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UPGRADE OF WASTE GLYCEROL TO SHORT-CHAIN POLYHYDROXYALKANOATES CO-POLYMERS

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Abstract

Polyhydroxyalkanoates (PHAs) are polyesters synthesized under unbalanced growth by many bacteria as intracellular storage compounds. Depending on the ratio of the incorporated monomeric units, polymers with very different physical-chemical properties can be obtained, suitable for applications in fields such as agriculture, medicine and pharmacy. Recently, studies on PHA incorporation in composite materials and on blending with other bioplastics have raised attention. Since the 80s, ca. two dozen companies have invested efforts in developing industrial processes that could launch PHAs in the market at competitive prices. Nowadays, a few more than a dozen produce at industrial scale and, apparently, most of them use noble C sources as feeding streams. Evaluation studies for high scale production have concluded that 48% of the total production costs are ascribed to the raw materials, the C source accounting for 70–80% of the total cost. Aiming at reducing these costs, the development of high productivity cultivation processes using as major C source waste glycerol (GRP), a by-product of the biodiesel industry, is being tackled in our group using a *Cupriavidus necator* strain. The results presented here focus on the fed-batch production of the copolymer P(3HB-co-4HB) in 2 liter STRs. Incorporation of 4HB monomers was promoted by γ-butyrolactone. Propionic acid, a stimulator of 4HB accumulation, increased two-fold the 4HB molar ratio, but also acted as 3HV precursor, yielding P(3HB-4HB-3HV). Cells were able to change the composition in fatty acids of the cellular membrane as response to the precursors used for co-polymer production. Dissolved oxygen (DOC) was a key parameter for the specific PHA accumulation and the volumetric productivity. By manipulating DOC and cultivation time, P(3HB-4HB) polymers with 4HB molar % between 11 and 22%, thus presenting a wide spectrum of thermal and mechanical properties, were obtained. High polydispersity indexes and multiple melting points indicated that the produced PHAs are polymeric blends.

In short, (i) PHA production from GRP shows a large integration potential with biodiesel plants and (ii) prospective PHA applications in various areas are envisaged, namely in the medical field.