Effect of Organic Acid Salts on the Biosynthesis of PHBV by Strain Yu-3 under a Nitrogen-Limited Condition

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ABSTRACT

In this study, sodium valerate was added in a nitrogen-limited medium as the second carbon source (glucose as the primary carbon source) to cultivate strain Yu-3 to produce PHBV (poly-hydroxybutyrate-co-valerate). A preliminary study was performed, one-factor-at-a-time, to investigate the effects of cultivating conditions on the biosynthesis of PHBV. The cultivating conditions included the glucose concentration, timing of adding sodium valerate, and sodium valerate concentration. The results obtained in the method of one-factor-at-a-time were then used in a central composite design to search for an overall optimal condition to produce PHBV.

First of all, strain Yu-3 was cultivated with various glucose concentrations(10, 20, 30, 40, 50 g/L). The glucose concentration, 20 g/L, is the best case in which the biomass, PHB and PHV reached 4.29, 0.84 and 0.25 g/L, respectively, and PHB/biomass being 19.58%. When strain Yu-3 was cultivated using sodium valerate as the second carbon source, the best timing of adding sodium valerate was 12 h. The biomass, PHB and PHV reached 6.25, 1.56 and 0.47 g/L, respectively, and the ratio of PHB/biomass was 24.96%. When strain DYU Yu-3 was cultivated with various sodium valerate concentrations (1, 2, 3, 4, 5 g/L), the sodium valerate concentrations, 5 g/L, is the best case in which the biomass, PHB and PHV reached 4.84, 0.29 and 0.76 g/L, respectively, and PHB/biomass being 5.99%. The best result obtained from the one-factor-at-a-time experiments was further examined and used as the center point in a central composite design. Finally, the optimal condition was composed of 19.78 g/L glucose, 7.97 g/L sodium valerate, and the timing of adding sodium valerate at 16.5 h. To validate the above result from the central composite design, an experiment was repeated at the optimal condition. The biomass, PHB and PHV reached 5.22, 0.35 and 0.93 g/L, respectively, and the ratio of PHV/biomass was 17.81% which was in the range of the anticipated interval (18.30±2.93%). The optimal condition was further tested in a batch fermenter. The biomass, PHB and PHV reached 7.31, 0.43 and 2.36 g/L, respectively, and the ratio of PHV/biomass was 32.28%. These results surpass the ones obtained in the flask culture.

Keywords : strain DYU Yu-3、PHBV、sodium valerate、central composite design

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