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- R. Jayashree and R. Murugaragavan

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BIOSURFACTANTS AND ITS APPLICATIONS

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R. Jayashree
R. Murugaragavan
Department of Soils and Environment, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai-625104

ABSTRACT

Biosurfactants are surface active biomolecules produced by microorganisms with wide range of applications. Biosurfactants are mainly classified according to their chemical structure and their microbial origin. The main classes of biosurfactants are glycolipids, phospholipids, polymeric biosurfactants and lipopeptides (surfactin). The best known glycolipids are rhamnolipids, sophorolipids and trehalolipids. biosurfactants were used in several industries including organic chemicals, petroleum, petrochemicals, mining, metallurgy (mainly bioleaching), agrochemicals, fertilizers, foods, beverages, cosmetics, pharmaceuticals and many others. It is derived from renewable resources and are low or nontoxic, biodegradable, demonstrate excellent surface activity, possess high specificity, show effectiveness under extreme conditions, and can be reused through regeneration too as compared to synthetic surfactants.

Keywords: Biosurfactants, Amphiphilic, Surfactin, Rhamnolipids, Petrochemicals

INTRODUCTION

Biosurfactants can be defined as the surface active biomolecules produced by microorganisms with wide range of applications. Biosurfactants are amphiphilic compounds produced in living surfaces, mostly on microbial cell surfaces or excreted extracellular hydrophobic and hydrophilic moieties that confer the ability to accumulate between fluid phases, thus reducing surface and interfacial tension at the surface and interface respectively.

Surfactants are the active ingredients found in soaps and detergents with the ability to concentrate at the air water interface and are commonly used to separate oily materials from a particular media due to the fact that they are able to increase aqueous solubility of Non Aqueous Phase Liquids (NAPLS) by reducing their surface or interfacial tension at air–water and water–oil interfaces.

USES OF BIOSURFACTANTS

Biosurfactants are mainly classified according to their chemical structure and their microbial origin. The main classes of biosurfactants are glycolipids, phospholipids, polymeric biosurfactants and lipopeptides (surfactin). The best known glycolipids are rhamnolipids, sophorolipids and trehalolipids. biosurfactants were used in several industries including organic chemicals, petroleum, petrochemicals, mining, metallurgy (mainly bioleaching), agrochemicals, fertilizers, foods, beverages, cosmetics, pharmaceuticals and many others. They can be used as emulsifiers as well as demulsifiers, wetting agents, foaming agents, spreading agents, functional food ingredients and detergents. The interfacial surface tension reducing ability of biosurfactants

made them to play important role in oil recovery and bioremediation of heavy crude oil.

APPLICATION OF BIOSURFACTANTS

(i) Agriculture

To improve the solubility of biohazardous chemical compounds such as Poly Aromatic Hydrocarbon(PAH) is to apply surfactants as mobilizing agents. This increases the apparent solubility of Hydrophobic Organic Contaminants (HOC). Also surfactants are said to help microbes adsorb to soil particles occupied by pollutants, thus decreasing the diffusion path length between the site of absorption and site of biouptake by the microorganisms . Also in agriculture, surfactants are used for hydrophilization of heavy soils to obtain good wettability and to achieve even distribution of fertilizer in the soil. They also prevent the caking of certain fertilizer during storage and promote spreading and penetration of the toxicants in pesticides. The rhamnolipid biosurfactant, mostly produced by the genus Pseudomonas is known to possess potent antimicrobial activity. There is no adverse effects on humans or the environments are anticipated from aggregate exposure to rhamnolipid biosurfactants. Fengycins are also reported to possess antifungal activity and therefore may be employed in biocontrol of plant diseases.

(ii) Commercial Laundrydetergents

Cyclic Lipopeptide (CLP) are stable over a wide pH range (7.0-12.0) and heating them at high temperature does not result in any loss of their surface active property . They showed good emulsion formation capability with vegetable oils and demonstrated excellent compatibility and stability with commercial laundry detergents favoring their inclusion in laundry detergents formulation

(iii) Biopesticide

Lipopeptide biosurfactants produced by several bacteria exhibit insecticidal activity against fruit fly *Drosophila melanogaster* and hence are promising to be used as biopesticide.

(iv) Medicine

1. Biosurfactants have strong antibacterial, antifungal and antivirus activity; these surfactants play a role of anti adhesive agents to pathogens making them useful for treating many diseases as well as its use as therapeutic and probiotic agent. A good example is the biosurfactant produced by marine *Bacillus circulans* that had a potent antimicrobial activity against Gram positive and Gram negative pathogens and Semi pathogenic microbial strains including MDR strain(Multi Drug Resistant).

2. Some of the microbial extracellular glycolipids induce cell differentiation instead of cell proliferation in the human promyelocytic leukemia cell line, also, exposure of PC 12 cells to MEL enhanced the activity of acetylcholine esterase and interrupted the cell cycle at the G1 phase with resulting overgrowth of neurites and partial cellular differentiation, this suggest that MEL induces neuronal differentiation in PC 12 cells and provides the ground work for the use of microbial extracellular glycolipids as novel reagents for the treatment of cancer cells.

3. Biosurfactants have been found to inhibit the adhesion of pathogenic organisms to solid surfaces or to infection sites. The precoating vinyl urethral catheter by running the surfactin solution through them before inoculation with media resulted in the decrease in the amount of biofilm formed by *Salmonella typhimurium*, *Salmonella enterica*, *E. coli* and *Proteus mirabilis*. The pretreatment of silicone rubber with *S. thermophilus* surfactant inhibited 85% adhesion of *Candida albicans* and surfactants from *Lactobacillus fermentum* and *L. acidophilus* adsorbed on glass, reduced by 77% the number of adhering uropathogenic cells of *Enterococcus faecalis*.

4. Bacterial lipopeptides constitute potent non toxic, non pyrogenic immunological adjuvants when mixed with conventional antigens. An improvement of the humoral humane response was demonstrated when low molecular mass antigens Iturin AL and herbicolin A.

5. The increased incidence of HIV in women, there arose the need for a female controlled, efficacious and safe vaginal topical microbicide. Sophorolipids surfactants from *Candida bombicola* and its structural analogues such as the sophorolipid diacetate ethyl ester is the most potent spermicidal and virucidal agent, it was also reported that this substance has a virucidal activity similar to nonoxynol – 9 against the human semen.

6. Isolation of genes for protein molecules of this surfactant and cloning in bacteria have made possible its fermentation production for medical application.

(v) Food processing industry

Biosurfactants were used for various food processing application but they usually play a role as food formulation ingredient and anti adhesive agents, as food formulation ingredient they promote the formation and stabilization of emulsion due to their ability to decrease the surface and interfacial tension. It is also used to control the agglomeration of fat globules, stabilize aerated systems, improve texture and shelf life of starch containing products, modify rheological properties of wheat dough and improve consistency and texture of fat based products.

(vi) Cosmetic industry

The surfactants are used as emulsifiers, foaming agents, solubilizers, wetting agents, cleansers, antimicrobial agents, mediators of enzyme action, in insect repellents, antacids, bath products, acne pads, anti dandruff products, contact lens solutions, baby products, mascara, lipsticks, toothpaste etc.,

(vii) Petroleum industry

Biosurfactant and bioemulsifiers are novel group of molecules and among the most powerful and versatile byproduct that modern microbial technology can offer in fields such as biocorrosion and biofouling degradation of hydrocarbons within oil reservoirs, enzymes and biocatalysts for petroleum up grading. Biosurfactants play a major role in petroleum extraction, transportation, upgrading and refining and petrochemical manufacturing. Microbial enhanced oil recovery includes use of microorganisms and the exploitation of their

metabolic processes to increase production of oil from marginally producing reservoirs. Microbial surfactants are widely used in oil recovery in recent times. The mechanism responsible for oil release is acidification of the solid phase. Certain microorganisms, such as *Bacillus subtilis*, *Pseudomonas aeruginosa*, *Torulopsis bombicola* have been reported to utilize crude oil & hydrocarbons as sole carbon sources and it can be used for oil spill remediation.

CONCLUSION

It is derived from renewable resources and are low or nontoxic, biodegradable, demonstrate excellent surface activity, possess high specificity, show effectiveness under extreme conditions, and can be reused through regeneration too as compared to synthetic surfactants. In future the biosurfactants are made by applying different modern biotechnological concept to explore the utilities for ecosystem protection.

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