

A Unique Ingredient Found in Nature

**TREHA**<sup>®</sup>  
trehalose



*The Science of*

**FRESHNESS**

**NAGASE**

*Over 180 Years of Japanese Quality*



## The Science of Freshness:

### Delivering Freshness to Packaged and Convenience Foods

From the frozen prepared foods aisle to the refrigerated case, consumers want foods that meet their expectations for freshness. Food and beverage formulators know that this is easier said than done and involves managing a variety of factors that consumers associate with freshness.

#### What are the Key Sensory Attributes that Consumers Associate with Freshness?

In addition to the foods staying safe to eat, consumers determine freshness by judging other aspects of food quality, including:

- Appearance
- Texture and mouthfeel
- Flavor and aroma

In order to deliver freshness in packaged and convenience foods, food formulators must effectively manage a variety of technical challenges including moisture migration, freeze-thaw stability and color retention.



*The purchase of packaged and convenience foods are forecasted to increase 10% by 2022, compared to a 4% increase forecast for restaurant traffic*  
– NPD Group

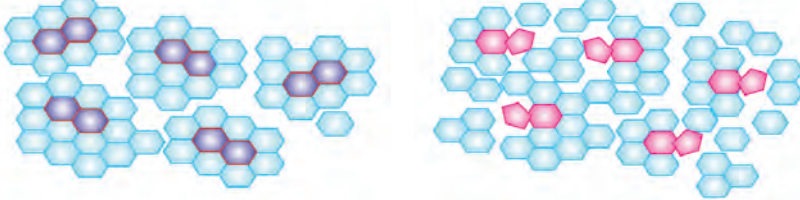
# Freshness Point #1: Controlling Moisture Migration

**TREHA<sup>®</sup>**  
trehalose

## Binding Water is Important to Keeping Foods Shelf-Stable.

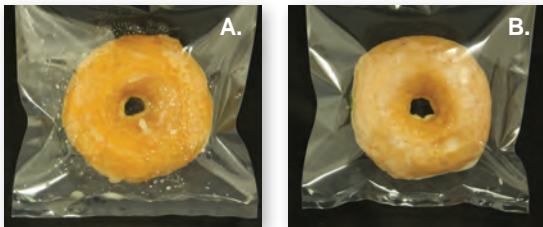
In food mixtures with drastically different water activities (unbound water), moisture migration from high to low water activity areas can negatively impact product quality, such as when a crispy cracker absorbs moisture from the air and becomes soggy. TREHA<sup>®</sup> trehalose has the ability to bind water and hold it tightly, becoming an effective tool to control moisture migration.<sup>1</sup>

Trehalose binds water better than sucrose



## Reducing Moisture Migration in Donuts:

Glaze on donuts absorbs moisture over time, and the glaze melts and sticks to the packaging, producing an unappealing appearance. TREHA<sup>®</sup> trehalose suppresses moisture migration, extending the freshness shelf life of the donuts. A comparison of two donuts prepared with glazes using either powdered sugar or microcrystalline TREHA<sup>®</sup> showed that the trehalose donut exhibited significantly less stickiness after storage for two days at 68°F (20°C).



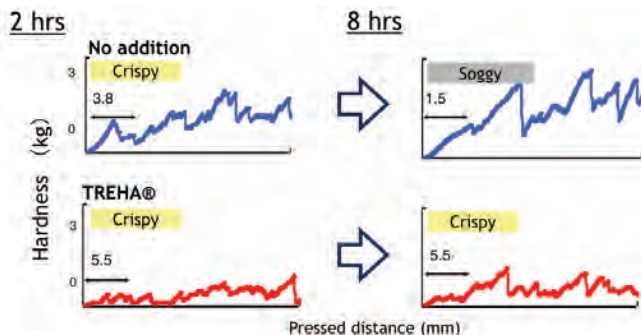
A. Powdered sugar glaze, Brix 85%

B. Microcrystalline TREHA<sup>®</sup> and powdered sugar (8:2 ratio) glaze, Brix 78%

## Maintaining Crispiness in Extruded Snacks:

Maintaining crispiness after package opening is important to consumer acceptance of freshness. A textural analysis of extruded rice snacks using a rheometer showed that, over time, the TREHA<sup>®</sup> trehalose snacks maintained a more similar texture profile to just-opened snacks, compared to snacks with no addition. The trehalose sample exhibited the same level of fracturing events at two hours and eight hours (5.5 events for both at RH 75%, 77°F/25°C), whereas the non-addition crackers absorbed moisture over time, exhibiting fewer fracturing events (from 3.8 at two hours to 1.5 at eight hours).

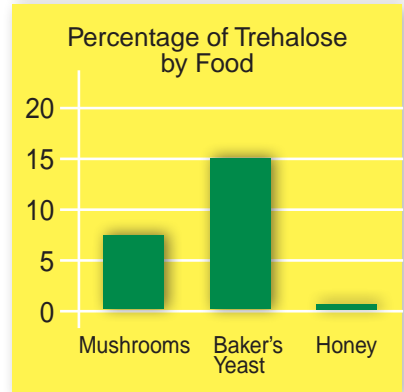
### Extruded Rice Cracker Texture Analysis



Number of fracturing events, representing crispiness.

## Trehalose: A Unique Ingredient Found in Nature

TREHA<sup>®</sup> trehalose is a multifunctional disaccharide with unique benefits for freshness, texture, and flavor/aroma in food and beverages. Trehalose is naturally occurring in many common foods, such as mushrooms, baker's yeast and honey. Trehalose is a GRAS ingredient that contains 4 kilocalories/grams of energy.





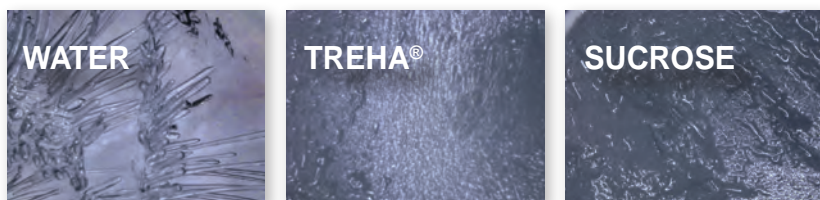
## Freshness Point #2: Reducing Freeze-Thaw Damage

# TREHA®

trehalose

### Freezing Food Can Cause Physical and Chemical Changes, Often Reducing the Fresh Quality of the Food.

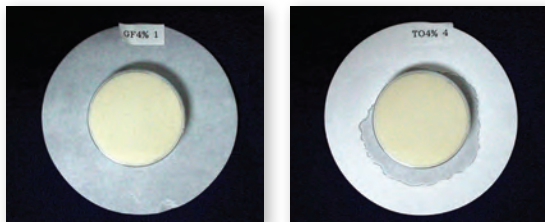
A variety of factors influence freeze-thaw damage, which is when a food changes irreversibly during freezing with the change noticeable upon thawing. One of the factors that causes freeze-thaw damage is the expansion of water during freezing, which can damage delicate cellular structures in food. TREHA® trehalose influences ice crystal size (smaller) and shape (less jagged), which means less structural freeze-thaw damage to the food?



Water/TREHA®/Sucrose 5% saccharide solutions were frozen at -20°C/-4°F for 2 weeks

### Reducing Freeze-Thaw Damage in White Sauce:

Freeze damage can cause moisture expulsion, or drip loss, upon thawing, negatively affecting food quality. A comparison of white sauce frozen at 4°F (-20°C) for four weeks with sucrose (4%) and one frozen with TREHA® trehalose (4%) showed that the trehalose version had less drip loss due to less freeze-thaw damage.



Comparison of white sauce drip loss after freezing at -20°C/-4°F for four weeks

## Freshness Point #3: Stabilizing color

### Color Can Determine Whether or Not the Consumer Accepts or Rejects the Product.

Food color is influenced by the food matrix, food processing, and storage conditions. TREHA® trehalose can stabilize color, especially in processed foods that undergo treatments such as dehydration, heat processing, and freeze drying.<sup>3</sup> Trehalose is highly stable in acidic conditions and is non-browning, helping to stabilize colors.



**Stabilizing Color of Fruit:** TREHA® trehalose can protect the pigments in fruit from oxidation and help bind moisture. A study using peeled avocados and apples, which were soaked in a 10% trehalose solution for 30 minutes and stored under refrigeration for 24 hours, showed less browning than the control.

### TREHA® trehalose at a Glance:

#### Freshness Benefits:

- Moisture Control
- Freeze-Thaw Stability
- Brilliant Color Retention
- Reduced Starch Retrogradation

#### Texture Benefits:

- Unique Texture (from crispiness to creaminess)
- Enhanced Stability Over Time
- Suppressed Protein Denaturation

#### Flavor/Aroma Benefits:

- Masks Off-Flavors and Odors
- Enhances Flavor
- Prevents Flavor Deterioration During Heat Processing

#### Physical Properties:

- Non-browning
- Heat/Acid Stability
- Low Moisture Attraction (Hygroscopicity)
- High Glass Transition Temperature

#### References:

<sup>1</sup> M. Sakurai and Y. Inoue, *Biology Physics*, 1997, 37, 326-330

<sup>2</sup> Sei T., Gonda T., and Y. Arima, *Journal of Crystal Growth*, 2002, 240, 218-229.

<sup>3</sup> Kopjar, M., Pilizota, V., and J. Hribar, et al., *Journal of Food Engineering*, 2008, 3, 341-350.

Cargill® is the exclusive distributor of TREHA® trehalose in the food and beverage markets in North America and the European Union.

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