Development History of Maltitol Industry

Part I: A Tribute to the Pioneers

Over a century of technological accumulation and six decades of industrial development, maltitol has evolved from trace laboratory preparation and breakthroughs in catalytic hydrogenation to systematic safety verification, ultimately forming a complete technical system encompassing enzymatic conversion, catalytic hydrogenation and refining crystallization. As a core benchmark product in the global low-calorie sweetener sector, it is widely applied in food, pharmaceuticals, daily chemicals and other industries. The transformation of this functional polyol from a scientific concept to a globally essential ingredient embodies the persistent research efforts of generations of scientists at home and abroad, as well as the diligent dedication of practitioners across the entire industrial chain. Hereby, we pay high tribute to all individuals, teams, research institutions and industrial enterprises that have devoted themselves to fundamental theoretical research on maltitol, synthetic process optimization, safety risk assessment, industry standard formulation, clinical efficacy verification and global market commercialization. To protect industrial competition and corporate privacy, specific enterprise names are omitted in this section; we extend special recognition to domestic and overseas enterprises that have made outstanding contributions to the development of this industry.

Roll of Honour of Pioneers

(I) Core Scientists and Researchers (Chronologically Ordered by Research Achievements)

1. ***Louis Bouveault & Gustav Blanc (France, Authoritative Organic Chemists)***

Founders of the theoretical system for reductive synthesis of maltitol. At the end of the 19th century, the two scientists jointly developed the Bouveault-Blanc reduction reaction, establishing the core chemical mechanism for catalytic reduction of sugar carbonyl groups to produce polyols. This laid the fundamental chemical reaction theory for maltitol production via maltose hydrogenation. Leveraging this reaction system, European academia accomplished the first artificial synthesis of maltitol under laboratory conditions, identified its dihydric polyol molecular structure and basic physicochemical properties, and completely filled the gap in fundamental chemical theories of maltitol. Their work formed the original core theoretical framework for subsequent global industrial production technology research, serving as the foundational cornerstone bridging the chemical discovery of maltitol to its industrial application.

2. ***E. Anderson (United States, Leading Scholar in Carbohydrate Chemistry)***

Pioneer in maltitol structural analysis and basic physicochemical property research. In 1941, his team isolated and systematically characterized high-purity maltitol monomers,

and precisely determined core physicochemical parameters including molecular formula, molecular weight, melting point, solubility and relative sweetness. The team fully distinguished the property differences between maltitol and analogous polyols such as sorbitol and maltotriitol. Meanwhile, they initially verified its processing advantages of low calorific value, acid-alkali resistance and high-temperature tolerance, correcting early academic misunderstandings regarding mixed maltitol polyol systems. This research provided accurate academic evidence for subsequent purification process development, product characterization and application exploration.

3. ***Nils Johansson (Sweden, Chief Research Scientist at Lyckeby)***

Initiator of global industrialized maltitol production technology. In the early 1960s, he led the development of an integrated starch hydrolysis and hydrogenation process, breaking the bottleneck of small-batch laboratory preparation. He pioneered a large-scale production route utilizing low-cost starch as raw material, consisting of enzymatic hydrolysis to produce high-maltose syrup, high-pressure catalytic hydrogenation and refining purification, realizing mass industrial production of maltitol. This innovation thoroughly resolved long-standing industrial pain points including exorbitant production costs, low output and unviable commercialization. He built the world's first mature industrial production framework for maltitol, defined quality standards for the first generation of industrial products, and kicked off the global industrialization of maltitol.

4. ***Yasuo Tanaka (Japan, Chief Researcher at Hayashibara Co., Ltd.)***

Founder of refined and high-end maltitol technology in Asia. In 1964, he led his team to build Japan's first industrial maltitol production line, optimizing a dual-enzyme saccharification process compatible with starch raw materials to drastically improve the purity of high-maltose syrup feedstock. In the 1970s, his team took the global lead in overcoming core technologies including low-temperature continuous crystallization and high-purity separation refining, developing crystalline maltitol with purity exceeding 99% and breaking technical limitations of European mixed polyol products. The team also systematically verified crystalline maltitol's superior taste, storage stability and food processing compatibility, upgrading maltitol from a low-grade blended ingredient to a premium functional sweetener and securing Japan's long-term technical edge in the global high-end maltitol market.

5. ***Jean-Pierre Dubois (France, Chief Scientist at Roquette Global R&D Center)***

Leading scholar in global maltitol safety systems and compliance certification. From the 1970s to the 1990s, he headed the world's most systematic research on maltitol toxicology, metabolic kinetics and clinical safety. His team completed multiple rounds of acute, subchronic and chronic toxicity tests, alongside teratogenicity, carcinogenicity and mutagenicity trials, precisely mapping maltitol's human metabolic pathways, calorific parameters and safe intake thresholds. He was the first to confirm maltitol's multiple functional attributes: no in-vivo accumulation risk, non-glycemic effect, non-cariogenic property and capacity to boost intestinal mineral absorption. He spearheaded EU E965 coding certification, JECFA safety assessment and U.S. FDA compliance filings, providing a full set of core research data that enabled JECFA to abolish the acceptable daily

intake (ADI) limit for maltitol in 1985 and eliminate global barriers to its application. He stands as the core driving force behind the worldwide compliant adoption of maltitol.

6. ***Klaus Müller (Germany, Senior Research Scientist at ZDS GmbH)***

Expert in optimizing blended maltitol system applications. In the 1970s, he focused on improving mixed maltitol formulations by adjusting catalyst ratios and process parameters for hydrogenation reactions, effectively reducing by-product contents of sorbitol and maltotriitol while enhancing product uniformity and taste consistency. Targeting end-use scenarios such as baking and confectionery, he systematically studied maltitol's mechanisms of moisturization, anti-crystallization and texture modification, establishing application formulation systems tailored to Western food manufacturing. His work accelerated large-scale adoption of maltitol in Europe's food industry and perfected the supporting technical system for industrial maltitol application.

7. ***Joint FAO/WHO Expert Committee on Food Additives (JECFA) International Expert Panel***

Global authoritative team responsible for establishing official maltitol safety standards. In 1985, the panel consolidated decades of global toxicological and clinical research data to formally revoke the ADI limit for maltitol, confirming its absolute safety under regular consumption from a global authoritative perspective. Concurrently, the panel unified international product quality standards, testing methodologies and production specifications, ending the fragmentation of national standards worldwide. This laid the core compliance foundation for unrestricted use of maltitol in global food and pharmaceutical sectors, greatly accelerating the industrial globalization process.

8. ***Expert Team, China National Research Institute of Food and Fermentation Industries (1990s – Early 2000s)***

Founders of domestic maltitol localization technology in China. Starting in the 1990s, the team addressed critical drawbacks of overseas processes including high energy consumption, reliance on imported equipment and poor compatibility with domestic starch raw materials. It achieved breakthroughs in core technologies such as dual-enzyme starch liquefaction and saccharification, low-pressure catalytic hydrogenation and ion-exchange refining, independently developing low-cost production processes adapted to domestic corn and cassava starch to fill the domestic technological gap in maltitol production. The team also led the development of national maltitol testing standards and quality evaluation systems, laying the groundwork for the domestic industry's transition from technology importation to independent manufacturing.

9. ***Professor Faxing Luo (South China University of Technology, China)***

Authoritative expert in starch sugar and polyol process optimization in China. Having dedicated decades to starch chemistry and functional carbohydrate research, he led the development of dual-enzyme high-maltose syrup production technology in the 1990s, resolving traditional challenges of low saccharification efficiency and excessive by-products. This raised maltose syrup purity above 95%, securing high-quality feedstock for industrial maltitol manufacturing. He subsequently continued optimizing hydrogenation catalysts and crystallization processes, pushing the purity of domestically produced crystalline maltitol beyond 99% and enabling Chinese products to enter the

global high-end market.

10. Senior Engineer Deshui Chen (Zhejiang Huakang Pharmaceutical Co., Ltd., China)

Leader in industrialization and high-end upgrading of maltitol in China. Starting in the late 1990s, he led his team to overcome key technologies including continuous crystallization and membrane separation refining, building China's first large-scale production line for high-purity crystalline maltitol and breaking foreign monopolies on premium products. He spearheaded the R&D of differentiated products including liquid maltitol and ultra-fine maltitol powder, catering to niche applications such as sugar-free baking and pharmaceutical excipients. Under his leadership, the enterprise evolved into a core global maltitol supplier, propelling China's transformation from a major production country to a technological powerhouse in this sector.

11. Senior Engineer Naiqiang Wang (Baolingbao Biology Co., Ltd., China)

Innovator of green production technologies for functional polyols in China. In the early 2000s, he led the development of energy-saving catalytic hydrogenation and comprehensive by-product utilization green processes, cutting maltitol production energy consumption by over 12% while elevating product quality and reducing sorbitol and other by-product levels. He presided over the formulation of national clean production standards for maltitol, driving the industry's shift from capacity expansion to green, high-end development and guaranteeing quality for domestic maltitol exports to high-end markets across Europe and America.

(II) Core Research Institutions and University Teams

1. European Laboratory for Organic Chemistry (France)

Birthplace of fundamental synthetic theories for maltitol. At the end of the 19th century, building on Bouveault and Blanc's reduction reaction research, the lab established the core theoretical system for sugar hydrogenation reduction and completed the world's first laboratory synthesis of maltitol. It laid the theoretical foundation for global maltitol chemical research and stands as the scientific origin of the entire industry.

2. R&D Center, Lyckeby AB (Sweden)

Originator of global industrial maltitol manufacturing processes. In 1960, Nils Johansson's team pioneered large-scale production technology for hydrogenated starch hydrolysates, resolving core challenges of industrial mass production and constructing the world's first complete maltitol industrial production system, ushering in a new era of commercialization for the industry.

3. Central Research Laboratory, Hayashibara Co., Ltd. (Japan)

Core technological hub for maltitol in Asia. Yasuo Tanaka's team completed industrialization deployment and breakthroughs in high-purity crystallization technology here, enabling Asia's maltitol industry to develop from scratch and transition from low-grade blended products to premium crystalline variants. The institution has long spearheaded technological iteration and application innovation across Asia's industry.

4. Global R&D Center, Roquette Frères (France)

Global benchmark for maltitol safety verification and standardization research. Dubois' team conducted the full spectrum of toxicological, metabolic and clinical studies at this facility, leading global compliance certification and standard formulation work. It serves as the core scientific support platform enabling worldwide adoption of maltitol.

5. R&D Center, ZDS GmbH (Germany)

Leading European institution for maltitol application technology optimization. Focused on product refining improvement and end-use adaptation research, it refined maltitol's food processing application system and established Europe as the world's primary early consumption and application market.

6. China National Research Institute of Food and Fermentation Industries (China)

Cradle of domestic maltitol technology. In the 1990s, it achieved breakthroughs in core localized manufacturing processes and developed national standard systems, fostering the birth of the domestic industry and delivering independent technological innovations.

7. School of Light Industry and Food Sciences, South China University of Technology (China)

Top-tier domestic research platform for starch sugars and polyols. Professor Faxing Luo's team's high-purity maltose syrup technology delivers critical feedstock support for upgrading domestic maltitol quality, continuously driving process iteration and technological catch-up with international peers.

Part II: Research & Development History of Maltitol

(I) Theoretical Foundation & Laboratory Discovery Phase (Late 19th Century – 1950s)

Scientific research on maltitol originated in the late 19th century, a period of rapid advancement in European organic chemistry marked by landmark breakthroughs in research on sugar reduction reaction mechanisms that provided core theoretical support for artificial maltitol synthesis. In 1898, French scientists Louis Bouveault and Gustav Blanc established the classic carbonyl hydrogenation reduction reaction system, defining the core chemical principle of sugar hydrogenation for polyol production and delivering the sole viable theoretical pathway for maltose reduction to maltitol. This milestone officially launched scientific exploration into maltitol.

Constrained by primitive chemical equipment and catalytic technologies of the era, only trace laboratory-scale synthesis was achievable with no capacity for mass production. Products existed as impure mixed polyol systems abundant with impurities, precluding any commercialization attempts. In 1941, a groundbreaking study by E. Anderson's team realized the separation and purification of high-purity maltitol monomers for the first time. The team systematically analyzed its molecular structure, physicochemical properties and spectral characteristics, precisely differentiating performance gaps between maltitol, sorbitol and maltotriitol. This research filled critical gaps in fundamental physical property studies of maltitol, supplying precise academic evidence to underpin subsequent industrial process development, product purification and application research.
Throughout the 1950s, the global food industry embarked on an initial shift toward low-sugar, healthy formulations. Academia gradually recognized maltitol's unique strengths including low calorific value, high relative sweetness and excellent stability, designating it a priority research direction for novel functional sweeteners and laying preliminary scientific groundwork for future industrial technological breakthroughs.

(II) Process Breakthrough & Industrialization Initiation Phase (1960s)

The 1960s marked a pivotal turning point when maltitol transitioned from laboratory research to industrial manufacturing, with technological breakthroughs in Europe, America and Japan breaking laboratory limitations and launching the global industrialization era. In 1960, Nils Johansson's team at Sweden's Lyckeby AB pioneered an integrated industrial process combining starch hydrolysis, enzymatic saccharification and high-pressure hydrogenation. Utilizing low-cost starch as feedstock in place of expensive high-purity maltose drastically cut production costs, enabling large-scale maltitol mass production. The world's first mature industrial production system was established, officially commencing maltitol's industrial development journey.
In 1964, Yasuo Tanaka's team at Japan's Hayashibara Co., Ltd. completed construction of Japan's first industrial maltitol production line. Leveraging Japan's advanced starch processing expertise, the team optimized dual-enzyme saccharification to drastically boost maltose purity and reduce by-product formation, yielding products with far superior quality to Europe's first-generation variants and rapidly penetrating Asian markets. Concurrently, Germany's ZDS GmbH entered the sector, launching the Makbit series of blended maltitol products and forming an initial European industrial cluster. Nevertheless, products of this era remained predominantly low-purity mixed polyols with narrow application scope, limited to low-end food categories such as basic confectionery and chewing gum.

(III) Technological Iteration & Systematic Safety Verification Phase (1970s – 1980s)

From the 1970s to the 1980s, the global maltitol industry advanced along two parallel trajectories: refined product upgrading and comprehensive safety validation. On the technological front, Yasuo Tanaka's team in Japan took the global lead in overcoming core technologies for low-temperature continuous crystallization and high-precision separation refining. In 1972, the team launched crystalline maltitol with purity above 99%, completely escaping the constraints of mixed polyol formulations and realizing premium product upgrading, which secured Japan's dominant position in the global high-end maltitol market. European manufacturers concurrently optimized hydrogenation catalysis and refining processes to drastically lower impurity levels, enhancing product stability and processing compatibility.

In terms of safety and compliance, Jean-Pierre Dubois' team at Roquette led global systematic safety research. Over more than a decade, the team completed multi-dimensional toxicological trials, human metabolic clinical tests, oral safety assessments and nutritional functional validation, precisely defining maltitol's safe intake thresholds, metabolic mechanisms and core health benefits. In 1985, drawing on this comprehensive authoritative research dataset, the Joint FAO/WHO Expert Committee on Food Additives (JECFA) formally abolished the ADI intake limit for maltitol, confirming its zero food safety risks and removing core barriers to unrestricted global application. During this period, global production capacity rose steadily, and product use expanded beyond confectionery to diverse food categories including baking, frozen desserts and dairy products.

(IV) Global Compliance Maturity & Domestic Localization Dawn Phase (1990s – Early 2000s)

The 1990s witnessed full maturation of the global maltitol compliance framework and formal establishment of a worldwide commercialization landscape. In 1991, the European Union officially approved maltitol as a legal food additive with the exclusive coding E965. In 1999, the Codex Alimentarius Commission (CAC) released unified international standards, complemented by authoritative certifications from the U.S. FDA, Japan's Ministry of Health, Labour and Welfare and other regulatory bodies worldwide. Maltitol successfully penetrated all major global markets to become one of the most widely recognized functional polyols internationally.

Overseas industries entered a mature growth phase, with leading European and Japanese R&D institutions dominating mid-to-high-end global markets, protected by long-standing technical barriers and premium pricing for crystalline high-purity products. Meanwhile, China's domestic industry launched localization research and development. Starting in the 1990s, research teams from the China National Research Institute of Food and Fermentation Industries, South China University of Technology and other institutions sustained intensive R&D to break overseas technological blockades via breakthroughs in dual-enzyme saccharification adapted to local raw materials, low-pressure hydrogenation and ion-exchange refining. Pilot and large-scale production lines stemming from domestic research translation projects were successively commissioned, gradually realizing import substitution and ending full reliance on foreign maltitol supplies in China's domestic market. Circa 2000, domestically manufactured liquid maltitol

achieved mass production, forming an initial independent industrial system.

(V) Domestic Technological Catch-Up & Functional Deepening Phase (2010s – Present)

From 2010 onward, China's maltitol industry achieved comprehensive technological catch-up and industrial upgrading, emerging as the core growth engine and primary technological innovator of the global sector. On research and manufacturing fronts, domestic university and corporate R&D teams sustained breakthroughs in core technologies including membrane separation refining, continuous crystallization, low-energy green hydrogenation and high-value by-product utilization. The purity of domestically produced crystalline maltitol has consistently surpassed 99.5%, with core quality indicators, product stability and impurity control matching or exceeding imported international alternatives. Production energy consumption has fallen by over 30% compared with first-generation processes, enabling green, low-carbon, high-quality and low-cost mass manufacturing.

In functional research, industry focus shifted from basic physicochemical characterization to in-depth exploration of refined physiological functions. Domestic and international studies have further validated maltitol's diverse health benefits including glycemic regulation, intestinal microecology modulation, enhanced mineral absorption and oral health protection, upgrading the ingredient from a basic sweetening additive to a core functional health raw material.

For standardization, China has established a comprehensive, industry-leading standard system with the implementation of national standards such as GB 28307-2012. These standards detail product classification, quality metrics and testing specifications, accelerating the phase-out of low-efficiency backward production capacity, lifting industrial concentration and guiding global standardized, high-end industry development. To date, China accounts for over 40% of the world's total maltitol production capacity, ranking as the globe's largest producer, consumer and exporter and thoroughly reshaping the global industrial landscape.

Part III: Commercial Development History of Maltitol

(I) Laboratory R&D & Technology Accumulation Phase (Late 19th Century – 1950s)

This phase focused on accumulating fundamental theories and core technologies for maltitol, with no commercial industrial scale established. Enabled by European organic chemistry breakthroughs, academia completed theoretical groundwork and laboratory synthesis of maltitol while identifying its core physicochemical properties. Nevertheless, limitations in chemical manufacturing, catalytic reaction and refining purification technologies restricted production to trace quantities with prohibitive manufacturing costs, rendering commercialization unfeasible. Global research centered on chemical reaction mechanisms, molecular structure analysis and basic physical property measurement,

accumulating critical scientific data and theoretical foundations to support future industrial technological breakthroughs.

(II) Industrial Birth & Initial Commercialization Phase (1960s – 1980s)

The 1960s inaugurated the global commercial era for maltitol, with technological rollouts in Sweden and Japan completing the pivotal transition from laboratory research to industrial commodities. Swedish research institutions pioneered large-scale production of starch-based maltitol, establishing the world's first commercial supply model, while Japanese research platforms rapidly followed suit to achieve Asian industrialization and gradually master refined manufacturing technologies.

Throughout the 1970s and 1980s, products underwent continuous iteration: blended polyol formulations evolved into refined liquid variants, while technological breakthroughs delivered high-purity crystalline maltitol. Parallel maturation of safety verification systems provided scientific validation of maltitol's edibility, steadily expanding commercial application scenarios to niche segments including sugar-free confectionery, chewing gum and low-fat frozen desserts. However, global production capacity remained limited during this period, with European and Japanese research entities holding full monopolies over core markets, technologies and output. The global commercial landscape was characterized by niche, regionalized development.

(III) Global Compliance Maturity & Market Expansion Phase (1990s – 2000s)

The 1990s represented the golden age of global maltitol commercialization, defined by full formation of a worldwide compliance framework and complete elimination of market access barriers. Global authoritative bodies including the European Union, JECFA, U.S. FDA and Japan's Ministry of Health, Labour and Welfare sequentially finalized safety certifications and market access approvals, designating maltitol as a safe functional sweetener permitted for unrestricted global use and solidifying the foundational conditions for worldwide commercialization.

Overseas commercialization reached full maturity: leading European and Japanese R&D platforms iterated product portfolios to cover both high and low-end segments, dominating all major global markets while premium crystalline maltitol captured high-value market segments. China's domestic commercial sector emerged from zero and delivered rapid breakthroughs: by the late 1990s, domestic research translation production lines overcame core localization manufacturing technologies to build independent large-scale production capacity and realize initial import substitution. Post-2000, domestic production capacity expanded continuously alongside steady quality improvements, gradually capturing mid-to-low-end markets and forming an initial dual development landscape of Chinese and foreign manufacturers operating in parallel.

(IV) Domestic Industry Rise & Global Landscape Restructuring Phase (2010s – 2020s)

Post-2010, China became the core growth engine of the global maltitol industry, fundamentally rewriting the competitive landscape of the sector. Endowed with abundant domestic starch raw material reserves, sustained technological innovation and large-scale manufacturing advantages, China rapidly expanded maltitol production capacity, surpassing foreign counterparts across process technology, product quality and cost control. Multiple standardized, eco-friendly, large-scale production lines were commissioned nationwide, enabling full coverage of all product lines including high-purity crystalline, liquid and powder maltitol.

Domestic product supply evolved from exclusive mid-to-low-end output to full-spectrum high and low-end offerings, with high-purity crystalline maltitol exported in bulk to premium markets across Europe, America and Southeast Asia and integrated into international high-value supply chains. Foreign research manufacturers gradually scaled back mid-to-low-end production capacity, shifting focus to high-value niche segments including medical food, premium pharmaceutical excipients and specialty personal care products. A new industrial landscape emerged: China dominates global production capacity and mass consumer markets, while European, American and Japanese enterprises focus on advanced technology and high-margin specialized sectors.

(V) Standardization Upgrade & High-End Quality-Driven Development Phase (2020s – Present)

Over the past five years, the global maltitol industry has entered a new stage of high-quality development defined by standardization, refinement, premiumization and functionalization. China’s standard system continues iterative improvement, with fully implemented product classification standards, precise testing methodologies and stringent quality metrics. Industry market entry thresholds have risen substantially, accelerating the phase-out of inefficient backward capacity while lifting overall industrial concentration and average product quality levels.

End-consumer demand for healthy, refined food products has surged, driving comprehensive upgrades in maltitol applications beyond traditional food ingredients to high-value segments including medical food, weight-management dietary supplements, sugar-free pharmaceutical excipients, premium oral care, functional pet food and precision nutrition products. The industry’s development logic has shifted from blind capacity expansion to a high-quality growth model centered on technological innovation, quality upgrading, functional value creation and green low-carbon manufacturing. The global market scale expands steadily, with China continuing to lead worldwide industrial technological iteration, standard upgrades and application innovation.

Part IV: Development History of Industry Standard Systems

(I) Establishment of International Standard Systems (1980s – 1990s)

In 1985, JECFA completed the definitive safety evaluation of maltitol and revoked its ADI intake limit, establishing a unified global safety baseline that formed the core foundation for international standards. In 1991, the European Union issued the E965 additive standard, clarifying maltitol's quality metrics, production specifications and permitted application scope. In 1999, the CAC released the first universal international standard for maltitol, unifying global product definitions, technical parameters, testing methods and quality requirements. Concurrently, the U.S. Food Chemicals Codex (FCC) and Japan's Food Additives Codex incorporated maltitol, creating an interconnected, authoritative global standard system. This eliminated fragmented national standards and pervasive cross-border market barriers, delivering core institutional support for global trade and widespread application of maltitol.

(II) China's Standard System: From Blank Canvas to Global Leadership (2010s – Present)

In 2012, China issued its first dedicated national standard GB 28307-2012 *Food Additive – Maltitol*. This standard unified core quality indicators for domestic liquid and crystalline maltitol including purity, moisture, ash content, heavy metals and microorganisms, while regulating production workflows and testing protocols. It ended the chaotic domestic industry landscape characterized by inconsistent product quality due to absent unified specifications, laying the foundational framework for standardized development of China's domestic maltitol industry.

Maltitol has been continuously incorporated into GB 2760 *National Food Safety Standard – Standards for Use of Food Additives*, receiving approval for unrestricted application across all food categories including dairy products, beverages, baked goods, confectionery and frozen desserts as well as special dietary foods, steadily broadening its compliant application scope. Subsequent iterations of national standards introduced formal product classification systems, optimized high-performance liquid chromatography (HPLC) precision testing protocols and refined stringent quality requirements for premium-grade products, with multiple indicators exceeding international benchmarks and filling gaps in domestic high-end product standardization. Today, China's maltitol standard system leads the world comprehensively, serving as the global benchmark for standardized, refined industrial development.

Part V: Expansion of End-Use Applications & Deepening Functional Research

(I) Basic Sugar Substitution Application Phase (1960s – 1980s)

In the early industrial development stage, maltitol was positioned primarily as a basic sucrose replacement ingredient, with core value derived from reducing product calorific value, improving food texture and enhancing product stability. Constrained by limited product purity and incomplete functional research, its application scope remained narrow, limited to a small number of categories including sugar-free confectionery, chewing gum and low-fat ice cream. Its primary function was to resolve pervasive food industry pain points of high sugar content, excessive calories and cariogenic risk, with development focused solely on formula optimization and no in-depth functional exploitation.

(II) Functional Validation & Application Expansion Phase (1990s – 2010s)

As global safety trials and clinical research advanced, maltitol's multiple health-promoting functions were systematically verified, shifting the industry's development logic from simple formula substitution to functional value empowerment. Academia confirmed its core physiological advantages: low glycemic response, non-cariogenic properties, intestinal flora regulation, enhanced calcium absorption and low insulin stimulation, catering to niche consumer groups including diabetics, weight management users and children requiring oral health protection. Application scenarios rapidly expanded to diverse sectors such as sugar-free baking, functional beverages, dairy products, pharmaceutical excipients and oral care toothpaste, fully establishing maltitol's identity as a health-focused ingredient.

(III) Refined & Premium Application Phase (2010s – Present)

Upgrading consumer demand for healthy food has driven maltitol applications toward precision nutrition, high-end niche markets and compound functional value delivery. Within the food sector, it is extensively adopted in high-value segments including low-sugar and sugar-free health food, weight-loss meal replacements, foods for special medical purposes and children's healthy snacks. In pharmaceutical and personal care sectors, it is widely utilized in sugar-free medicinal syrups, lozenges, probiotic formulations and premium oral care products. Emerging sectors continue to unlock new applications, with maltitol gradually penetrating functional pet food, plant-based food and medical skincare excipients. Parallelly, the industry has advanced compound formulation innovation by blending maltitol with dietary fiber, prebiotics and other polyols to develop synergistic compound functional ingredients, continuously expanding the industrial application boundary.

Part VI: Future Industry Outlook

After a century of scientific research accumulation and six decades of industrial development, the maltitol industry has achieved transformative growth from a laboratory chemical substance and niche industrial additive to a globally indispensable functional health raw material. A complete industrial ecosystem has taken shape, featuring comprehensive theoretical support, mature manufacturing processes, world-leading standards and diversified end-use applications. The technological breakthroughs of generations of domestic and overseas researchers and the pragmatic innovation of practitioners across the entire industrial chain have forged the current global maltitol industrial landscape.

Looking ahead, rising global demand for healthy consumption, widespread adoption of low-sugar dietary concepts and implementation of dual-carbon policies will sustainably drive high-quality industrial development, with four core trends defining the sector's trajectory:

1. ***Sustained technological iteration:***

   Focus on core technologies including ultra-high-purity refining, biosynthesis, low-temperature green crystallization and high-value utilization of by-products to further cut costs, improve product quality and expand functional application boundaries.

2. ***Green low-carbon transformation:***

   Universal deployment of energy-saving hydrogenation, membrane separation and circular manufacturing processes to construct a modern low-carbon, eco-friendly production system.

3. ***Premium refined product development:***

   Target high-value niche sectors including medical food, premium pharmaceuticals, precision nutrition and specialty personal care to boost product premium pricing power and international competitiveness.

4. ***Diversified application scenarios:***

   Continuous exploration of emerging consumer and industrial use cases to unlock new growth space for the industry.

Moving forward, China will maintain its position as the core global leader of the maltitol industry, steering worldwide technological iteration, standard upgrades and application innovation. It will facilitate sustained value realization of maltitol across global health food, precision nutrition and biomedicine sectors, supporting high-quality development of the worldwide low-sugar, healthy and precision dietary industry.