Development of dynamic metabolic profiling and its application to fuel and chemical production in algae

Tomohisa Hasunuma[1 *]

[1] Graduate School of Science, Technology and Innovation, Kobe University
1-1Rokkodai, Nada, Kobe 657-8501, Japan

*e-mail: hasunuma@port.kobe-u.ac.jp

The issue of fossil resource depletion and global warming has prompted research on the sustainable production of environmentally benign fuels and chemicals. In particular, the utilization of biomass as a starting material for the production has attracted considerable recent attention. The "bio-refinery", a manufacturing process for producing wide variety of chemicals from biomass, is a promising approach for securing energy and resources, as an alternative to conventional oil refinery processes. Moreover, the use of bio-based chemicals can help reduce CO_2 emitted by fossil fuel combustion. Photosynthetic algae are of increasing interest as a renewable source of biomass for the sustainable production of bio-based fuels and chemicals, because algae cultivation does not directly compete with terrestrial agriculture resources including the productive land and fresh water. Several species of microalgae and cyanobacteria have the ability to store significant amounts of energy-rich compounds such as lipids and polysaccharides that can be utilized for the production of distinct bio-fuels, including bio-diesel and bio-ethanol. In particular, cyanobacteria are attractive because they are responsible for a substantial proportion of primary production in the hydrosphere. Because cyanobacteria are prokaryotes, their metabolic pathways are more readily amenable to genetic modifications designed to enhance photosynthetic activity than are those of eukaryotic algae. *Synechocystis* sp. PCC6803 is one of the most widely investigated species in studies of cyanobacteria. Recently, organic acids produced into fermentation medium by the dark anoxic cultivation of *Synechocystis* 6803 were investigated. Time-course analysis of intracellular metabolomics and the dynamic metabolic profiling were performed during the cultivation to isolate rate-limiting steps of succinic acid biosynthesis. The limiting step was lifted by the control of medium component to improve succinic acid production. This work demonstrates the synergistic integration of cultivation and metabolic analysis technologies to develop a simple and effective strategy for development of cell factories of cyanobacteria.Font size 12 pt. in regular type,

Keywords: Biofuels, Bio-based Chemicals, Cyanobacteria, Green algae, Metabolomics

References

1. Hasunuma, T., et al. (2016) *Metabolic Engineering Communications*, in press
2. Wang, Y., et al. (2016) *Biotechnology Journal*, in press
3. Sumiya, N., et al. (2015) *Plant and Cell Physiology*, 56(10), 1962-1980
4. Hasunuma, T., et al. (2015) *Current Opinion in Chemical Biology*, 29, 1-9
5. Aikawa, S., et al. (2015) *Biotechnology Journal*, 10(6), 886-898
6. Ho, S.H., et al. (2015) *Biotechnology for Biofuels*, 8: 48
7. Hasunuma, T., et al. (2014) *Biotechnology for Biofuels*, 7: 493
8. Ho, S.H., et al. (2014) *Biotechnology Advances*. 32, 1448-1459
9. Hasunuma, T., et al. (2013) *Journal of Experimental Botany*, 64(10), 2943-2954
10. Hasunuma, T., et al. (2010) *Journal of Experimental Botany*, 61(4), 1041-1051