Efficient Biogas Production by Termites and Their Symbiotic Microorganisms

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In search of a nonconventional sources of energy and lack of fossil fuels, the relevance of hydrogen as an alternative energy source is increasing day by day. Hydrogen is considered as pollution free fuel for the future. Chemical route of hydrogen production is an energy intensive process, in contrast, the fermentation process is an energy saving with obvious advantages. Methane is also a potential biogas, and is produced by the fermentation of various organic materials. Many trials have been carried out to supply methane to the local community as a part of "Zero-Emission Processing" of bio-waste materials.

To construct the effective energy gas production system with wood-feeding pest termites, effects of diets and antibiotics treatments on hydrogen and methane emissions of workers of the termite, *Coptoterrmes formosanus* Shiraki were investigated as well as the isolation of hydrogen-producing facultative anaerobic bacteria from the termite.

When workers of *C. formosanus* were forced to feed on sapwood powder of Japanese red pine (*Pinus densiflora* Sieb. Et Zucc.), cellulose powder, microcrystalline cellulose, carboxymethyl cellulose (CMC), cellobiose and glucose, the highest emission rate (3.46 nmol/termite/h) was obtained in cellulose powder-fed workers. This was 2.7 times higher than that in wood powder-fed workers. But the dietary effect was not obvious in the methane emission.

Five antibiotics effectively enhanced the hydrogen emission of workers, resulting in the maximum emission rate of 17.5 nmol/termite/h when untreated workers emitted it at the rate of 3.73 nmol/termite/h. Similar to the dietary effect, no special effectiveness of antibiotics treatments was observed on methane emission. These results indicated that protists were the major agents to produce hydrogen in the hindgut of workers of *C. formosanus*, not bacteria, and that the artificial modification of the hindgut microorganisms could be applicable to the energy gas production system with termites.

The hydrogen-producing facultative anaerobic bacteria was isolated from the static culture of the homogenate of workers of *C. formosanus*. They effectively converted glucose to hydrogen in an anaerobic condition. But they were not able to convert wood powder and cellulose to hydrogen. The gene analysis of 16S rRNA of the bacteria showed the 100 % similarity to *Enterobacter cloacae*.

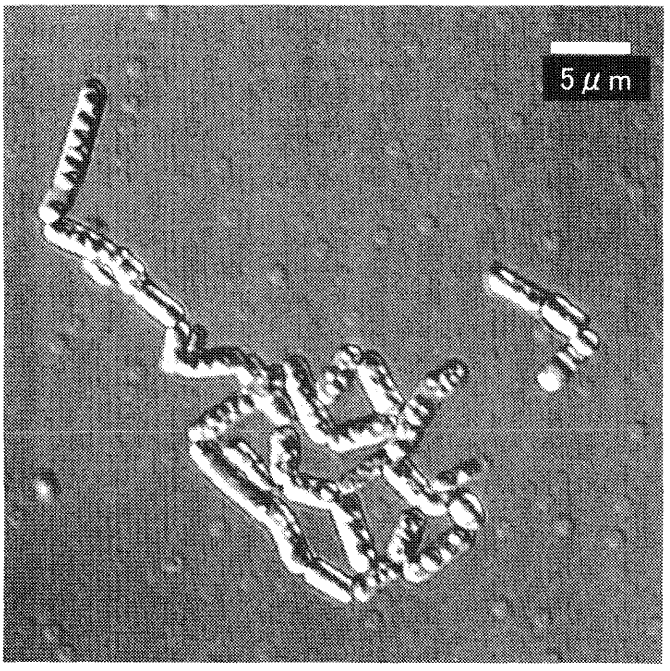

Fig.1. An isolated bacteria from the homogenate of workers of *Coptotermes formosanus*.