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Shapoval I., Filipova T., Galkin M.

BIOSURFACTANTS PRODUCED BY MARINE MICROORGANISMS

*Odesa I. I. Mechnikov National University,
Dvorianska str., 2, Odesa, 65082, Ukraine,
e-mail: ivan875shapoval@gmail.com*

Abstract. *This report provides an overview of the recent advances in the study of biosurfactants (BSs), surface-active metabolites produced by bacteria. These metabolites have gained significant attention due to their biodegradability, low toxicity, and potential for production from renewable and cheaper substrates. The report focuses on marine BSs, highlighting their sources, characterization, and potential biotechnological applications. The research on BSs is still evolving, with promising results obtained from marine resources in terms of BS chemical diversity, effectiveness, and microbial production capacity. The report concludes by highlighting the potential of marine bioprospecting and blue biotechnology as promising areas for future research and applications.*

Keywords: *biosurfactant, bacteria, biotechnology, aquatic environment.*

Introduction. Through the process of evolution, bacteria have adapted to survive by creating and utilizing surface-active products that facilitate the adsorption, emulsification, wetting, dispersal, and solubilization of water-immiscible compounds. Because of their biodegradability, low toxicity, and capacity to be synthesized from less expensive and renewable substrates, surface active metabolites, or BSs, have drawn a lot of attention in this context. As a result, they have gained an important ecological role due to their structural and functional diversity as well as their potential for multidisciplinary applications in the environmental and industrial fields [1].

Results and discussion. Bacterial secondary metabolic products, or BSs, have hydrophobic end groups and hydrophilic water soluble ends that allow them to show their surface and emulsifying properties. A range of yeasts, bacteria, and filamentous fungi produce them either outside the cell or as a component of the cell membrane from a number of substrates, including sugars, oils, alkanes, and waste products [2]. There are three main steps to investigating the production of BS from microorganisms: isolating potential BS producers; screening for BS production; and extracting and purifying the product, which is

occasionally enhanced by chemically characterizing molecules. These investigations are becoming more and more common. Fish from the Indian Ocean, sponges, sea pens, polychaetes in the Mediterranean Sea as sources of BS producers with ideal potentialities have all been identified [3].

One common property shared by BSs is their ability to relax or decrease surface tension, which promotes solubility and allows BSs to interact with interfaces that regulate bacterial adhesion and detachment. Together with the ability to remove contaminants, all of these characteristics give BS antibacterial, antifungal, and antiviral effects [4].

The class of glycolipids has been extensively researched in the marine environment because a large range of bacteria isolated from different marine matrices, including fish gut, sea pen *Pteroeides*, and annelida, as well as polluted soils (Arctic and Antarctic sediments), produce them [5].

The diverse roles that biosurfactants play are frequently exclusive to the physiology and ecology of the microorganisms that create them. As previously said, one of the most fascinating roles from an environmental perspective is illustrated by the various tactics used by microbes to improve their bioavailability and accessibility to hydrophobic substances as a source of carbon. A suggested mechanism for the incorporation of hydrocarbons into the hydrophobic core of the BS micelles is presented. This process, known as "micelle solubilization," was investigated using alkanes as model substrates [6]. It has been observed that strains of the Mediterranean Sea connected to *Rhodococcus spp.* can lower surface tension when oily substrates are present. The isolated beta-carotene synthases (BSs) have also been shown to be the best enhancers for the biodegradation of n-hexadecane and tetradecane [7].

The best option for oil removal was found to be a glycolipidic biosurfactant with a 45% removal capacity that is produced by the Mediterranean *Bacillus spp.*, a bacteria that is connected with coral. It has been demonstrated that marine-derived lipopeptides and glycolipids are effective against a variety of bacterial infections [8]. In fact, the lipopeptide generated by *N. alba* that was isolated from the Indian Ocean shown antibacterial action against *B. subtilis*, *C. albicans*, and *E. faecalis*. Certain microbes have the ability to control the characteristics of their cell surface using their BS, allowing them to adhere to or separate from surfaces as needed. It's interesting to note that *P. aeruginosa* ATCC10145, which was isolated from the Gulf of Mannar, exhibits suppression of biofilm formation; this appears to be related to BSs generated by strains linked to coral mucus [3, 8].

Furthermore, it has been discovered that rhamnolipids play a new role in the induction of defense responses in plants and animals. Specifically, it has been shown that rhamnolipids directly operate as a biocide on bacteria and fungus, and they also make some Gram-positive and Gram-negative bacteria more vulnerable to certain antibiotics [2].

Conclusions. The field of BS research is still developing and needs a lot of improvement in a number of areas. The outcomes from marine resources over the past few decades are highly promising in terms of microbiological production capacity, BS effectiveness, and BS chemical diversity. Blue biotechnology and marine bioprospecting are study fields that merit attention, should be investigated, and have the potential to yield important discoveries and practical uses for people [1].

Шаповал І., Філіпова Т., Галкін М.

БИОСУРФАКТАНТИ, ЩО ПРОДУКТУЮТЬСЯ МОРСЬКИМИ МІКРООРГАНІЗМАМИ

*Одеський національний університет імені І. І. Мечникова,
вул. Дворянська, 2, Одеса, 65082, Україна
e-mail: ivan875shapoval@gmail.com*

Анотація. У даному звіті представлено огляд останніх досягнень у вивченні біоповерхнево-активних речовин (біо-ПАР), поверхнево-активних метаболітів, що виробляються бактеріями. Ці метаболіти привернули значну увагу завдяки здатності до біологічного розкладання, низької токсичності та потенціалу виробництва з відновлюваних і дешевших субстратів. Доповідь присвячена морським біо-ПАР і висвітлює їх джерела, характеристики та потенційне коло застосування. Дослідження біо-ПАР все ще розвиваються і мають багатообіцяючі результати. Особливо це стосується біо-ПАР, отриманих з морських ресурсів, їх хімічного різноманіття, ефективності та мікробної продуктивності. Звіт завершується підкресленням значущості потенціалу морської біорозвідки та блакитної біотехнології як перспективних областей для майбутніх досліджень і застосувань.

Ключові слова: біосурфактант, бактерії, біотехнологія, водне середовище.

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