Research Paper

Growth kinetics, effect of carbon substrate in biosynthesis of mcl-PHA by 
*Pseudomonas putida* Bet001

A.M. Gumel¹, M.S.M. Annuar¹, T. Heidelberg²

¹Institute of Biological Sciences, Faculty of Science, University of Malaya, Kuala Lumpur, Malaysia. 
²Department of Chemistry, Faculty of Science, University of Malaya, Kuala Lumpur, Malaysia.


Abstract

Growth associated biosynthesis of medium chain length poly-3-hydroxyalkanoates (mcl-PHA) in *Pseudomonas putida* Bet001 isolated from palm oil mill effluent was studied. Models with substrate inhibition terms described well the kinetics of its growth. Selected fatty acids (C₈:0 to C₁₈:1) and ammonium were used as carbon and nitrogen sources during growth and PHA biosynthesis, resulting in PHA accumulation of about 50 to 69% (w/w) and PHA yields ranging from 10.12 g L⁻¹ to 15.45 g L⁻¹, respectively. The monomer composition of the PHA ranges from C₄ to C₁₄, and was strongly influenced by the type of carbon substrate fed. Interestingly, an odd carbon chain length (C₇) monomer was also detected when C₁₈:1 was fed. Polymer showed melting temperature (*Tₘ*) of 42.0 (± 0.2) °C, glass transition temperature (*T₉*) of -1.0 (± 0.2) °C and endothermic melting enthalpy of fusion (ΔHᵢ) of 110.3 (± 0.1) J g⁻¹. The molecular weight (*Mₔ*) range of the polymer was relatively narrow between 55 to 77 kDa.

Key words: biopolymers, kinetics, polyesters, polyhydroxyalkanoates, *Pseudomonas*.

Introduction

Polyhydroxyalkanoates (PHA) are bio-polymeric materials that exhibit excellent biodegradability and biocompatibility. These biodegradable polymers possess excellent physico-mechanical properties resulting in their current increase in diverse applications. In fact they are used as emulsifiers, surfactants, and textile auxiliaries. PHA with lower melting temperature (less than 60 °C) begins to crystallize at higher temperatures, resulting in shorter chain length polymers. Product accumulation and substrate consumption is normally required (Baei et al., 2011). Several kinetics models to describe the cell growth during biosynthesis of PHA in different bacterial species have been proposed (Annuar et al., 2008; Agarry et al., 2009; Baei et al., 2011). The culture conditions, nutrient limitation and the type of feeding substrate influence the growth pattern.