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

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ABSTRACT

In this study, strain Yu-3 was cultured in flasks using glucose as the first carbon source, sodium valerate as the secondary carbon source and ammonium nitrate as the nitrogen source. The purpose was to explore the effects of the concentrations of ammonium nitrate and phosphorus on the microbial growth and PHB/PHBV produc-tion. In addition, strain Yu-3 was also cultivated in a batch fermenter under a phos-phorus-limited condition.

First, to explore the effect of the medium volume in a flask of 250 mL on the microbial growth and PHB production, three medium sizes (50, 100, and 150 mL) were used to cultivate strain Yu-3. Experimental results show that the medium size of 100 mL had the best results, including a biomass of 5.98 g/L, and PHB production of 1.25 g/L (about 20.9% of biomass). Therefore, the substrate volume was set to be 100 mL in a flask for later experimental runs.

To study the effects of nitrogen and phosphorus concentrations on the microbial growth and PHB production, three ammonium nitrate concentrations (1.5, 2.0 and 2.5 g/L) and three phosphorus concentrations were used to cultivate strain Yu-3. The phosphorus concentration in the basic medium (3.6 g/L Na2HPO4 and 1.5 g/L KH2PO4) was considered as one unit. The three phosphorus concentrations were 1/2, 1, and 2 units of the phosphorus in the basic medium. Thirty-six experimental runs were performed and they included all the combinations of 3 nitrogen concentrations, 3 phosphorus concentrations as well as with or without addition of sodium valerate, and each combination being repeated 2 times. Experimental results show that, when so-dium valerate was not added, the phosphorus source doubled, and the ammonium ni-trate concentration 2.0 g/L, the highest biomass (4.89 g/L) was obtained with a PHB production of 1.5 g/L (about 30.6% of the biomass); when the phosphorus source was doubled and the ammonium nitrate concentration was 1.5 g/L, the highest PHB pro-duction (1.85 g/L and 48.8% of the biomass) was obtained, and the biomass was 3.79 g/L. When sodium valerate was added, the phosphorus source was a unit, and the ammonium nitrate was 1.5 g/L, the highest PHB production (1.42 g/L and 44.5% of the biomass) was obtained, meanwhile the PHV production reached 0.34 g/L, which was about 10.6% of the biomass. When the ammonium nitrate concentration was set at 2.0 g/L and the phosphorus source was doubled, the highest PHV production (0.43 g/L and 12.2% of the biomass) was obtained.

Under a phosphorus-limited condition, strain Yu-3 was cultivated in a batch fermenter with a medium containing 30 g/L glucose, 4.5 g/L ammonium nitrate, 0.72 g/L Na2HPO4, and 0.3 g/L KH2PO4 (the phosphorus content was one-fifth in the basic medium). Results show that the highest biomass (8.85 g/L) was obtained at 96 h, and the PHB production was 0.73 g/L accounting for 8.24% of the biomass.

Keywords : strain Yu-3、PHB/PHBV、phosphorus-limited、medium volume、sodium valerate

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