



# TREHA™ Trehalose

*“We’ve got an app for that!”*



**Unique functionality and benefits across a wide range of food & beverage applications**



A Nagase Group Company

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# Agenda

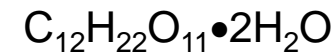
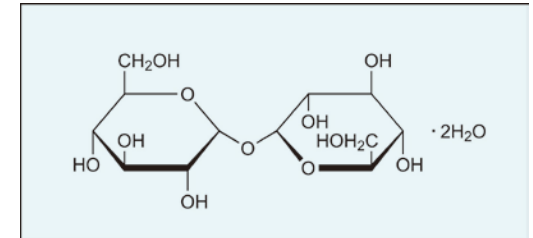
- **What is trehalose?**
- **What are the functional properties of trehalose?**
- **What benefits does trehalose offer food & beverage formulators?**

# TREHA™ trehalose has an app for every formulation.

Snack	Unique Crispiness	Longer Shelf-Life	Enhanced Formability	Stabilized Glazes
Meat	Reduced Sodium	Juiciness & Quality after Freeze-Thaw	Masked Off-Notes	Reduced Drip Loss
Beverage	Stability of Protein Beverages	Masked Off-Notes	Stabilized Color	Mild Sweetness
Bakery	Longer Shelf-Life	Improved Frozen Dough Performance	Improved Texture	Enhanced Volume
Fruit & Veg.	Maintained Freshness	Improved Freeze-Thaw Stability	Stabilized Color	Higher Dried Yield

# What is Trehalose?

- A carbohydrate found naturally in mushrooms, honey and yeast, and in the desert plant *Selaginella lepidophylla* (Resurrection Plant)
- A non-reducing disaccharide consisting of two glucose molecules with  $\alpha, \alpha$  (1-1) glycosidic linkage
- An ingredient commercially produced by enzymatic conversion of starch



Desiccated  
Resurrection Plant



Same plant 8 hours  
after rehydration



Data and photos provided by Hayashibara Co., Ltd., a Nagase Group Company.

# Key Properties of Trehalose

Trehalose imparts numerous functional properties that make it a unique ingredient for use in foods and beverages

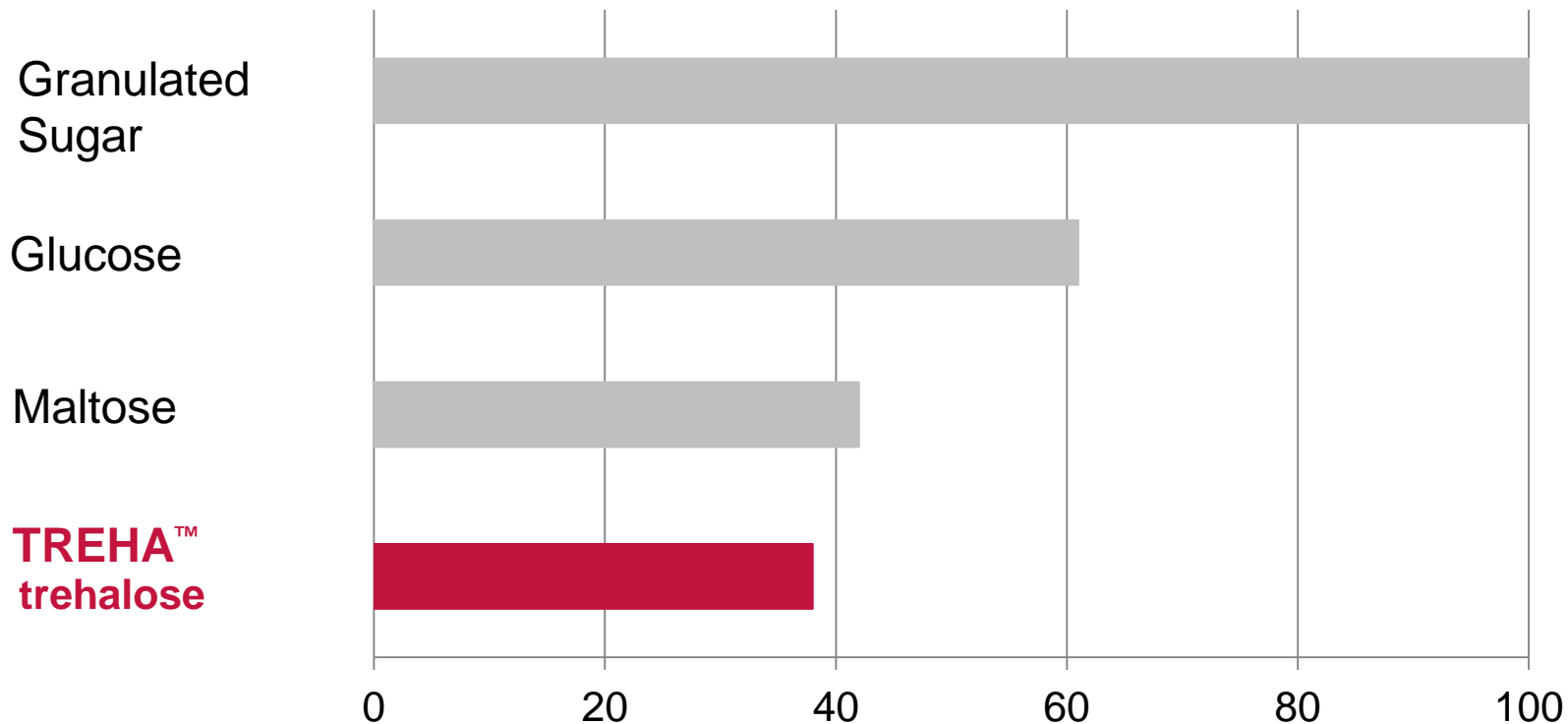
- **Nutrition**
- **Sensory**
- **Browning**
- **Stability to Acid and Heat**
- **Hygroscopicity**
- **Glass Transition (T<sub>g</sub>) Temperature**
- **Crystallization Control**

# Nutritional Properties of TREHA™ Trehalose

Nutrition Facts / 100g	
Calories	361 kcal
Calories from Fat	0
Total Fat	0
Sodium mg/100g	0
Total Carbohydrates	90.2 mg
Dietary Fiber	0
Sugars	90.2mg
Protein	0
Ash	0
Moisture	9.8 %

# Relative Sweetness

Relative sweetness of 5% aqueous solutions where granulated sucrose is 100.



Data and photos provided by Hayashibara Co., Ltd., a Nagase Group Company.



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# Masking/Enhancement of Taste and Odor

**TREHA™ trehalose masks a wide range of unpleasant tastes/odors.**

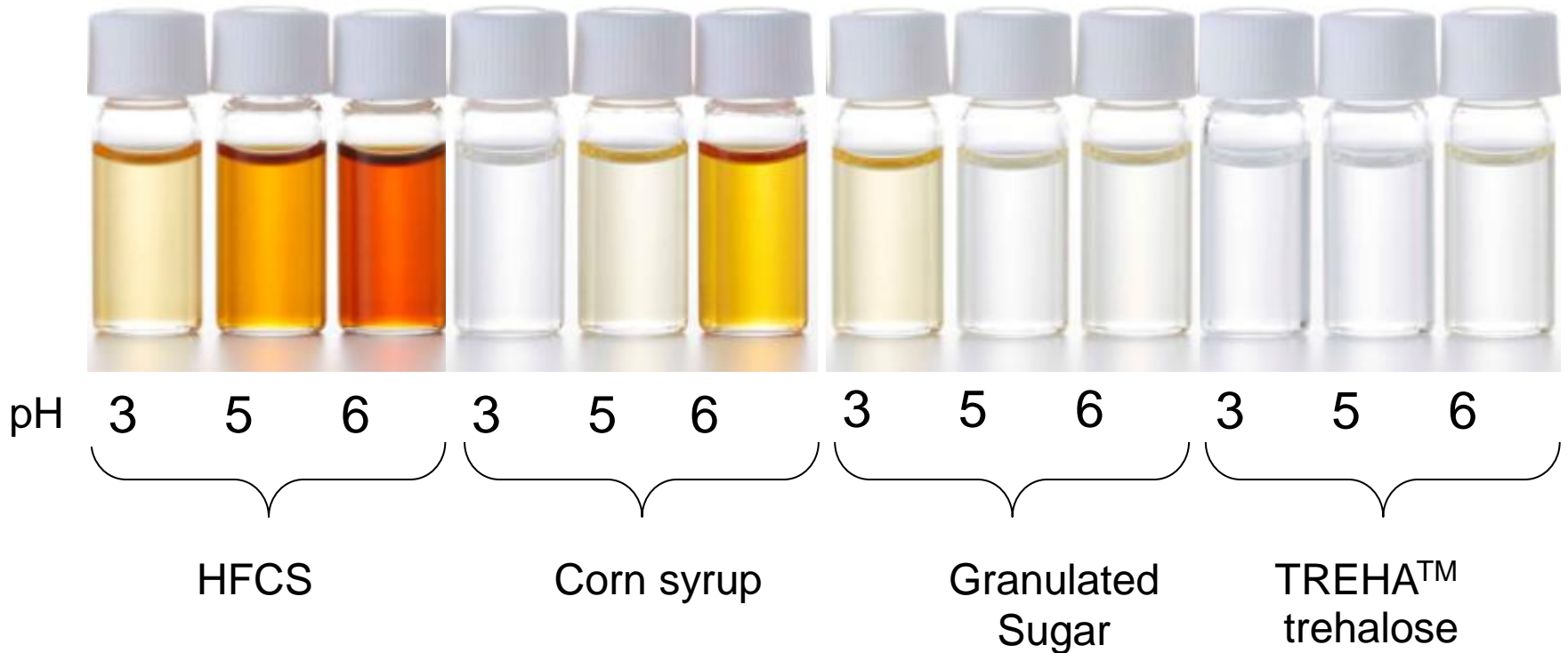
Source	Effect of TREHA™
High-intensity sweeteners Stevia Acesulfame-K Sucralose Glucosyl stevioside Aspartame	Improves aftertaste
Amino acids Valine Leucine Isoleucine Arginine	Reduces astringency
Iron	Masks metallic taste

Source	Effect of TREHA™
Collagen Soy protein Fish / Meat / Egg	Masks characteristic unpleasant odor
Vegetables	Masks grassiness / harshness
Rice sourced products	Masks rice bran odor
Tap water	Masks chloride odor
Retort	Masks retort odor



Data and photos provided by Hayashibara Co., Ltd., a Nagase Group Company.

# As a non-reducing sugar, trehalose doesn't participate in the Maillard Reaction



12.5% saccharide + 0.5% glycine  
Heated at 120°C/248°F for 30 min.

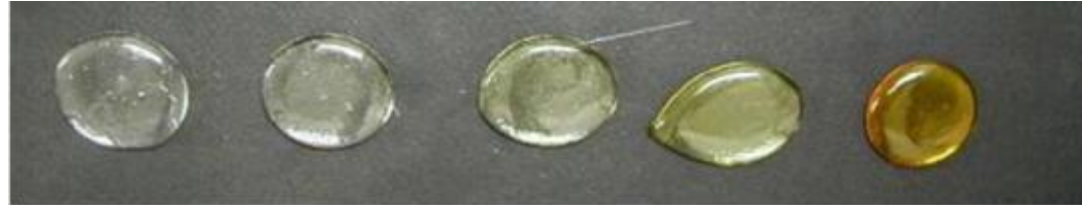


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# Caramelization

150°C 160°C 170°C 180°C 190°C  
302°F 320°F 338°F 356°F 374°F

Granulated  
sugar



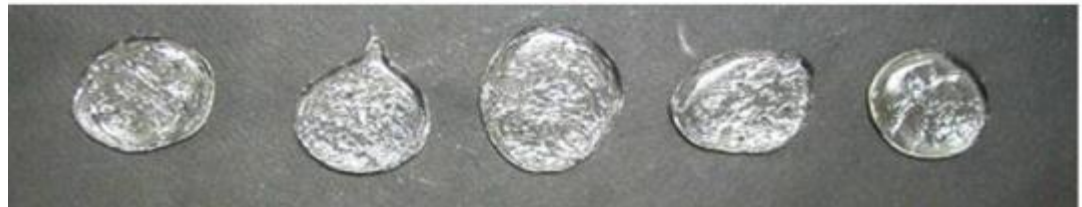
Corn Syrup



Maltitol

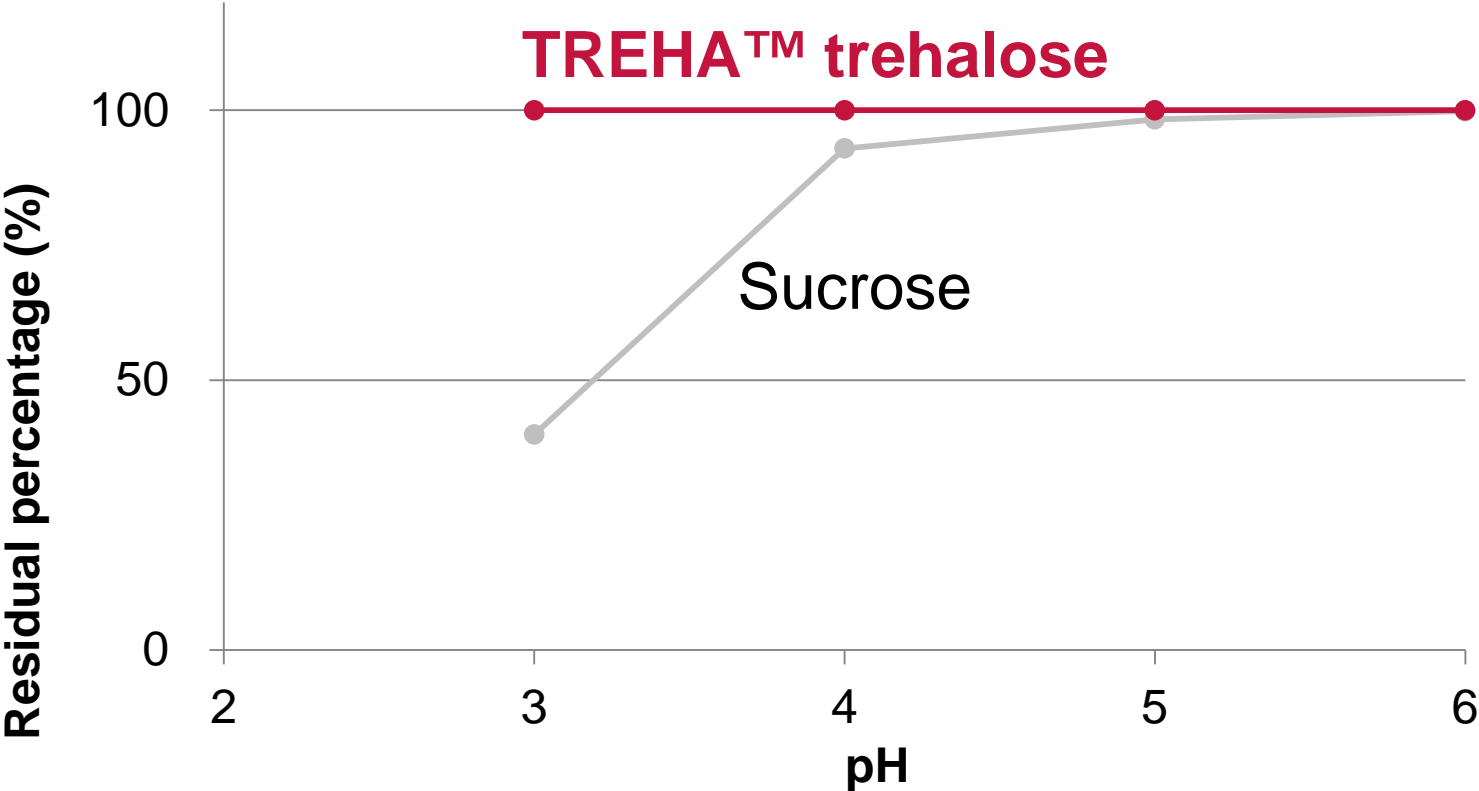


TREHA™  
trehalose



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# Trehalose is stable in the presence of heat and acid



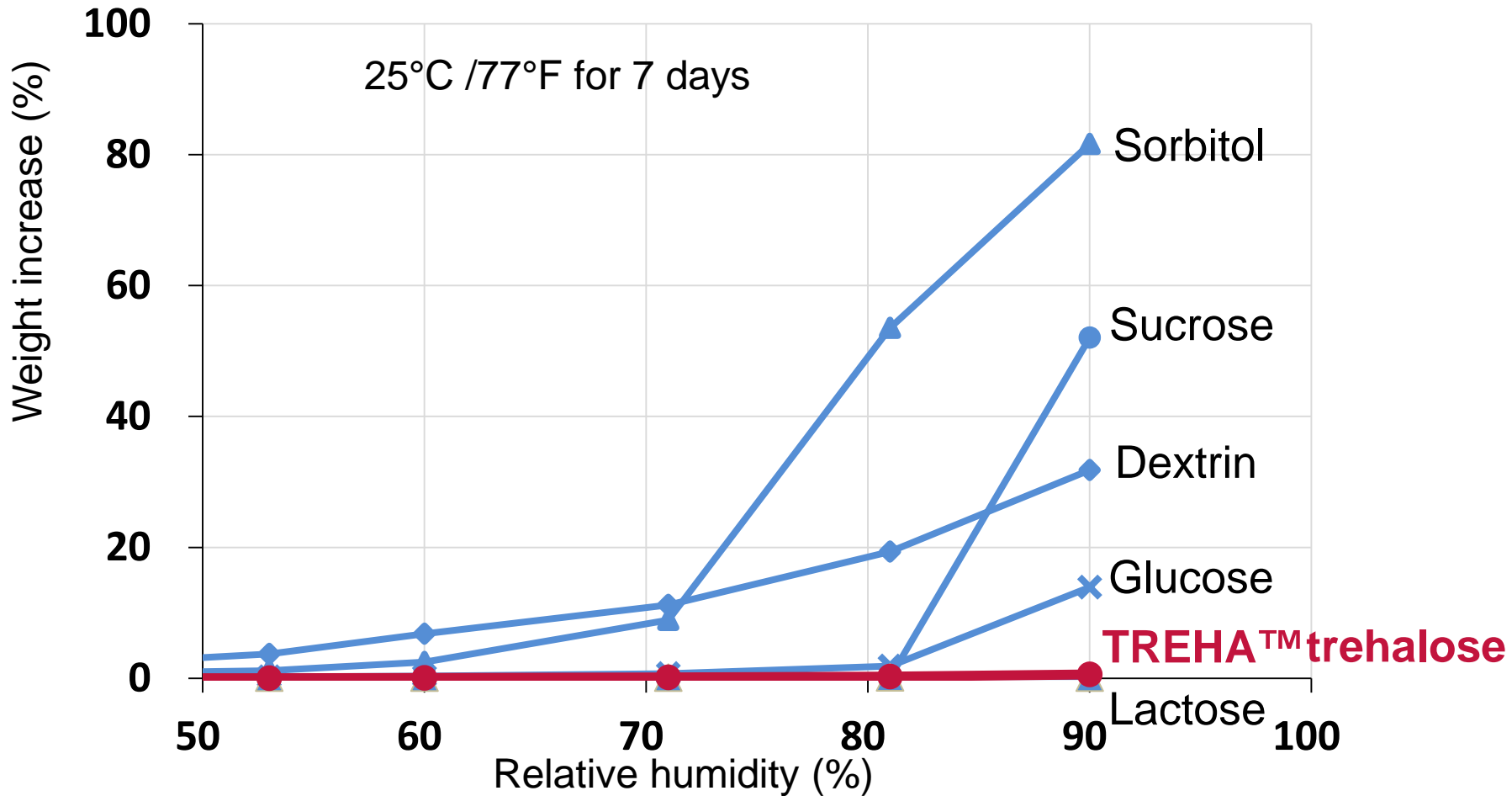
Saccharide concentration 30%, held at 100°C for 30 min



Data and photos provided by Hayashibara Co., Ltd., a Nagase Group Company.

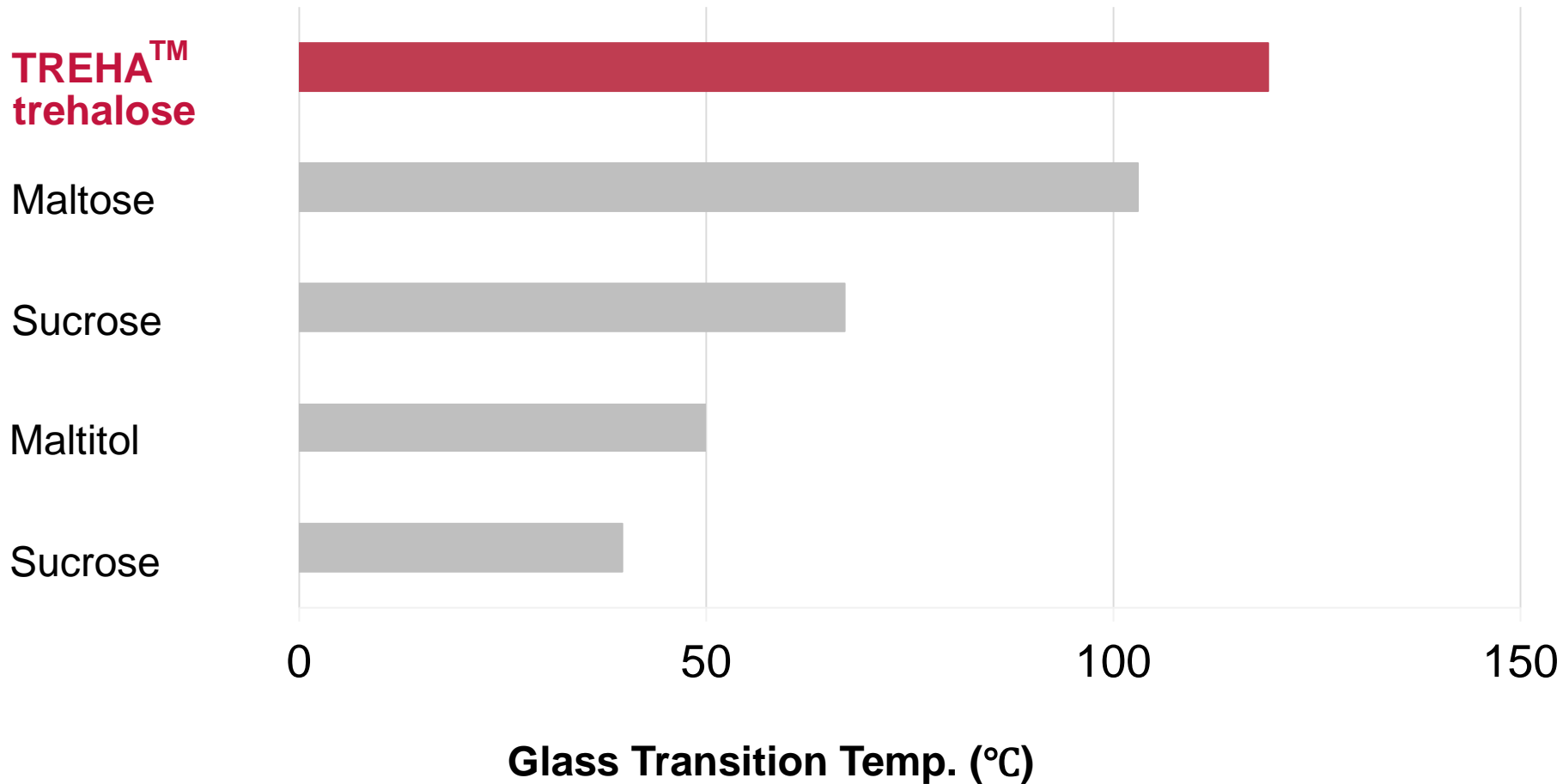


# Compared to other sugars, trehalose exhibits low hygroscopicity



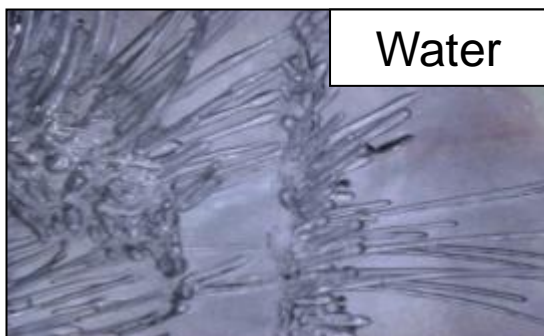
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# Glass Transition Temperature (Tg)

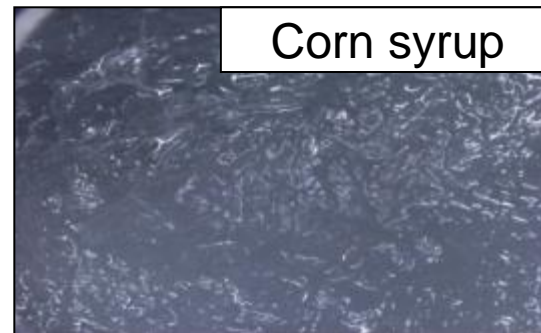
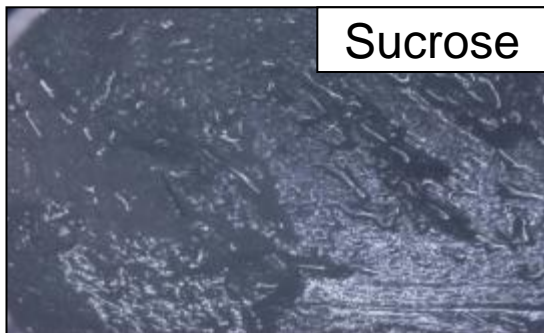


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# Trehalose solutions form smaller and smoother ice crystals compared to plain water and sugar solutions.....



**Trehalose solution:** small, round ice crystals



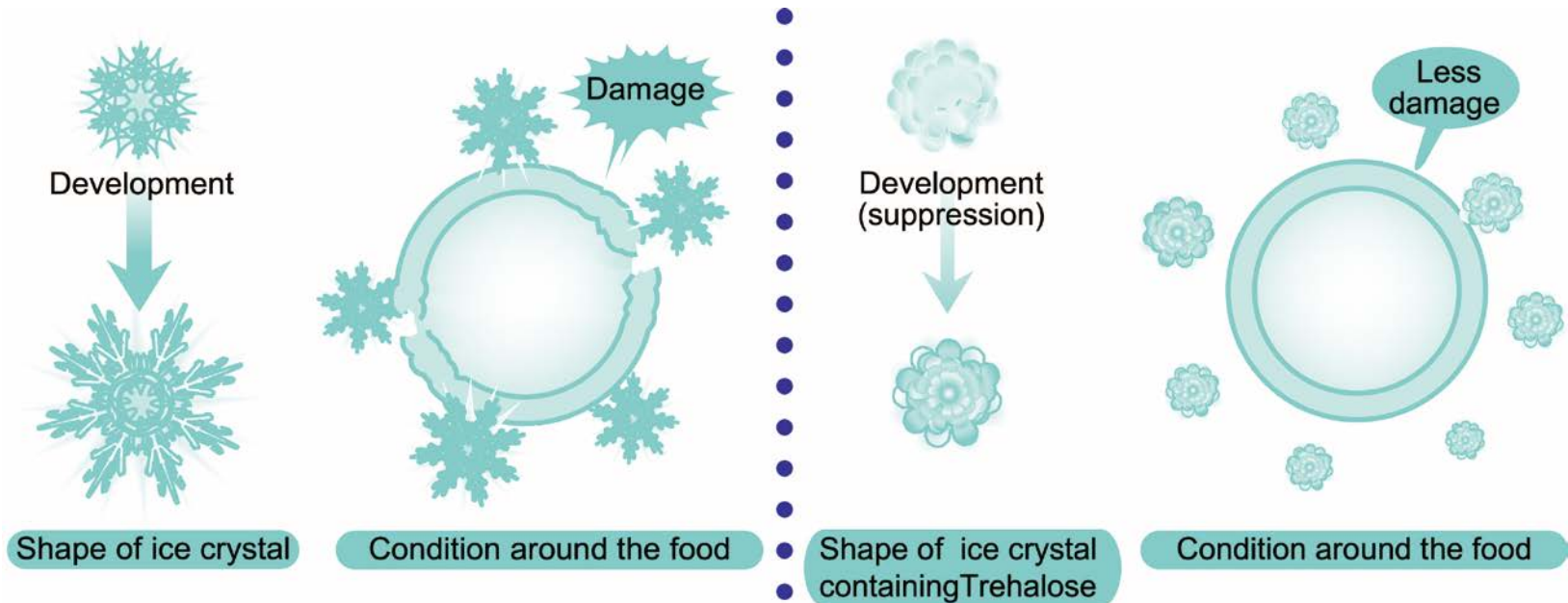
**Sucrose solution:** large, sharp ice crystals, growing larger over time

5% saccharide solutions were frozen at  $-20^{\circ}\text{C}/-4^{\circ}\text{F}$  for 2 weeks



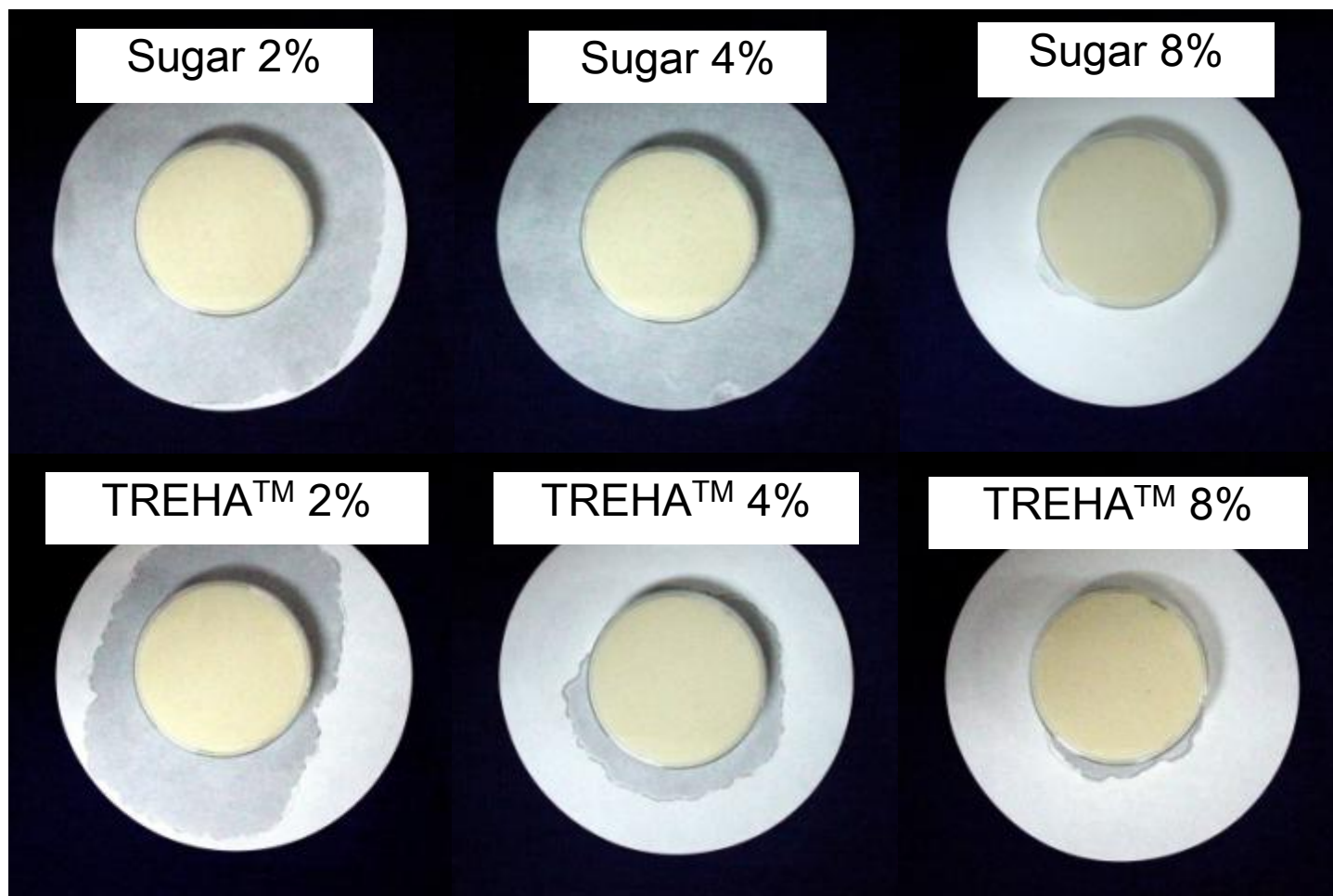
Data and photos provided by Hayashibara Co., Ltd., a Nagase Group Company.

# .....which reduces freeze/thaw damage in foods



Data and photos provided by Hayashibara Co., Ltd., a Nagase Group Company.

# White sauce moisture loss after freeze-thawing



Stored for 1 month at  $-20^{\circ}\text{C}/-4^{\circ}\text{F}$



Data and photos provided by Hayashibara Co., Ltd., a Nagase Group Company.

# These unique properties of trehalose provide a variety of benefits in foods

- **Extend shelf life**
- **Enhance quality**
- **Stabilize and improve texture**
- **Enhance and preserve flavor**

# Trehalose In Foods

## Bakery – Bread, Cakes Donuts

- Extends Shelf Life
  - Reduces staling
  - Increases stability
- Product improvement
  - Increases volume
  - Improves crumb texture



## Meat and Seafood

- Maintains texture and appearance
  - Reduces freeze-thaw damage
  - Maintains quality in reduced sodium products



## Snacks (crackers, cereal, chips, cookies):

- Enhances and maintains crispiness
- Provides enhanced dough formability and volume
- Prolongs shelf life after package opening

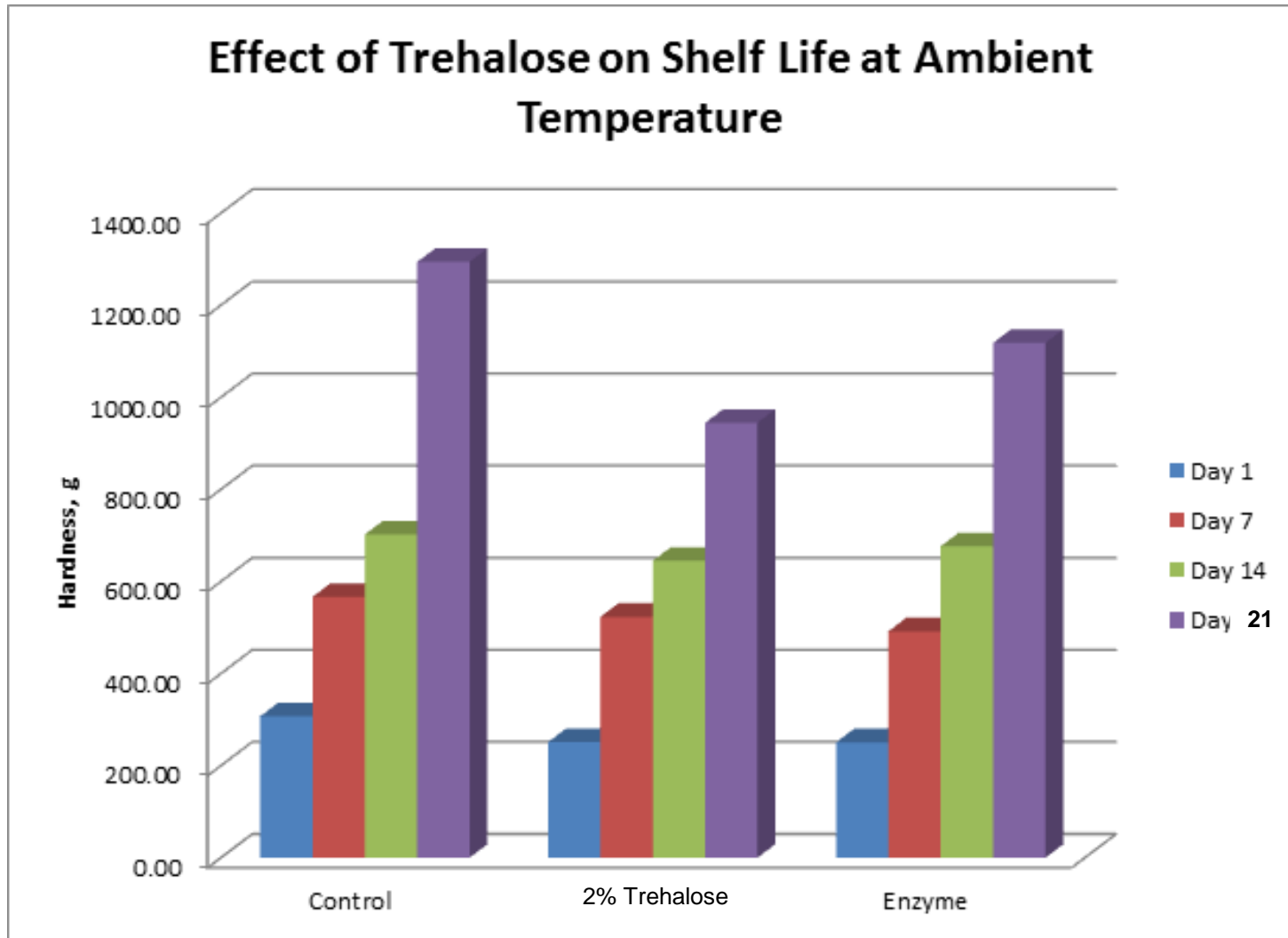


## Other

- Masks off-notes and odors in meats, beverages
- Improves texture of ice cream through reduced ice crystal size
- Increases yield and maintains color/texture in dried vegetables and fruit

# Bakery Applications

# Trehalose maintains soft texture in breads over time, potentially extending shelf life



# Advantages of trehalose for glaze

## Extending Shelf Life

- Excellent in stability during storage due to **low hygroscopicity**
- **Suppresses stickiness of glaze** through water migration
- **Reduces glaze loss**; preventing glaze from penetrating into the food product

## Maintaining the original texture:

- Trehalose **crystals are stable**; giving smooth melting texture.

## Acid Tolerance:

- Ingredients such as fruit extract/juice can be used, so a wide range of flavored glaze is possible.



# TREHA™ Trehalose can help improve volume in a variety of bakery products

## Improved cake volume

(30% replacement in meringue)



	Relative	
Density	Sucrose	TREHA™ trehalose
Meringue	0.175	0.178
Cake batter	0.497	0.458

## Croissants with low trans fat

Height (mm)

47±1.6      43±1.1 \*      46±1.9 \*\*      47±1.9 \*\*



Only Sucrose      Only Sucrose      2% TREHA™      5% TREHA™  
Full fat      Reduced fat

# Confectionery Applications



- Trehalose replaces sugar and reduces sweetness in chocolate confections.
- Trehalose produces hard candies resistant to cold flow and pan coated confections that are color stable and non-hygroscopic

# Pate · de · fruits/Pectin jelly

Sucrose Brix 70%



Sucrose Brix 73%



Sucrose Brix 76%



TREHA™ Brix 70%



TREHA™ Brix 73%



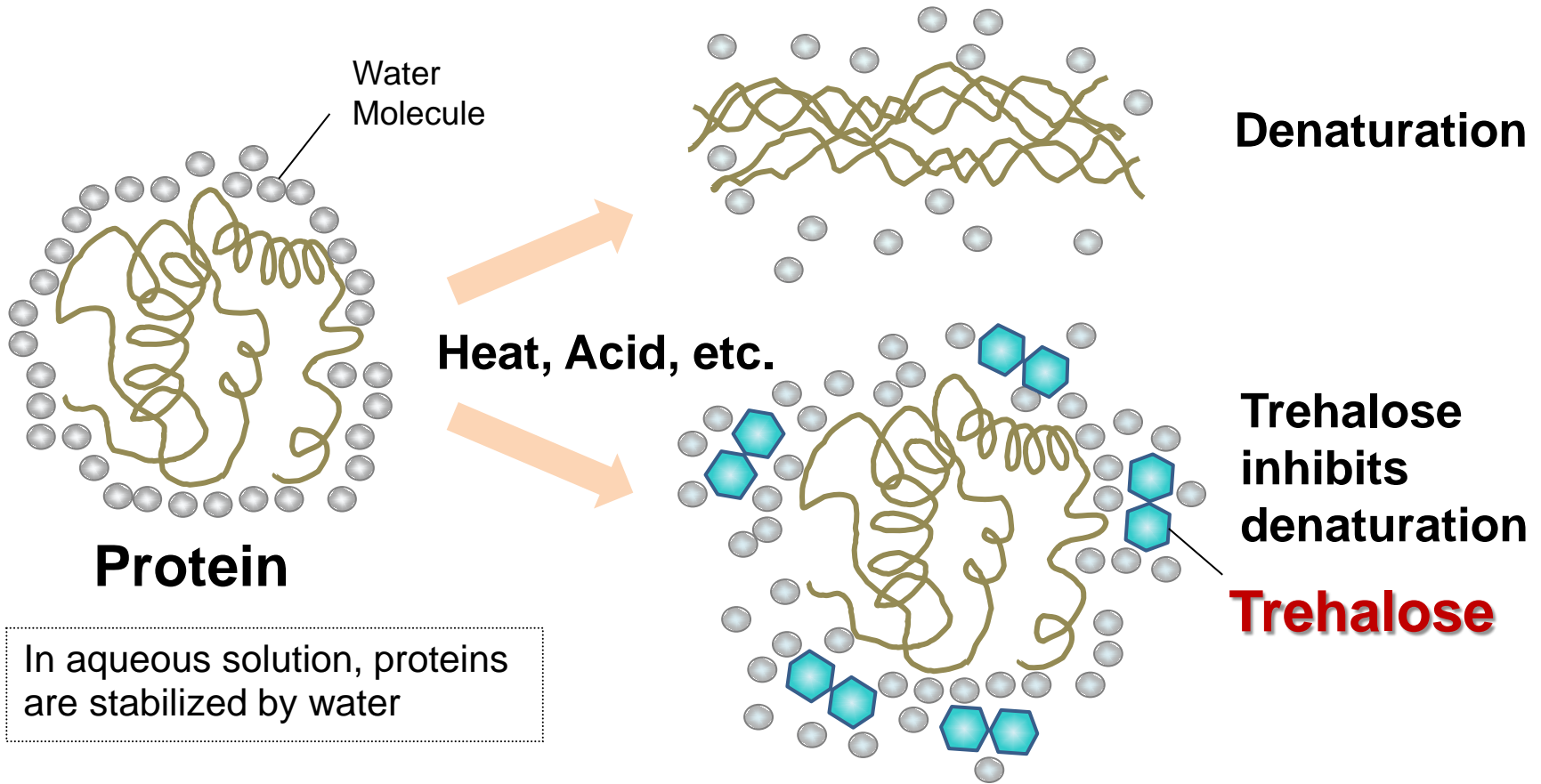
Trehalose can **reduce weeping** and **extend the shelf-life** of pectin jellies.



Data and photos provided by Hayashibara Co., Ltd., a Nagase Group Company.

# Meat & Seafood Applications

# Trehalose inhibits protein denaturation



In aqueous solution, proteins are stabilized by water

Trehalose supports water structure and maintains stability



Data and photos provided by Hayashibara Co., Ltd., a Nagase Group Company.

# Trehalose inhibits egg coagulation

Scrambled egg test: Whole egg + dairy cream (25% of egg weight) + 0.5% salt

Start of coagulation      End of coagulation

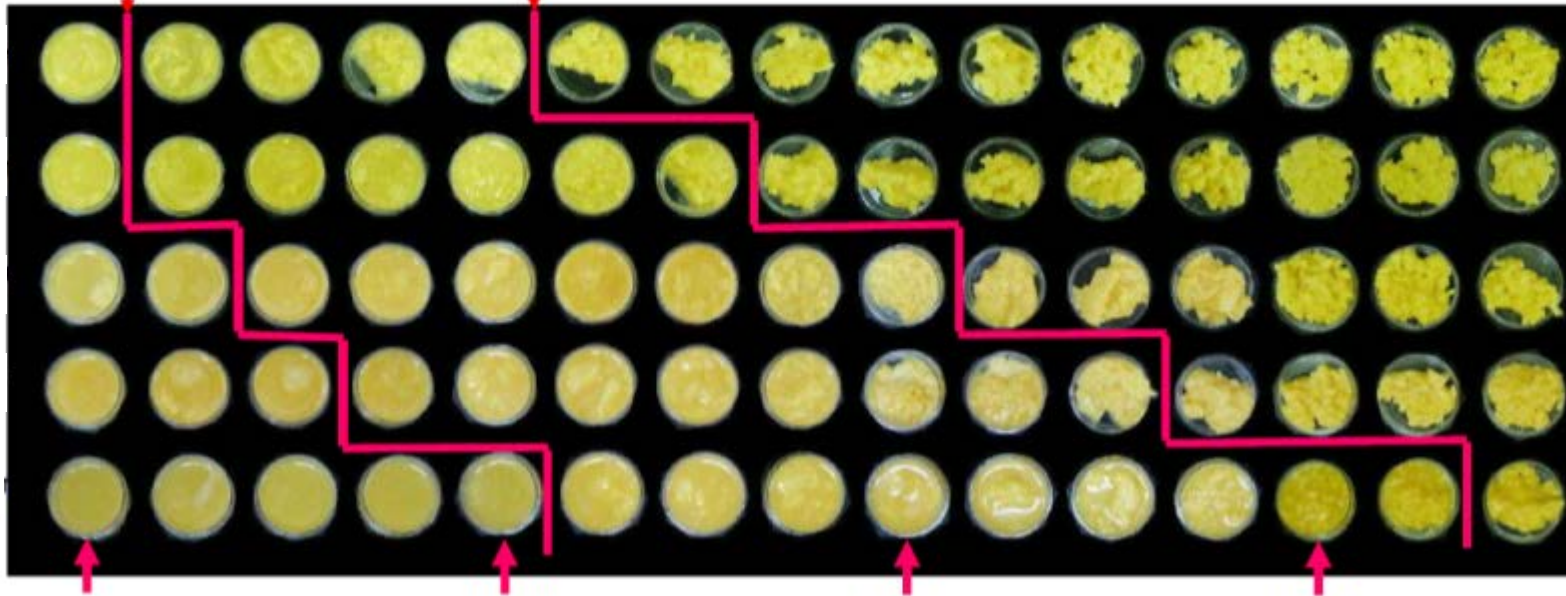
0% TREHA™

1.5% TREHA™

3% TREHA™

6% TREHA™

10% TREHA™



Time (minutes)

5'30''

6'30''

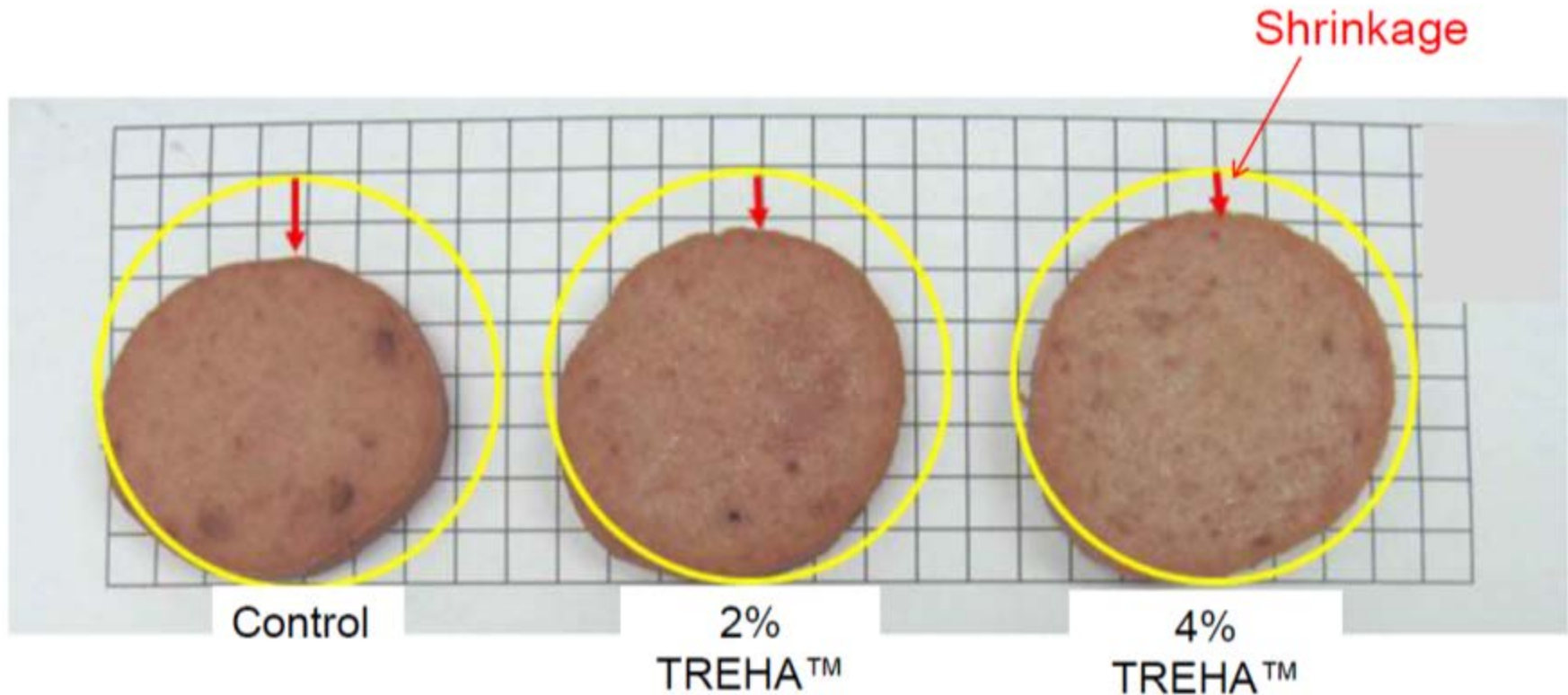
7'30''

8'30''



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# Trehalose prevents shrinkage of sausage held in a warmer for 4 hours



Stored in a warmer

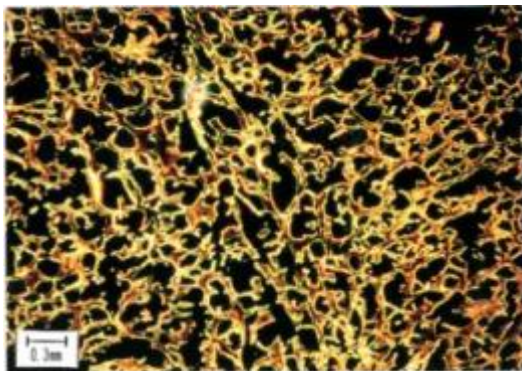


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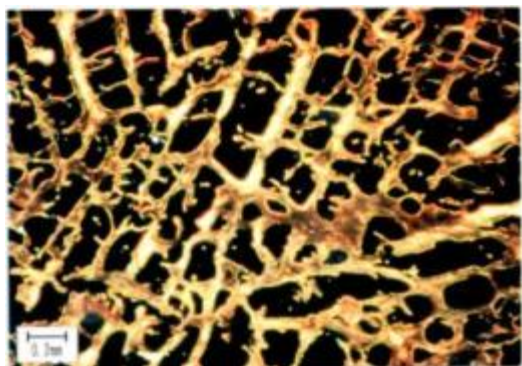
# Trehalose helps maintain the texture and juiciness of frozen meat and seafood

Micrograph of myofibrillary protein in pollack surimi after 7 months of frozen storage

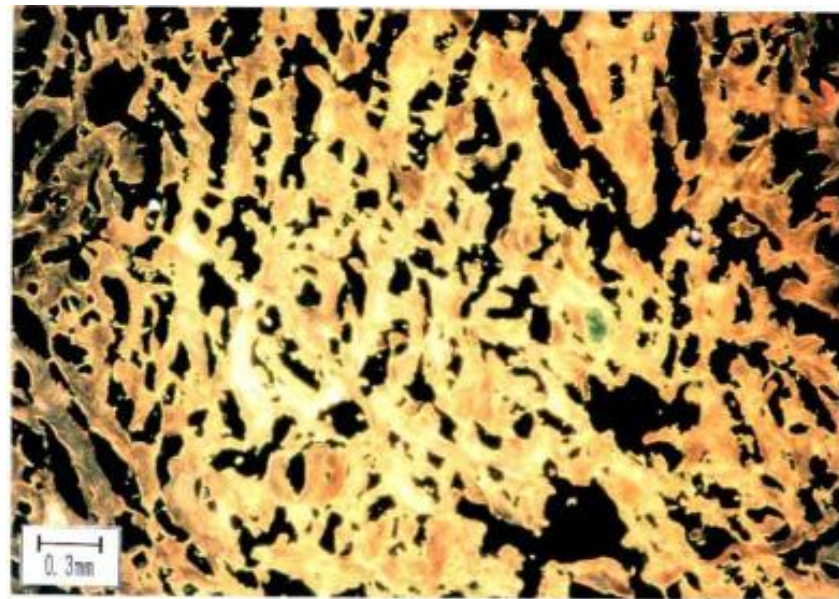
Sorbitol 5%  
+ Sodium  
Carbonate



Sucrose 5%  
+ Sodium  
Phosphate



TREHA™ 5% + Sodium Carbonate



Data and photos provided by Hayashibara Co., Ltd., a Nagase Group Company.

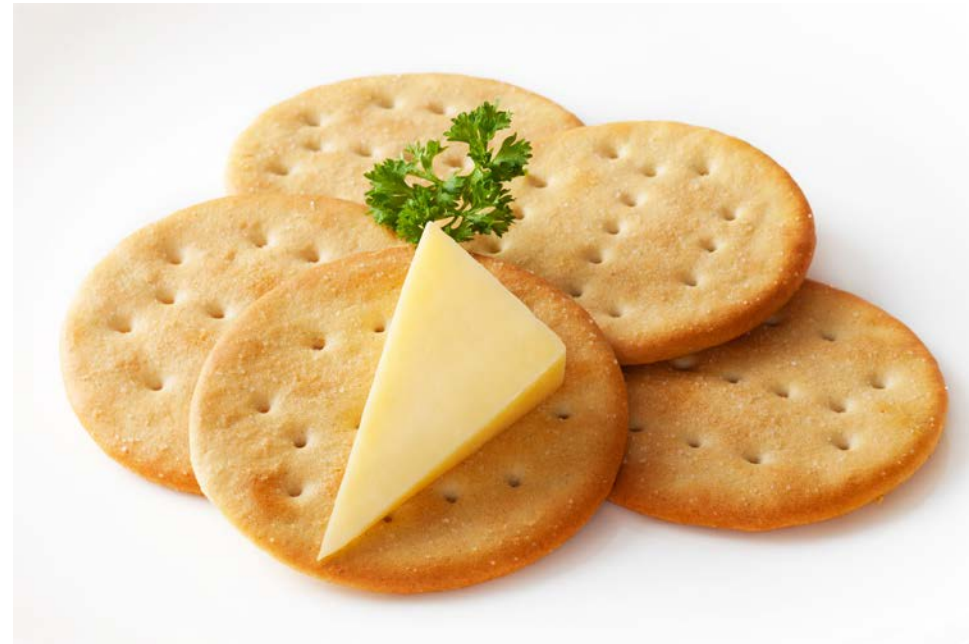
# Snack Food Applications



- Trehalose enhances and maintains crispiness of snacks, even when they absorb moisture
- Trehalose provides good formability to the dough, prevents flattening and gives higher volume

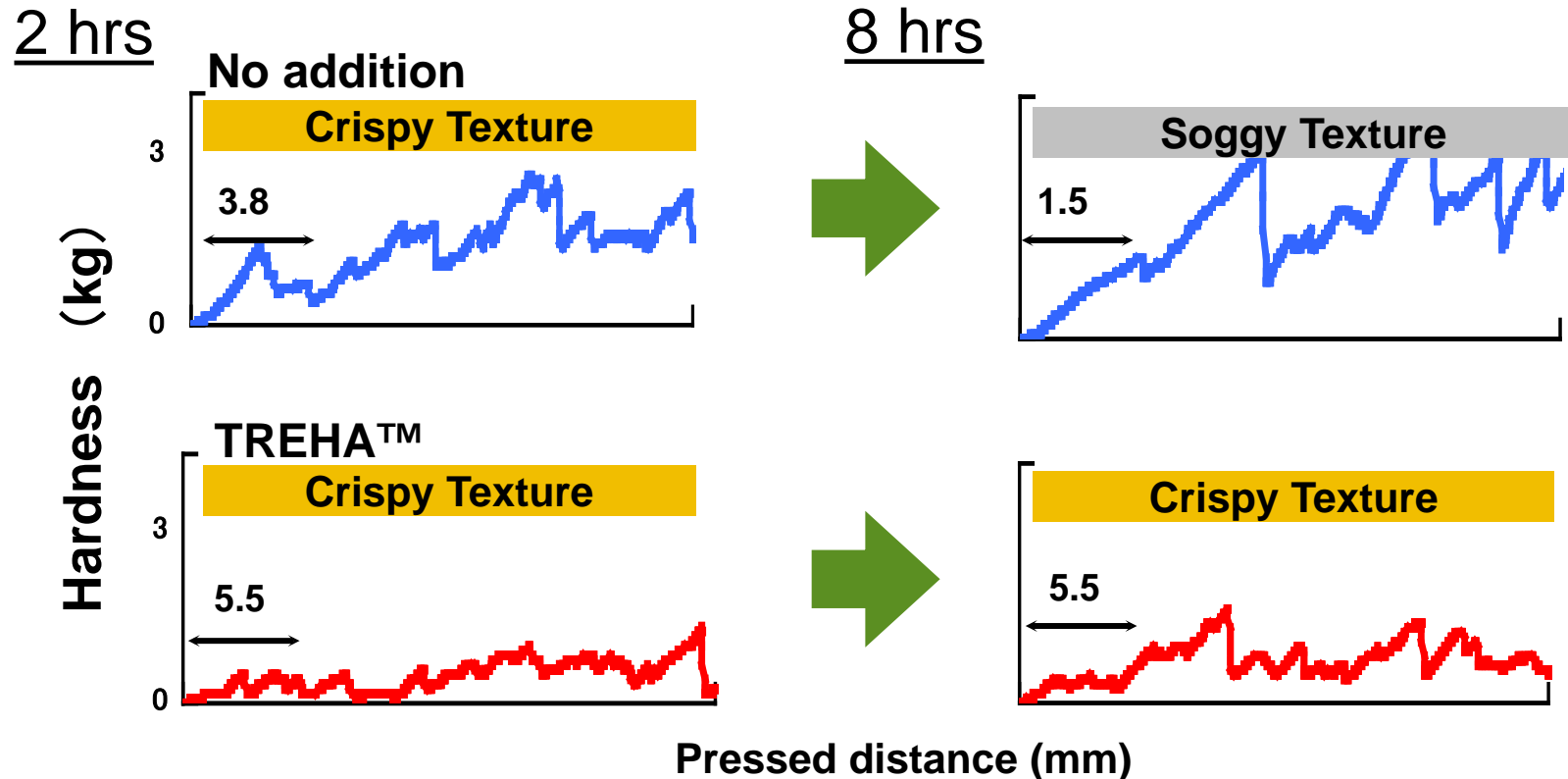
# Extra Crispiness & Improved Flavor

- **Trehalose suppresses hygroscopicity & maintains crispiness**
- **Reduces sticking to teeth**
- **Gives snacks good melt-in-mouth sensation**



Data and photos provided by Hayashibara Co., Ltd., a Nagase Group Company.

# Trehalose helps maintain crispiness in puffed snacks



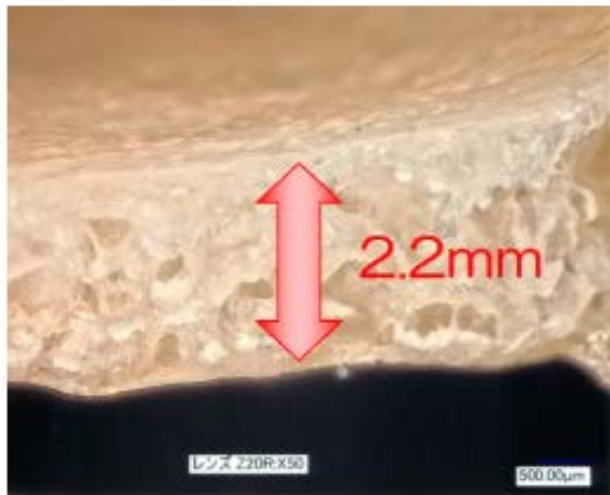
Figures are the number of peaks in a waveform when pressed 1 mm into crackers.



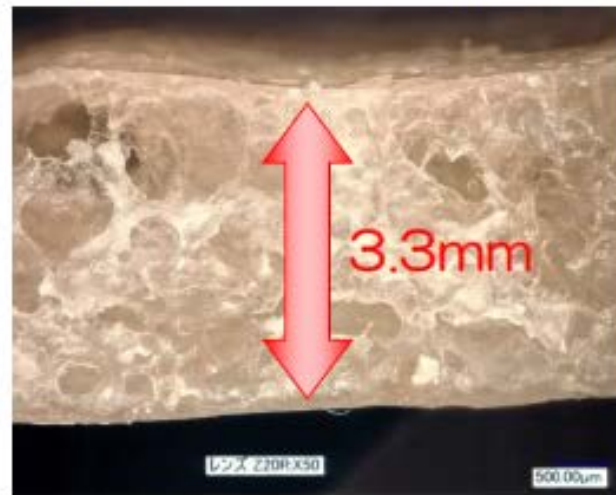
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# Improved Volume in Rice Crackers

Control (No sugar)



10% TREHA™ addition



(Observed by  
microscope ×50)



Data and photos provided by Hayashibara Co., Ltd., a Nagase Group Company.

# Fruit & Vegetable Applications

# Trehalose keeps fruits & vegetables fresh by preventing color change and drying.



10% TREHA™ solution



No treatment



Water  
Solution



3% TREHA™  
Drying of vegetable sticks



Data and photos provided by Hayashibara Co., Ltd., a Nagase Group Company.

# Trehalose helps preserve color of air-dried carrot strips

Control

Glucose

TREHA™



After stress test (100°C/212°F, 3 hours)

Control

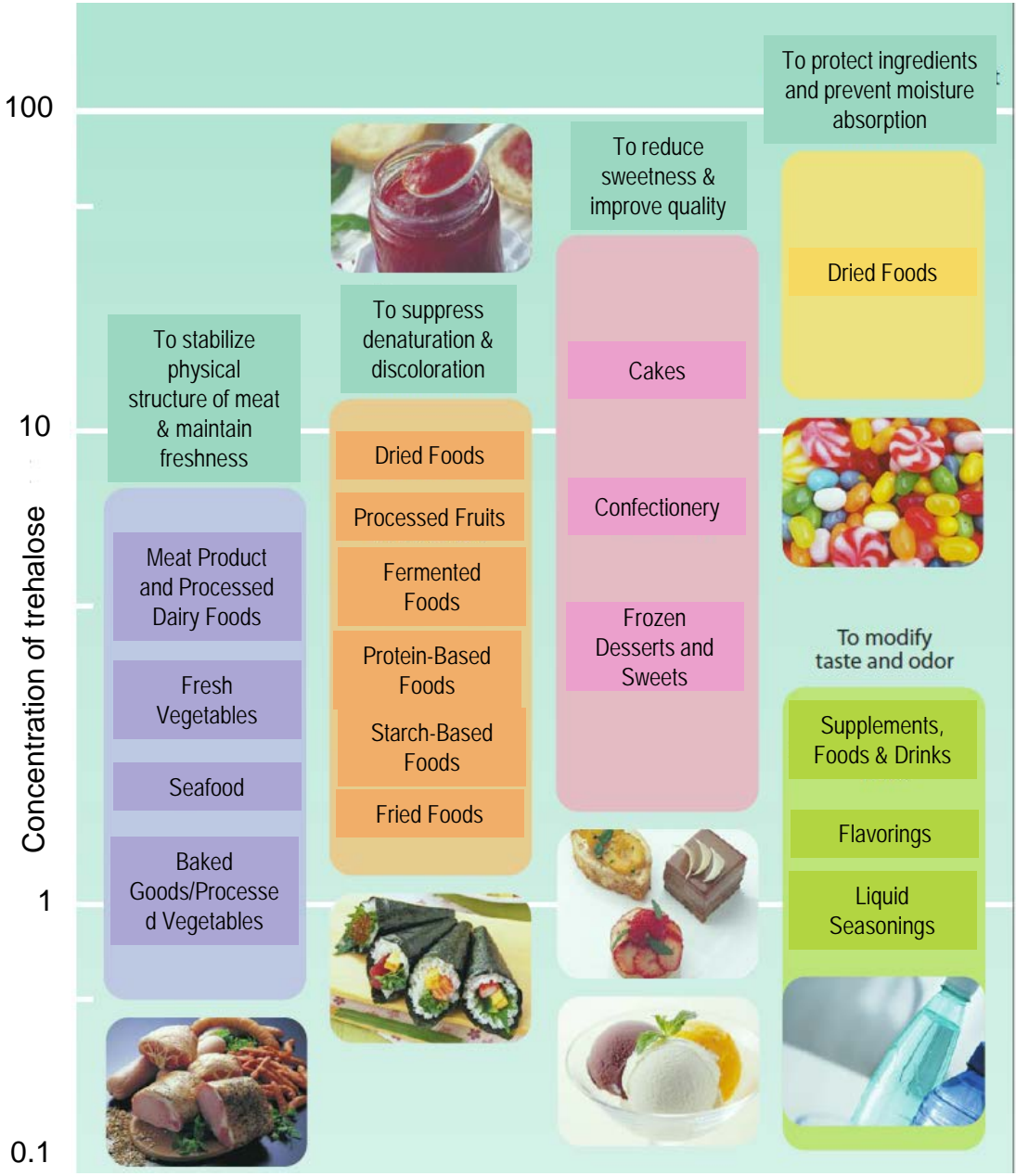
Glucose

TREHA™



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# Trehalose Usage Guidelines



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# TREHA™ Trehalose. We've Got An App For That.

Snack

Meat

Beverage

Bakery

Fruit & Veg.

			
Unique Crispiness	Longer Shelf-Life	Enhanced Formability	Stabilized Glazes
			
Reduced Sodium	Juiciness & Quality after Freeze-Thaw	Masked Off-Notes	Reduced Drip Loss
			
Stability of Protein Beverages	Masked Off-Notes	Stabilized Color	Mild Sweetness
			
Longer Shelf-Life	Improved Frozen Dough Performance	Improved Texture	Enhanced Volume
			
Maintained Freshness	Improved Freeze-Thaw Stability	Stabilized Color	Higher Dried Yield

# thank you

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