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Improvement of monomer composition in poly(3-hydroxybutyrate-*co*-3-hydroxyhexanoate) biosynthesized from CO_2 by genetically engineered hydrogen-oxidizing bacterium

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Bacterial polyester, polyhydroxyalkanoates (PHAs) are biodegradable, thermoplastic and elastomeric. PHAs can be eco-friendly plastics which are alternative to petrochemical-derived plastics. Homopolyester of (R)-3-hydroxybutyrate, P(3HB), which can be synthesized from many kinds of carbon sources, is well-known and the best characterized PHA. However, P(3HB) is stiff and poor in impact strength. Copolymer PHAs which are consisting of 3HB and medium-chain-length (C6-C12) 3-hydroxyalkanoates (mcl-3HA) are expected as practical biodegradable plastics because they are flexible and the properties are similar to those of several common petroleum-based plastics. Incorporation of 3HA units except 3HB into PHA have often been achieved by using structurally related expensive and toxic precursors such as alkanoic acids. Genetic modification is available to construct the pathways for biosynthesis of the copolymer PHAs from structurally unrelated carbon sources. In previous study, we established an improved artificial pathway for the biosynthesis of copolyester of 3HB and (R)-3-hydroxyhexanoate (3HHx) with high molar fraction from fructose in Ralstonia eutropha H16. One of the engineered *R. eutropha* strains, MF01ΔB1/pBPP-ccrMeJ4a-emd accumulated P(3HB-co-22mol%3HHx) with high cellular content. *R.eutropha* is a facultative hydrogen-oxidizing bacterium that chemolithoautotrophically grows using CO_2 as the carbon source, and H_2 and O_2 as the energy source. We also investigated the biosynthesis of P(3HB-co-3HHx) from CO_2 in the chemolithoautotrophic culture of our engineered strains *R.eutropha* MF01/pBPP-ccrMeJ4a-emd and MF01ΔB1/pBPP-ccrMeJ4a-emd. As a result, these strains accumulated the copolymer with the higher 3HHx ratio from CO_2 than fructose. Particularly, the strain MF01ΔB1/pBPP-ccrMeJ4a-emd showed remarkably high 3HHx ratio (51.7 mol%) however it is excessive from the standpoint of physical property of the copolyester. Then, we added further genetic modification for biosynthesis of P(3HB-co-3HHx) to the *R.eutropha* strains so as to reduce 3HHx ratio. By substituting medium chain length (R)–enoyl CoA hydratase gene of *R.eutropha* (*phaJ4a*) with the short chain length (R)–enoyl CoA hydratase gene of *Aeromonas caviae* FA440 (phaJAc) in the new engineered strain, 3HHx ratio was lowered to about 10mol% that gives the best physical property to P(3HB-co-3HHx).

Biography

Tanaka K has completed his PhD at Kyushu University, Fukuoka Japan. He is now a professor of Dept. Biological and Environmental Chemistry, Sch. Humanity-Oriented Science & Engineering, Kindai University. His research field is bioprocess engineering. He has published many papers for microbial production of biodegradable plastic from CO2 and biomass.

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