Operating Guidelines for Xylo-oligosaccharide Addition in Application Fields

1 General Provisions

1.1 Purpose

To standardize the addition methods, operating procedures, dosage control and quality assurance of xylo-oligosaccharide in various application fields, ensure products meet process requirements, nutritional claims and relevant regulatory standards, improve production efficiency, reduce production risks, guarantee stable product quality, give full play to the prebiotic and functional properties of xylo-oligosaccharide, and balance product taste and health value.

1.2 Scope of Application

This guideline applies to all production links using xylo-oligosaccharide as a raw material in food, health food, feed and pet food, covering a full range of application fields including beverages, dairy products, baked goods, meat products, confectionery, frozen food, condiments, health food, feed/pet food. It is intended for production operators, technicians, quality inspectors and relevant training purposes.

1.3 Reference Standards

Formulated in accordance with *National Food Safety Standard Standard for the Use of Food Additives* (GB 2760-2024), *National Food Safety Standard Dietary Fiber* (GB 28050), *Xylo-oligosaccharide* (GB/T 35544-2017), *Feed Additive Xylo-oligosaccharide* (NY/T 2334-2013) and production process specifications of related products, combined with the product characteristics of xylo-oligosaccharide.

2 Basic Characteristics of Xylo-oligosaccharide

The core prerequisite for guiding xylo-oligosaccharide addition is to master its inherent characteristics, which determine the addition process, timing and dosage, as detailed below:

2.1 Physicochemical Characteristics

- Solubility and Dispersibility: Highly soluble in water, can be added directly as dry powder or dissolved in warm water; excellent dispersibility, not easy to agglomerate, shear-resistant, compatible with various food processing processes such as homogenization, emulsification and stirring. A 10% aqueous solution is colorless and transparent, free of precipitation and odor.
- Thermal Stability and Acid Stability: Excellent high-temperature resistance, can withstand baking, sugar cooking, extrusion, high-temperature sterilization (121℃, 30min) and other processes without easy decomposition; extremely strong acid resistance, stable in systems with pH≥2.5, suitable for various acidic products such as fruit juice, yogurt and fruit vinegar, with optimal activity maintained at pH 3.0–7.0.
- Basic Parameters: Degree of polymerization 2–7 (calculated as xylose units), dietary fiber content ≥95%,

calorific value approx. 1.2 kcal/g (1/4 of sucrose, 1/7 of fat), sweetness 0.2–0.4 times that of sucrose, low hygroscopicity, pH value of 10% aqueous solution 4.5–6.5, refreshing taste with no irritating off-odor, compatible with various raw materials.

2.2 Core Functional Characteristics

- Dietary Fiber Fortification: Serves as a high-quality source of water-soluble dietary fiber, meeting nutritional claims such as "high fiber" and "contains dietary fiber". It does not affect the original taste and flavor of products after addition, suitable for the R&D of various low-sugar and healthy products.
- Texture Modification: Exhibits mild thickening, stabilizing, moisturizing, anti-aging and ice crystal growth inhibition effects, improving product taste and texture, enhancing system stability, reducing syneresis and layering, and extending shelf life.
- Health Functions: Low calorie and low sweetness, can replace part of sugar and fat to achieve low-sugar, low-fat and low-calorie product positioning; core prebiotic function, selectively proliferates beneficial bacteria such as intestinal Bifidobacterium and Lactobacillus, inhibits harmful bacteria such as Escherichia coli, regulates intestinal flora balance, promotes intestinal peristalsis, and is not easily decomposed by human digestive enzymes, suitable for functional product development.
- Process Compatibility: Extremely high compatibility, can be compounded with sugar alcohols, sugar substitutes, colloids, starches, probiotics and other raw materials without affecting the functions of other raw materials; compatible with production processes of various foods, health foods and feeds, with no significant impact on the fermentation efficiency of fermented products.

2.3 Safety and Compliance Requirements

Xylo-oligosaccharide is a nationally permitted food additive (functional categories: dietary fiber, prebiotic), complying with GB 2760-2024, used in an appropriate amount as required for production with no general limit requirements; applicable to infant food, health food, ordinary food and feed/pet food. Addition in infant food shall comply with GB 28050 and *National Food Safety Standard Infant Formula Food* (GB 10765-2021); feed-grade xylo-oligosaccharide shall meet NY/T 2334-2013 to ensure compliant use. The nutritional label of finished products shall be consistent with the actual addition amount during use, and false claims are strictly prohibited.

3 General Specifications for Addition Process

In all application fields, xylo-oligosaccharide addition shall comply with the following general specifications to ensure uniform addition, full dissolution, no impact on product quality, and full retention of its prebiotic function.

3.1 Pretreatment and Dissolution Methods

- Direct Dry Powder Addition: Applicable to solid mixed products (e.g., baking flour, solid beverages,

compressed tablets, pet pellet feed). Operation key points: Pre-mix xylo-oligosaccharide evenly with other dry powder raw materials (flour, maltodextrin, sugar substitutes, etc.) in advance, with a recommended pre-mixing time of no less than 5 minutes to ensure uniform dispersion and avoid local agglomeration before subsequent processing. Mixing uniformity can be sampled and tested after pre-mixing, and use is allowed only after meeting standards.

- Aqueous Solution Preparation: Applicable to liquid and emulsified products (e.g., beverages, dairy products, sauces, ice cream). Operation key points: Dissolve xylo-oligosaccharide in warm water at 40–55℃ at a ratio of 1:2.8–3.5 (xylo-oligosaccharide: softened water), stir for 15–25 minutes until the solution is completely clear, filter through 80–120 mesh before use to remove undissolved particles and impurities and avoid affecting product taste and appearance; use promptly after dissolution to prevent microbial growth from prolonged standing.
- Compounding Principles: Prioritize compounding with sugar alcohols (e.g., sorbitol, maltitol), sugar substitutes (e.g., steviol glycosides, erythritol) and colloids (e.g., xanthan gum, pectin) to enhance functional effects and system stability; avoid direct contact with strong oxidants and high-concentration heavy metal ions; in strongly acidic systems with pH<2.5, verify the stability of xylo-oligosaccharide in advance, adjust pH or select refined-grade products if necessary.

3.2 General Key Points for Addition Procedures

- Addition Timing: Select an appropriate addition node according to product process characteristics, with the core principle of "ensuring full dissolution/dispersion and avoiding functional loss from prolonged high-temperature heating". For probiotic products, addition at low-temperature stage (≤40℃) is recommended; for fermented products, addition in the late fermentation stage is recommended.
- Stirring Requirements: Stir thoroughly after addition; stirring speed for liquid systems controlled at 800–1200 r/min, stirring time no less than 10 minutes; stir solid systems until no obvious agglomeration and uniform mixing, ensuring consistent distribution of xylo-oligosaccharide in the system to avoid local high concentration affecting product quality.
- Metering Requirements: Adopt precision metering equipment (electronic scales, metering pumps, etc.), strictly control addition amount per formula requirements with metering error not exceeding ±1% to avoid abnormal product quality, inconsistent nutritional claims or insufficient prebiotic function caused by metering deviation; calibrate metering equipment regularly to ensure accurate measurement.

3.3 General Quality Control Standards

- Solubility: Solution is clear and transparent after dissolution, free of precipitation and visible particles; no agglomeration of xylo-oligosaccharide in solid products, mixing uniformity meets relevant standards (coefficient of variation ≤5%).

- Sensory Requirements: Does not affect the original flavor and color of products after addition, no off-odor or abnormal color change; can moderately enhance refreshing taste and relieve sweet or salty greasiness.
- Nutritional Control: Dietary fiber content of finished products meets formula requirements and nutritional label specifications; prebiotic products shall ensure the effective content of xylo-oligosaccharide meets standards (≥80%), ensuring authentic and valid claims such as "high fiber", "contains dietary fiber" and "prebiotic", with false labeling strictly prohibited.

4 Field-Specific Process Guidance for Addition

Combined with product characteristics and production processes in each application field, the addition amount, addition procedures, operation key points and functional objectives of xylo-oligosaccharide are specified to ensure direct implementation of guidance and full play of its prebiotic and functional value.

4.1 Beverages (Liquid Beverages, Solid Beverages)

4.1.1 Applicable Products

Fruit juice drinks, carbonated drinks, sports drinks, functional drinks, solid beverages, meal replacement powder, fruit vinegar drinks, plant protein drinks, etc.

4.1.2 Addition Amount

Liquid beverages: 0.5%–4%; solid beverages: 5%–22% (based on total formula mass). Prebiotic functional drinks can be appropriately increased to 2.5%–7%, and addition amount for acidic drinks such as fruit vinegar is controlled at 0.5%–3%.

4.1.3 Addition Procedures and Operation Key Points

- Liquid Beverages: Add in the batching stage. First dissolve xylo-oligosaccharide in warm water at 40–55℃ at a ratio of 1:2.8–3.5, filter and add to the batching tank, mix evenly with sweeteners, stabilizers, flavors, fruit juice and other raw materials, homogenize (pressure 18–28 MPa), then enter the sterilization process (pasteurization or UHT sterilization). UHT sterilization temperature is controlled within 135℃ for no more than 5 seconds to avoid damage to prebiotic function from prolonged high-temperature heating; adjust pH to ≥2.5 for acidic drinks before adding xylo-oligosaccharide.
- Solid Beverages: Add in the dry mixing stage. Pre-mix xylo-oligosaccharide evenly with dry powder raw materials such as maltodextrin, sugar substitutes, vitamins and minerals for no less than 5 minutes, then proceed to granulation, drying, tableting and other subsequent processes. Properly increase warm water dosage during granulation to ensure good solubility and no agglomeration, with no precipitation after finished product dissolution.

4.1.4 Functional Objectives and Precautions

Functional Objectives: Fortify dietary fiber content, exert prebiotic effects, improve beverage taste (enhance refreshment), reduce product calorie and sweetness, adapt to "sugar-free/low-sugar" and "prebiotic" product

positioning, enhance system stability and reduce syneresis of liquid beverages.

Precautions: Complete dissolution of xylo-oligosaccharide before carbonation for carbonated drinks to avoid affecting carbonation effect and product taste; select refined-grade xylo-oligosaccharide for acidic drinks (pH<2.5) to prevent sour taste or functional loss; control sterilization temperature and time for prebiotic drinks to retain xylo-oligosaccharide activity to the greatest extent; test mixing uniformity after pre-mixing of solid beverages to ensure consistent quality of each batch.

4.2 Dairy Products (Liquid Milk, Yogurt, Milk Powder, Soy Milk)

4.2.1 Applicable Products

Pure milk, flavored milk, fermented yogurt, yogurt drinks, infant milk powder, middle-aged and elderly milk powder, soy milk, cheese, milk drinks, etc.

4.2.2 Addition Amount

0.5%–5% (based on total formula mass). Addition amount for infant milk powder is controlled at 0.8%–2.5%, fermented yogurt can be increased to 2.5%–7%, and yogurt drinks at 1%–4%.

4.2.3 Addition Procedures and Operation Key Points

- Liquid Milk/Soy Milk: Add in the batching stage. Dissolve xylo-oligosaccharide and add to the batching tank, mix evenly with milk/soy milk, stabilizers and sweeteners, homogenize (pressure 22–32 MPa), sterilize, then enter the filling process. Sterilization temperature is controlled within 121℃ for no more than 30 minutes to avoid high-temperature damage to xylo-oligosaccharide activity.
- Yogurt/Milk Drinks: Prioritize addition after fermentation. After fermentation, mix dissolved xylo-oligosaccharide evenly with yogurt, homogenize and fill to avoid affecting probiotic activity if added before fermentation; if addition before fermentation is required, control addition amount within 4% and add separately from fermentation strains to reduce impact on fermentation efficiency, with fermentation temperature controlled at 42–45℃.
- Milk Powder: Add in the dry mixing stage. Pre-mix xylo-oligosaccharide evenly with milk powder, maltodextrin, nutritional fortifiers and other dry powders, test mixing uniformity (coefficient of variation ≤5%) after pre-mixing to meet standards, then package after spray drying or mixing. Control ambient humidity ≤60% during packaging to avoid moisture absorption and agglomeration.

4.2.4 Functional Objectives and Precautions

Functional Objectives: Synergize with probiotics to regulate intestinal health, fortify dietary fiber content, enhance nutritional label value of products, improve dairy product taste (relieve sweet greasiness) and stability, extend shelf life, adapt to "prebiotic" and "high fiber" dairy product positioning, especially suitable for intestinal-sensitive groups such as the elderly and infants.

Precautions: Control xylo-oligosaccharide addition amount within 4% when adding before fermentation to avoid affecting fermentation efficiency and yogurt consistency; test mixing uniformity after pre-mixing in milk powder

production to ensure consistent batch quality; strictly follow GB 28050 and *National Food Safety Standard Infant Formula Food* (GB 10765-2021) for addition in infant milk powder, with excessive addition strictly prohibited; add xylo-oligosaccharide in the late curdling stage during cheese production to avoid affecting curdling effect.

4.3 Baked Goods (Bread, Pastries, Biscuits, Dried Noodles)

4.3.1 Applicable Products

Toast bread, cakes, biscuits, mooncakes, dried noodles, steamed buns, pastry fillings, etc.

4.3.2 Addition Amount

0.5%–10% (based on flour mass), can replace 5%–20% of flour or sugar. Addition amount for pastry fillings can be increased to 7%–14%, and biscuits at 1%–8%.

4.3.3 Addition Procedures and Operation Key Points

- Bread/Cake: Add in the flour stage. Dry-mix xylo-oligosaccharide evenly with flour, yeast, sugar, oil and other raw materials, then add water, egg liquid and other ingredients for dough mixing. Control dough mixing temperature at 28–32℃, adjust fermentation time per original process (can appropriately shorten fermentation time by 10%–15%). Baking temperature 170–210℃, baking time adjusted according to product size; avoid prolonged high-temperature baking (temperature not exceeding 220℃) to prevent caramelization of xylo-oligosaccharide.
- Biscuits: Add in the dry mixing stage. Pre-mix xylo-oligosaccharide evenly with flour, butter, sugar, leavening agents, etc., add a small amount of water to knead into dough, rest, sheet and shape. Baking temperature 150–170℃, baking time 8–15 minutes to ensure crispness, avoiding softness and stickiness caused by excessive addition.
- Dried Noodles: Pre-mix evenly with flour and starch, add appropriate water to knead into dough, roll, cut, dry and package. Drying temperature controlled at 60–80℃, which can improve toughness, reduce breakage and gelatinization during cooking, enhance taste and extend cooking time.

4.3.4 Functional Objectives and Precautions

Functional Objectives: Improve dough water retention and fermentation performance, make finished products soft, delay staling and extend shelf life; reduce product calorie and sweetness, fortify dietary fiber content, improve taste and texture, adapt to "low-sugar" and "high fiber" baked product positioning, reduce syneresis of pastry fillings.

Precautions: Appropriately adjust water volume and dough mixing time when addition amount exceeds 10% to avoid overly dry or sticky dough; compound with colloids (pectin, xanthan gum) in biscuit production to enhance crispness; baking temperature shall not exceed 220℃ to avoid caramelization affecting taste and function; dissolve xylo-oligosaccharide first before mixing with filling raw materials for pastry fillings to ensure uniform dispersion.

4.4 Meat Products (Ham, Sausage, Canned Meat, Fillings)

4.4.1 Applicable Products

Low-temperature ham, high-temperature sausage, canned meat, meatballs, dumpling fillings, bun fillings, etc.

4.4.2 Addition Amount

2%–20% (based on meat paste mass). Can appropriately increase dosage (not exceeding 23%) as a fat substitute, fillings at 4%–14%, low-temperature ham at 3%–8%.

4.4.3 Addition Procedures and Operation Key Points

- Ham/Sausage: Add in the chopping/emulsification stage. Put meat paste into a chopper, chop at medium-high speed to a viscous state, add dissolved xylo-oligosaccharide solution, continue chopping for 6–12 minutes to fully emulsify with meat paste, then add other auxiliary materials (salt, soy sauce, spices, etc.), chop evenly, enema and sterilize. Sterilization temperature controlled within 121℃ for no more than 30 minutes, chopping temperature ≤10℃.
- Canned Meat/Meatballs: Add in the emulsification stage. Mix meat paste, xylo-oligosaccharide, starch, salt and other ingredients, emulsify with an emulsifier, shape, cook and sterilize. Cooking temperature 95–100℃, time 15–25 minutes, which can reduce water loss during cooking, improve tenderness and yield.
- Fillings: Mix evenly with meat, vegetables, starch and other raw materials, add appropriate water and stir to viscosity to enhance water retention and formability, avoid water release during cooking, improve taste and reduce greasiness.

4.4.4 Functional Objectives and Precautions

Functional Objectives: Serve as a water-retaining agent and fat substitute to reduce water and fat loss during cooking and freezing, improve product tenderness and yield, achieve low-fat positioning; fortify dietary fiber content, exert mild prebiotic effects, enhance health attributes, improve meat product taste and relieve greasiness.

Precautions: Control chopping temperature ≤10℃ to avoid meat paste deterioration; adjust addition amount according to fat content of meat, appropriately increase dosage when fat content is low; avoid excessively long sterilization time to prevent affecting xylo-oligosaccharide function and product taste; fully mix xylo-oligosaccharide with raw materials in filling production to avoid abnormal taste caused by local agglomeration.

4.5 Confectionery/Chocolate (Hard Candy, Soft Candy, Gum Base Candy, Chocolate)

4.5.1 Applicable Products

Hard candy, soft candy, nougat, gum base candy, chocolate, jelly, etc.

4.5.2 Addition Amount

Hard/soft candy: 2%–10%; gum base candy/jelly: 8%–14%; chocolate: 5%–10% (based on total formula mass). Sugar-free candy can be increased to 7%–13%.

4.5.3 Addition Procedures and Operation Key Points

- Hard/Soft Candy: Add in the sugar cooking stage. Heat sugar and water to boiling, add xylo-oligosaccharide

and sugar alcohols (e.g., sorbitol, maltitol), continue cooking to specified temperature (hard candy 145–155℃, soft candy 105–115℃), stir evenly, cool and shape. Inhibits sugar crystallization, improves transparency and toughness; compound with pectin in soft candy production to enhance gel stability.

- Gum Base Candy: Add after gum base softening. Heat and soften gum base (temperature 60–80℃), add xylo-oligosaccharide, sweeteners, flavors, etc., mix evenly, tablet and shape to enhance chewiness and refreshing taste, relieve sweet greasiness and extend oral aftertaste.
- Chocolate: Add after cocoa butter melting. Melt and mix cocoa butter, cocoa powder and sugar, add xylo-oligosaccharide, stir evenly, homogenize, temper, shape and cool. Replaces part of cocoa butter and sugar, reduces calorie and sweetness, improves fineness and prevents blooming.

4.5.4 Functional Objectives and Precautions

Functional Objectives: Inhibit sugar crystallization, improve product taste (enhance chewiness, fineness, refreshment), reduce sweetness and calories, fortify dietary fiber content, exert prebiotic effects, adapt to "sugar-free/low-sugar" and "prebiotic" confectionery positioning, extend shelf life.

Precautions: Control temperature and time during sugar cooking to avoid xylo-oligosaccharide caramelization (temperature not exceeding 160℃); fully dissolve xylo-oligosaccharide in chocolate production to avoid affecting gloss and taste; compound with pectin in soft candy production to enhance gel stability; avoid excessive addition of xylo-oligosaccharide in gum base candy production to prevent affecting gum base toughness.

4.6 Frozen Food (Ice Cream, Sorbet, Frozen Dough)

4.6.1 Applicable Products

Ice cream, sorbet, frozen glutinous rice balls, frozen dumplings, frozen bread dough, etc.

4.6.2 Addition Amount

0.5%–5% (based on total formula mass). Ice cream can be increased to 2.5%–7%, frozen dough at 0.8%–4%, frozen glutinous rice balls at 1%–3%.

4.6.3 Addition Procedures and Operation Key Points

- Ice Cream/Sorbet: Add in the batching stage. Dissolve xylo-oligosaccharide and add to the batching tank, mix evenly with milk, cream, sugar, stabilizers and other raw materials, homogenize (pressure 18–28 MPa), sterilize, cool, age (4–6℃, 4–8 hours), freeze, then fill and frozen storage. Effectively inhibits ice crystal growth, improves fineness and reduces ice crystals.
- Frozen Dough: Add in the dry mixing stage. Pre-mix xylo-oligosaccharide evenly with flour, yeast, sugar, oil and other raw materials, add water to knead dough, shape and quick-freeze (temperature ≤-18℃). Enhances dough water retention, inhibits ice crystal formation during freezing, ensures stable quality and good fermentation performance after thawing, reduces dough cracking.
- Frozen Glutinous Rice Balls/Dumplings: Add in fillings or dough. Dissolve xylo-oligosaccharide first for filling addition and mix evenly with fillings; pre-mix with flour for dough addition to improve toughness

of wrappers, avoid breakage during freezing and cooking, and enhance taste.

4.6.4 Functional Objectives and Precautions

Functional Objectives: Inhibit ice crystal growth, improve product fineness and taste, reduce quality loss during freezing/thawing, extend shelf life; reduce fat usage to achieve low-fat positioning, fortify dietary fiber content, exert prebiotic effects and improve texture stability of frozen food.

Precautions: Ensure sufficient aging time for ice cream to achieve full integration of xylo-oligosaccharide with other raw materials; control frozen dough temperature below -18℃ to avoid repeated thawing; compound xylo-oligosaccharide with stabilizers in ice cream production to enhance system stability; avoid excessive addition in frozen glutinous rice ball and dumpling production to prevent affecting wrapper toughness and taste.

4.7 Condiments (Sauces, Hot Pot Base, Soup Mix, Soy Sauce)

4.7.1 Applicable Products

Tomato sauce, salad dressing, hot pot base, soup mix, soy sauce, oyster sauce, seasoning sauce, etc.

4.7.2 Addition Amount

5%–16% (based on total formula mass). Soup mix and soy sauce at 4%–10%, hot pot base can be increased to 9%–18%, salad dressing at 6%–14%.

4.7.3 Addition Procedures and Operation Key Points

- Sauces/Hot Pot Base: Add in the emulsification stage. Put oil, water and sauce base into an emulsifier, emulsify at medium-high speed, add dissolved xylo-oligosaccharide solution, continue emulsifying for 12–18 minutes, add spices, salt and other auxiliary materials, stir evenly, sterilize and fill. Sterilization temperature controlled within 121℃ for no more than 20 minutes to ensure stable system without layering.
- Soup Mix/Soy Sauce: Add in the batching stage. Dissolve xylo-oligosaccharide and add to soup mix tank or soy sauce fermentation tank, mix evenly with other raw materials, cook, filter, sterilize and package. Add fermented products such as soy sauce in the late fermentation stage to avoid affecting fermentation process and flavor, enhance flavor fullness and fiber content, relieve salty greasiness of sauces and soy sauce.

4.7.4 Functional Objectives and Precautions

Functional Objectives: Thicken and stabilize the system, improve water retention and clinginess, enhance taste (relieve salty greasiness), fortify dietary fiber content, improve health attributes, extend shelf life and prevent sauce layering and syneresis.

Precautions: Control emulsification temperature and speed in sauce production to avoid system layering; add fermented products such as soy sauce in the late fermentation stage to prevent affecting fermentation and flavor; compound xylo-oligosaccharide with colloids in hot pot base to enhance viscosity and stability; prepare xylo-oligosaccharide as dry powder for soup mix production and pre-mix evenly with other raw materials to ensure full dissolution after brewing.

4.8 Health Food (Capsules, Tablets, Granules, Oral Liquids)

4.8.1 Applicable Products

Dietary fiber capsules, dietary fiber tablets, meal replacement granules, intestinal health oral liquids, prebiotic preparations, etc.

4.8.2 Addition Amount

0.5%–55% (based on total formula mass). Daily intake controlled at 2–8 g, prebiotic preparations can be increased to 35%–55%, meal replacement granules at 8%–20%.

4.8.3 Addition Procedures and Operation Key Points

- Capsules/Tablets: Add in the dry mixing stage. Pre-mix xylo-oligosaccharide evenly with other auxiliary materials (microcrystalline cellulose, magnesium stearate, etc.), granulate, dry, then tablet or fill capsules. Ensure good formability, disintegration time meets health food specifications (tablet disintegration time ≤30 minutes, capsule disintegration time ≤60 minutes), and mixing uniformity meets standards.
- Granules/Oral Liquids: Process granules per solid beverage process, pre-mix evenly with other dry powders to ensure good solubility and no precipitation after brewing; process oral liquids per liquid process, dissolve and filter xylo-oligosaccharide, add to batching tank, mix evenly with other functional ingredients (e.g., probiotics, vitamins), homogenize, sterilize and fill. Sterilization temperature controlled within 100℃ to avoid damaging functional ingredients, pH controlled at 4.5–6.5.

4.8.4 Functional Objectives and Precautions

Functional Objectives: Supplement dietary fiber, exert prebiotic effects, regulate intestinal health, assist in sugar and lipid control, improve intestinal peristalsis, adapt to positioning of dietary fiber supplement and intestinal health health food, meet health needs of specific groups.

Precautions: Strictly control addition amount to ensure daily intake complies with health food specifications, avoid intestinal discomfort (e.g., bloating, diarrhea) caused by excessive addition; adjust xylo-oligosaccharide dosage in tablet production to ensure hardness and disintegration time meet standards; avoid direct mixing with strongly acidic ingredients in oral liquid production to prevent functional loss; crush xylo-oligosaccharide to above 80 mesh for capsule production to ensure uniform filling.

4.9 Feed/Pet Food (Pellet Feed, Pet Dry Food, Pet Wet Food)

4.9.1 Applicable Products

Livestock and poultry pellet feed, aquatic feed, pet dry food, pet wet food, pet snacks, etc.

4.9.2 Addition Amount

1.2%–10% (based on total formula mass). Livestock and poultry feed at 1.2%–7%, pet food can be increased to 4%–10%, aquatic feed at 1.5%–8%.

4.9.3 Addition Procedures and Operation Key Points

- Pellet Feed: Add in the dry mixing stage. Pre-mix xylo-oligosaccharide evenly with corn flour, soybean

meal, fish meal and other raw materials, extrude, expand and dry to shape. Serves as a binder and carrier to improve pellet formability and moisture resistance. Expansion temperature 120–150℃, drying temperature 80–100℃ to ensure xylo-oligosaccharide activity.

- Pet Dry/Wet Food: Process dry food per pellet feed process to ensure uniform mixing and improve palatability; add wet food in the batching stage, dissolve xylo-oligosaccharide and add to batching tank, mix evenly with meat, vegetables and other nutrients, sterilize and fill. Sterilization temperature controlled within 121℃ for no more than 20 minutes to avoid affecting pet palatability.
- Aquatic Feed: Select water-resistant xylo-oligosaccharide, add in the dry mixing stage, pre-mix evenly with other raw materials, extrude and shape to ensure pellets do not disintegrate after soaking in water for more than 30 minutes, avoid xylo-oligosaccharide loss and improve intestinal health of aquatic animals.

4.9.4 Functional Objectives and Precautions

Functional Objectives: Supplement dietary fiber, improve intestinal health of livestock, poultry and pets, enhance digestibility and immunity; serve as a binder to improve pellet formability and moisture resistance, extend storage time; enhance pet food palatability, suitable for intestinal-sensitive pets, reduce diarrhea incidence in livestock, poultry and pets.

Precautions: Fully pre-mix with other raw materials in feed production to ensure uniform mixing and avoid local high concentration affecting palatability; control xylo-oligosaccharide addition amount in pet wet food to prevent intestinal discomfort such as diarrhea; select water-resistant xylo-oligosaccharide for aquatic feed to avoid loss during soaking; compound with probiotics in livestock and poultry feed to enhance intestinal regulation effect.

5 Common Problems and Solutions

For common production problems during xylo-oligosaccharide addition, causes and solutions are specified to ensure smooth production and guarantee product quality and functional effects.

5.1 Incomplete Dissolution, Precipitation/Particles in Solution

⊙ Causes: Low water temperature, insufficient stirring time, direct addition without pre-mixing, impurities in raw materials, improper dissolution ratio;

⊙ Solutions: Raise water temperature to 40–55℃, extend stirring time to 15–25 minutes; pre-mix solid products with other dry powders first, filter liquid products through 80–120 mesh after dissolution to remove impurities and undissolved particles; adjust dissolution ratio to 1:2.8–3.5 (xylo-oligosaccharide: softened water); crush agglomerated raw materials before dissolution if any.

5.2 Sour Taste and Off-Odor in Products

⊙ Causes: Use of regular-grade xylo-oligosaccharide, excessively low pH in acidic system, excessive addition amount, improper matching with other raw materials;

⊙ Solutions: Select refined-grade xylo-oligosaccharide; adjust system pH to 4.5–6.5; compound with sweeteners (e.g., maltitol, steviol glycosides) to mask off-odor; appropriately reduce addition amount to a reasonable range; avoid direct mixing with strongly acidic raw materials.

5.3 Abnormal Product Texture (Too Hard, Too Soft, Sticky)

⊙ Causes: Unreasonable addition amount, no compounding with colloids/starches, improper process parameters (temperature, time, shear speed);

⊙ Solutions: Adjust xylo-oligosaccharide addition amount to a reasonable range; compound with colloids (xanthan gum, pectin) and starches to optimize texture; adjust process parameters (e.g., dough mixing time, sugar cooking temperature, emulsification speed) to adapt to product characteristics; appropriately increase oil dosage for baked products to relieve stickiness.

5.4 Inconsistency Between Finished Product Nutritional Label and Claims

⊙ Causes: Metering deviation, insufficient addition amount, finished product inspection error, substandard raw material purity;

⊙ Solutions: Adopt precision metering equipment, strictly control addition amount per formula with metering error not exceeding ±1%; select xylo-oligosaccharide raw materials with purity ≥95%; test dietary fiber and xylo-oligosaccharide content of finished products before delivery to meet claim requirements such as "contains dietary fiber", "high fiber" and "prebiotic"; calibrate metering equipment regularly and standardize inspection procedures.

5.5 Layering and Syneresis During Product Shelf Life

⊙ Causes: Uneven dispersion of xylo-oligosaccharide, insufficient or incomplete homogenization, insufficient stabilizer addition, improper storage conditions;

⊙ Solutions: Ensure full dissolution and dispersion of xylo-oligosaccharide; optimize homogenization process (pressure, time), homogenization pressure for liquid products 18–32 MPa; appropriately increase stabilizer dosage and compound with xylo-oligosaccharide to enhance stability; strictly control storage temperature and humidity, avoid dampness and high temperature, storage temperature for liquid products 2–8℃.

5.6 Substandard Prebiotic Function

⊙ Causes: Prolonged high-temperature heating, insufficient addition amount, invalid raw materials, contact with strong oxidants;

⊙ Solutions: Control sterilization temperature and time, avoid prolonged high-temperature heating (sterilization temperature ≤135℃, time ≤30 minutes); add full dosage per formula to ensure effective content ≥80%; select raw materials within shelf life and store sealed; avoid direct contact with strong oxidants and add separately; regularly test prebiotic activity of finished products.

6 Storage and Transportation Requirements

6.1 Storage Requirements

- Xylo-oligosaccharide raw materials shall be sealed and stored in a cool, dry and ventilated warehouse with temperature ≤25℃ and relative humidity ≤60%, avoiding dampness, sunlight and high temperature (easy to absorb moisture and agglomerate above 30℃). Smoking and open flames are prohibited in the warehouse.
- Store separately from toxic, harmful and odorous items to avoid contamination; stacking height shall not be too high to prevent extrusion and agglomeration, keep no less than 10 cm away from the ground and walls, and stay away from heat and water sources.
- Raw material shelf life is 24 months (sealed unopened); expired raw materials are strictly prohibited from use; use promptly after opening (recommended to use up within 1 month), seal unused parts to prevent moisture absorption, agglomeration and failure, and mark the opening date after opening.

6.2 Transportation Requirements

- Avoid sunlight, rain and moisture during transportation, prevent raw material contamination or agglomeration caused by damaged packaging. Transportation temperature controlled at 5–30℃, avoiding extreme high and low temperature environments.
- Transport vehicles shall be clean, dry and odor-free, transported separately from toxic and harmful items to ensure raw materials are not contaminated; vehicles shall be equipped with ventilation and moisture-proof facilities.
- Handle with care during loading and unloading to avoid packaging damage, strictly prohibit extrusion and impact on raw materials to prevent dust flying; loading and unloading personnel shall wear personal protective equipment (masks, gloves).

7 Operational Safety Requirements

- Operators shall wear personal protective equipment (masks, gloves, work clothes, hats) before taking post to avoid inhalation of xylo-oligosaccharide dust and direct skin contact. Leave the scene promptly, gargle and inhale oxygen after dust inhalation; rinse skin thoroughly with clean water after contact.
- Maintain good ventilation in the operation area during dissolution and stirring to avoid dust flying; pay attention to anti-scald when operating high-temperature equipment (sugar cooking pots, sterilizers, etc.), wear anti-scald gloves and goggles, and strictly prohibit illegal operation.
- Xylo-oligosaccharide dust is prone to static electricity; take anti-static measures (e.g., wearing anti-static work clothes, grounding) during operation to avoid potential safety hazards caused by static accumulation; open flames and static equipment are prohibited in the operation area.

- Classify and dispose of waste generated during production (e.g., undissolved particles, packaging waste) per environmental protection requirements to avoid environmental pollution; seal waste raw materials and dispose per hazardous waste treatment specifications, strictly prohibit random discarding.
- Operators shall be familiar with operation specifications of various equipment and strictly prohibit illegal operation; stop the machine immediately and report to the person in charge when equipment failure or raw material abnormality (agglomeration, off-odor, discoloration) is found, and abnormal raw materials are strictly prohibited from use; regularly maintain and service equipment to ensure normal operation.