Using Glycerol as Carbon Source for ε-Poly-lysine Production by Streptomyces albulus

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ABSTRACT

ε-Poly-Lysine (ε-PL) is a naturally occurring bio-material produced by microbial fermentation. It ’s water soluble, biodegradable, edible and nontoxic toward humans and the environment. ε-PL shows a wide range of antimicrobial activity, it is stable at high temperatures and safe to eat. It is effective by adding trace amount, and doesn ’t affect the taste. Therefore, it ’s now widely used as a food preservative. The study first focused on isolation of ε-PL production strain Streptomyces albulus DYU 1 for using glycerol as carbon source to produce ε-PL in two stage culture fermentation. The optimal culture condition was studied, first by using one factor at a time method, followed by using response surface methodology (RSM) in the shaking flask culture. Finally, the use of jar fermentor to study the production of ε-PL by batch culture was also described. In the investigation of the effects of carbon and nitrogen source on ε-PL production, it was found that (NH4)2SO4 had significant effect on ε-PL production, and glycerol has less effect; in addition, pH also showed significant effect. The optimum culture condition found was glycerol 25 g/L, (NH4)2SO4 10 g/L, Citric acid 18 g/L, and L-lysine 1.6 g/L; in this medium, Streptomyces albulus DYU 1 produced ε-PL 1.2 g/L to 1.6 g/L after incubation at 30℃, 160 rpm for six days. In the study of optimizing ε-PL production by RSM, the results indicated that there is no improvement of ε-PL production in the process, the theoretical value predicted from the model was not in accordance with the actual value. Therefore, the optimal condition (glycerol 25 g/L, (NH4)2SO4 10 g/L, pH 4.5) found by one factor at time method was used for futher investigation in fermenter. In the study of ε-PL production in the fermenter, two-stage fermentation was applied. The bacteria was first cultivated in shake flask at pH 6.8, for 36 hours, which were isolated and transfered into medium, and the pH was control at 3.5, 4, and 4.5, respectively. After six day incubation, the results showed that glycerol consumption were 13.553 g/L, 17.379 g/L, and 19.468 g/L, and the ε-PL concentration were 1.17 g/L, 2.103 g/L and 1.78 g/L when the pH was at 3.5, 4, and 4.5, respectively. For improving ε-PL production, back-feeding of glycerol was applied when the glycerol concentration decreased below 10 g/L. The final ε-PL concentration produced increased to 2.805 g/L from 2.103 g/L (1.3 fold increase) after one feeding. Our results have shown that Streptomyces albulus DYU 1 was capable of converting glycerol into ε-PL, a versatile biopolymer. The conversion of waste glycerol into valuable products will not only enhance the value of biodiesel production, but also solve the environmental problem of waste glycerol.

Keywords : ε-Poly-Lysine、two stage culture method、response surface methodology、jar fermentor

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