



Trehalose

Trehalose is a kind of safe and reliable natural sugar, which is very stable in its own properties, and has good stability. It has a magical protective effect on a variety of bio-active substances. Because Trehalose can form a unique protective film on the cell surface under the harsh environmental conditions such as high temperature, high cold, high osmotic pressure and dehydration, which can effectively protect the protein molecule from constant inactivation, thus maintaining the life process and biological characteristics of life. Many of the species that show extraordinary stress tolerance to the harsh environment are directly related to the presence of a large amount of Trehalose in their bodies.



It has been found that the desert plant *Cupressus convolutus* nearly died in drought, but after meeting the water, it can miraculously revive. Resurrection grass, an alpine plant, can withstand severe ice and snow. Some insects do not freeze or die under the conditions of high cold, high temperature and dry water loss, which is the miracle of trehalose in their bodies. Trehalose is known as the "sugar of life" in the scientific community. In July 2000, the international authoritative journal *Nature* published a special article on the evaluation of trehalose, which pointed out that "for many living organisms, the presence or absence of trehalose means life or death".

However, other sugars in nature, such as sucrose and glucose, do not have this function. Because of this unique functional property, trehalose can be used not only as an excellent active protective agent for protein drugs, enzymes, vaccines and other biological products, but also as an important component for maintaining cell activity and moisturizing cosmetics. It can also be used as a unique food ingredient to prevent food deterioration, maintain fresh flavor and improve food quality. It greatly expanded the function of trehalose as a natural sweet sugar.

The Magic Sugar of Life



Dry Selaginella

After 2 hours of water supply

After 8 hours of water supply

Cryptogenic phenomenon:

Bad conditions, false death ;

Appropriate, Resurrection.

Dry yeast, cypress, Rana



When cells are in starvation, drying, high temperature, freezing, high pressure or toxic conditions, trehalose content increases, which can protect cell membrane, protein, DNA and other tissues.



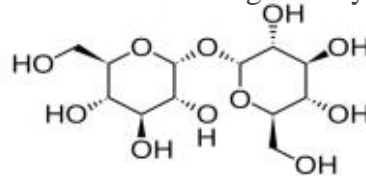
海藻糖

Trehalose is a kind of non reducing sugar which is composed of two glucose molecules combined with a, A-1 and 1. The starch was used as raw material, and the reductive end of starch was transformed into trehalose structure by enzyme transformation, and then trehalose was separated to form crystalline trehalose containing two crystalline water.

The structure of crystal Trehalose containing two crystalline water:

Molecular formula: $C_{12}H_{22}O_{11} \cdot 2H_2O$

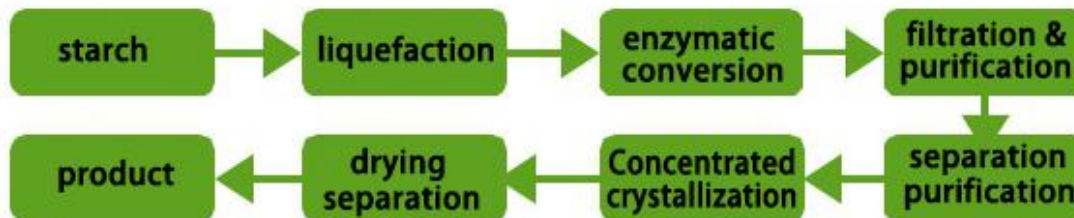
CAS: 6138-23-4



Product Specifications

Appearance	White crystalline powder (dihydrate)
Assay	$\geq 98.0\%$
Ph Value (30% solution)	5.0-6.7
Loss on drying	$\leq 1.5\%$ (60°C, 5 hours, Room temperature drying)
Burning residue	$\leq 0.05\%$

Production Process of Trehalose





Physicochemical Properties of Trehalose

- (1) Density Crystal trehalose 1.512g/cm³
- (2) Melting point Crystal trehalose 97°C, lose water at 130°C
- (3) Heat of fusion Crystal trehalose 57.8kJ/mol
- (4) Rotation $[\alpha]_D^{20} +199^\circ$ (5% water solution)

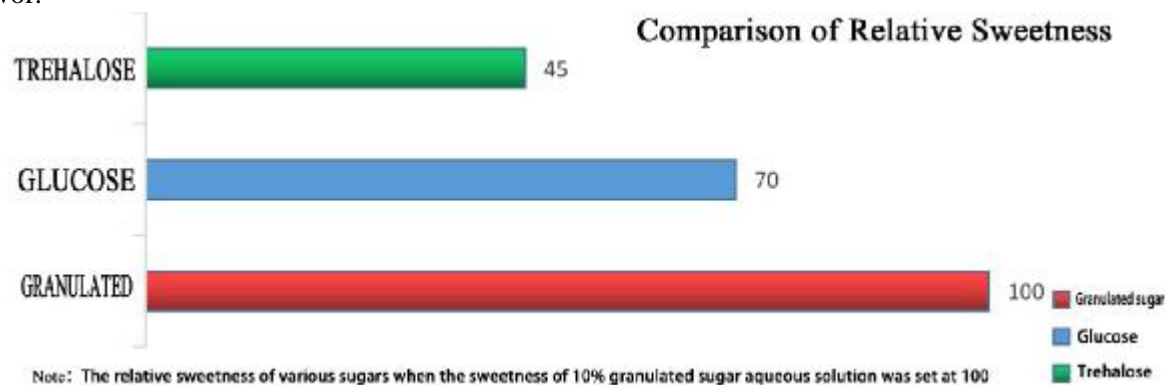
(5) OSMOTIC Pressure (mosm/kg)

Concentration %	5	10	20	30
Trehalose	193	298	690	1229
Maltose	195	299	676	1221

Basic Properties of Trehalose

1. Low sweetness

Trehalose is 45% of the sweetness of sugar, trehalose sweet refreshing, soft taste, and sugar, sweet can quickly penetrate, after eating no remaining flavor.





Physical and Chemical Properties of Trehalose

2. Nonbrowning

Trehalose is non-reductive, and it is difficult to Browning even when heated in the presence of Amino Acids and proteins (Commonly known as the Maillard reaction) .

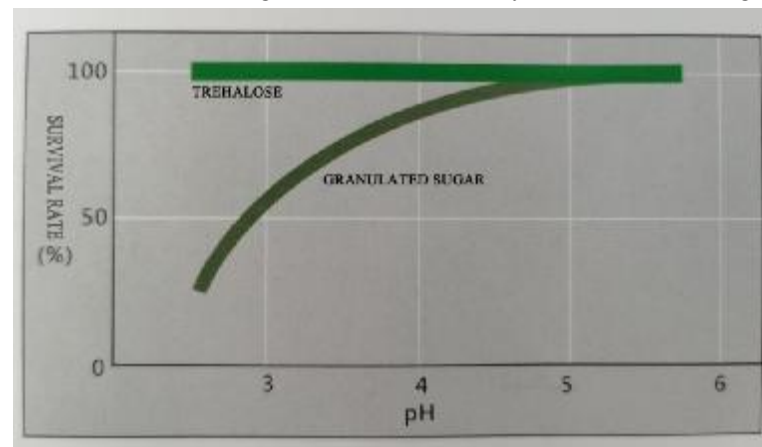


pH 4 5 6 4 5 6 4 5 6
Trehalose of Huiyang Granulated Sugar Water Malt

Note: Maillard reaction (Sugar concentration 12.5%, Glycine 0.5%, 120°C heating 30mins)

3. Stability

Trehalose is the most heat-resistant and acid-resistant of disaccharides. It has stable properties and is not easy to color and decompose. It can be widely used in food processing.



Heat Resistance, Acid Resistance

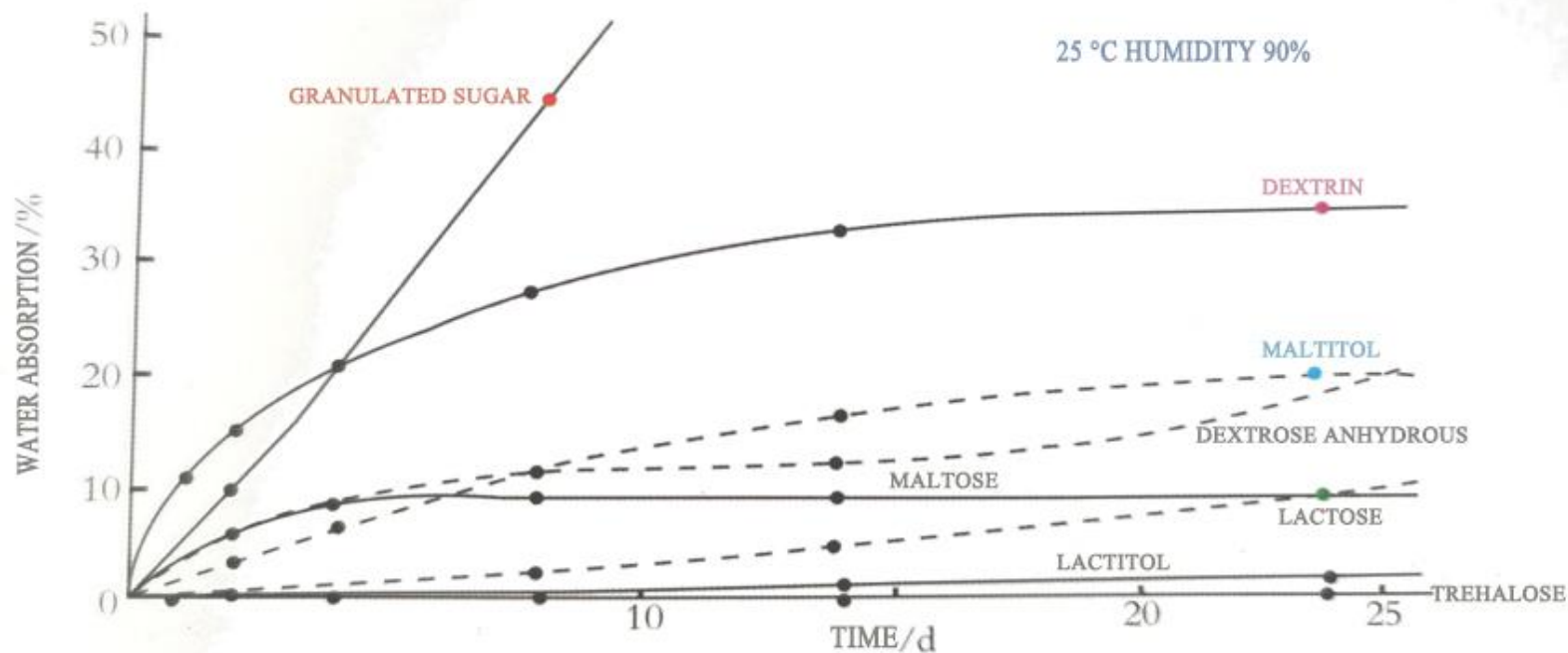
Note : 100°C、30Mins



4. Low hygroscopicity

Trehalose properties are very stable, not easy to absorb moisture, the most suitable for the production of candy, cakes, sugar-coated tablets and so on. Don't have to worry about hygroscopicity when you're in the food business.

Water Absorption Rate of Various Sugars:





5. Solubility

The solubility of trehalose in water is lower than that of granulated sugar and close to that of Maltose. Because of its good crystallinity, it can be used to make low hygroscopicity products.

Temperature °C	10	20	30	40	50	60
Trehalose g/100g·water	55.3	68.9	86.3	109.1	140.1	184.1
Granulated Sugar g/100g·water	190.5	203.9	219.5	238.1	260.4	287.3

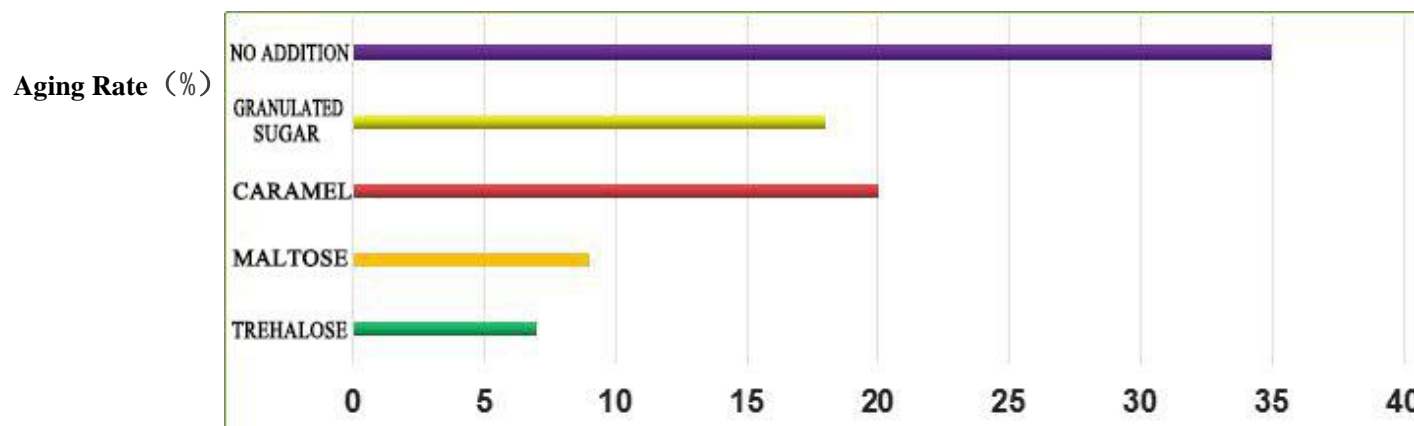
6. Glass transition temperature

Trehalose has a glass transition temperature of up to 120 °C. This property, combined with its process stability and low hygroscopicity, makes trehalose high-protein protector and an ideal spray-drying flavor preserver.

Functional Characteristics of Trehalose

1. Inhibition of Starch Retrogradation

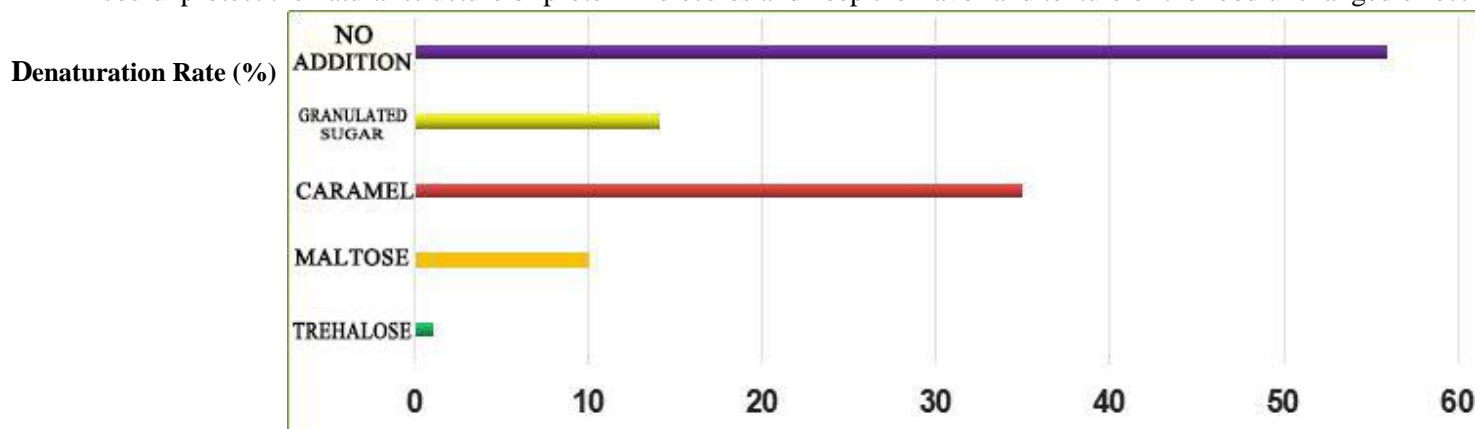
Trehalose is effective in preventing starch from aging, so it can be used in rice cakes, noodles, rice, cream, sauces and fried cakes, especially in low temperature and freezing conditions.



Note: The starch solution (2%) and total carbohydrate (12%) are mixed in equal amounts, and stored at 4°C after gelatinization. the turbidity before storage to after 12 hours is aging rate

2. Inhibit protein denaturation

Trehalose could prevent protein denaturation during freezing high temperature or drying. Adding trehalose to various protein-containing foods could protect the natural structure of protein molecules and keep the flavor and texture of the food unchanged effectively



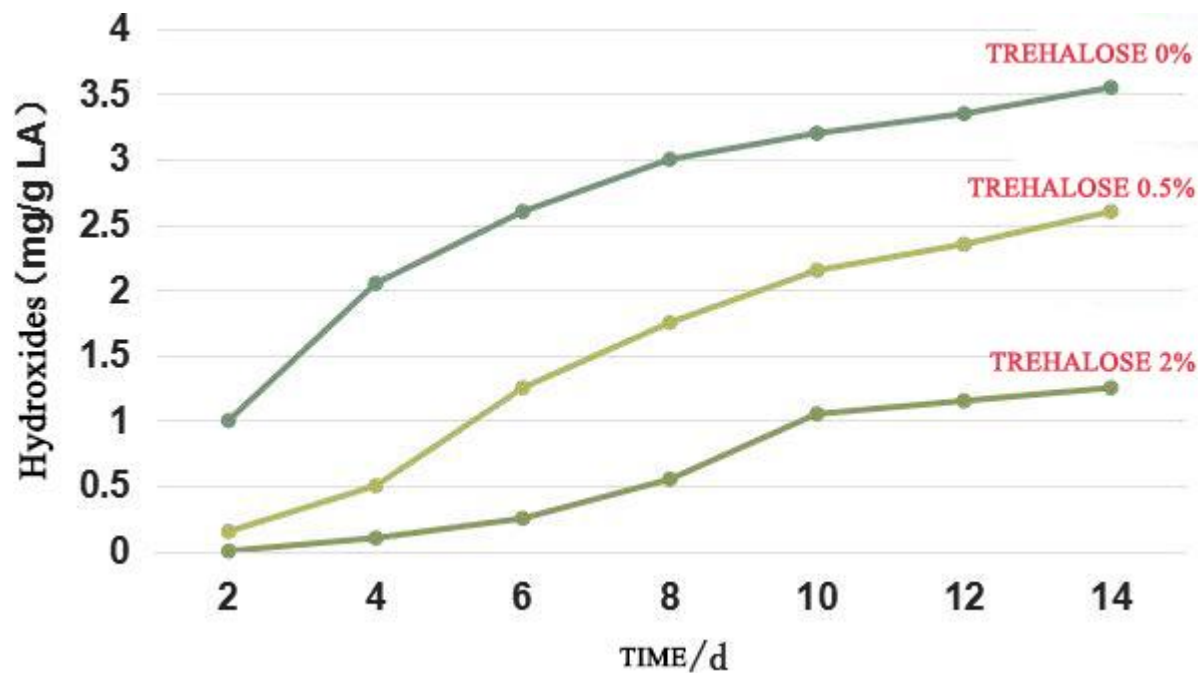
Note: Add various carbohydrates (5%) to the protein and store it at -20°C for 5 days. The turbidity before freezing to after thawing is



3. Inhibit Lipid Oxidation and Deterioration

When fat is acidified or hydrolyzed, it will produce superacid compounds or volatile aldehydes, which will affect the taste of food and even make it inedible. Most foods contain fat to some extent, and inhibiting fat deterioration is an important part of ensuring food quality; trehalose can exert its effect on inhibiting fat deterioration. For example: when rice is stored, the fatty acids in the rice will decompose to create aldehydes, causing the odor of rice bran. If 2% trehalose is added, this phenomenon will be suppressed.

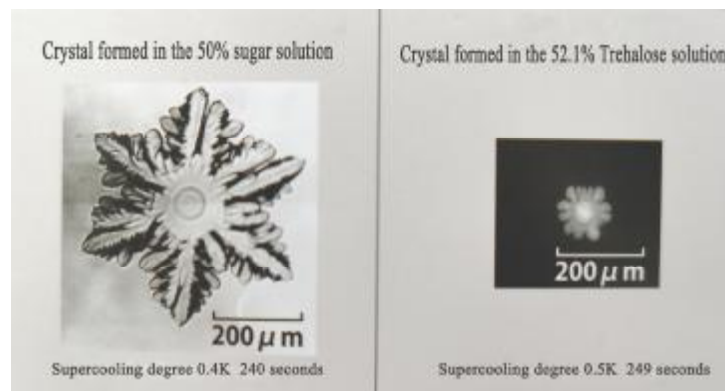
Effect of Trehalose on the Autoxidation of Linoleic Acid



4. Inhibit the growth of ice crystals

Experiments show that trehalose can inhibit the formation of ice crystals.

Therefore, the degree of damage to food during freezing and thawing could be reduced.



5. Stable organization and maintain quality

Trehalose could be quickly replaced with water in the tissues or cells of animals and plants, so that the tissues or cells will not be damaged by drying or freezing when they are in a dehydrated status.

Maintain the freshness of vegetables



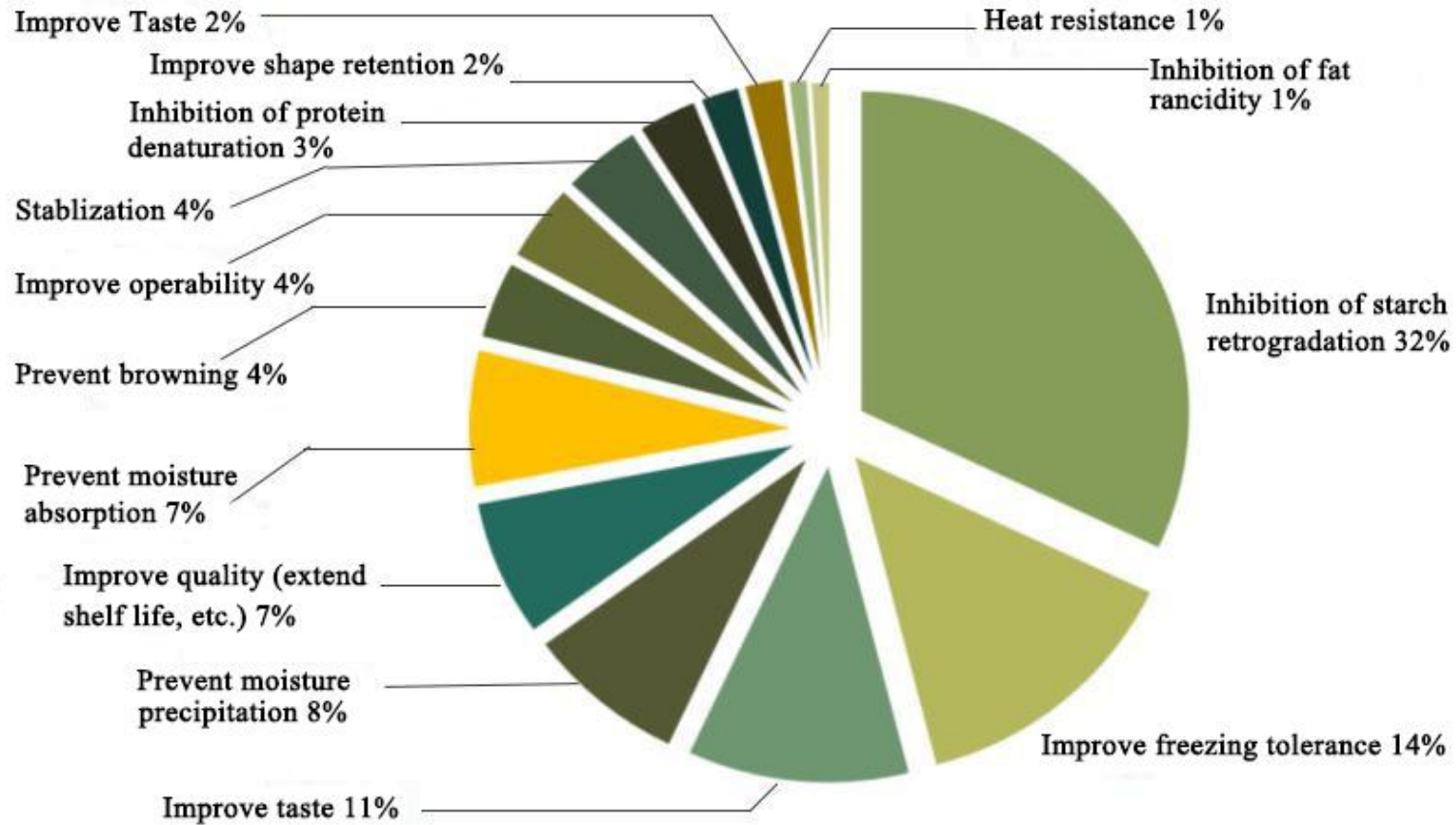
3% trehalose aqueous solution



Note: The status of vegetable sticks after placed at room temperature for 1 hour which have been soaked in water and 3% trehalose aqueous solution for 30 minute.

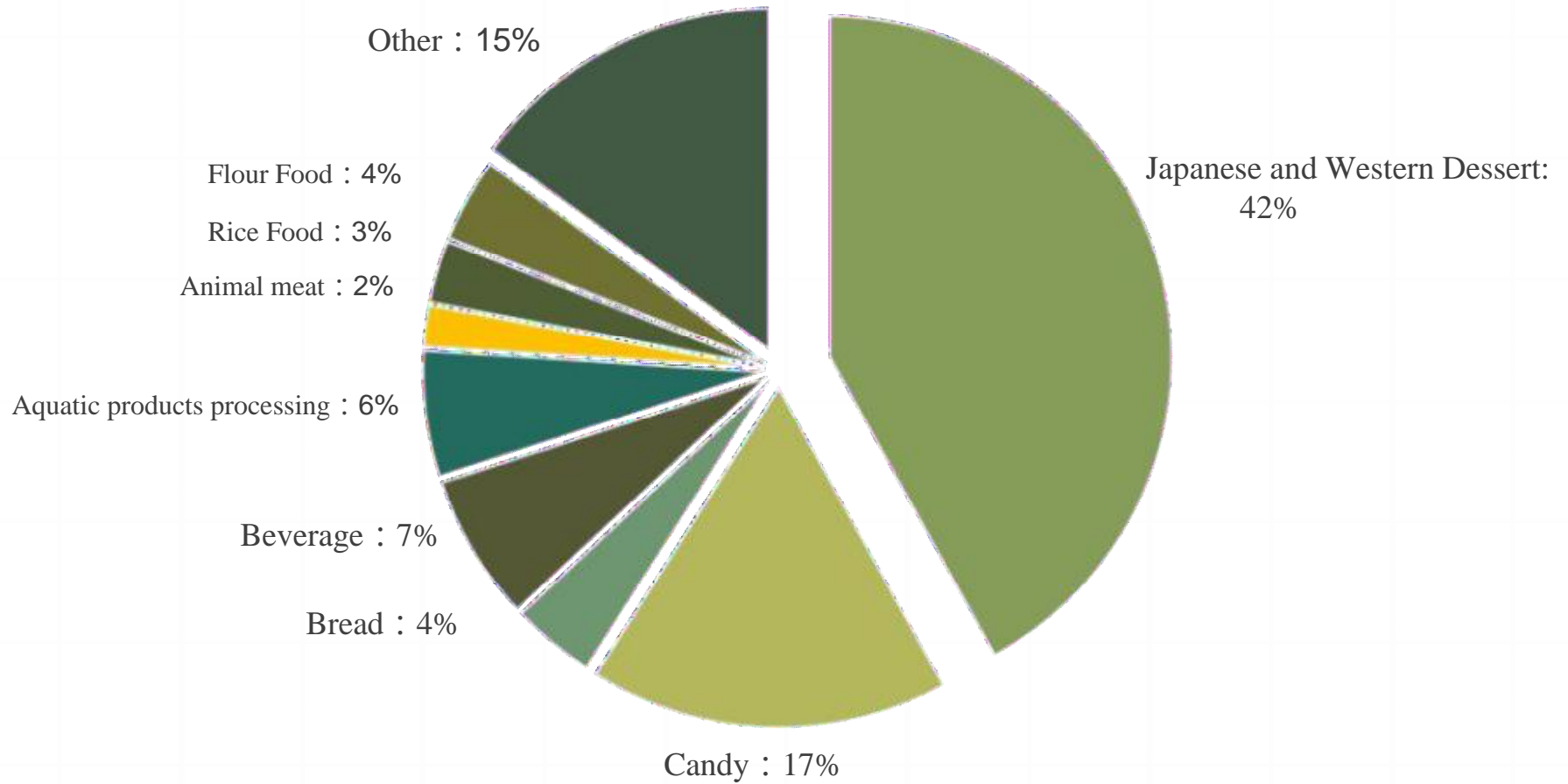


Functional Application of Trehalose





Application Fields of Trehalose





The Seasoning Effect of Trehalose

Item	Odour	Stronger or weaker	Item	Odour	Stronger or weaker	Item	Odour	Stronger or weaker			
Salt solution Soy sauce Seaweed sauce	salty	stronger	Cocoa Natto Aojiru Potassium chloride Amino acids Valine Leucine Isoleucine arginine	Bitter flavor	weaker	Collagen Egg products Soybean protein Meat Fish	Distinctive smell	weaker			
Vinegar	sour	weaker				High sweetness sweetener			aftertaste	weaker	
Lemonade		stronger				Irony	Iron taste				
Perilla		stronger				Curry Mustard	Piquancy	stronger			
Bittern	astringent	weaker				Retort pouch	Metallic flavor	weaker	Rice Rice products	Rice bran smell	weaker
Vegetable	Grass stank					Tap water	Bleach smell				
Laminaria soup	Fishy										
Soymilk	Fishy										
Soup-stock Powder	Umami	stronger									



Application of trehalose

	Function	Examples
Pastry	Inhibition of starch retrogradation (inhibition of hardening, maintain the Translucence)	Dumpling, Tai Fook Cake, Mistletoe cake, Fern cake, Ohagi, Wobbly mochi
	Lower the sweetness (lower sweetness, increase brix)	Dumpling, skin of Tai Fook Cake, bean paste, Ohagi, fresh cream, Japanese material of cold pastry
	Increase freezing tolerance (Inhibition of freezing deterioration, Inhibition of ice crystal formation, maintain shape retention)	Frozen Japanese and Western style cakes
	Inhibition of water loss (Improve water retention)	Bean paste, Mizuyokan, fresh cream
	Improve taste, prevent moisture absorption (Maintain crispness)	Fruits, pies, sweet natto, Powdered sugar on doughnuts, biscuits
	Prevent over coloring	Bean paste, fresh cream
	Prevent sugar crystallization	Mutton soup, poundcake
	Improve bubble stabilization (replace emulsifier)	Sponge cake, Chiffon Cake, protein powder
	Inhibition of rancidity odor of oil	Frozen cake, Almond cream cake, pie
	Maintain freshness	Fruits used for frozen, cold cakes
	Adjust water content	pastry
Reduce the bad smell after heating	Chocolate, cocoa beans	



	Function	Examples
Candy Bread	Lower sweetness·improve taste	Candy, cream filling, biscuit, jelly drops, tea bread, honey cake
	Prevent over coloring	White bread, biscuit
	Prevent moisture absorption (Prevent moisture regain)	Candy, dry jelly, Bean snacks, Fondant, sugar icing
	Improve taste (Maintain crispness)	Candy, biscuit, nut sugar coating
	Maintain taste (Inhibition of retrogradation)	Rice flour bread, sandwich
	Increase freezing tolerance	Semi finished frozen bread, steamed stuffed bun
	Improve bubble stabilization (replace emulsifier)	Toast
Cold drinks Desserts	Lower sweetness·improve taste	Ice-cream, pudding, jelly, mousse
	Inhibition of protein denaturation	Pudding, jelly, mousse
	Inhibition of water loss	Frozen pudding, jelly
	Inhibits ice crystal growth	Sorbet
	Improve milk taste (Reduce the bad smell after heating)	Kadas stuffing, milk pudding
	Maintain shape retention	Jelly, mousse
	Prevent moisture absorption	Fruit chips
Beverage	Low colorability	Amino acid beverage, Fruit and vegetable juice, hot drinks
	Low sweetness	beverages
	Improve flavor (Add flavor)	Beverage contains lemonade and milk
	Improve flavor (masking effect)	Beverage contains iron, soy milk, vinegar drink, amino acid beverage, Fruit and vegetable juice, mineral drinks, tea drinks
	Increase solubility	Beverage containing calcium and polyphenols
	Maintain antioxidant activity, prevent β Carotene deterioration	Fruit and vegetable juice
	Increase endurance	Powerade, fashion drinks
	Reduce the bad smell after heating	Coffee milk, milk tea, cocoa, fruit juice



	Function	Examples
Food made of flour	Inhibition of starch retrogradation	Udon noodles, dumpling wrapper, Lamian Noodles
	Prevent noodles from clumping	Udon noodles, Lamian Noodles, noodles, Italian noodles
	Prevent noodles from being too soft	Udon noodles, Lamian Noodles, noodles, Italian noodles
	Prevent being too dry	dumpling wrapper, shao-mai wrapper, raw noodles
	Shorten the noodles cooking time	Udon noodles, Lamian Noodles, noodles, soba noodles
Flavoring	Add flavor	Japanese style noodle sauce, powder flavoring, mustard, tomato sauce
	Prevent moisture absorption	powder flavoring
	Inhibition of protein denaturation (reduce scum)	Seasoning for meat
	Inhibition of starch retrogradation	Liquid seasoning containing starch
	Increase freezing tolerance	Sauce, Mayonnaise Sauce, Salad Sauce, Sushi vinegar
	Odor control	Liquid seasoning
	Prevent over coloring	Liquid seasoning, Cream Sauce
Aquatic products processing	Increase the solidity (extend shelf life, prevent water loss)	Liquid seasoning
	Inhibition of protein denaturation	Frozen Surimi, Fried fish rice
	Inhibition of starch retrogradation	Surimi with starch
	Inhibition of moisture absorption and dehumidification	Seaweed, dried shellfish (e.g. shredded squid), Kelp products, Dried fish with sweet wine
	Improve flavor	Boiled seafood, Frozen Surimi, shredded squid
	Improve taste (Elastic, Crisp)	Fish cake, crab sticks, Chikuwa, shredded squid, Jam products
	Prevent browning	shredded squid, dried fish, Snout fish
	Reduce fishy smell	Crab, tuna, Saury, spotted mackerel, horse mackerel
	Reduce Odor (masking effect)	Aquatic products
	Prevent disintegration	braised fish in soy sauce
Increase freezing tolerance	fish fillet (Processed products)	



	Function	Examples
agrotechny	Cover up odor	Fried eggs, frozen Bento, pickles
	Maintain freshness	Salad, pre-cut vegetables
	Improving sweet taste quality	Jam, Stewed chestnuts with mannitol, boiled beans, pickles
	Increase freezing tolerance	Tofu, fruits, croquette, Japanese pancakes
	Maintain original color	Dried vegetables, nardostachys, Vegetables in clear soup
	Prevent browning	Pre-cut fruits
	Improve reducibility in hot water	Dry goods
	Prevent form collapse during stewing	Stewed taro, Stewed pork with potatoes, chikuzen ni
Animal meat processing	Cover up odor	Meat (beef, chicken, pork)
	Increase freezing tolerance	fried pork chop, other processed meat products
	Improve water retention (Prevent the loss of gravy)	Hamburger Steak, Ham, beef steak, Japanese fried chicken
	reduce scum	Hot-pot, red stew
	Improve taste (crispness, softness)	Japanese roast chicken,
Other	Increase stability	Excipient of tablet, Powder perfume
	Promote plant growth	Fertilizer, pants nutrient solution
	Keep sugar content of fruits and vegetables	Fertilizer, pants nutrient solution
	Improve survival rate and promote growth	Fish culture bait, insect bait, shellfish
	Improve meat and milk quality	Feed