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Regulating the molar fraction of 4 - hydroxybutyrate in Poly(3-hydroxybutyrate -co- 4 - hydroxybutyrate) by biological fermentation and enzymatic degradation (Article)

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Abstract

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The regulation of 4-hydroxybutyrate (4HB) molar fraction in the poly(3-hydroxybutyrate-co-4-hydroxybutyrate) [P(3HB-co-4HB)] of a local isolate *Cupriavidus* sp. USMAA1020 was attempted by employing a feeding strategy through fed-batch fermentation in 100-L fermenter. The growth of *Cupriavidus* sp. USMAA1020 was enhanced by frequently feeding carbon and nitrogen at a ratio of 5 (C/N 5) using a DO-stat with cascade mode at 20% (v/v) dissolved oxygen (DO). The feeding of C/N 5 and the use of the DO-stat mode were able to regulate the 4HB composition from 0-67 mol% by sequential feeding of γ -butyrolactone and supplementing oleic acid. A high 4HB molar fraction of 67 mol% with a PHA concentration of 5.2 g/L was successfully obtained by employing this feeding strategy. Notably, enzymatic degradation carried out enhanced the 4HB composition of the copolymer synthesized. PHB depolymerase enzyme from *Acidovorax* sp. was used to degrade this P(3HB-co-70-mol%4HB) copolymer and the 4HB composition could be increased up to 83 mol%. The degradation process was observed by monitoring the time-dependent change in the weight loss of copolymer films. The percentage of weight loss of solvent-cast film increased proportionally up to 19% within 3 h, whereas salt-leached films showed 90% of weight loss within 3 h of incubation and were completely degraded by 4 h. The molecular weight (M_n) of the films treated with enzyme demonstrated a slight decrease. SEM observation exhibited a rough surface morphology of the copolymer degraded with depolymerase enzyme. © 2011 Springer Science+Business Media B.V.

Author keywords

Depolymerase enzyme Enzymatic degradation Fed-batch fermentation Poly(3-hydroxybutyrate-co-4-hydroxybutyrate)

Indexed keywords

Compendex keywords

4-hydroxybutyrate Butyrolactones Carbon and nitrogen Copolymer films
Degradation process Depolymerase Enzymatic Degradation Fed-batch fermentation
Feeding strategies Molar fractions PHA concentration
Poly(3-hydroxybutyrate-co-4-hydroxybutyrate) SEM observation Sequential feeding
Solvent cast films Time-dependent changes Weight loss

Engineering controlled terms:

Copolymers Degradation Dissolved oxygen Enzymes Feeding Leaching
Oleic acid

Engineering main heading:

Fermentation

Species Index:

Acidovorax Cupriavidus

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