion, and their oxidation must be coupled to the decrease of a reasonable electron acceptor. Vigorous corruption happens with atomic oxygen (O2) as both a reactant to oxidize the substrate and an electron acceptor for microbial breath. Interestingly, anaerobic corruption utilizes diverse biotransformation pathways that don't rely upon oxygen, coupled to microbial breath of an assortment of electron acceptors. Under anaerobic conditions, biodegradation frequently results from the stepwise purposeful activity of various organisms in a procedure called syntrophy.

Biodegradation happens normally in light of the fact that hydrocarbons have consistently been available in the earth, discharged from leaks and supplies through different geologic procedures. Characteristic constriction of hydrocarbon tainting can be checked by various diagnostic techniques, including gas chromatography and infrared spectroscopy. Supreme confirmation of debasement versus weakening or other non-degradative procedures can be acquired utilizing compound explicit isotope examination (CSIA), where an improvement in the characteristic wealth of heavier isotopes of carbon and hydrogen in the parent hydrocarbons affirms biotransformation. Regularly biostimulation - the expansion of constraining supplements - might be wanted in locales where lessening happens gradually or not under any condition.

Soils can be dirtied with a few natural and inorganic poisons. Natural pollutatnts incorporate dangerous industrious natural mixes, for example, polycyclic sweet-smelling hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), polychlorinated naphthalines (PCNs), polychlorinated dibenzodioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and other relentless natural substances. Inorganic contaminations for the most part incorporate substantial metals, for example, lead (Pb), cadmium (Cd), mercury (Hg), zinc (Zn), copper (Cu) and nickel (Ni), just as the metalloid arsenic (As), and radioactive substances or radionuclides. The wellsprings of soil poisons are for the most part anthopogenic. There are additionally point and diffuse sources; the point sources incorporate city squanders, mechanical squanders, clinical squanders, rural squanders, fertilizers and mucks, agrochemicals, residential squanders and atomic squanders. Natural and inorganic soil contaminations can be poisonous to soil life forms, plants and creatures. A portion of the dirt toxins go into the evolved way of life, and can unfavorably influence human wellbeing. In addition, soil toxins can be moved to encompassing air and water through volatilization, spillover, dust tempests and draining. In these manners, the nature of air and water, both surface and groundwater, can be debased. There are a few noteworthy occasions where soil contamination effectsly affected local populace. Accordingly, remediation of contaminated soils has become a critical need in numerous zones of the world. In the interim, some valuable strategies have been produced for the anticipation of soil contamination, including waste administration and waste removal, and remediation of natural poisons, overwhelming metals and radioactive toxins.

Keywords: hydrocarbons vigorously, microorganisms, nitrogen, phosphorous