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Applications of Biosurfactants in Biotechnology and Pharmaceuticals on the Physicochemical and Biological

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Abstract

The chemical substances known as biosurfactants are derived from diverse microorganisms and have the capacity to lessen the interfacial tension between two similar or dissimilar phases. Biosurfactants are an intriguing option in a variety of physico-chemical and biological applications due to their significance in the cosmetics, pharmaceutical, biotechnology, agricultural, food, and oil sectors. This review article emphasises the uses of biosurfactants in many sectors while highlighting their significance in each industry in order to portray the diverse qualities of these substances. Additionally, the manufacture of recently created biosurfactants that are significant from both a chemical and biological standpoint has been described. With a focus on the most recent results and research conducted globally, the advantages of biosurfactants over chemical surfactants have also been explored. Additionally, the physical and chemical characteristics of certain biosurfactants Various characterisation methods have been given and explored. The review paper covers the most recent advances in biosurfactants as well as their physico-chemical characteristics and uses in a variety of industries, particularly in biotechnology and pharmaceuticals.

Keywords: Biosurfactants; Microbes; Applications Biotechnology; Pharmaceuticals

Introduction

Chemical substances known as surfactants, sometimes known as surface-active agents, are amphiphilic in nature because they include both hydrophobic and hydrophilic areas. They change a fluid's surface or interfacial tension characteristics, allowing a micro emulsion to develop and causing colloidal solutions, micellar systems, and water-oil suspensions to dissolve [1]. Surfactants are a necessity in many industries, including the food, oil, cosmetics, pharmaceutical, and agricultural sectors due to this phenomena [2]. The elastic propensity of liquid surfaces is known as surface tension, which quantifies the force of attraction between the liquid-liquid, liquid-solid, or liquid-gas interfaces that are in touch with it [3]. The most frequent examples of this phenomenon are little liquid droplets and soap bubbles with an approximately spherical form [4]. It is a crucial facto. For determining a surfactant's efficacy, when their concentration in a solution rises and micelle production happens as a result of a drop in surface tension [5]. Micelle production results from the lipophilic region of the surfactant's inability to make hydrogen bonds in the aqueous phase, which raises the system's free energy [6]. Dealing with this enhanced free energy is necessary to support the separation of the hydrocarbon tail from the water by allowing the hydrophobic area to be orientated toward the centre and the hydrophilic region to be facing the water [7]. By reducing their intermolecular interactions, surfactants reduce the interfacial tension between two molecules in a liquid. Large hydrocarbon chains make up the structure of the surfactants [8]. Once these surfactants have been added, they inhabit the intermolecular gaps between the liquid particle in a liquid solvent solution [9].

Discussion

Lowered interfacial tension and weak intermolecular interactions between the molecules are the results of this. Due to the creation of fresh extra surfaces caused by the reduction in surface tension between molecules, immiscible fluids become miscible when solid or liquid solute particles engage in hydrophilic or hydrophobic interactions with the solvent [10]. Micelles are described as aggregates of hydrophobic and hydrophilic molecules, with the hydrophilic groups orientated toward water and the hydrophobic groups oriented toward oil. By distributing hydrophobic substances into the pseudocore located in the middle of the micelle, solubility is improved [11]. This improves compound dispersion and increases the mobility of adsorbed hydrophobic soil [12]. By reducing the capillary forces, pollutants. Critical Micelle Concentration is the lowest surfactant concentration at which a liquid's solution characteristics change abruptly. In place of chemical surfactants, biosurfactants, which are biological substances of microbial origin, may be utilised successfully, having surface-active qualities [13]. They contribute to a greater drop in surface tension of oil-water or air-water interfaces at extremely low concentrations and have a lower CMC than synthetic counterparts [14]. Biosurfactants are an excellent option for froth stabilisation and emulsification due to their properties [15]. In comparison to chemical surfactants, microbial ones are more effective and offer more benefits, especially in terms of biodegradability, moderate production conditions, ecological compatibility, reduced toxicity, greater selectivity, and explicit activity throughout extreme temperatures, pH, and salinities. Promoting their usage in the represented industries Biosurfactants are amphiphilic compounds having hydrophilic tails and hydrophobic head ends. Long chain fatty acids, hydroxyl fatty acids, -alkyl-hydroxyl fatty acids, etc. are often found in the hydrophobic zone of biomolecules, whereas cyclic peptides, phosphates, carboxyl acids, or alcoholic groups are typically found in the hydrophilic section of biomolecules. In addition to lowering the fluid's surface pressure, these molecules have a significant impact on the interfacial conduct and mass exchange because they also reduce the strain at the limit of the interface between immiscible fluid stages between different fluid stages. Microbial

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surfactants have a strong capacity to reduce surface tension as well as a variety of other qualities, including emulsification, lubricating ability, phase dispersion, and detergency. The food, petroleum, cosmetics, bioremediation, environmental, and pharmaceutical sectors all employ them extensively. Amphipathic in nature, surfactant molecules divide into two phases with various degrees of polarity. These microbial surfactants function best at their micelle concentration, which can range from 10 to 40 times lower than the concentration of chemical surfactants. Microbial surfactants are frequently regarded as low- or non-poisonous substances because of the moisturising and low toxicity features of complex lipids like lip peptides and glycolipids. Biosurfactants separate at surfaces with specific polarity and hydrogen holding, which affects how microorganisms adhere. Several methods, including colorimetric analysis, emulsification index determination, drop collapsing test, and thin layer chromatography, can be used to identify the presence of biosurfactants in a medium. The biosurfactants created from non-delectable renewable resources, resulting in high surface activity, high specificity, and the capacity to operate in harsh environments. They are often created by microorganisms that are aerobically developing and use feedstock as a source of carbohydrates, lipids, etc. Actively produced in the culture medium, microbial surfactants are thought to promote microbial growth by aiding the transfer of insoluble solutes across cell membranes. They often contain both lipophilic and hydrophilic groups and are non-ionic or anionic moieties. Microorganisms are used to create biosurfactants with high and low molecular weights. Glycolipids including trihalide, fructose lipids, and sophorolipids are included in low molecular weight biosurfactants, whereas peptidyl lipids include surfactant, polymyxin, and other compounds. Bacillus subtilis produces a biosurfactants called surfactant, which possesses an amphiphilic structure, acts as a powerful inhibitor of bacterial and tumour development, and is linked to lowering fluid surface tension. Higher molecular weight biosurfactants, on the other hand, are amphiphilic polysaccharides that help generate stable emulsions but do not reduce interfacial tension. Bacteria can adhere more firmly to hydrophobic surfaces thanks to their ability to generate powerful emulsions. The majority of biosurfactants are produced by a variety of bacteria, including Arthrobacter, Bacillus subtilis, Pseudomonas aeruginosa, Acinetobacter calcoaceticus, Candida lipolytica, Corynebacterium, Nocardia, Bacillus subtilis, Bacillus licheniformis, Candida spp., and many more. The majority of biosurfactants are made up of water-insoluble substrates. Some scientists have developed a culture of Candida lipolytica on groundnut oil to get biosurfactants. Similar biosurfactants are produced by Candida glabrata fed on vegetable oil. A few researches have also discussed the formation of rhamnolipids using Pseudomonas aeruginosa's low-value carbon sources.

Conclusion

Rhamnolipids have been obtained from Pseudomonas aeruginosa strains utilising restaurant waste oil in a bioreactor format. In order to produce rhamnolipids, Siddhartha et al. revealed another low-cost medium that contained waste cassava water and waste frying oil. Endophytic fungi, which are present on tropical plants like Piper hispidum and operate as a powerful source for the final generation of biosurfactants, have also been employed to get biosurfactants, according to Silva. Numerous studies have shown the significance of glycolipids and lipopeptides in the synthesis of microbial biosurfactants. Production of rhamnolipids from Pseudomonas aeruginosa trehalolipids is one of the notable advancements accomplished in this research. Sophorolipids made by Candida bombicola and mannosyl erythritol lipids MELs made by Pseudozyma yeasts are generated by Rhodococcus erythropolis. There is a list of some typical biosurfactants and the microbes from which they have been created in the metabolic pathway of the generating organism as well as the chemical structure of biosurfactants should be thoroughly studied in order to improve the circumstances to boost the production of biosurfactants. Zouari et al. used buttermilk and chicken farm waste as possible sources of nitrogen and carbon by using this knowledge. This combination was discovered to be effective for producing SPB1 lipopeptide. Due to the high cost of producing biosurfactants and the manner they are currently produced, oil-based synthetic surfactants are now the most often used across numerous projects. To meet the demands of the present world, their widespread creation has not yet been defined. The use of alternative substrates, microbial culture, and culture conditions are the primary areas of attention in this field of research to find ways to lower the cost of production. Utilizing low-cost media can also assist in lowering the cost of producing biosurfactants They may be made more effective by further adjusting working parameters including temperature, pH, agitation speed, time, and recovery of products, although they are still somewhat more expensive than synthetic ones. Cost may no longer be a problem if low-cost agro-industrial waste is used. For a product to be used on a wide scale, processes must be developed that make manufacture and downstream processing simple. Selecting a workable recovery approach depends on the design, organisation, and centralization of operations. By employing industrial by-products like glycerol and vegetal waste oil in the right quantities, Xiaowei et al. were able to fix this issue. It was noted that these byproducts functioned as an incredible source of carbon and did not impede growth. A massive amount of Enterprise waste can be processed and used as fantastic elective substrates. Therefore, using this method to produce affordable biosurfactants is an alternative.

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Conflict of Interest

None

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