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Characterization and biodegradation of lactate-based polymer biosynthesized from renewable carbon sources

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Biologically synthesized polyhydroxyalkanoates (PHAs) are attractive materials as bio-based alternatives of petroleum-derived thermoplastics. We developed a microbial platform carrying evolutionarily engineered PHA synthetic enzymes that confer high enantioselectivity and broad substrate specificity toward monomeric constituents. The finding of an engineered PHA synthase with lactate (LA)-polymerizing activity (lactate polymerizing enzyme, LPE) was a major breakthrough to achieve the microbial production of the diverse polymers, particularly LA-based polymers. Polylactic acid (PLA) is most widespread bio-based polymer due to its superior transparency and processability. Our microbial processes produce LA-based polymers from renewable resources via one-pot fermentation. In this talk, topics for the engineering approaches to synthesize new biopolymers will be introduced together with the polymer biodegradation. Especially, combination of metabolic engineering and enzyme engineering are very powerful toolboxes for this purpose. Recently, using analytical GC-MS, we established the quantitative metabolite analysis procedure to address the rate-limiting step for synthesis of LA-based polymers. This new analytical system actually provided us with improved production of PLA-related polymers. This strategy should be applicable to a wide range of PHA-producing systems. It should also be noted that the unusual substrate specificity of LPE was found to be applicable for the synthesis of PLA-related polymers incorporating even other 2-hydroxyalkanoate (2HA) monomers; glycolate and 2-hydroxybutyrate. This finding further expands the structural diversity in microbial polyesters. Xylose utilization was also effective for production of PLA-related polymers with respect to realizing the value chain system from raw biomass to value-added biomaterials.

Biography

Seiichi Taguchi has completed his PhD from The University of Tokyo and was promoted as a Professor of the Graduate School of Engineering, Hokkaido University, in 2004. In 1997, he had visited to join as a Research Scientist at the Institute of Molecular and Cellular Biology of Immune System, Luis-Pasteur University. He also worked at the Polymer Chemistry Laboratory of RIKEN as a Senior Research Scientist. His current main research focuses are on the creation of novel biological catalysts that can be adapted to the desired environment or biosystem. He has published more than 150 papers in reputed journals.

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