DOI: 10.46991/JISEES.2025.SI1.101

New Horizons in Lactate-Driven Hydrogen Fermentation: The Future of Biohydrogen Production Unveiled by *Megasphaera* spp.

Akihiro Ohnishi*, Madoka Kagawa, Waka Ando

Department of Fermentation Science, Faculty of Applied Bio-Science,
Tokyo University of Agriculture, Tokyo, Japan

ABSTRACT

Hydrogen has recently attracted global attention as a Bioproduct due to its relevance to energy and health. While conventional dark fermentation research has mainly focused on genus Clostridium, several challenges remain, including contamination by non-target microbes and substrate limitations. In this lecture, we will present our recent advances in "Lactate-Driven Hydrogen Fermentation" using genus Megasphaera, a novel approach pioneered by our research group. This system enables anaerobic fermentation of lactate to produce hydrogen and short-chain fatty acids, allowing the use of non-sugar substrates and eliminating the need for thermal pretreatment, which has traditionally been required. We will also introduce our technical developments, such as rapid detection methods for Megasphaera species (PCR-RFLP and FISH) and improved process stability via co-cultivation with lactic acid bacteria. These findings redefine the microbial ecology of hydrogen fermentation and open new avenues for the biotechnological utilization of unused organic resources. We have maintained a long-standing friendship with Professor Karen Trchounian of YSU, and together we have actively explored possibilities for technological collaboration between our two countries. Through this work, I aim to bridge traditional fermentation science with next-generation bio-industries and challenge the future with innovation.

Keywords: *Megasphaera*, hydrogen, fermentation, microbe

References:

1. Ohnishi, Akihiro; et al. Biohydrogen production by mixed culture of *Megasphaera elsdenii* with lactic acid bacteria as lactate-driven dark fermentation. *Bioresource Technol.* **2022,** *343*, 126076. DOI:10.1016/j.biortech.2021.126076
2. Ohnishi, Akihiro *Megasphaera* as lactate-utilizing hydrogen-producing bacteria. In: *Microbial Factories: Biofuels, Waste treatment: Volume 1, Springer India.* **2015,** 47–71. DOI:10.1007/978-81-322-2598-0_4
3. Ohnishi, Akihiro; et al. Development of a 16S rRNA gene primer and PCR-restriction fragment length polymorphism method for rapid detection of members of the genus *Megasphaera* and species-level identification. *Appl. Environ. Microbiol.* **2011,** *77*, 5533–5535. DOI:10.1128/AEM.00359-11
4. Ohnishi, Akihiro; et al. Development of a simple bio-hydrogen production system through dark fermentation by using unique microflora. *Int. J. Hydrogen Energy* **2010,** *35*, 8544–8553. DOI:10.1016/j.ijhydene.2010.05.113

***Corresponding Author:**

Akihiro Ohnishi, Department of Fermentation Science, Tokyo University of Agriculture, Tokyo 156-8502, Japan.
Email: a1ohnish@nodai.ac.jp