The production of levan in stirred tank reactor

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ABSTRACT

Levan is a polymer of fructose linked by β-(2→6) fructofuranosidic bond and found in many plants and microbial products. Microbial levan is of commercial importance, which offers a variety of industrial applications in the fields of cosmetics, foods and pharmaceuticals; it can be used as industrial gums, blood plasma extender, sweeteners. Potential applications of levan have also been proposed as an emulsifier, formulation aid, stabilizer and thickener, surface-finishing agent, encapsulating agent, and carrier for flavor and fragrances. Previous studies on levan production were mostly carried out in shake-flask; however, for industrial application, it is obviously necessary and important to develop a process for the production of this biopolymer in bioreactors. In this study, levan production of B. subtilis (natto) Takahashi was evaluated in a stirred tank reactor (STR); the effects of nutrient and operational factors were studied in batch and fed-batch fermentation. In addition, the sucrose feeding for enhanced production of levan were also demonstrated. Fermentation of B. subtilis (natto) Takahashi was carried out in 5L SM medium (Sucrose：250 g/L，MgSO4．7H2O：0.5 g/L，NaH2PO4．2H2O：3 g/L，Na2HPO4．12H2O：3 g/L), the pH was controlled at 7.0 using 2N HCL and 2N NaOH for the adjustment. Culture condition was kept at 37 ℃, agitation at 175rpm and aeration at 5L/min (the air as 100%). The pH and DO were detected online, while the cell concentration, the sugar concentration and levan production were analyzed off-line. The results showed that the highest yield (61g / L at 24h) was obtained when the sucrose concentration was 250 g / L, pH 7.0, temperature 37 ℃ and agitation speed 175rpm. In addition, pulsed feeding of sucrose was carried out when it was depleted from the culture medium; the results showed that 100 g/L of levan (1.7 fold of that obtained in batch culture) was obtained when sucrose was fed back at 130g/L for 3 times. This work has shown that the shake-flask process was successfully reproduced in a stirred bioreactor and it is useful to the large-scale fermentation of B. subtilis (natto) Takahashi for the production of levan polyfructan.

Keywords : Bacillus subtilis natto, fructan, levan, Stirred Tank Reactor

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