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INVESTIGATING THE IMPACT OF NANOPARTICLE SYNTHESIZED WITH BIOSURFACTANTS ON HYDROCARBON DEGRADATION

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ABSTRACT The discharge of potentially toxic petroleum hydrocarbons into the environment has been a matter of concern, as these organic pollutants accumulate in many ecosystems due to their hydrophobicity and low bioavailability. Petroleum hydrocarbons are neurotoxic and carcinogenic organic pollutants, extremely harmful to human and environmental health. Traditional treatment methods for removing hydrocarbons from polluted areas, including various mechanical and chemical strategies, are ineffective and costly. However, many indigenous microorganisms in soil and water can utilise hydrocarbon compounds as sources of carbon and energy and hence, can be employed to degrade hydrocarbon contaminants. Biosurfactants have a wide range of industrial applications including enhanced oil recovery, bioremediation, industrial emulsification, medicine, food preservatives, health care industries, cosmetic industries and cleaning toxic chemicals of industrial and agricultural origin. Among the bacterial genera, Bacillus sp (Gram-positive) and Pseudomonas sp (Gram-negative) produce a wide range of effective biosurfactants that are useful for agricultural, chemical, food and pharmaceutical industries. Due to diverse structures and properties, biosurfactants find consolidated applications in various industrial processes. Among these, they can be effectively employed in the production of nanomaterials, easily form a variety of liquid crystals in aqueous solutions. The synthesis of stable silver nanoparticles using surfactin and a lipopeptide with fungicidal properties produced by Bacillus cereus as stabilizers has been reported.

KEYWORDS : Biosurfactants, Hydrocarbon degradation , Bioremediation, Fermentation, eco-friendly

INTRODUCTION

Biosurfactants are indispensable components of daily life and are structurally diverse group of surface active amphiphilic biological compounds produced extracellularly or as part of the cell membrane by microorganisms such as bacteria, yeast and filamentous fungi. Biosurfactants are indispensable components of daily life and are structurally diverse group of surface active amphiphilic biological compounds produced extracellularly or as part of the cell membrane by microorganisms such as bacteria, yeast and filamentous fungi (Ananda raj et al., 2010).

The bio surfactants are isolated from sites which were contaminated by petroleum hydrocarbons. The total bio surfactant production has exceeded 2.5 million tons in 2002 for many purposes such as polymers, lubricants and solvents. Low-molecular-weight biosurfactants reduce the surface tension at the air-water interfaces and interfacial tension at oil-water interfaces, whereas the high molecular weight biosurfactant are more effective in stabilizing oil-in-water emulsions, called bioemulsifiers.

Water treatment easy to perform but soil bioremedation is is relatively much more difficult and complex. The first problem arises due to difficulties in treating soil, especially when pollution is distributed over a large area.

The removal of soil from contaminated site becomes a costly undertaking, even though such ex-situ treatment might be well established. This could be accomplished in two ways: (i) Addition of nutrition to the soil in form of nitrogen, phosphorus, carbon compounds, which would allow the native microbial population to develop and augment, and thus provide more microorganisms for metabolism(ii) Produce ex situ a microbial population which is adapted to the pollutant and add this population, along with necessary nutrients, to the polluted soil. The added biomass under proper conditions, would be able to survive in the soil and further degrade objectionable organics.

Various hydrocarbons can be used as substrate like Diesel, petroleum, kerosene,engine oil, lubricant oil, castor oil, peanut oil, vegetable oil, plant derived oils like sunfloweroil, oil wastes like soapstock, oil refinery wastes etc.

Biosurfactants are surface-active, valuable, biologically efficient amphiphilic molecules synthesized by microbes and have a wide range of applications due to their unique characteristics, low toxicity and biological acceptability (Gayathiri et al. 2022, Shivlata et al. 2015). Being an amphiphilic molecule, biosurfactant has monosaccharide, oligosaccharide, polysaccharide and proteins as hydrophilic polar moiety and saturated, unsaturated fatty alcohols or hydroxylated fatty acids as hydrophobic nonpolar moiety (Rodrigues 2015; Santos et al. 2016). However, the hydrophilic–lipophilic balance responsible for determining the hydrophilic and hydrophobic components in surface-active chemicals is one of the essential properties of biosurfactants.

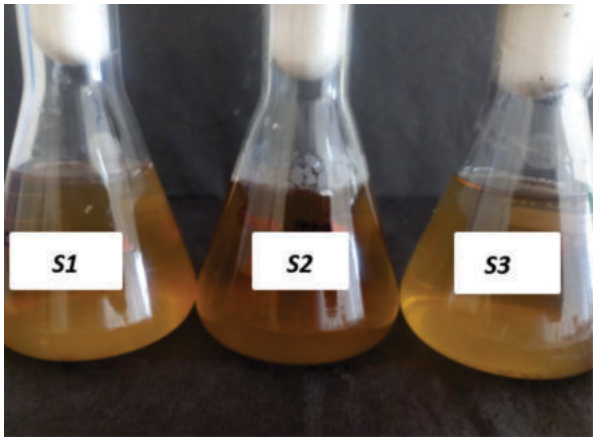

Figure 1: Nutrient Agar Medium For Production Of Biosurfactants

Applications Of Biosurfactants

The worldwide production of surfactants increased upto 17 million metric tones in 2000 (including soaps) expected future growth rates of 3-4% per year globally. These chemically synthesized surfactants are mainly petroleum based , non biodegradable and remain toxic to the environment. Also these compounds may bio-accumulate and their production processes and by-products can be environmentally hazardous. Due to this increasing awareness on the need to protect the ecosystem, environmental scientist have necessitating an increased interest in microbially produced biosurfactant as possible

alternatives to chemically synthesized ones.

Case Study

Extraction of biosurfactant was done and cell free broth was obtained for screening methods. Emulsification test was performed, it shows that the emulsification activity of Bacillus sp were high in when compared to other carbon sources. Oil screening test was performed for extracted biosurfactants. Among this Bacillus sp produces the highest oil clearing zone.

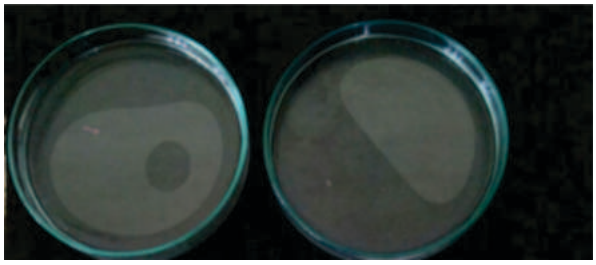

Figure 2 : Bacillus Showing Biosurfactant Production

CONCLUSION

The synthesis of stable silver nanoparticles using surfactin and a lipopeptide with fungicidal properties produced by Bacillus cereus as stabilizers has been reported, while a rhamnolipid biosurfactant, consisting of a mixture of two rhamnolipids, was successful in the synthesis/stabilization of nanozirconia particles.

REFERENCES

1. Ajay Singh, Jonathan D. Van Hamm, Owen P. Ward, 2007. Surfactants in microbiology and biotechnology: Part 2. Application aspects, Biotechnology Advances, 25: 99–121.
2. Amod Anil Apte, Dr. Unnati Padalia, 2018. Production of Biosurfactant From Bacillus
3. Subtilis MTCC 441 And Its Industrial And Environmental Applications, IOSR Journal of
4. Pharmacy and Biological Sciences , 13(2):1-9.
5. Catherine N. Mulligan and Bernard F. Gibbs, 2004. Types, Production and Applications of Biosurfactants, Indian National Science Academy, 1:31-55.
6. Ibrahim M Banat, 1995. Biosurfactant production and possible uses in microbial enhanced oil recovery and oil pollution remediation: a review, Bioresource technology, 51(1):1-12.
7. Surekha K. Satpute, Arun G. Banpurkar, Prashant K. Dhakephalkar, Ibrahim M. Banat, and Balu A. Chopade, 2010. Methods for investigating biosurfactants and bioemulsifiers: a review, Critical Reviews in Biotechnology, 1–18.
8. Gayathiri E, Prakash P, Karmegam N, Varjani S, Awasthi MK, Ravindran B. Biosurfactants: potential and eco-friendly material for sustainable agriculture and environmental safety—a review. Agronomy. 2022;12(3):662. doi: 10.3390/agronomy12030662