



## An efficient process for production of Trehalose and Trehalulose employing a novel Trehalose synthase enzyme

TECHNOLOGY AVAILABLE FOR TRANSFER

### UNMET NEED AND OPPORTUNITY

Trehalose is a sugar consisting of two molecules of glucose. Trehalose reduces freezing point of food product and prevents ice crystal formation. It is stable in a wide range pH. It prevents starch aging. It has water retention capability and extends shelf-life of food product. With these properties, trehalose is a very demanding biomolecule in food industry. It is highly important in biological research, with its property to stabilize cell membrane and membrane proteins. It is a promising agent for cryopreservation of human cells (Sperm and Blood stem cells), various tissues and organs for transplantation. In addition to the pharmaceutical, food and beverage industries, Trehalose is also used in cosmetic products such as skin moisturizers and anti-aging creams [1]. Trehalulose is a non-cariogenic sugar of reduced glycaemic index and it also exhibits antioxidant properties. Industrial service and Food service are the two end users of the Trehalose market where as Food service segment currently generate the highest revenue share in the market and is predicted to continue to rise at rapid pace. These factors collectively influence the global Trehalose market and it is predicted to grow from USD 242.7 Million in 2021 to USD 330.5 Million by 2029 with a CAGR of 5% during the forecast period [2]. North America currently earns the highest revenue share in the Trehalose market. Asia Pacific Trehalose market is also expected to expand at a higher rate throughout the projected period. In the above context, efficient method or technology for production of Trehalose is very important.

### TECHNOLOGY

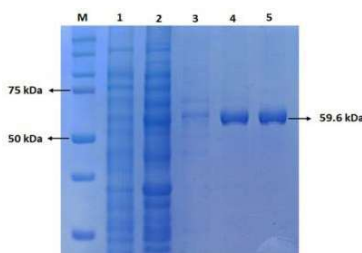
The technology relates to the biosynthesis of non-cariogenic and low-calorigenic sugar, Trehalose using Maltose or Maltose containing feedstocks and Trehalulose using Sucrose employing a novel **Trehalose Synthase enzyme (TreM)** identified from the metagenomic data of a geothermal aquatic habitat.

### UNIQUE SELLING PROPOSITIONS

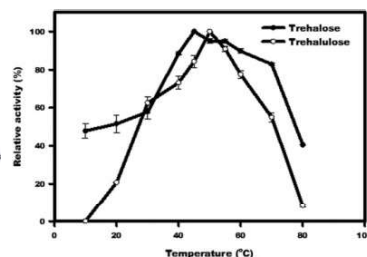
- Easy to use for the bioconversion of feedstocks into products using TreM (Trehalose synthase).
- Cost effective as all low-cost sugar feedstocks can be used to produce high yield of products.
- Trehalose can be biosynthesized by employing TreM in a wide range of temperature (5°C to 80°C) and pH (5.0 to 9.0).
- TreM can yield about 74% Trehalose from Maltose at 5°C with negligible by product formation.
- The enzyme can also catalyse the Sucrose to Trehalulose conversion with about 90% yield efficiently.

### STAGE OF DEVELOPMENT

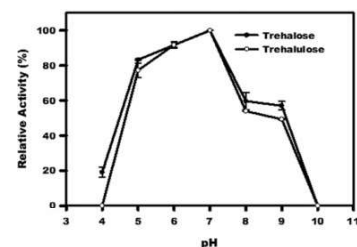
The technology has been validated at the laboratory scale. Currently, the technology is at R&D stage with primary proof of concept established at bench scale.



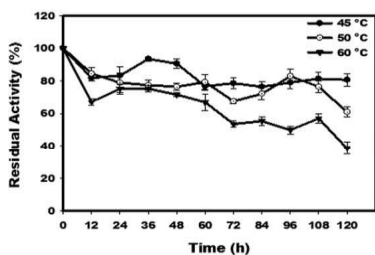
The recombinant TreM has purified and found that the molecular weight of 60 kDa and the purity of about 95%



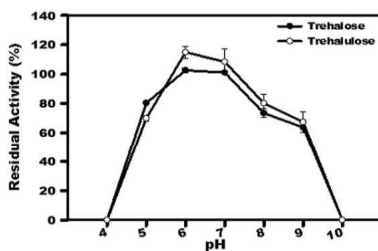
TreM can catalyze Trehalose and Trehalulose biosynthesis in a wide range of temperatures, 10°C to 80°C with optimum activity at 45°C or 50°C, respectively



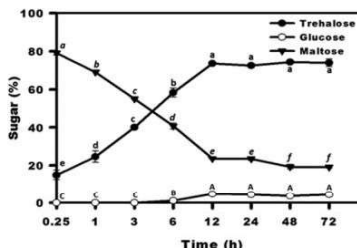
TreM is functional and stable in the pH range of 4.0 to 9.0, however the optimum pH for the catalytic biosynthesis of Trehalose or Trehalulose is 7.0



After heat exposure for 5 days, the enzyme retained about 80%, 60%, and 40% residual activities at 45°C, 50°C, and 60°C, respectively



The residual activity for Trehalose and Trehalulose synthesis was nil in the case of TreM exposed to pH 4.0 and 10.0



At low temperature (5°C) Trehalose synthesis (74%) with nil biproduct form

## APPLICATION

This enzymatic process may be used to produce functional sugar molecules Trehalose and Trehalulose. Trehalose being a GRAS sugar, has diverse uses, including those in food, pharmaceutical and cosmetic industries.

### Food Industry

- Flavor enhancer and low-glycemic index
- Preparation of frozen food products
- Low-cariogenic and antioxidant ingredient
- Increases the shelf life of food and maintains the food aroma

### Pharmaceutical Industry

- Tissues and organ preservation
- Cryopreservation of stem and sperm cells
- Maintain viability of cryopreserved cells.

### Cosmetic Industry

- Moisture retaining agent
- Shelf-life enhancer
- Body odor suppressor agent

## INTELLECTUAL PROPERTY

Patent application has been filed in India

## LICENSING OPPORTUNITY

BCIL is looking for suitable industrial partner for commercialization of this novel recombinant enzyme technology for the production of functional sugar molecules Trehalose and Trehalulose from low-cost raw sugar substrates.

### Reference:

1. <https://www.marketdataforecast.com/market-reports/trehalose-market>
2. [https://www.globenewswire.com/newsrelease/2022/07/28/2488034/0/en/Trehalose-Market-to-Garner- USD-330-5-million-by-2029](https://www.globenewswire.com/newsrelease/2022/07/28/2488034/0/en/Trehalose-Market-to-Garner-USD-330-5-million-by-2029)

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