Analysis on Unique Properties of Maltitol

Overview

Maltitol (1,4-O-α-D-glucopyranosyl-D-sorbitol, CAS: 585-88-6) is a naturally derived **di-alcohol (polyol)** with a structure formed by glucose and sorbitol linked via an α-1,4 glycosidic bond. Since the 1970s, it has been legally recognized by global authoritative institutions including China, the United States, the European Union and JECFA, classified as a safe bulking sweet raw material. It features core advantages such as **high sweetness close to sucrose, low calorie, low GI, excellent processing stability, strong moisture retention, anti-caries effect and calcium absorption promotion**. Currently, it is one of the mainstream sugar substitutes widely applied in the market, meeting dual demands of sugar control & weight loss and food quality improvement.

I. Physicochemical Properties

1. Basic Chemical Information

- Chinese Name: 麦芽糖醇
- English Name: Maltitol
- Molecular Formula: $C_{12}H_{24}O_{11}$
- Molecular Weight: 344.31
- Structure: Di-alcohol with multiple hydroxyl groups (-OH) in the molecule, composed of glucose and sorbitol
- Source: Industrially produced mainly from corn, potato and cassava starch. Starch is liquefied and saccharified to obtain maltose, followed by catalytic hydrogenation reduction and refining.

2. Sensory and Physical Properties

- Appearance: White crystalline powder or colorless transparent viscous liquid, odorless
- Sweetness: 75%–95% (relative to 100% of sucrose), with a taste similar to sucrose
- Sweetness Quality: Pure sweet taste without bitterness or metallic aftertaste, mild and non-irritating lingering taste
- Cooling Sensation: Mild heat absorption upon dissolution (dissolution heat: approx. -55 kJ/kg), weaker cooling sensation than xylitol
- Solubility: Highly soluble in water (solubility at 25℃ ≈ 150g/100mL), with clear aqueous solution and high viscosity
- Melting Point: 148℃–152℃
- Calorie Value: 2.1 kcal/g (8.79 kJ/g), approximately 52.5% of sucrose (4 kcal/g)

3. Stability

- Thermal Stability: Excellent heat resistance (stable below 220℃), suitable for high-temperature baking, cooking, pasteurization and UHT sterilization
- pH Stability: Broad stability within pH 3–9, adaptable to acidic, neutral and weakly alkaline food systems
- Maillard Reaction: Free of free aldehyde or ketone groups, free from Maillard browning, maintaining original

food color during processing

- Caramelization: Resistant to caramelization under high temperature with extremely weak coloring, ideal for light-colored baked goods and confectionery
- Hygroscopicity: Extremely strong moisture retention (superior to sorbitol and glycerin), delaying staling of baked products and extending shelf life
- Crystallinity: Moderate crystallinity; fine crystals precipitate from high-concentration solutions, applicable to the production of hard candy, chewing gum and chocolate

II. Functional Characteristics

1. Metabolic Traits: Low Metabolic Burden, Blood Sugar Stabilization, Non-insulin Dependent

- GI Value ≈ 35: Far lower than sucrose (GI=65), causing slight postprandial blood sugar fluctuation
- Absorption Mechanism: About 15%–20% absorbed in the small intestine, and the remaining part enters the large intestine for slow fermentation
- Non-insulin Dependence: Metabolism does not rely on insulin or stimulate insulin secretion, suitable for diabetic patients
- Non-cariogenic: Unable to be fermented and utilized by oral Streptococcus mutans, producing no acid and preventing enamel corrosion

2. Physiological Functions

(1) Blood Sugar and Metabolism Regulation (Sugar Control & Weight Loss Friendly)

- Low glycemic response and low insulin response with low and steadily declining postprandial blood sugar peak
- Applicable Crowds: Ideal sucrose substitute for type 1/type 2 diabetes, impaired glucose tolerance, obesity and weight management groups
- Fat Storage Inhibition: Reduces lipoprotein lipase (LPL) activity when consumed with fat, thereby decreasing fat accumulation

(2) High Intestinal Tolerance

- 15%–20% absorbed in the small intestine, 80%–85% fermented slowly in the large intestine
- Tolerance Dose: Adults have no obvious discomfort with daily intake ≤50–80g, higher than xylitol and erythritol
- Overdose Risk: Hyperosmotic abdominal distension and diarrhea with minor individual differences

(3) Oral Health (Strong Anti-caries Property)

- Powerful anti-caries effect: Inhibits oral pathogenic bacteria, reduces dental plaque and dextran synthesis, lowering caries incidence
- Applicable Scenarios: Preferred sweetener for sugar-free chewing gum, hard candy, chocolate and children's food

(4) Calcium Absorption Promotion (Unique Advantage)

- Enhances intestinal calcium absorption and calcium retention rate, increasing bone mass and bone strength
- Applicable Products: High-calcium yogurt, children's nutritional food and middle-aged & elderly calcium-supplementing food

(5) Liver Function Support

- Does not increase liver metabolic burden and assists in improving liver glycogen metabolism, suitable for patients with liver diseases

III. Unique Performance Advantages

1. Taste: Sucrose-grade Mild Sweetness with Wide Compatibility

- Sweetness close to sucrose with no peculiar odor; compounded with high-intensity sweeteners to improve bitter aftertaste and enhance taste mellowness
- Mild cooling sensation without the strong cooling effect of xylitol or residual cold taste of erythritol, more suitable for baked goods, soft candy and chocolate
- Mellow and rich taste with moderate viscosity, improving food fullness and smooth texture

2. Processing Performance: Superior Stability & Moisturization, Outstanding Quality Improvement

- Heat and acid resistance with anti-browning property: Maintains original color and flavor in high-temperature baked goods and acidic beverages, preventing yellowing and flavor deterioration
- Ultimate moisturizing capacity: Delays staling of bread, cakes and biscuits, maintains soft texture and extends shelf life by 2–3 times
- High viscosity adaptability: Improves consistency of beverages, syrups and sauces to optimize texture and mouthfeel
- Controllable crystallization: Fine crystals facilitate forming of chewing gum, hard candy and compressed candy, with anti-sticking and easy demolding properties

3. Health Value: Low-calorie & Sugar Control, Dental Protection & Calcium Enhancement, Weight-loss Friendly

- Low calorie (2.1 kcal/g): Reduces calorie intake by 47.5% compared with sucrose, bringing no burden for weight management
- Low GI and non-insulin dependent: Safe sucrose alternative for diabetics to stabilize postprandial blood sugar
- Dental protection and calcium absorption promotion: Dual benefits for oral and bone health, optimal choice for children and middle-aged & elderly food
- Fat accumulation inhibition: Reduces fat storage when paired with high-fat food to assist weight management

4. Regulation & Safety

- China (1990): Compliant with **GB 2760**, allowed for use in appropriate amounts according to production requirements
- United States (1987): FDA GRAS certified, permitted in all types of food and nutritional supplements
- JECFA (1985): No specific ADI value required with top-grade safety
- EU EFSA (2008): Verified anti-caries and calcium absorption enhancing effects, authorized corresponding health claims
- Toxicology: LD_{50} > 10g/kg bw (oral administration in rats), practically non-toxic and safe for long-term consumption

IV. Summary

Maltitol is an all-round sugar substitute featuring natural derivation, sucrose-grade mild taste, low calorie, low GI, strong moisture retention, anti-caries property and calcium absorption promotion. With combined strengths of pure sweet taste, mild flavor, sugar control & weight loss, processing stability, dental protection and calcium enhancement, it serves as a mainstream sweetening and quality improvement solution for sugar-free baked goods, confectionery & chocolate, beverages & sauces, diabetic-specific food and children's nutritional food. Among all sugar alcohols, it delivers the widest application coverage and the best comprehensive performance balance.