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**Performance and Microbial Community of Hydrogenotrophic Methanogenesis
under Thermophilic and Extreme-thermophilic Conditions**

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Abstract: In this study, hydrogenotrophic methanogenesis with respect to methanogenic activity and microbial structures under extreme-thermophilic conditions were examined, and compared with the conventional thermophilic condition. The hydrogenotrophic methanogens were successfully acclimated to the temperatures of 55, 65 and 70°C. Although acclimation was slower at 65 and 70°C, hydrogenotrophic methanogenesis remained fairly stable. High-throughput sequencing using 16S rRNA analysis showed that the higher temperatures resulted in single archaea community dominated by hydrogenotrophic *Methanothermobacter*. Moreover, the syntrophic bacteria changed from *Coprothermobacter* and *Thermodesulfovibrio* at 55°C to *Thermodesulfovibrio* at 70°C. Specific hydrogenotrophic methanogenic rate at 70°C was 98.6 ± 4.2 Nml CH₄/g VS/hr, which was over 4-folds higher than that at 55°C. The lag phase under extreme-thermophilic conditions was longer than thermophilic condition, which was probably due to the archaeal structure with low diversity. Extreme-thermophilic condition resulted in a shift in methanogenesis pathway from acetoclastic methanogenesis to hydrogenotrophic methanogenesis with the enrichment of *Methanothermobacter thermautotrophicus*.

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