



Biosurfactant Producers: Multifunctional Microbial Strains Pioneering Environmental Clean-Up Strategies

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Biosurfactants are surface active compounds better known for their capacity to lower down surface tension of water and are one of the very well-considered classes of valorizable products synthesised by bacteria from a wide range of genres. The earliest reports on biosurfactants from bacteria dates back to 1986 by Kaeppli and Guerra-Santos, where the team obtained the first ever patent on bacterial derived biosurfactants, described as rhamnolipids from *Pseudomonas aeruginosa* DSM 2659 [1]. By the end of 1990s hundreds of bacterial species that produced biosurfactants had been thoroughly investigated and research went on for increasing

the production volume for environmental and industrial usage. The long list of bacterial species that are engaged in secretion of valuable biosurfactants include *Bacillus*, *Lactobacillus*, *Pseudomonas*, *Burkholderia*, *Mycobacterium*, *Rhodococcus*, *Arthrobacter*, *Nocardia*, *Gordonia* and *Acinetobacter* etc. [2] and multiple patents have been obtained by different scientific groups till date (Table 1). Along with such diverse groups of BS producers, multiple areas of applications where BSs could have profound environmental, industrial and therapeutic uses started to gain limelight.

Sl. no.	Microorganisms/ Biosurfactant	Patent holder	Title of patent	Publication no.	Date/year
1	Glycolipids	Wagner	Method and installation for flooding petroleum wells and oil-sands	CA 1119794	1982
2	BS producing Bacterial consortium	Hitzman	Enhanced oil recovery process using microbes	US 4450908	1984
3	Sophorolipid producer	Borzeix F	Sophorolipids as stimulating agent of dermal fibroblast metabolism	US 6057302A	2 nd May, 2000
4	Sophorolipid producer	Gross RA, Shah V, Doncel GF	Spermicidal and virucidal properties of various forms of Sophorolipids	WO 2005089522 A2	19 th Sept, 2005
5	<i>Pseudomonas aeruginosa</i>	Silvanito Alves Barbosa, Roberto Rodrigues De Souza	Biosurfactant production for development of biodegradable detergent	PI 1102592-1A2	16 th May, 2011
6	<i>Streptomyces sp</i>	Ana LF Porto, Eduardo F Santos, Leonie A Sarubbo	Biosurfactant and production process	PI 1105951-6 A2	28 th Nov, 2011
7	Lipopeptide	Cox TF, Crawford RJ, Gregory LG, Hosking SL, Kotsakis	Mild skin foaming detergent composition	WO2011120776A1	6 th Oct, 2011
8	Lipopeptide producer	X. Vecino, R. Dvesa-Rey, J.M. Cruz, A.B. Moldes	Methods for separating the surfactants present in washing liquors of corn and uses	WO2014044876 A1	27 th Mar, 2014

Table 1

The amphiphilic nature of BSs forges them to form micelles, above a certain concentration called the Critical Micelle Concentration (CMC) with the hydrophilic tails hanging out from a hydrophobic core, hence making them great entrapment vehicles and tensioactive agents that are engaged in altering surface tension between immiscible fluids, solid surfaces or gaseous substances (Figure 1) [3]. These characteristics including increased absorption, transport, biodegradation of hydrocarbons and xenobiotics make the BS to be efficient tools in bioremediation [4]. Markande., et al. [5] in its recent review on BSs has given a described detail of involvement of BS in environmentally friendly processes like anti biofilm agent, Soil health, Biofilms, oil spill remediation, waste water treatment etc.

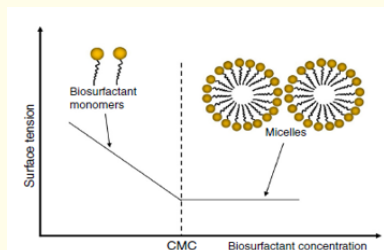


Figure 1: Critical Micelle Concentration of biosurfactant.

A striking feature of biosurfactant producing microbes has been observed in multiple strains for both bacteria as well as fungi, which is their parallel capability to degrade pollutants, or enhanced bioremediation. The reason behind this may be the micelle formation and entrapment of pollutants inside them to increase bioavailability to the bacterial degraders [6]. The idea behind the occurrence of the two simultaneous phenomenon of biosurfactant production along with the degradation of environmentally deteriorating substances have instigated the genre of studies where the double edged nature of the multi-utility wonder microbes have opened new horizons for the hunt of such novel organisms that participate in the “Waste to Wealth” strategies today. In one of the reports by Cameotra., et al. [7], a myriad of hydrophobic contaminants present in the environment are degraded or removed by stable biosurfactants produced from different bacteria have been listed. Increased bioavailability of pollutants via BS is mediated by the micelle forming units. They impose the increment in capacity of the microbe to utilize them as carbon source, hence facilitating its degradation. Enhanced production of biosurfactants in presence

of pollutants in the surrounding environment has been reported by Behera., et al. [8], where presence of O cresol has increased the BS production by two-fold. The presence of quorum sensing mechanism as quorum sensing and quenching abilities induces production of BS within the microbe [9,10].

One of the most important aspects in studying role of BS and BS producing microbes is their involvement in increasing capability of degradation of pollutants. In one of the reports by Cameotra and Makkar (2010) a myriad of hydrophobic contaminants present in the environment are degraded or removed by stable biosurfactants produced from different bacteria have been listed. Increased bioavailability of pollutants via BS is mediated by the micelle forming units. They impose the increment in capacity of the microbe to utilize them as carbon source, hence facilitating its degradation. Enhanced production of biosurfactants in presence of pollutants in the surrounding environment has been reported by Behera., et al. [8], where presence of O-cresol has increased the BS production by two-fold. The presence of quorum sensing mechanism as quorum sensing and quenching abilities induces production of BS within the microbe [9,10]. These bacterial strains that are active participants in producing value added biosurfactants as well as simultaneously capable of degrading pollutants at like two edged swords in environmental clean-up strategies.

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