INTERNATIONAL JOURNAL OF ADVANCE RESEARCH AND DEVELOPMENT

IJARnD

(Volume2, Issue2)
Available online at: www.ijarnd.com

Biosurfactants-Review

S. Sreeremya
Department of Biotechnology
Sree Narayana Guru College, Coimbatore, Tamil Nadu.
7025369665
sreeremyasasi@gmail.com

ABSTRACT

Biosurfactants are a structurally diverse group of surface-active substances synthesized by microorganisms. All biosurfactants are amphiphiles, they consist of two parts—a polar (hydrophilic) moiety and non polar (hydrophobic) group. These biosurfactants have tremendous applications. This review focuses on the varying microorganisms which have the potential ability to synthesize surface active substance, and the microorganisms which have the pivotal role to play in bioremediation.

Keyword:- Biosurfactants, Surface, Microorganisms, Bioremediation, Polar, Non polar.

INTRODUCTION

A hydrophilic group consists of mono-, oligo- or polysaccharides, peptides or proteins and a hydrophobic moiety usually comprises saturated, unsaturated and hydroxylated fatty acids or fatty alcohols the significant properties of biosurfactants allow their use and possible replacement of chemically synthesized surfactants in a great number of industrial operations (Kosaric, 1992). Chemically produced biosurfactants are mostly derived from oil and are widely used in cosmetics. Biosurfactants reduce surface tension, critical micelle concentration (CMC) and interfacial tension in both aqueous solutions and hydrocarbon mixtures (Banat, 1995; Rahman et al., 2002).

Biosurfactants and their Classification

Biosurfactants have many applications in the field of bioremediation. The term ‘biosurfactant’ refers to any compound from microorganisms, which has some influence on interfaces i.e. surface active agents, which brings down the interfacial tension between the two liquids(Benjamin S.et.al.,1998). The minimum surface tension value reached and the critical micelle concentration (CMC) needed are the parameters used to measure the efficiency of a surfactant. A successful biosurfactant can reduce the surface tension of water or growth medium from 72 mN/m to around 27 mN/m [9]. Biological surfactants have many advantages over their chemical similitude’s as they are easily degraded by the microorganisms, they have low toxicity, they can be produced from very cheap and economical raw materials, they are not easily affected by environmental factors such as temperature, pH, ionic strength and they have the unique property of biocompatibility and digestibility. Biosurfactants are amphipathic molecules with both hydrophilic and hydrophobic moieties existing within the same molecule (Lima de CJB.et.al.,2009). The hydrophobic moiety of a biosurfactant is either a long-chain fatty acid, hydroxy fatty acid or α-alkyl β-hydroxy fatty acid and the hydrophilic moiety can be a carbohydrate, amino acid, cyclic peptide, phosphate, carboxylic acid, or an alcohol. While, synthetic surfactants are usually categorized according to the nature of their polar groups, microbial biosurfactants are generally classified mainly on the basis of their biochemical composition and microbial origin(Sutyak KE.et.al.,2008). The microbial surfactants are complex molecules in the range of peptides, fatty acids, glycolipids, rhamnolipids, lipopeptides and sophorolipids. The low molecular weight biosurfactants are glycolipids whereas the high molecular weight microbial surfactants are generally polyanionic heteropolysaccharides containing both polysaccharides and proteins (Sekhon KK.et.al., 2011).

BIOSURFACTANT – SYNTHESIZED BY BACTERIA FOUND IN CONTAMINATED AND UNCONTAMINATED SOILS

Microbially synthesized surfactants have been studied for microbially enhanced oil recovery (MEOR) and the bioremediation of hydrocarbons. Most of these studies have availed biosurfactants produced by one of a small number of pure-culture microbes isolated in a laboratory. The biosurfactant-producing microorganisms were naturally present at two hydrocarbon-impacted sites Biosurfactant-producing bacteria were found to constitute a major proportion (up to 35%) of aerobic heterotrophs. Biosurfactant producers were isolated. Isolates were identified primarily as strains of *Bacillus* and *Pseudomonas* (Yakimov M.et.al., 1997).

Biosurfactant Production from olive oil by *Pseudomonas Fluorescens*

The genus *Pseudomonas* is capable of using different substrates, such as glycerol, mannitol, fructose, glucose, n-paraffins and vegetable oils, to produce rhamnolipid-type biosurfactants. Several studies have been carried out to define the best ratio between carbon, nitrogen, phosphorus and iron needed to acquire high production yields. Optimizing factors that affect growth in biosurfactant synthesizing organisms with potential for commercial exploitation is of top notch importance (Carlsen S,1994).These molecules could be widely used in cosmetic, pharmaceutical, and food processes as emulsifiers, preservatives, and detergents, and in bioremediation processes. They can be produced from various substrates, mainly renewable resources such as vegetable oils, distillery and dairy wastes. The biosurfactant named *Pseudomonas fluorescens* Migula 1895-DSMZ, were identified, synthesis was followed by measuring surface tension and emulsifying index E24. The best results were obtained when using olive oil and ammonium nitrate as carbon and nitrogen sources respectively with a C: N ratio of 10. The properties of biosurfactant that was separated by acetone precipitation were investigated in a particular study (Jenninngs.E.M, 1999).

List of biosurfactant producing organisms (Banat, I.M, 1995)**.**

SL NO	Biosurfactant	Microorganism(s)	Current economic importance
1	Cellobiose lipids	*Ustilago maydis*	Antifungal Compounds
2	Serrawettin	*Serratia marcescens*	Emulsification of hydrocarbons
3	Polyol lipids	*Rhodotorula glutinis, R. graminis*	Anti-proliferative activity
4	Trehalose lipids	*Rhodococcus erythropolis*, *Arthrobacter* sp., *Nocardia erythropolis*, *Corynebacterium* sp., *Mycobacterium* sp	Dissolution of hydrocarbons
5	Ornithine lipids	*Pseudomonas* sp., *Thiobacillus thiooxidans*, *Agrobacterium* sp.	Bio-emulsifiers
6	Rhamnolipids	*Pseudomonas aeruginosa, Pseudomonas chlororaphis,Serratia rubidea*	Bioremediation, Antimicrobial and biocontrol properties
7	Viscosin	*Pseudomonas fluorescens, Leuconostoc mesenteriods*	Surface active lipopeptides
8	Sophorolipids	*Candida bombicola, C. antartica, Torulopsis petrophilum C. botistae, C. apicola, C. riodocensis, C. stellata,*	Antimicrobial, Antiviral, Spermicidal

Regulatory factors related to biofilm formation

Biofilm formation provides several advantages to the bacteria, providing protection that may enhance bacterial survival under environmental stress conditions. Rhamnolipids play a pivotal role in the architecture of biofilms produced by *P.* aeruginosa (Onbasli.et.al. 2009). The cell seperation of the biofilm structure and the formation of water channels have been shown to be dependent of the rhamnolipids synthesis. It has been reported that rhamnolipid production is related to biofilms in *P. aeruginosa* through AlgR, a regulatory factor related to biosynthesis of alginate. AlgR was shown to be the main repressor of rhamnolipid production within adherent biofilms and during its development, acting as a repressor of the expression of *rhlI* and *rhlAB* . No such effect was reported on planktonic growth so far, therefore, it was hypothesized that AlgR acts through a contact-dependent or biofilm-specific mode of regulation. BqsS-BqsR, a two component system, has also been reported to be related to biofilm formation in *P. aerugionosa* (Tsujita T.et.al., 1990). In *P. aeruginosa*, bqsS-bqsR mutant showed reduced rhamnolipids production, which might be an indirect regulation, since the production of C4-HSL, as well as PQS, were reduced in this mutant. Although the environmental stimuli that trigger BqsS-BqsR activity are still unknown, evidences support the existence of opposite effects of AlgR and BqsS-BqsR on rhamnolipid production in the context of biofilm formation (Kitamoto D.et.al., 1993) .

Application of biosurfactants

Biosurfactants are potentially replacements for synthetic surfactants in several industrial processes, such as lubrication, wetting, softening, fixing dyes, making emulsions, stabilizing dispersions, foaming, preventing foaming, as well as in food, biomedical and pharmaceutical industry, and bioremediation of organic- or inorganic-contaminated sites. Glycolipids and lipopeptides are the most important biosurfactants (BS) for commercial purpose(Panda T.et.al.2005). The patents on biosurfactants and bioemulsifiers (255 patents issued worldwide) showing high number of patents in the petroleum industry (33%), cosmetics (15%), antimicrobial agent and medicine (12%) and bioremediation (11%). Sophorolipids (24%), surfactin (13%) and rhamnolipids (12%) represent a large portion of the patents, however, this may be underestimated since many patents do not specify the producer organism restricting to the specific use of the BS only(Arguelles-Arias A.et.al.,2009).

CONCLUSION

Biosurfactants are unique group of surface active agents,which have diverse application. The major area for the surfactant activity is primarily for bioremediation. Synthetic biosurfactants can be replaced by potential biosurfactants. The efficacy of surfactant activity of various microorganisms from large scale to molecular level has to be explored.

REFRENCE

1. Arguelles-Arias A, Ongena M, Halimi B, Lara Y, Brans A, Joris B, Fickers P, 2009. *Bacillus amyloliquefaciens* GA1 as a source of potent antibiotics and other secondary metabolites for biocontrol of plant pathogens. Microbial Cell Factory, 8:63.
2. Banat, I.M., 1995. “Biosurfactants Production and Possible Uses in Microbial-Enhanced Oil Recovery and Oil Pollution Remediation: A Review.” Bioresource Technology, 51, 1-12.
3. Benjamin S, Pandey A (1998) *Candida rugosa* lipases: Molecular biology and versatility in biotechnology. Yeast 14: 1069-1087.
4. Carlsen S (1994) Lipolytic enzymes and their use in the oleo chemical and detergent industry. Fat Sci Technol 96: 408.
5. Cotter PD, Hill C, Ross RP, 2005. Bacteriocins: developing innate immunity for food.Nature Review Microbiology. 3:777-788.
6. Jenninngs.E.M.1999.Rhamnolipid biosurfactant production by strains of *Pseudomonas aeruginosa* using low-cost raw materials.2002. Biotechnol Prog 18:1277-1281.
7. Kitamoto D, Yanagishita H, Shinbo T, Nakane T, Kamisava C, Nakahara T, 1993. Surface-active properties and antimicrobial activities of mannosylerythritol lipids as biosurfactants produced by *Candida antarctica*. Journal of Biotechnology. 29:91-96.
8. Lima de CJB, Ribeiro EJ, Sérvulo EFC, Resende MM, Cardoso VL, 2009. Biosurfactant Production by *Pseudomonas aeruginosa* Grown in Residual Soybean Oil. Applied Biochemistry and Biotechnology, 152: 156-168.
9. Onbasli, Aslim B, 2009. Biosurfactant production in sugar beet molasses by some *Pseudomonas* spp. Journal of Environmental Biology, 30:161-163.
10. Panda T, Gowrishankar BS (2005) Production and applications of esterases. Appl Microbiol Biotechnol 67: 160-69.
11. Sekhon KK, Khanna S, Cameotra SS (2011) Enhanced biosurfactant production through cloning of three genes and role of esterase in biosurfactant release. Micro Cell fact 10: 49.

12. Sutyak KE, Wirawan RE, Aroutcheva AA, Chiindas ML, 2008. Isolation of the *Bacillus subtilis* antimicrobial peptide subtilosin from the dairy product derived *Bacillus amyliquefaceiens*. Journal of Applied Microbiology. 104:1067-1074.
13. Tsujita T, Shirai K, Saito Y, Okuda H (1990) Relationship between lipase and esterase. Prog Clin Biol Res 344: 915-933.
14. Yakimov M, Amro M, Bock M, *et al*., 1997. The potential of *Bacillus licheniformis* strains for in situ enhanced oil recovery. Journal of Petroleum Science Engineering, 18: 147-60.

