IJPPR
INTERNATIONAL JOURNAL OF PHARMACY & PHARMACEUTICAL RESEARCH
An official Publication of Human Journals
ISSN 2349-7203
HUMAN

Human Journals
Review Article
March 2019 Vol.:14, Issue:4

Effects of Some Conditions on Microbial Biosurfactant Production

IJPPR
INTERNATIONAL JOURNAL OF PHARMACY & PHARMACEUTICAL RESEARCH
An official Publication of Human Journals
ISSN 2349-720
HUMAN

Samer M. Al-Hulu

Al-Qasim Green University/Environmental Sciences College

Submission: 23 February 2019
Accepted: 28 February 2019
Published: 30 March 2019

www.ijppr.humanjournals.com

Keywords: Biosurfactant, microbial ,production, factors, conditions

ABSTRACT

Biosurfactants are amphiphilic compounds created on microbial cell surfaces, it contains containing unmistakable polar and nonpolar moieties**.** It can have one of the accompanying structures: glycolipids, mycolic corrosive, polysaccharide- lipid composite, lipoprotein/lipopeptide, phospholipid, or the microbial cell surface itself**.** Many factors effects on biosurfuctant production, the Glucose was the excellent carbon source at concentration of 2% for rhamnolipids production. Yeast extract is the most closely used nitrogen substrate for biosurfactant production. The productions of Rhamnolipid increase with temperature from 25 to 30°C and remains constant from 30 to 37°C and little decrease when the temperature reached 42°C**.** pH is another important factor that impact on biosurfactant production. The biosurfactant production by *Pseudomonas aeruginosa* PBSC1 was maximum at pH 7.0.Increase in agitation rate from 50 to 200 ppm increased the growth rate from 0.2 to 0.72/ hour due to maximum production for biosurfactant.

INTRODUCTION

Biosurfactants are amphiphilic compounds created on microbial cell surfaces, it contains containing unmistakable polar and nonpolar moieties which enable them to shape micelles that collect at interface between fluids of various polarities, for example, water and oil they have capacity to diminish surface pressure [Adamczak and Bednarski ,2000]. A biosurfactant may have one of the following structures- glycolipids, olysaccharide–phospholipid, lipid complex, mycolic acid, lipoprotein or lipopeptide, phospholipid, or the microbial cell surface itself [Adamczak and Bednarski ,2000]. .Generally, biological surfactants are highly biodegradable, non-toxic and renewable and may perform over synthetic surfactants with high surface tension, interfacial tension and critical micelle concentration. These can be produced easily in a short interval of time. Biological surfactants have excellent detergent, foaming, wetting, and micro-emulsifying properties [Mukherjee et al.,2006].A variety of microorganisms are capable of producing biosurfactants with different molecular structures. The following are among the most commonly reported microorganisms investigated for the production of biosurfactants: *Arthrobacter, Pseudomonas aeruginosa, Acinetobacter calcoaceticus, Bacillus subtilis, Candida lipolytica*, and *Torulopsis bombicola*. Most biosurfactants are produced from water insoluble substrates, such as solid and liquid hydrocarbons, oils and fats, although many are obtained through soluble substrates or a combination of both types of substrates [Van-Hamme *et al.*,2006]. Microbial biosurfactants attracted considerable attention because of their characteristics of biodegradability, low toxicity, ecological acceptability, and the ability to be produced from low-cost, renewable sources [Rufino, *et al.*,2007 , Sarubbo ,*et al.,* 1999, Franzetti *et al.*,2012].

Effect of different factors on biosurfactant production from microorganism

Effect of Carbon Sources

Microbes consumed in the biosurfactant production utilize different of carbon sources and energy for their growth. *Pseudomonas aeruginosa* utilises water soluble carbon source such as glycerol, mannitol, glucose and ethanol for rhamnolipid production [Robert *et al.*,1989]. Amongst the different carbon sources glycerol manage differently in such a way that when glycerol concentration is higher than 2%, the rhamnolipid level sharply decreases. Safi *et al*.,2007 notified that 3% glycerol produce only 2 g/L rhamnolipids with fermentation. He also recorded that 6% grape seed oil and sunflower oil also produce 2 g/L of rhamnolipids. In case

of 6% glucose, the rhamnolipid yield was form to be 1400-1500 mg/l. It was also spotted that 1.3 and 2.1 g/L rhamnolipids were produced with 6% and 28 5% concentration of diesel and kerosene oil respectively [Arima *et al.*,1968].Soybean lecithin and crude oil were also fixed as apropriate carbon sources for biosurfatant production. Changjun Zoua *et al.,* 2014 , through his study show that soybean lecithin was well utilized for biosurfactant production than crude oil with a little difference. But crude oil also proved to be an active carbon source in case of *Acenitobacter* related bacteria as reported by Huy *et al* . 1999 The profit of hydrocarbons such as n-hexadecane and paraffin were also were also attempted as carbon source by Jorge *et al.,* 2013 found that only water soluble carbon sources could be easily utilized for biosurfactant production than paraffin and n-hexadecane.

Effects of Nitrogen sources

Nitrogen is one of the most extreme growth factor for any type of microorganism because it supply the building units for the proteins. Many types of nitrogen sources are uitlize in the production of biosurfactants like such as urea, peptone, ammonium sulphate [Thanomsub, *et al.*,2004], ammonium nitrate [Putri,*et al.*,2015], sodium nitrate [Zinjarde *et al.*, 1997] and malt extract. Yeast extract is the most closly used nitrogen substrate for biosurfactant production. But the amount or concentration of nitrogen source used in the culture composition medium depends on the type and nature of microorganism culture and the production appear during the stationary phase of cell growth. In one testing it was shown that the concentration of ammonium and the amount biomass produced are proportional to each other in biosurfactant production [Bednarski *et al.*,2004, Gudina *et al.*,2011].

Effect of Temperature

Temperature is also one of the significant factors for biosurfactant production. Rhamnolipid productions increase with temperature from 25 to 30°C and remains constant from 30 to 37°C and little decrease when the temperature reached 42°C. Vollbrecht *et al* 1998, studied effects of temperature on the growth of *Pseudomonas aeruginosa* and rhamnolipid production. At high temperature such as 47°C provided unfavourable condition for the culture growth and hence rhamnolipid production was found to be lesser. Similarly for *Tsukamurella sp.* culture, at higher temperature cell aggregation occurs which results in lower glycolipid production. However certain microorganisms such as *Acinetobacter baylyi ZJ2* could withstand higher temperature (40–45°C) was identified through the investigation carried out by [Changjun Zoua

et al., 2014]. An optimum temperature of 30°C was suggested where cell growth was promoted and yielded a higher glycolipid production. Joice and Parthasarathi *et al*.,2014, also show that the high biosurfactant production by *Pseudomonas aeruginosa* PBSCI was at the temperature of 30°C [Vollbrecht , *et al.*, 1998, Jorge *et al*.,2014,].

Effect of pH

pH is another important factor that impact on biosurfactant production [Muthusamy et al.,2008]. A pH range of 6.0-6.5 found to be ambient for the biosurfactant production. At pH above 6.5, the biosurfactant production was found to be low. At pH 4 - 4.5, the bacterium was unable to minimize the surface tension of culture medium therefore yield of biosurfactant tends to decrease.Healy *et al.*, 1996 recorded that an increase in pH from 6.5 to 7.0 has not decreased the growth of microorganism for biosurfactant production. However decrace the pH affected the biosurfactant production [Desai and Banat,1997] .Similarly above pH 7, the growth was retarded in an alkaline environment and was recorded by Changjun Zoua *et al.*, 2014,while researching biosurfactant production using *Acinetobacterbaylyi ZJ2* 29**.** pH was found to affect the metabolism of microorganisms [Desai and Banat,1997].Joice and Parthasarathi ,2014 study the biosurfactant production by altering the pH from 5.0 to 8.5 and observed that surface tension reduction of 29.19 mN/m at pH 6.5 and emulsification activity was 75.12% at pH 7.0. Joice and Parthasarathi deduce that biosurfactant production by *Pseudomonas aeruginosa* PBSC1 was maximum at pH 7.0.

Effect of Aeration and Agitation

Aeration is related to foam accumulation [Shaligram *et al.*, 2010]. Agitation affects both mass transfer of oxygen and medium components. Hence aeration and agitation need to be considered an important factor for cell growth and biosurfactant production especially for aerobic organisms. Sen *et al.*, 1997, optimized the air flow rate using response surface method as 0.75 vvm for biosurfactant production. Similarly the effect of agitation was studied and reported that an increase in agitation rate from 50 to 200 ppm increased the growth rate from 0.2 to 0.72/ hour and a maximum biosurfactant yield of 80% could be achieved at this condition Response[Sen *et al.*, 1997]. This is because the increase in agitation rate greatly affected the dissolved oxygen level in the system from 0.1 to 0.55 mg/l. Hence at higher dissolved oxygen levels, the cell growth was greatly influenced and thereby higher biosurfactant production [Wei *et al.*,2005].

CONCLUSIONS:

Biosurfactants are amphiphilic compounds created on microbial cell surfaces, it contains containing unmistakable polar and nonpolar moieties. Glucose is excellent carbon source for rhamnolipids production. Yeast extract is the most closely used nitrogen substrate for biosurfactant production. The productions of biosurfuctant increase at temperature from 25 to 30°C. The biosurfactant production by *Pseudomonas aeruginosa* PBSC1 was maximum at pH 7.0. Increase in agitation rate due to maximum production for biosurfactant.

REFERENCES:

1. Adamczak M, Bednarski W (2000) Influence of medium composition and aeration on the synthesis of biosurfactants produced by Candida antartica. Biotechnol Lett 22: 313-316.
2. Arima K, Kakinuma A, Tamura G (1968) Surfactin, a crystalline peptidelipid surfactant produced by Bacillus subtilis: Isolation, characterization and its inhibition of fibrin clot formation. Biochem Biophys Res Commun 3: 488-494.
3. Bednarski W, Adamczak M, Tomasik Application of oil refinery waste in the biosynthesis of glycolipids by yeast.J. Bioresource Technology. 2004; 95, 15-18.
4. Changjun Zoua, Meng Wanga, Yu Xingb, Guihong Lana, Tingting Gea *et al*, Characterization and optimization of biosurfactants produced by Acinetobacter baylyi ZJ2 isolated from crude oil-contaminated soil sample toward microbial enhanced oil recovery applications, *Biochem Eng J*, 90, 2014, 49-58.
5. Desai J D & Banat I M, Microbial production of surfactants and their commercial potential, *Microbiol Mol Biol Rev*, 61, 1997, 47-64.
6. Franzetti A, Gandolfi I, Raimondi C, Bestetti G, Banat IM,Smyth TJ, Papacchini M, Cavallo M, Fracchia L. Environmental fate, toxicity, characteristics and potential applications of novel bioemulsifiers produced by Variovorax paradoxus 7bCT5. Bioresour Technol. 2012;108:245–51.
7. Gudina EJ, Teixeira JA, Rodrigues LR. Applied and Environmental Soil Science. 2011; DOI: 10.1155/2011/201254.
8. Healy MG, Devine CM, Murphy R. Resour. Conserv. Recy. Microbial production of biosurfactants 1996; 18 (1), 41-57.
9. Joice P A & Parthasarathi R, Optimisation of biosurfactant production from *Pseudomonas aeruginosa* PBSC1, *Int J Curr Microbiol App Sci*, 3, 2014, 140-151.
10. Jorge F.B Pereira, Eduardo J. Gudina, Rita Costa, Rui Vitorina, Jose A. Teixeira *et al*, Optimization and characterization of biosurfactant production by Bacillus subtilis isolates towards microbial enhanced oil recovery applications, *Fuel*, 113, 2013, 259-268.
11. Huy N.Q., S. Jin, K. Amada, M. Haruki, N.B. Huu *et al*, Characterization of petroleum-degrading bacteria from oil-contaminated sites in Vietnam, *J. Biosci. Bioeng*, 88, 1999, 100–102.
12. Muthusamy K, Gopalakrishnan S, Ravi TK, Sivachidambaram P. Current Science. 2008; 94, 736-774.
13. Mukherjee S, Das P & Sen R, Towards commercial production of microbial surfactants, *Trend Biotechnol*, 24, 2006, 509-515.
14. Putri M, Hertadi R. Effect of Glycerol as Carbon Source for Biosurfactant Production by Halophilic Bacteria *Pseudomonas Stutzeri* BK-AB12 Procedia Chemistry. 2015; 16, 321-327.
15. Robert M, Mercade M E, Bosch M P, Parra J L, Espuny M J *et al*, Effect of the carbon source on the biosurfactant production by *P. aeruginosa* 44T, *Biotechnol Lett*, 11,1989, 871-874.
16. Rufino RD, Sarubbo LA, Campos-Takaki GM. Enhancement of stability of biosurfactant produced by Candida lipolytica using industrial residue as substrate. World J Microbiol Biotechnol.2007;23:734–741.

17. Safi A M, Gilherme Sasa Ki L, Lauro M, De souza, Joel Meira A *et al*, Molecular structural characterization of the biosurfactant produced by *Pseudomonas aeruginosa* DAUPE614, *Chem and Physics of lipids*, 147, 2007, 1-13.
18. Shaligram N S & Singhal R S, Surfactin-A review on biosynthesis, fermentation, purification and applications. *Food Technol Biotechnol*, 48, 2010, 119-134.
19. Sen R, Response surface optimization of the critical media components for the production of surfactin, *J Chem Technol Biotechnol*, 68, 1997, 263-270.
20. Sarubbo LA, Porto ALF, Campos-Takaki GM. The use of babassu oil as substrate to produce bioemulsifiers by Candida lipolytica. Can J Microbiol. 1999;45:423–426.
21. Thanomsub B, Watcharachaipong T, Chotelersak Teruhiko Nitoda, Hiroshi Kanzaki Monoacylglycerols: Glycolipid biosurfactants produced by a thermotolerant yeast, Candida ishiwadae K. Journal of Applied Microbiology, 2004; 96, 588-592.
22. Van-Hamme JD, Singh A, Ward OP. Physiological aspects part 1 in a series of papers devoted to surfactants in microbiology and biotechnology. Biotechnol Adv. 2006;24:604–620.
23. Vollbrecht E, Heckmann R, Wray V, Nimtz M & Lang S, Production and structure elucidation of di- and oligosaccharide lipids (biosurfactants) from *Tsukamurella sp*. nov, *Appl Microbiol Biotechnol*, 50, 1998, 530-537.
24. Zinjarde SS, Pant A. Emulsifier from a tropical marine yeast, yarrowia lipolytica NCIM 3589. J Basic Microbiol 2002; 42, 67-73.
25. Zinjarde SS, Sativel C, Lachke AH, Pant A. Letter of Applied Microbiology. 1997; 24, 117-121.
26. Wei Y H, Chien L C & Chang J S, Rhamnolipid production by indigeneous *Pseudomonas aeruginosa* J4 originating from petrochemicals wastes, *Biochem Eng J*, 27, 2005, 146-154.