HYDROGEN PRODUCTION BY THE HYPERTHERMOPHILE, *T. KODAKARENSIS*

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Abstract

In recent years, hydrogen gas (H_2) is attracting widespread attention as a clean, non-polluting fuel. A large number of microbes living in anaerobic conditions are known to produce H_2 as a means of disposing of excess reducing equivalents (fermentation). However, in terms of productivity, research on fermentative H_2 production has been focused mainly on two bacterial genera. One is *Clostridium*, whose members are obligate anaerobic heterotrophs producing H_2 by fermenting carbohydrates. The other genus, *Enterobacter*, is recently gaining more attention because of its high H_2 productivity. Here, we demonstrate a high H_2-producing potential of the hyperthermophilic archaeon, *Thermococcus kodakarensis* KOD1.

At a cultivation temperature of 85 °C using a complex medium supplemented with elemental sulfur (S^0), a rapid growth of *T. kodakarensis* was observed evolving H_2S and CO_2 as metabolites. When S^0 was omitted and pyruvate or starch was added in the medium, the cells produced H_2 at high levels instead of H_2S. As the level of H_2 appeared to correlate with the specific growth rate, analysis in continuous cultures was performed to develop a continuous H_2 production system. In a steady-state condition at a dilution rate of 1.5 h^{-1}, a continuous H_2 production rate of 50 mmol L^{-1} h^{-1} (1.1 L L^{-1} h^{-1}) was observed in media supplemented with starch. Based on the experimental results along with data of the entire genome sequence, the metabolic pathway of the strain relating to starch and pyruvate degradation is discussed.

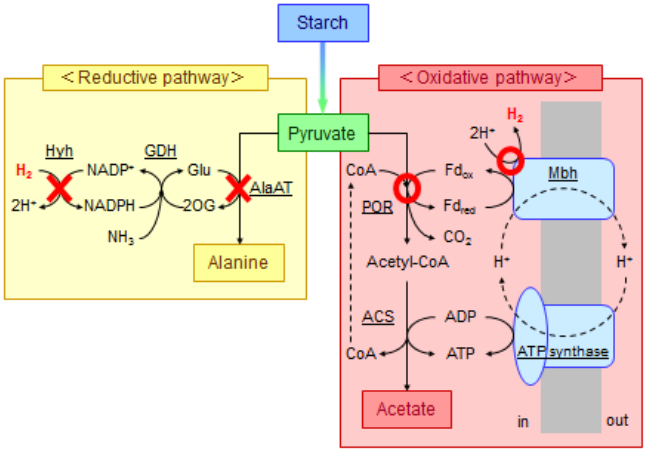


Fig. 1 Metabolic pathway for hydrogen production

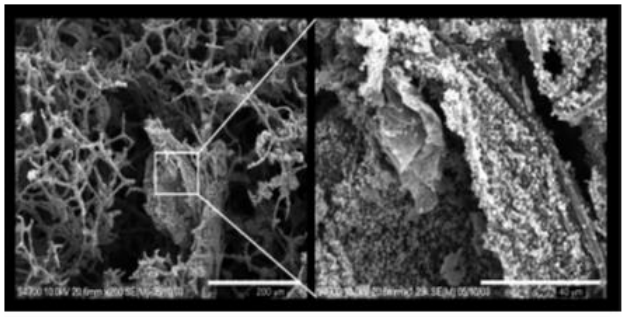
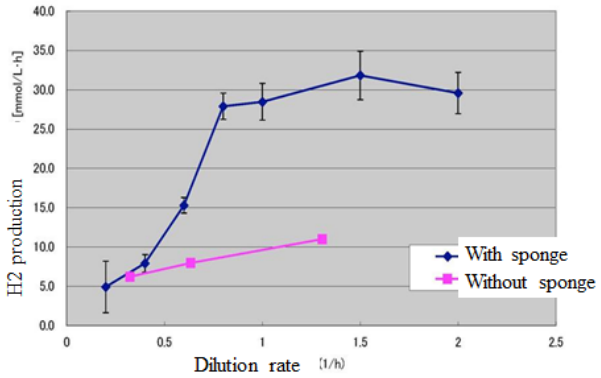


Fig. 2 Biofilm of *T. kodakarensis* formed in continuous culture



H2 production: 0.7 L/L/h Max. h2 production: 1.1 L/L/h

Fig. 3 Hydrogen production by continuous culture

Conclusions.

Hyperthermophilic archaeon, *Thermococcus kodakarensis* could produce hydrogen gas efficiently.

References.

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