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SYNTHETIC BIOLOGY FOR INTRACELLULAR AND SECRETORY PRODUCTION OF POLYMERIZED ENANTIOPURE ESTER-PRODUCTS IN MICROBIAL PLATFORM

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In our previous study, the first incorporation of lactate (D-LA) into the P(3HB) backbone in the *Escherichia coli*-based microbial factory carrying a newly developed D-LA-polymerizing enzyme LPE was reported [1,2]. LPE was one of the artificially evolved PHA synthases through our long-term enzyme engineering studies [3,4]. In the second generation, LPE has led us to further expand the range of structural diversity of PHA members other than LA-based polymers. New unnatural monomeric constituents such as glycolic acid and 2-hydroxybutyrate can also be polymerized by LPE. Like these, the study intends to synthesize the chiral copolymers with various monomer compositions, owing to the extremely high enantio-selectivity and broad substrate specificity of LPE catalyst [5]. In this conference, the main focus will be on the overview of biosynthesis and properties of LPE-catalyzed polymers. The possibility of "secretion" of polymerized ester-products by microbial platform should be a promising issue to overcome the cell volume limitation in the large amount of production of microbial polymers. Fortunately, we have met the "secretion" of low-molecular-weight D-LA-based polymers [or D-LA-based oligomers (D-LAOs)] [6]] The second topic will be about the first observation of microbial secretion of D-LAOs and its advanced microbial secretion platform through the chain transfer reaction and modified cultivation conditions. Furthermore, synthesis of lactate (LA)-based poly(ester-urethane) using hydroxyl-terminated LA-based oligomers from a microbial secretion system will be presented.

Recent Publications

1. S. Taguchi *et al.* (2008) A microbial factory for lactate-based polyesters using a lactate-polymerizing enzyme. *Proc. Natl. Acad. Sci. U.S.A.,* 105(45): 17323-17327
2. K. Tajima *et al.* (2009) Chemo-enzymatic synthesis of poly(lactate-co-(3-hydroxybutyrate)) by a lactate-polymerizing enzyme. Macromolecules, 42(6): 1985-1989
3. S. Taguchi; Y. Doi (2004) Evolution of polyhydroxyalkanoate (PHA) production system by "enzyme evolution": successful case studies of directed evolution. Macromol. Biosci. (Review), 4(3): 145-156
4. C. T. Nomura; S. Taguchi (2007) PHA synthase engineering toward superbiocatalysts for custom-made biopolymers. Appll. Microbiol. Biotechnol (Review), 73(5): 969-979
5. K. Matsumoto; S. Taguchi (2013) Enzyme and metabolic engineering for the production of novel polymers: crossover of biological and chemical processes. Curr. Opin. Biotechnol. (Review), 24(6): 1054-1060
6. C. Utsunomia *et al.* (2017) Microbial secretion of D-lactate-based oligomers. ACS Sustainable Chemistry & Engineering, 5(3): 2360-2367.

Biography

Seiichi Taguchi is a Professor of Biomolecular Chemistry in Tokyo University of Agriculture. He received a PhD in Molecular Biology in 1991 from the University of Tokyo. After that, he joined the Faculty of Bioscience and Engineering as an Assistant Professor at the Tokyo University of Science. During the period, he was a short-time Visiting Scientist at the Louis Pasteur University. He later joined the Polymer Chemistry Lab in RIKEN Institute as a Senior Research Scientist. He moved to Meiji University as an Associate Professor in 2002 and was promoted to Professor of Hokkaido University in 2004, and shifted to the present position in 2017. His research interests are in the field of Bioplastic, Biodegradable Plastic, Applied Microbiology, Synthetic Biology, Molecular Biology, Biochemistry and Metabolic Engineering.

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