Discovery of *Capillibacterium thermochitinicola*, a thermophilic anaerobic bacterium that decomposes chitin

Chitin, a type of polysaccharide contained in many organisms such as shrimp, crab, insects, shellfish, and mushrooms, is the second-most abundant natural biological resource on earth next to cellulose. It is expected to be used as a biomaterial such as fiber material and soil conditioner, but its poor solubility makes it limited to industrial use. Biomass containing chitin such as shrimp shells and crab shells from fish processing factories is discarded in large quantities. There are many microorganisms that have chitin-degrading enzymes, but no bacteria that can decompose and assimilate chitin in a thermophilic anaerobic environment have been found. Therefore, in order to make effective use of chitin-based biomass by microbial saccharification, we researched for thermophilic anaerobic bacteria that can efficiently decompose chitin in a high-temperature environment and clarified their novelty and usefulness.

To identify a microorganism that decomposes chitin, we screened from composts on Ishigaki Island at 60°C in an anaerobic environment using a medium containing crystalline chitin as a carbon source. A new genus and new species of chitin-degrading, thermophilicanaerobic bacterium was successfully isolated and identified as *Capillibacterium thermochitinicola* UUS1-1 (Fig. 1). This bacterium is taxonomically positioned in the OPB54 cluster of uncultured bacteria of the phylum *Firmicutes*, a gram-positive bacterium. Its discovery as a bacterium that can be cultivated in the OPB54 cluster followed that of the previously known *Hydrogenispora ethanolica*. Strain UUS1-1 is the first thermophilic anaerobic bacterium that has been confirmed to be able to decompose and assimilate crystalline chitin by producing two types of chitin-degrading enzymes (Fig. 2). From genome analysis, strain UUS1-1 has at least 6 chitin-degrading enzymes and metabolic pathways required for chitin utilization, and it can produce hydrogen directly from chitin. Strain UUS1-1 has been deposited as a reference strain at RIKEN BioResource Center (JCM 33882T) and German Microbial Cell Culture Collection Center (DSM 111537T).

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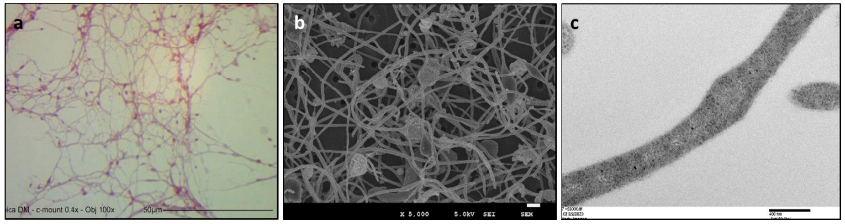

Fig. 1. Morphological observation of *C. thermochitinicola* UUS1-1
a: UUS1-1 optical micrograph (black horizontal bar scale at the bottom of the photo is 50 µm), b: UUS1-1 scanning electron micrograph (white horizontal bar scale at the bottom of the photo is 1.0 µm), c: transmission electron micrograph (black horizontal bar scale at the bottom of the photo is 0.4 µm).

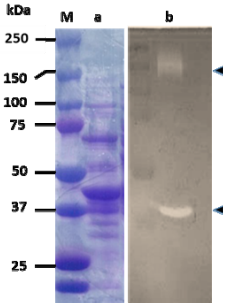

Fig. 2. Chitin degradation ability by extracellular enzyme of *C. thermochitinicola* UUS1-1
a: SDS-PAGE of the extracellular enzyme of the isolate UUS1-1, b: Zymogram analysis on chitin degradation activity of the extracellular enzyme prepared from the isolate UUS1-1. ▲: Chitin degradation activity is observed in the molecular weight.
M: Molecular weight marker

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