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*1st International Conference on Modern and Advanced Research*
*July 29-31, 2023 : Konya, Turkey*



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# Biosurfactants for Environmental Application

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***Abstract*** – Microbial surfactants, commonly referred to as biosurfactants, are a class of surface-active molecules that originate from a diverse array of microorganisms. Which are small compounds with surface-active properties that are being widely studied in various industries. This research highlights the importance of selecting the right microorganism and carbon source for biosurfactant production, as they influence the chemistry and cost of production. The focus of biosurfactant applications has been on environmental uses, particularly in bioremediation of contaminated soils containing persistent pollutants like hydrocarbons and heavy metals, which aids in emulsification and solubilization of pollutants, facilitating in-situ biostimulation and bioaugmentation. Also mentions that biosurfactants have low toxicity but can have biocidal effects at higher concentrations. The use of alternative substrates, such as organic waste materials and solid-state fermentation, is gaining interest to enhance biosurfactant production and explore applications within a circular economy framework. This study concludes by stating that the review summarizes recent research on the environmental use of biosurfactants as alternatives to conventional chemical surfactants, and it discusses novel strategies for their production and applications.

*Keywords – Biosurfactants; Microbial Surfactants; Microbial Surface-Active, Bioremediation.*

## I. Introduction

Microbial surfactants, commonly known as biosurfactants, are deemed valuable, surface-active, and biologically efficient amphiphilic molecules originating from various microorganisms [1]. Microorganisms such as bacteria, yeasts, and filamentous fungi predominantly produce Biosurfactants, although they can also be found in plants and animals [2, 3]. Due to their low toxicity, biosurfactants are considered more effective and environmentally friendly [4], making them ecologically safe options in the fields of bioremediation and waste treatment [3].

The ever-growing environmental issues resulting from natural resource extraction and industrial activities necessitate increased efforts to address environmental problems. Petroleum and its associated products, widely employed as energy resources, often give rise to diverse forms of pollution during transportation and usage [5]. Some microorganisms possess metabolic pathways that enable the creation of molecules capable of solubilizing hydrophobic substrates, including hydrocarbons, lipids, oils, and antibiotics [6].

Biosurfactants hold great promise as effective candidates for bioremediation. When compared to commercial surfactants, biosurfactants can achieve remarkable efficiency against contaminants with minimal negative consequences, even in modest quantities [7]. In the past five years, a comprehensive literature review was undertaken, examining 108 papers [8]. In light of these promising developments and growing interest in biosurfactants, this article aims to present a comprehensive review of their potential applications in environment.

## II. Materials and Method

### A. *Biosurfactants productions*

Several research studies have been conducted on biosurfactant production, with a particular focus on enhancing production methods efficiency and scalability. For instance, in a study published by [9] in the Journal of Industrial Microbiology and Biotechnology, response surface methodology was employed to optimize fermentation conditions for biosurfactant production using a Bacillus subtilis strain. Another study, published by [10] in the Journal of Cleaner Production, explored the utilization of agricultural waste as a cost-effective substrate for biosurfactant production using a strain of Pseudomonas aeruginosa.

Table 1. Microorganism's product biosurfactants with carbon source.

| Biosurfactants | Micro-organisms | Carbon source | Refer-ences |
|---|---|---|---|
| **Glycolipides** | Aspergillus fumigatus | Glycerol on solid state fermentatio n. | [1] |
| **Lipopeptide** | *Bacillus velezensis* MHNK1 | Residual frying oil 2% (v/v) | [11] |
| **Sophorolipide** | Candida glabrata | Cotton seed oil/glucose | [1] |

Fig. 1 Crude biosurfactant extraction

### B. *Environmental Applications of Biosurfactants*

Biosurfactants find extensive applications in environmental biotechnology as shown in table 2. They have proven effective in bioremediating contaminated soils and water, as well as in treating industrial effluents. Additionally, biosurfactants play a crucial role in increasing the bioavailability of nutrients and pollutants, thereby enhancing the efficiency of microbial processes, including biodegradation.

Table 2. Environmental applications and efficiency of biosurfactants

| Environmental Application (Biosurfactants exemple) | Micro-organisms | Efficiency (%) | Refer-ences |
|---|---|---|---|
| **Petroleum** Bioremediation of hydrocarbon compounds (TPH) (Rhamnolipid ) | Pseudomonas aeruginosa SR17 | At 1.50 g /L biosurfactant TPH removal of: 86.10% for soil with 6800 rpm | [12] |
| **Removal metal** Biosurfactant extract | *Candida sphaerica* UCP0995 | Removal rates for Zn, Fe and Pb: 90%, 95%, 79% | [13] |
| **Biocidalactivity** Determine biosurfactant effectiveness on potato leaves against zoospores of phytopathogens (Rhamnolipid) | Phytophthora infestans | At 0.2% biosurfactant concentration growth inhibition of *P. Infestans* and no-phytotoxicity | [14] |

## III. Conclusion

Biosurfactants showcase a diverse array of environmental applications, stemming from their exceptional ability to emulsify hydrophobic compounds. These characteristics render them valuable in the biodegradation of pollutants and the effective treatment of industrial effluents. The substitution of synthetic surfactants with biosurfactants proves advantageous due to their environmentally friendly nature, biodegradability, and frequent production from renewable resources.

As a result, the increasing attractiveness of biosurfactants in various industries is evident.

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