Development History of Polydextrose Industry

A Tribute to the Pioneers

Since its laboratory debut, polydextrose has undergone six decades of technological iteration and industrial cultivation. Evolving from primitive chemical synthesis, systematic safety verification and multiple rounds of process innovation, it has grown into a benchmark water-soluble dietary fiber boasting a globally mature manufacturing system, full-spectrum application scenarios and overwhelming market recognition. Transforming a functional food raw material from a scientific research concept into a globally prevalent essential ingredient embodies decades of dedicated research by scientists worldwide and diligent efforts by practitioners across the entire industrial chain. We hereby pay sincere tribute to all individuals, teams, research institutions and industrial enterprises that have devoted themselves to fundamental theoretical research, synthetic process improvement, safety risk assessment, industrial standard formulation, clinical efficacy verification and global commercialization of polydextrose. In compliance with industrial competition rules and corporate privacy protection principles, specific enterprise names are omitted in this section. Special recognition is extended to all domestic and overseas enterprises that have made remarkable contributions to the development of this industry.

Tribute List

1. Core Scientists and Researchers (Chronologically Ordered by Research Achievements)

- ***Dr. Hans Rennhard (Pfizer Inc., United States)***

The original inventor of polydextrose. In 1965, his team pioneered a high-temperature melt vacuum polycondensation technology based on a ternary system of glucose, sorbitol and citric acid, successfully synthesizing high-molecular randomly cross-linked glucan. For the first time, the core physicochemical properties of this substance—high water solubility, indigestibility and low calorific value—were identified. This research broke the limitations of traditional carbohydrate synthesis, established the basic molecular structure and preparation principle of polydextrose, and laid the original core theoretical and technical foundation for subsequent industrial development and commercial application.

- ***Joint International Research Team of IFF (Europe and the United States)***

Led systematic safety and application research on polydextrose from the 1970s to the 1980s. Building on the first-generation synthesis technology, the team realized iterative upgrades of product refining and modification processes, conducted multi-dimensional toxicological safety evaluations and human digestive metabolism trials, and precisely

clarified the human metabolic pathway and safety threshold of polydextrose. Meanwhile, the team completed food compliance registration in numerous countries across the globe, providing complete research data to support its approval by the U.S. FDA in 1981 and wide-scale global market access, consolidating the foundation for industrial commercialization.

- ***Dr. Julian D. Stowell (Authoritative Scholar in the Field of International Food Ingredients)***

Filled gaps in the fundamental theoretical system of polydextrose in the 1990s. Through systematic molecular structure analysis, in vitro simulated digestion and flora culture experiments, he accurately defined the highly branched polysaccharide structural characteristics of polydextrose, and confirmed its dual properties: indigestible by human digestive enzymes yet utilizable by intestinal microbiota. This formally established its dual functional positioning as both a dietary fiber and a prebiotic. Relevant research outcomes perfected the industry's fundamental theoretical framework, delivering critical academic evidence for diversified food applications, functional claims and compliant utilization of polydextrose.

- ***Professor Hara H (Japan)***

Expanded the research scope of nutritional functions of polydextrose in the late 1990s. Focusing on human mineral metabolism, human feeding trials verified that long-term polydextrose intake can effectively boost intestinal calcium absorption, improve skeletal mineralization efficiency and optimize human calcium nutritional metabolism. This research broke the industry's narrow focus on single intestinal functions, enriched the nutritional and health value of polydextrose, and opened new research directions and data support for its application in special diets and nutrient-fortified foods.

- ***Professor Hitoshi Mineo (Japan)***

Completed refined research on the intestinal functions of polydextrose in the early 2000s. A series of controlled trials centering on intestinal nutrient absorption and flora regulation mechanisms clarified the efficacy differences of polydextrose under varying addition dosages and intake cycles, and defined the dose-effect relationship between dosage and functional performance. The research accurately interpreted the mechanisms through which polydextrose regulates intestinal peristalsis and optimizes intestinal microecology, driving the industry to shift from crude ingredient addition to refined, functional and targeted formulation matching.

- ***Domestic Expert Teams in Food Science and Engineering (Jiangnan University, Beijing Technology and Business University, etc.)***

Since the 1990s, these teams have consistently dedicated themselves to independent technological breakthroughs and localized application research for domestic polydextrose production. Targeting pain points of overseas processes including high energy consumption, unstable purity and poor compatibility with domestic food systems, they conquered core technical challenges covering independent synthesis, refining and purification, quality control and localized functional verification one by one. The teams took the lead

in establishing production technology, testing standard and functional application systems tailored to China's industrial landscape, fueling leapfrog development of the domestic polydextrose industry from technology introduction and imitative iteration to independent innovation and comprehensive technological catch-up.

2. Core Research Institutions and University Teams

- ***Pfizer Central Research Laboratories (United States)***

The birthplace of the global polydextrose industry and the R&D carrier of its first-generation technologies. As the core research platform behind polydextrose's invention, after completing the world's first artificial synthesis trial in 1965, the institution carried out systematic follow-up research including molecular structure analysis, physicochemical property testing, preliminary toxicological trials and optimization of initial production processes. The full set of fundamental technical achievements and safety data generated here constructed the original technical framework of the polydextrose industry, underpinning the emergence and early exploratory development of the global sector.

- ***School of Food Science and Technology, Jiangnan University (China)***

A core domestic research institution for technological innovation and process upgrading of polydextrose. It has long focused on innovating domestic production processes to cut costs and enhance product quality, and conquered key technologies such as microwave-assisted synthesis, precise molecular weight regulation, uniform polymerization degree control and high-purity refining. The university effectively resolved prevalent industrial drawbacks of traditional processes such as excessive energy consumption, unstable batch quality and excessive impurity content, and continuously leads iterative process upgrades, quality improvement and large-scale, high-end industrial development of domestically produced polydextrose.

- ***School of Food and Chemical Engineering, Beijing Technology and Business University (China)***

A core supporting institution for standardization construction and quality control of China's polydextrose industry. It conducts applied fundamental research covering optimized product testing technology, quality grading system construction and production process improvement, and develops precise quality inspection and control protocols adapted to the characteristics of domestic products. The school deeply participates in the project initiation, compilation and revision of national and industrial standards for polydextrose in China, and has promoted standardized, compliant and high-quality industrial development throughout the whole process.

Party I. R&D History of Polydextrose

1. Theoretical Exploration and Technological Inception Stage (1960s)

In the 1960s, the global food industry embarked on a health-oriented transformation, with low-sugar, low-fat and high-fiber formulations becoming the core direction of food formula upgrades. The industry was in urgent need of new functional ingredients featuring strong compatibility and high stability, rendering indigestible glucans a key research priority for research institutions worldwide.

In 1965, Hans Rennhard's team at Pfizer Inc., United States, achieved a technological breakthrough. Using glucose as the primary raw material, sorbitol as an auxiliary agent and citric acid as a catalyst, crude polydextrose was synthesized via high-temperature melt vacuum polycondensation. Systematic physicochemical tests verified that the substance featured excellent water solubility, low human digestibility and extremely low calorific value, marking the official launch of polydextrose as a novel water-soluble dietary fiber.

From 1965 to 1969, the R&D team refined fundamental research, fully analyzing the molecular structure of polydextrose and identifying it as a highly branched randomly cross-linked polysaccharide linked mainly by 1,6-glycosidic bonds, and clarifying its basic molecular composition and physicochemical action mechanisms. Meanwhile, multiple rounds of preliminary toxicological trials were conducted to initially verify the edible safety of the product, laying a solid theoretical foundation for subsequent food applications, process improvements and commercial development.

2. Process Optimization and Safety Verification Stage (1970s)

From 1970 to 1975, targeting drawbacks of the initial crude product including excessive acidity, dark color, coarse taste and residual impurities, the industry continuously optimized melt polycondensation parameters and the complete refining workflow. Simultaneously, multi-dimensional acute and subchronic toxicity trials were performed, confirming that polydextrose causes no acute toxicity, no in-vivo accumulation and no teratogenic or mutagenic risks, scientifically eliminating safety concerns regarding applications of the first-generation product.

In 1975, supported by advanced finishing technologies including ion exchange, fine decolorization and deep impurity removal, the first modified refined polydextrose product Litesse® was successfully developed. The product delivered comprehensive improvements in taste, color, storage stability and food processing compatibility, fully meeting the requirements for industrial mass production and end-food applications.

From 1976 to 1979, multiple batches of human metabolic clinical trials were carried out sequentially. The calorific value of polydextrose was measured at only 1 kcal/g, and

its metabolic characteristics—indigestible in the small intestine yet mildly fermentable by intestinal microbiota in the large intestine—were defined, formally establishing its dual functional positioning as a dietary fiber and prebiotic. During this period, research teams initiated food compliance registration across dozens of countries worldwide, removing pre-regulatory barriers for subsequent global market access and large-scale commercial promotion.

3. Technological Maturity and Domestic Independent Breakthrough Stage (1980s – Early 2000s)

In 1981, polydextrose passed the safety review of the U.S. FDA, obtaining approval for application in the food industry as a low-calorie bulking agent and water-soluble dietary fiber, and was incorporated into the official food additive catalog, officially launching the global commercialization cycle of the industry.

From 1980 to 1990, industrial processes continued to iterate. The IFF research team launched the second-generation hydrogenated modified product Litesse Ultra®. The hydrogenation process removed residual reducing sugars to enable compliant sugar-free labeling, while greatly boosting the product's heat resistance, acid resistance and long-term storage performance. The product subsequently secured application approvals in the European Union, Japan and other economies, and the overseas commercial supply system was gradually perfected.

After 1990, university research teams in China launched independent technological research on polydextrose, breaking overseas technological monopolies and gradually mastering core laboratory synthesis processes. Domestic research institutions successively completed lab-scale and pilot trials, initiating the exploration of localized industrialization.

In 2008, polydextrose was incorporated into China's food additive usage catalog, granting it legal qualification for food applications in China. Clear compliance grounds were established for the industrialization and commercialization of domestically produced polydextrose, ushering the domestic industry into a phase of rapid development.

4. Deepened Functional Research and Technological Overtaking Stage (2010s – Present)

Starting in 2010, global research focus on functional ingredients shifted from physicochemical properties and production processes to exploration of human physiological efficacy. Extensive clinical and in vitro trials confirmed that polydextrose can regulate intestinal microecology, proliferate beneficial probiotics, assist in blood glucose and blood lipid control, activate intestinal metabolic factors and support weight management. Its health benefits have reached a global industry consensus, cementing its position as a core ingredient in health foods and special dietary products.

From 2010 to 2025, China's polydextrose industry achieved comprehensive technological catch-up. Universities including Jiangnan University developed new microwave-

assisted synthesis processes that cut production energy consumption, improve reaction efficiency and enhance the uniformity of product polymerization degrees. Domestic R&D institutions continuously conquered core technologies for precise polymerization degree regulation, ultra-high-purity refining and low-residual-sugar modification. The purity of domestic products can exceed 99.5%, with multiple key quality indicators surpassing imported equivalents.

In 2023, the national standard GB 29923-2023 was officially implemented, detailing product quality indicators, production control specifications and testing methods. This standard accelerated the phase-out of backward production capacity and drove the domestic industry toward standardized, refined and high-end upgrading.

Party II. Commercial Development History of Polydextrose

The commercialization of polydextrose has advanced in parallel with the improvement of global food regulations, iterative production processes, rise of domestic manufacturing, upgraded industrial standards and expanded end-use functional scenarios. Over six decades, the industry has passed five major phases: overseas technological monopoly, global compliance popularization, China's independent industrial breakthrough, completion of standard systems and reshaping of the global industrial landscape. Its clear evolutionary trajectory follows the path of "laboratory research achievement → standardized industrial raw material → essential functional health ingredient". A chronological breakdown by dimension is presented below:

1. Regulatory Approval and International Recognition (1980s – 1990s)

The 1980s and 1990s marked a critical period for global compliance rollout of polydextrose. The core milestone was the acquisition of authoritative safety certifications across numerous countries and the opening of global market access channels, laying a compliance foundation for large-scale commercial adoption.

In 1981, the U.S. FDA approved polydextrose as a compliant food additive under regulation 21 CFR 172.841, officially recognizing it as a safe soluble dietary fiber and low-calorie bulking raw material and defining its legal application scope.

In the same period, the Joint FAO/WHO Expert Committee on Food Additives (JECFA) completed a full safety assessment and endorsed its safety for food use; the ingredient was included in the Food Chemicals Codex (FCC). The European Union assigned it the exclusive additive code E1200, while Japan's Ministry of Health, Labour and Welfare concurrently recognized its status as a compliant food raw material.

By the late 1990s, polydextrose had obtained market access qualifications in more than 50 countries and regions including the United States, the European Union, Japan, South Korea, Australia and China. It became one of the most widely applicable and highly recognized water-soluble dietary fibers worldwide, completely eliminating regulatory

barriers to global commercial promotion.

2. Industrialized Production and Domestic Import Substitution (1990s – Early 2000s)

From the 1990s to the early 2000s, the industry realized mature overseas industrialization and independent domestic industrial breakthroughs, shifting the global landscape from exclusive overseas monopoly to parallel domestic and overseas development.

Overseas industrialization launched at an earlier stage. In the early 1980s, the first-generation commercial products entered mass production, initiating a phase of stable global supply. Subsequent business divisions underwent multiple rounds of corporate consolidation, with overseas entities long dominating global high-end production capacity, core processes and mainstream markets.

The early domestic industry was constrained by overseas technology blockades. Before the 1990s, the domestic market fully relied on imports, accompanied by high raw material prices and limited end-product applications. From 1998 to 2002, domestic R&D institutions conquered the full suite of synthesis, refining and stabilization processes, building China's first large-scale production line, breaking overseas technological monopolies and filling the gap in local independent industrialization.

After 2000, domestic production processes were continuously optimized, production capacity expanded steadily and product quality gradually stabilized. The inclusion of polydextrose in China's food additive catalog in 2008 formalized the domestic compliance system. Multiple domestic manufacturers launched standardized GMP mass production lines, resolved bottlenecks in large-scale manufacturing, reduced raw material costs while improving quality, and comprehensively advanced import substitution in the domestic market.

In 2014, overseas enterprises established Asia-Pacific production bases, constructing a global capacity network covering Europe, the Americas and Asia. This enriched domestic supply channels for high-end raw materials and formed an industrial landscape featuring complementary competition and coordinated development between domestic and overseas market players.

3. Standard System Establishment and Industrial Standardized Upgrading (2010 – Present)

The period from 2010 to the present represents the core phase of standardized, regulated and high-end upgrading for China's polydextrose industry. China has built a comprehensive, world-leading industrial standard framework, ending unregulated industrial development and guiding standardized upgrades of the global sector.

In 2010, China released its first dedicated national standard GB 25541-2010 *Food Additive – Polydextrose*, unifying national technical indicators, production control

requirements and testing methods for the product. This resolved long-standing industrial pain points including inconsistent product quality and lack of unified evaluation criteria, laying the foundation for standardized domestic manufacturing.

Polydextrose has been continuously listed in GB 2760 *National Food Safety Standard – Standards for Uses of Food Additives*, gaining approval for on-demand application across dairy products, beverages, baked goods, confectionery, frozen drinks and other food categories, with its compliant application scope expanding persistently.

The revised national standard GB 29923-2023 was implemented in 2023, refining physicochemical and hygienic indicators as well as full-process inspection specifications. It raised industrial market entry thresholds, accelerated the elimination of inefficient small-scale production capacity and improved the overall concentration and product quality of China's industry.

In 2025, the brand-new national standard GB 1886.385-2025 was issued to meet demand for refined and high-end industrial development. It added classification indicators for liquid and solid products, optimized HPLC (High Performance Liquid Chromatography) testing protocols and filled the standardization gap for liquid polydextrose. Officially implemented in September 2025, this standard confirms China's world-leading polydextrose standard system and provides authoritative institutional support for diversified, high-quality industrial development.

4. Expanded End-Use Applications and Deepened Functional Research (1990s – 2020s)

Driven by iterative processes, perfected safety certifications and mature standard systems, polydextrose has upgraded its positioning from a basic bulking ingredient to a functional health raw material, with continuously expanding application scenarios and deepening functional research.

In the early stage of industrial development, polydextrose primarily functioned as a substitute for sugar, fat and starch, mainly applied in formula optimization for sugar-free confectionery, low-fat baked goods and low-temperature ice cream. Its core value lay in reducing product calorific value, improving food texture and extending shelf stability, with relatively limited functional application dimensions.

After 2000, fundamental trials and human clinical studies were carried out worldwide, enabling in-depth exploration of its health benefits. Research confirmed that polydextrose can proliferate beneficial intestinal bacteria such as bifidobacteria with excellent prebiotic activity; it also improves intestinal peristalsis, balances intestinal microecology and assists blood glucose and blood lipid regulation. Multiple physiological functions have been scientifically validated, continuously highlighting the health attributes of the product.

Since 2020, upgraded consumer health demands have driven refined transformation of the industry. Product application boundaries have extended beyond traditional food and

beverages to high-value-added tracks including functional drinks, meal replacements, weight-management foods, special diets and foods for special medical purposes (FSMPs). The industry has simultaneously developed compound raw materials by blending polydextrose with dietary fibers such as inulin and fructooligosaccharides to create synbiotic ingredients that amplify synergistic health effects. This continues to expand industrial development boundaries, shifting the core industrial logic from capacity expansion to value enhancement.

5. Reshaping the Global Landscape and China's New Leadership Phase (2022 – Present)

Backed by independent technological catch-up, large-scale capacity advantages and a comprehensive standard system, the global polydextrose industrial landscape underwent a complete restructuring after 2022, with China emerging as the core global industry leader.

Currently, China's total production capacity accounts for over 60% of global capacity, making it the world's largest producer and exporter of polydextrose. Domestic products are supplied in bulk to mainstream global markets including Europe, the Americas, Australia and Southeast Asia, deeply integrating into high-end global supply chains and completely reversing the long-standing market monopoly by overseas enterprises.

The industry now features a new landscape of complementary competition between domestic and overseas players: overseas entities focus on high-end modified products and dedicated FSMP ingredients to sustain advantages in premium brands, while domestic R&D and manufacturing institutions continuously develop ultra-high-purity, low-residual-sugar and customized functional raw materials to capture an increasing share of the global high-end market, with steadily rising international competitiveness of domestic products.

Looking ahead, the application scope of polydextrose will keep expanding, gradually penetrating emerging niche sectors such as biomedicine, functional pet food and precision nutritional diets. The core driving force of industrial development will shift from capacity expansion to a high-quality development model centered on technological innovation, standard leadership and functional empowerment. The global market scale will maintain steady growth, and China will continue to lead iterative process upgrades, standard revisions and application scenario innovation for polydextrose worldwide.