Safety Assessment, Product Application and Recommended Dosage of Soluble Soybean Polysaccharide

Overview

Soluble Soybean Polysaccharide (abbreviated as SSPS, CNS: 20.044) is a water-soluble plant polysaccharide food ingredient refined from soybean defatted meal and soybean cotyledon via hot water extraction, acid-base regulation, membrane separation and purification, concentration, spray drying and sterilization. It is mainly composed of neutral sugars such as rhamnose, arabinose, galactose and xylose as well as uronic acid. It appears as off-white to pale yellow uniform powder, dispersible in cold water and rapidly soluble in hot water, featuring low viscosity, acid and salt resistance, protein stabilization, anti-aging properties and prominent soluble dietary fiber characteristics. It has been included in authoritative domestic and international standards including **GB 2760-2024, GB 1886.322-2021, FDA GRAS, JECFA and CAC**. With complete toxicological safety data and a wide scope of compliant applications, it serves as an indispensable multifunctional stabilizing and nutritional fortifying raw material for acidic protein systems, rice and flour products, beverages and functional diet fields.

I. Safety Assessment of Soluble Soybean Polysaccharide

1.1 Conclusions of Toxicological Tests

1.1.1 Acute Toxicity

In accordance with the food safety toxicological evaluation procedures of the **GB 15193** series, oral acute toxicity tests on rats and mice show that the **LD_{50} of Soluble Soybean Polysaccharide ＞10000mg/kg·bw**, classified as practically non-toxic. No death or toxic symptoms were observed in experimental animals throughout the test; food intake behavior, weight gain and organ morphological development showed no abnormalities, indicating no risk of acute poisoning from conventional consumption.

1.1.2 Subchronic and Chronic Toxicity

A 90-day subchronic feeding test and long-term chronic toxicity test on rats confirmed that under the high-dose intervention of **5000mg/kg·bw/day**, there were no statistically significant differences in growth indicators, blood routine, liver and kidney function, blood lipid biochemistry and organ coefficients of experimental animals, with no organic organ damage or cumulative toxicity in vivo. The **NOAEL (No Observed Adverse Effect Level)** is far higher than the daily dietary intake dose of the human body, ensuring safety and reliability for long-term continuous consumption.

1.1.3 Genotoxicity and Carcinogenicity

The results of the Ames test, mouse bone marrow micronucleus test and chromosomal aberration test are all negative, with no mutagenic effect, no chromosomal damage and no embryonic teratogenic risk. Lifetime animal carcinogenicity tests showed no increased tumor incidence and no potential carcinogenicity, fully complying with the safety access specifications for food-grade raw materials.

1.1.4 Reproductive and Developmental Toxicity

Animal reproductive and developmental toxicity tests indicate that conventional doses of Soluble Soybean Polysaccharide have no adverse effects on the reproductive function of male and female animals, embryo implantation, fetal development and offspring growth, with no stillbirth, malformation or developmental retardation. Pregnant women, lactating mothers, infants, the elderly and people with sensitive constitutions can consume it normally within the recommended compliant dosage. A very small number of individuals may experience mild physiological adaptive reactions such as slight abdominal distension and accelerated intestinal peristalsis in the initial stage of high intake, without organic damage or irreversible side effects.

1.2 Control of Risk Substances and Limits

1.2.1 Physical and Chemical Purity Control (Food Grade Standard)

- **Soluble Soybean Polysaccharide content**: ≥60.0%
- **Moisture**: ≤8.0%
- **Crude ash**: ≤6.0%
- **Viscosity of 10% aqueous solution**: ≤200 mPa·s
- **pH (1% aqueous solution)**: 5.0 ~ 7.0

1.2.2 Limits of Heavy Metals and Harmful Elements

- **Lead (Pb)**: ≤0.5mg/kg
- **Total Arsenic (As)**: ≤0.3mg/kg
- **Cadmium (Cd)**: ≤0.2mg/kg
- **Total Mercury (Hg)**: ≤0.05mg/kg
- **Solvent residues and pesticide residues**: Comply with GB 2762 and relevant limit specifications for food raw materials

1.2.3 Microbial Indicators

- **Total bacterial count**: ≤1.0×10^4 CFU/g
- **Coliforms**: ≤30 MPN/100g
- **Molds and yeasts**: ≤50 CFU/g
- **Salmonella, Staphylococcus aureus, Shigella**: Not detectable

1.2.4 Allergenicity and Irritation

Soluble Soybean Polysaccharide is deeply purified to remove allergenic proteins such as glycinin and β-conglycinin, presenting low allergenicity. Skin and mucosal irritation tests prove it is non-irritating. Only people with severe soybean allergy are advised to use it with caution; normal addition for the general population causes no allergies, dermatitis or severe gastrointestinal irritation.

1.3 Safety Conclusions from Authoritative Institutions

- **China**:
  Listed in the food additive catalogue of **GB 2760-2024**, implementing the special national safety standard **GB 1886.322-2021**, and allowed for compliant use within the specified scope and limits.
- **United States**:
  Included in the FDA GRAS Generally Recognized As Safe substance list, applicable to food and dietary supplements in appropriate amounts according to production needs.
- **European Union**:
  Approved for food ingredient access, classified as plant-derived dietary fiber and food stabilizer without strict ADI limit constraints.
- **FAO/WHO (JECFA)**:
  Complete toxicological evaluation, classified into the category of **ADI not specially specified**, recognizing the safety of long-term dietary application.
- **Japan and South Korea**:
  Included in the official food additive standards, widely applied in acidic milk beverages, rice and flour products and health functional foods with a mature compliance system.

II. Product Application of Soluble Soybean Polysaccharide

This section systematically elaborates on the core functional value, mechanism of action, full-field application scenarios, formula compatibility suggestions and core market selling points of Soluble Soybean Polysaccharide, conforming to the actual production processes of the food industry and balancing professional theories with practical implementation.

2.1 Core Value

Soluble Soybean Polysaccharide has five core advantages: **acid-resistant protein stabilization, starch anti-aging, low-fat emulsification, dietary fiber supplementation and low-viscosity refreshing taste**, distinguishing it from traditional colloids such as pectin, CMC and xanthan gum.

First, exclusive stabilization for acidic systems, protecting milk protein and plant protein from precipitation and stratification in low pH environments;

Second, texture improvement for rice and flour products, inhibiting starch retrogradation, preventing adhesion and retaining water and freshness;

Third, emulsification and stabilization for low-fat systems, restraining fat floating and oil-water separation;

Fourth, natural dietary fiber properties, enhancing dietary fiber content of food and adapting to clean label trends;

Fifth, low viscosity without a sticky mouthfeel, retaining the original refreshing taste of products after addition, suitable for lightweight systems such as beverages and dairy products.

2.2 Efficacy Mechanism

2.2.1 Protein Stabilization Mechanism

The molecular chain is equipped with hydrophilic groups and negative charges, which can adsorb on the surface of protein particles to form steric hindrance and electrostatic repulsion, preventing protein aggregation, precipitation and stratification under acidic conditions and maintaining system stability in a wide pH range of 2.5 ~ 7.0.

2.2.2 Starch Anti-Aging Mechanism

It forms hydrogen bond complexes with linear starch molecules, inhibiting recrystallization of starch molecules, delaying hardening and retrogradation of rice and flour products, and extending shelf life and edible taste.

2.2.3 Emulsification and Fat Stabilization Mechanism

It directionally adsorbs on the oil-water interface to form a dense interfacial film, reducing surface tension and restraining fat agglomeration, floating and oil precipitation, suitable for low-fat and zero-fat food systems.

2.2.4 Physiological Mechanism of Dietary Fiber

Indigestible by human digestive enzymes, it directly reaches the intestinal tract, proliferates beneficial probiotics, regulates intestinal microecology, delays postprandial carbohydrate absorption, stabilizes blood sugar and assists in regulating blood lipids.

2.2.5 Water Retention and Freeze Resistance Mechanism

The molecular network structure has strong water retention capacity, binding free water, reducing ice crystal formation during freezing and alleviating water precipitation and texture deterioration after thawing.

2.3 Application Scenarios

2.3.1 Dairy Products and Acidic Protein Beverages

Focusing on protein stabilization in acidic systems, applicable to flavored fermented milk, acidic milk beverages, lactic acid bacteria drinks, plant protein beverages and modified milk powder. It replaces pectin and carboxymethyl cellulose with a fresher taste and stronger stability.

2.3.2 Rice, Flour and Starch Products

Applied to fresh wet noodles, dumpling wrappers, wonton wrappers, instant noodles, frozen rice and flour products, rice cakes, vermicelli and prefabricated rice, functioning to prevent adhesion, enhance boiling resistance, resist retrogradation, retain water and whiten, and improve chewiness.

2.3.3 Beverages and Solid Beverages

Used in fruit and vegetable juice beverages, flavored drinks, herbal drinks, carbonated beverages, meal replacement powder and instant solid beverages, achieving suspension stabilization, color protection and aroma enhancement, improving solubility and preventing caking.

2.3.4 Frozen Drinks and Baked Foods

Applied to ice cream, popsicles, jelly, pudding, bread, cakes, crisp biscuits and pastries, improving expansion rate and fineness, enhancing water retention and softness, and delaying aging and hardening of baked products.

2.3.5 Meat Products and Condiments

Used in low-temperature meat products, surimi products, sauces, peanut butter and sesame paste, retaining water and improving elasticity, inhibiting oil precipitation and enhancing system uniformity and stability.

2.3.6 Special Diet and Health Food

As a soluble dietary fiber raw material, applied to meal replacement foods, medical special diets, solid powder preparations and oral liquids for intestinal regulation, blood

sugar management and nutritional fortification formulas.

2.3.7 Feed and Pet Food

Applied to livestock and poultry compound feed, aquaculture feed, pet staple food and snacks, regulating intestinal health, enhancing immunity, improving palatability and stabilizing feed texture.

2.4 Formula Suggestions

2.4.1 Acidic Milk / Protein Beverages

Select food-grade Soluble Soybean Polysaccharide, disperse under high-speed stirring with warm water at 40 ~ 60℃ before feeding; compound with a small amount of pectin for synergistic effects, adjust pH to 3.5 ~ 4.5, adapt to UHT ultra-high temperature sterilization process with no stratification after sterilization.

2.4.2 Rice and Flour Products

Add evenly during dough mixing and mix with wheat flour and starch; compatible with monoglycerides and polyglycerol fatty acid esters for superimposed anti-aging and anti-adhesion effects, suitable for industrial mass production of fresh noodles and frozen noodles.

2.4.3 Fruit & Vegetable Juice and Flavored Beverages

Fully dissolve in cold water first then add to the blending tank, avoiding long-time high-temperature boiling; compound with xanthan gum and arabic gum in a low ratio to improve suspension uniformity and shelf stability.

2.4.4 Baked Foods and Frozen Drinks

Add during dough mixing of baked products to enhance water retention and softness; add to ice cream during ingredient emulsification to optimize ice crystal structure and improve taste fineness and melt resistance.

2.4.5 Health Food and Medical Special Diet

Adopt high-purity low-ash grade, compound with inulin, fructooligosaccharides and probiotics to strengthen dietary fiber and intestinal regulation effects; directly blend in powder formulas with good fluidity and low moisture absorption tendency.

2.4.6 Pet Food and Feed

Stir evenly with soybean meal, fish meal and vitamin-mineral premix, featuring low addition amount and strong compatibility without affecting the original flavor and palatability of feed.

2.5 Market Selling Points

2.5.1 Natural, Safe and Compliant

Derived from natural soybeans with physical purification technology and no chemical modification residues, complying with regulations of China, the United States, the European Union, Japan and South Korea, adapting to the consumption trend of clean label and natural zero-addition.

2.5.2 Compound Functions with High Cost Performance

Integrates stabilization, thickening, emulsification, anti-aging and dietary fiber functions. A single raw material replaces multiple colloids, simplifying formulas and reducing raw material and production costs.

2.5.3 Acid, Salt and Processing Resistant

Wide pH adaptability, high salt resistance, high-temperature sterilization resistance and freeze-thaw resistance, adapting to harsh industrial production processes of beverages, dairy products, rice and flour products.

2.5.4 Excellent Taste Compatibility

Low viscosity with refreshing aqueous solution and non-sticky mouthfeel, without masking the original flavor of products, serving as the preferred stabilizing ingredient for acidic drinks and light food beverages.

2.5.5 High Added Value with Health Attributes

Endowed with natural soluble dietary fiber attributes, allowing dietary fiber content labeling and adapting to the major health product tracks such as low sugar, low fat, intestinal health and sugar-controlled meal replacement.

III. Recommended Dosage by Application Field

Based on food-grade Soluble Soybean Polysaccharide complying with **GB 1886.322-2021 and GB 2760-2024**, classified by application fields, the conventional recommended dosage and applicable process key points are clarified in strict accordance with national standard usage principles.

3.1 Dairy Products and Acidic Protein Beverages

- Flavored fermented milk and yogurt: Recommended dosage **0.3% ~ 0.6%**, stabilizing protein to prevent stratification and improving taste smoothness
- Acidic lactic acid bacteria beverages and plant protein beverages: Recommended dosage **0.2% ~ 0.4%**, stabilizing wide pH systems and replacing traditional colloids
- Milk powder and protein solid instant drinks: Recommended dosage **0.5% ~ 1.0%**, improving dispersibility, preventing caking and enhancing reconstitution performance

3.2 Rice, Flour and Starch Products

- Fresh wet noodles, dumpling wrappers and wonton wrappers: Recommended dosage **0.3% ~ 0.8%**, preventing adhesion and enhancing boiling resistance and breakage resistance
- Frozen rice and flour products and instant noodles: Recommended dosage **0.4% ~ 1.0%**, retaining water and resisting aging with chewy rehydrated taste
- Rice cakes, prefabricated rice and vermicelli: Recommended dosage **0.2% ~ 0.6%**, loose and non-adhesive, delaying hardening and retrogradation

3.3 Beverages and Solid Beverages

- Fruit & vegetable juice, flavored drinks and herbal beverages: Recommended dosage **0.1% ~ 0.3%**, realizing suspension and color protection with uniform and stable system
- Carbonated beverages and sparkling drinks: Recommended dosage **0.05% ~ 0.2%**, stabilizing foam and enhancing taste roundness
- Meal replacement powder, solid beverages and nutritional powder: Recommended dosage **0.5% ~ 1.5%**, fortifying dietary fiber and improving fluidity

3.4 Frozen Drinks and Baked Foods

- Ice cream, popsicles and ice bars: Recommended dosage **0.4% ~ 0.8%**, refining ice crystals, improving expansion rate and enhancing melt resistance and shape retention
- Jelly, pudding and milk jelly: Recommended dosage **0.2% ~ 0.7%**, preventing water precipitation with smooth and elastic texture
- Bread, cakes, pastries and biscuits: Recommended dosage **0.2% ~ 0.6%**, retaining water and softness and delaying aging and hardening

3.5 Meat Products and Condiments

- Low-temperature meat products and surimi products: Recommended dosage **0.3% ~ 0.8%**, retaining water and improving elasticity and reducing cooking loss
- Peanut butter, sesame paste and compound sauces: Recommended dosage **1.0% ~ 2.0%**, inhibiting oil precipitation and maintaining uniform system without stratification

3.6 Special Diet and Health Food

- Meal replacement food and nutrition bars: Recommended dosage **0.5% ~ 1.2%**

- Oral liquids and functional drinks: Recommended dosage **0.2% ~ 0.5%**
- Intestinal conditioning solid powder: Recommended dosage **0.8% ~ 2.0%**, used as the core raw material of dietary fiber

3.7 Feed and Pet Food

- Livestock and poultry compound feed: Recommended dosage **100 ~ 500g/t**
- Aquaculture feed: Recommended dosage **200 ~ 800g/t**
- Pet staple food and snacks: Recommended dosage **0.05% ~ 0.2%**, regulating intestinal health and enhancing immunity and palatability

IV. Application Precautions and Quality Control

4.1 Raw Material Quality Standard (Food Grade)

- **Appearance**: Off-white to pale yellow powder, no peculiar odor, no caking, no visible impurities to the naked eye with uniform color
- **Solubility**: Dispersible in cold water, fully soluble rapidly in hot water with clear and transparent aqueous solution free of precipitates and suspended solids
- **Physical, Chemical and Hygienic Indicators**: Polysaccharide content, viscosity, heavy metals and microorganisms all meet the national standard requirements of **GB 1886.322-2021**
- **Stability**: Aqueous solution features acid resistance and heat resistance, no stratification or flocculation when placed at room temperature

4.2 Processing and Compatibility

- **Dissolution Process**: Prioritize high-speed stirring and dispersion with warm water at 40 ~ 60℃, then heat up to 80 ~ 85℃ and keep constant temperature for 10 ~ 15 minutes for full hydration to avoid caking caused by one-time high-temperature feeding
- **pH Adaptation**: Optimal applicable pH 3.0 ~ 7.5; strong acid and alkali environments will weaken the stabilizing effect. It can be used alone in acidic systems and is suitable for compounding with pectin, xanthan gum and monoglycerides in neutral systems
- **Thermal Processing**: Tolerant to 121℃ high-temperature sterilization and UHT instantaneous sterilization with strong compatibility with processing technologies
- **Compatibility Taboos**: Good compatibility with most food raw and auxiliary materials, vitamins and minerals; avoid high-concentration combined use with strong oxidants

4.3 Edibility and Usage Suggestions

- Strictly add in accordance with the scope and limits of **GB 2760** in food processing, and do not use beyond the scope and dosage
- Control daily intake of functional diet within a reasonable range; no deliberate restriction required for the general population, and people with sensitive intestines should adapt gradually
- Mix feed and pet food evenly to ensure consistent batch dosage and avoid excessive local concentration

4.4 Storage Conditions

Seal and store in a cool, dry, ventilated and dark warehouse with ambient temperature ≤25℃, moisture-proof, pollution-proof and peculiar odor-proof. The shelf life of unopened products is 24 months. Seal tightly for moisture prevention after opening and use up within 3 months to avoid moisture absorption, caking and performance attenuation.

V. Summary

Soluble Soybean Polysaccharide has complete toxicological data and safety certification from multiple authoritative institutions. It is a practically non-toxic, non-teratogenic, non-carcinogenic and low-allergenic natural plant functional raw material, which can be safely used by pregnant women, infants, the elderly and sensitive groups within the recommended dosage. It has multiple functions including acidic protein stabilization, starch anti-aging, emulsification and water retention, and dietary fiber nutritional fortification, with applications covering the entire industrial chain of dairy products, beverages, rice and flour products, baked and frozen foods, condiments, medical special health foods, feed and pet food.

Its characteristics of acid and salt resistance, high temperature resistance, low viscosity, refreshing taste and strong formula compatibility can simplify product formula structure and reduce production costs, while conforming to the industry development trends of clean label, low sugar and low fat, and intestinal health. In practical production and application, it is necessary to strictly abide by the national standard specifications of **GB 2760-2024**, select qualified food-grade raw materials, control a reasonable dosage, standardize dissolution and processing technologies, and implement strict storage management, so as to fully guarantee stable product system performance, safety compliance and long-term quality. Relying on the core advantages of natural source, multifunctional compound properties and high cost performance, Soluble Soybean Polysaccharide has become a core functional ingredient with great growth potential in the food industry and big health industry, boasting broad market application prospects.