A fed-batch strategy to produce high poly(3-hydroxybutyrateco- 3-hydroxyvalerate-co-4-hydroxybutyrate) terpolymer yield with enhanced mechanical properties in bioreactor

ABSTRACT

This study reports an efficient fed-batch strategy to improve poly(3-hydroxybutyrate-co-3-hydroxyvalerateco- 4-hydroxybutyrate) [P(3HB-co-3HV-co-4HB)] terpolymer production by Cupriavidus sp. USMAA2-4 with enhanced mechanical properties in bioreactor. The cultivations have been performed by combining oleic acid with c-butyrolactone at different concentration ratios with 1-pentanol at a fixed concentration. The batch and fedbatch fermentations have resulted in P(3HB-co-3HV-co- 4HB) with compositions of 9–35 mol% 3HV and 4–24 mol% 4HB monomers. The DO-stat fed-batch fermentation strategies have significantly improved the production with a maximum 4.4-fold increment of cell dry weight (CDW). Besides, appropriate feeding of the substrates has resulted in an increment of terpolymer productivity from 0.086–0.347 g/L/h, with a significantly shortened cultivation time. The bacterial growth and terpolymer formation have been found to be affected by the concentration of carbon sources supplied. Characterization of P(3HB-co-3HV-co-4HB) has demonstrated that incorporation of 3HV and 4HB monomer has significantly improved the physical and thermodynamic properties of the polymers, by reducing the polymer's crystallinity. The tensile strength, Young's modulus of the terpolymer has been discovered to increase with the increase of Mw. The fed-batch fermentation strategies employed in this study have resulted in terpolymers with a range of flexible materials having improved tensile strength and Young's modulus as compared to the terpolymer produced from batch fermentation. Possession of lower melting temperature indicates an enhanced thermal stability which broadens the polymer processing window.