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Study of Trehalose-relating Enzymes

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Trehalose (α -Glc p -(1 \leftrightarrow 1)- α -Glc p) is widely distributed in nature such as microorganisms, insects, plants, and invertebrates. This sugar exists not only as an energy source but also as an important functionality-material that protects the organization from damage by various stresses such as drying, freezing, and osmotic pressure. Therefore, organisms have various trehalose-related enzymes that participate in degradation or synthesis of trehalose to adjust the concentration in response to the environment. In this study, we obtained trehalase, trehalose synthase or trehalose phosphorylase producing bacterium from soil or an already identified bacterium. The trehalose-related enzymes are classified from the catalyst style into three groups named the degradation, the intramolecular transglucosylation, and the intermolecular transglucosylation. Three enzymes we screened were different from other kinds of trehalose-related enzymes. In addition, we clarified some properties of these enzymes, and examined the synthesis of useful oligosaccharides. Trehalase, which hydrolyzes trehalose to glucose, was purified from the *Bacillus* sp. T3 cultures. Trehalose synthase, which catalyzes the interconversion of maltose and trehalose by intramolecular transglucosylation, was purified from cell-free extracts of *Pimelobacter* sp. R48 and the thermophilic bacterium *Thermus aquaticus* ATCC33923. Trehalose phosphorylase, which catalyzes the reversible phosphorolytic cleavage of trehalose, was purified from a cell-free extract of thermophilic anaerobe, *Thermoanaerobacter brockii* ATCC 35047. Trehalose synthase was useful for not only the synthesis of trehalose but also the production of trehalulose (1-*O*- α -D-glucopyranosyl-D-fructose) from sucrose. Moreover, a non-reducing disaccharide, α -galactosyl α -glucoside, was synthesized for the first time by trehalose phosphorylase using galactose as an acceptor.

Key words: trehalose, trehalase, trehalose synthase, trehalose phosphorylase

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