Operation Guidelines for Xylitol Addition Methods in Application Fields

I. General Provisions

1.1 Basic Information

Xylitol (CNS: 19.007, INS: 967, CAS: 87-99-0) is a five-carbon sugar alcohol. It naturally exists in fruits, vegetables and plants such as strawberries, spinach and birch, and also serves as an intermediate in human carbohydrate metabolism.

- **Sweetness**: Approximately 90%~100% of sucrose, with pure taste and no after-bitterness.
- **Energy Coefficient**: About 2.4kJ/g (60% of sucrose).
- **Solubility**: Highly soluble in water (solubility ≈ 60g/100mL at 25°C), endothermic upon dissolution with a refreshing cooling sensation in aqueous solution.
- **Core Characteristics**: Low glycemic index (GI≈7), insulin-independent metabolism, anti-caries, high stability, excellent moisture retention and starch retrogradation inhibition.

1.2 Authoritative Compliance Basis

★ China (National Health Commission / GB 2760-2024)

- Approved as a sweetener for appropriate addition in all food categories as required by production, with no daily intake limit.
- National Food Safety Standard: GB 1886.234-2016 *National Food Safety Standard – Food Additive: Xylitol*.

★ International Authoritative Certification

- US FDA: Granted GRAS certification and approved for use in all food categories.
- EU EFSA: Established unrestricted ADI values and confirmed its safety.
- JECFA, Australia & New Zealand, Japan, South Korea, Canada and other authorities have approved its widespread application and included it in food additive standards.

★ Population Applicability

- No specific contraindicated groups; safe for normal consumption by infants, pregnant women, lactating women and diabetic populations. The recommended daily intake for adults is **≤30g** to prevent gastrointestinal discomfort caused by excessive consumption.

1.3 Operation Principles

- **Compliance Priority**: Strictly comply with GB 1886.234 and GB 2760 standards, and add appropriately according to production demands.
- **Characteristic Adaptation**: Match production processes based on the properties of low glycemic response, anti-caries, moisture retention and high stability.
- **Gradient Test**: Start with **30%~70%** sucrose substitution and verify through lab trial → pilot test → mass production.
- **Tolerance Control**: Single intake for adults shall be **≤0.5g/kg·bw** to avoid abdominal distension and diarrhea caused by overconsumption.
- **Label Specification**: Clearly mark xylitol in the ingredient list; eligible claims include "low calorie", "anti-caries" and "suitable for diabetic populations".

II. Physicochemical Properties & Basic Addition Parameters

2.1 Key Physicochemical Parameters

- **Sweetness Equivalent**: 1.0g Xylitol ≈ 0.9~1.0g Sucrose, with a 1:1 conversion ratio for formula substitution.
- **Thermal Stability**: Stable below 200℃; no decomposition, discoloration or peculiar odor during high-temperature baking and sugar boiling.
- **Maillard Reaction**: Resistant to Maillard reaction, presenting light color in baked goods and assisting in browning degree regulation.
- **Freezing Point Regulation**: Freezing point reduction capacity reaches 80% of sucrose, refining ice crystals and delivering dense texture in ice cream products.
- **Hygroscopicity**: Crystalline form is hygroscopic (moisture absorption rate ≈ 5% at 25℃/75% RH); sealed storage is required to prevent caking.
- **pH Stability**: Stable within pH 3~10, compatible with the full system of beverages, baked goods and dairy products.

2.2 Basic Addition Methods

- **Direct Powder Addition**: Applicable to baked goods, tablet candies and solid beverages. Sift through 80~100 mesh and pre-mix evenly with powder raw materials.
- **Aqueous Solution Addition**: Dissolve under stirring at normal temperature to 60℃ (40%~60% syrup) for application in beverages, dairy products and sauces.
- **Compound Addition**: Compound with erythritol, maltitol, steviol glycosides and sucralose to optimize taste and adjust texture.
- **Stepwise Addition**: Add in batches during baking and confectionery production to improve mixing uniformity and product stability.

III. Addition Methods for Various Food Categories

3.1 Beverages (Carbonated / Fruit Juice / Protein / Functional Drinks)

- **Dosage**: 2%~8% based on finished product mass; increased to 5%~12% for sugar-free beverages.
- **Application Method**: Dissolve in warm water at 50℃ to prepare 50% syrup, filter and add to the batching tank; avoid prolonged high-temperature heating.
- **Process Key Points**: Good compatibility with citric acid and vitamin C to enhance freshness; control pressure in carbonated beverages to prevent carbonation loss.

3.2 Baked Goods (Biscuits / Cakes / Bread / Pastries)

- **Dosage**: 5%~20% based on flour mass; increased to 15%~30% for sugar-free baked products.
- **Application Method**: Pre-mix sieved powder with flour and leavening agents, or dissolve in water/milk before adding to dough to control dough moisture.
- **Process Key Points**: Inhibit starch retrogradation and extend shelf life; improve moisture retention by blending with butter and eggs to prevent product cracking.

3.3 Confectionery (Hard Candy / Gummy / Chewing Gum / Chocolate)

- **Dosage**: 10%~50% for hard candy, 30%~60% for chewing gum, 5%~15% for chocolate.
- **Application Method**: Control sugar boiling temperature **≤140℃** for hard candy to prevent darkening; mix evenly with gum base for chewing gum and control humidity **≤50%**.
- **Process Key Points**: Provide cooling sensation and anti-caries effect; compound with gelatin and pectin in gummies to improve elasticity and chewiness.

3.4 Dairy Products (Yogurt / Modified Milk / Dairy Drinks / Ice Cream)

- **Dosage**: 1%~5% for yogurt, 3%~12% for ice cream, 2%~6% for dairy drinks.
- **Application Method**: Add before or after yogurt fermentation without affecting lactic acid bacteria activity; add during the aging stage of ice cream, followed by homogenization and cooling.
- **Process Key Points**: Reduce whey precipitation and enhance product stability; inhibit large ice crystal formation in ice cream for fine texture without ice residue.

3.5 Other Foods (Jam / Sauces / Solid Beverages / Health Products)

- **Jam & Sauces**: Dosage 3%~15% to improve viscosity, extend shelf life and inhibit microbial reproduction.
- **Solid Beverages**: Dosage 10%~30%; mix powder evenly and sift to prevent caking and enhance instant solubility.
- **Health Products**: Dosage 5%~20%; compound with functional ingredients (vitamins, dietary fiber), low in calories and suitable for sugar-controlled populations.

IV. Compound Formulation & Application Principles

4.1 Classic Compound Formulas

- **Xylitol + Erythritol (Ratio: 1:1~3:1)**

Advantages: Balance sweetness and calories, optimize taste and reduce hygroscopicity; suitable for baked goods, ice cream and confectionery.

- **Xylitol + Maltitol (Ratio: 2:1~4:1)**

Advantages: Enhance texture and moisture retention, inhibit crystallization; suitable for hard candy, gummies and baked foods.

- **Xylitol + Steviol Glycosides / Mogroside (Ratio: 99:1~99.5:0.5)**

Advantages: Low calorie, sucrose-like sweetness and elimination of after-bitterness; suitable for beverages, solid beverages and sugar-free foods.

- **Xylitol + Polydextrose / Soluble Fiber (Ratio: 3:1~5:1)**

Advantages: Fortify dietary fiber, improve texture and reduce calories; suitable for yogurt, baked goods and health products.

4.2 Compound Addition Principles

- **Adding Sequence**: Dissolve xylitol first → add high-intensity sweeteners secondly → finally incorporate stabilizers and flavor substances.
- **High-Intensity Sweetener Control**: The sweetness proportion of high-intensity sweeteners shall be **≤3%** to avoid bitterness, metallic taste and abnormal aftertaste.
- **Gradient Verification**: Conduct mass production only after passing sensory, physicochemical and stability tests with 20%/40%/60% substitution gradients.

V. Quality Control & Safety Specifications

5.1 Raw Material Quality Standards (GB 1886.234-2016)

- Xylitol content (dry basis): 98.5%~101.0%; loss on drying **≤0.50%**; ignition residue **≤0.10%**.
- Heavy Metals: Pb **≤1.0mg/kg**, Ni **≤1.0mg/kg**; Microorganisms: total bacterial count **≤100CFU/g**, coliform negative.
- Appearance: White crystal or powder, odorless, impurity-free, non-caking and hygroscopic.

5.2 Production Process Control

- **Batching**: Precise weighing by electronic scale with error **≤±0.5%**; sift powder through 80~100 mesh and filter liquid to remove impurities.
- **Mixing**: Ensure no caking and segregation with uniformity RSD **≤3%**.
- **Heating**: Real-time temperature monitoring; baking temperature **≤200℃** and sugar boiling temperature **≤140℃**, over-temperature is strictly prohibited.
- **Cooling**: Rapid cooling within **≤30min** to prevent moisture absorption, crystallization and flavor attenuation.

5.3 Finished Product Inspection & Storage

- **Finished Product Inspection**: Test items include content, moisture, pH, color, flavor, microorganisms and gastrointestinal tolerance assessment.
- **Storage Conditions**: Sealed, cool and dry environment with temperature **≤25℃** and humidity **≤60%**; shelf life: 18~24 months.
- **Transportation**: Protect from sunlight, moisture and rain; mixed transportation with toxic and harmful substances is forbidden to prevent extrusion and damage.

VI. Common Problems & Solutions

Problem	Cause	Solution
Overly light color and lack of caramel flavor in baked goods	Weak Maillard reaction	Compound with 5%~10% maltitol, extend baking time or appropriately raise temperature
Grainy texture and excessive ice crystals in ice cream	Insufficient freezing point reduction effect	Compound with 3%~5% erythritol/maltitol and prolong aging time ≥8h
Weak sweetness and bland taste in beverages	Sweetness equivalent to about 90% of sucrose	Adopt 1:0.9~1:1 substitution ratio and add a small amount of high-intensity sweeteners (≤0.5%)
Sticky and hygroscopic chewing gum	Excessive ambient humidity or xylitol hygroscopicity	Control production humidity ≤50%, add 1%~2% magnesium stearate and adopt sealed packaging
Abdominal distension, diarrhea and borborygmus after consumption	Excessive single intake (> 0.5g/kg·bw)	Strictly limit single dose ≤0.5g/kg·bw, take in divided doses and achieve gradual adaptation
Caking and poor fluidity of solid beverages	Moisture absorption or uneven mixing	Dry raw materials (moisture ≤0.5%), fully sieve and add 0.5%~1% silicon dioxide
Easy crystallization and coarse texture of confectionery	Strong crystallinity of xylitol	Compound with 10%~20% maltitol and control sugar boiling temperature & cooling rate

VII. Labeling Specifications

1. Clearly mark **"Xylitol"** in the ingredient list (CNS 19.007 / INS 967).
2. Compliant optional claims: *Low Calorie*, *Anti-Caries*, *Low Glycemic*, *Suitable for Diabetic Populations*.
3. Nutrition Facts: Label energy at 2.4kJ/g and clearly indicate carbohydrates and sugar content.
4. No mandatory labeling of unsuitable groups and daily limits required by authoritative standards; optional marking: *Recommended daily intake for adults: ≤30g*.