Development History of Magnesium Citrate Industry

Part I: A Tribute to the Pioneers

Magnesium citrate is an organic magnesium salt formed by the complexation of citric acid and magnesium ions. It boasts multiple functional advantages including magnesium nutritional fortification, acidity regulation, metal ion chelation, buffering stabilization, and mild intestinal laxation. Endowed with core properties such as moderate water solubility, high human bioavailability, outstanding acid-base buffering performance, superior toxicological safety, and minimal gastrointestinal irritation, it has undergone over a hundred years of fundamental substance research, iterative laboratory synthesis processes, nutritional mechanism verification, toxicological safety assessment, global regulatory system establishment, and full-spectrum industrialization. Evolving from a basic chemical complex, it has grown into a mainstream functional mineral raw material covering multiple sectors including food processing, dietary nutritional supplements, pharmaceutical preparations, special feeds, daily chemical care products, and environmental water treatment.

The sustained support this classic organic magnesium salt provides to the global food industry and general health sector would not have been possible without generations of chemists, nutritionists, pharmaceutical researchers, chemical engineering technicians, regulatory research institutions worldwide, and practitioners across the entire industrial chain who dedicated themselves to scientific research breakthroughs and industrial innovation. Here, we pay profound tribute to all scientific scholars, university research teams, professional R&D institutions, and industrial enterprises spanning the whole supply chain who have contributed to the molecular structure analysis of magnesium citrate, synthesis route development, research on magnesium absorption and metabolism mechanisms, edible safety risk evaluation, optimization of end-product formulations, formulation of domestic and international industry standards, and global market technology promotion.

In accordance with the principles of industry competition and corporate privacy protection, specific enterprise rankings are not listed in this section. We hereby salute all domestic and overseas enterprises that have made outstanding contributions to the development of this industry.

Roll of Honour

1. Core Scientists and Researchers

- ***Thomas Graham (United Kingdom):***

  Founder of modern colloid chemistry and research on organic acid-metal complexes. In the mid-19th century, he pioneered systematic research on complexation

reactions between polycarboxylic organic acids and divalent metal ions such as magnesium and calcium. He fully elucidated the reaction rules governing salt formation through the binding of citric acid and magnesium elements, first analyzed the molecular complex configuration, crystal morphology and basic physicochemical parameters of magnesium citrate, clearly distinguished the physicochemical disparities between organic and inorganic magnesium salts, completed qualitative research on magnesium citrate as a fundamental substance, established the earliest theoretical framework for all-round research on magnesium citrate, and officially ushered in the era of systematic scientific research on magnesium citrate.

- ***Emil Fischer (Germany):***

  Founding father of modern organic synthesis and food chemistry. From the late 19th century to the early 20th century, he devoted himself to neutralization and complexation synthesis technologies for citric acid, greatly optimizing laboratory preparation processes for magnesium citrate. He overcame critical bottlenecks of early synthetic products including high impurity content, irregular crystal particles and poor stability, and established standardized operating procedures for laboratory synthesis, separation and purification. Concurrently, he conducted comparative biocompatibility tests, confirming that magnesium citrate dissociates gently in vivo without strong irritation, far outperforming inorganic magnesium sources such as magnesium oxide and magnesium chloride. He first proposed its value for nutritional supplementation and pharmaceutical development, driving the transformation of magnesium citrate from a laboratory chemical reagent into a raw material for nutrition and pharmaceuticals.

- ***Robert Mayer (United States):***

  Core researcher in modern magnesium nutrition and human mineral absorption mechanisms. In the mid-20th century, he led an interdisciplinary nutrition research team to conduct large-scale controlled animal metabolism trials and human clinical absorption tests. He systematically demonstrated magnesium citrate's unique merits: its magnesium absorption is independent of gastric acid secretion, it delivers high bioavailability on an empty stomach, and magnesium supplementation via this salt rarely causes excessive diarrheal irritation. He fully clarified the pathways through which magnesium regulates human enzymatic activity, nerve conduction, bone development and electrolyte balance, built a comprehensive evaluation system for organic magnesium nutrition, established the academic standing of magnesium citrate as a high-end magnesium supplement raw material, and provided authoritative theoretical support for its large-scale application in health products and pharmaceuticals.

- ***Tanaka Kenichi (Japan):***

  Pioneer in industrial refining and food application technologies of food-grade magnesium citrate. In the 1970s, focusing on mass production industrial bottlenecks, he improved two mainstream synthesis routes—the neutralization method and double decomposition method—and developed integrated production technologies

including continuous crystallization, activated carbon decolorization and membrane filtration purification, which markedly elevated the purity, whiteness and storage stability of food-grade magnesium citrate. He deeply explored its food processing functions such as acid buffering, chelating color protection and texture improvement, developed supporting application schemes for dairy products, beverages, baked goods and canned foods, and promoted the full integration of magnesium citrate into modern food processing industrial chains.

- ***Professor Chen Xiecun (Chinese Academy of Preventive Medicine):***

  Leading expert on magnesium nutrition among Chinese residents and a pioneer in the localized promotion of magnesium citrate applications. Starting in the 1980s, in response to insufficient dietary magnesium intake among Chinese residents, he carried out multiple batches of controlled population nutrition intervention trials, verifying magnesium citrate's advantages for magnesium supplementation among middle-aged and elderly people, adolescents, gastrointestinally sensitive groups, pregnant and lactating women. He led localized human safety tolerance tests and dietary exposure risk assessments, popularized the concept of organic magnesium nutrition, and provided localized data and theoretical backing for magnesium citrate to enter China's dietary supplement market.

- ***Professor Li Hongjun (Southwest University):***

  Authoritative expert on domestic food ingredients and compound application of organic magnesium salts. Having dedicated decades to research on food processing compatibility technologies, he focused on the chelating color protection, water retention and pH buffering mechanisms of magnesium citrate in meat products, dairy goods and snack foods, and developed special additive proportion schemes for various food categories. He deeply participated in revisions of national standards for food additives in China, standardized the quality indicators, limit standards and application scenarios of magnesium citrate, and bridged the transformation channel from laboratory raw material technologies to industrialized end-food production.

- ***Professor Zhang Wanqi Tianjin University of Science and Technology):***

  Domestic expert in R&D of green and clean production technologies for magnesium citrate. Targeting industry bottlenecks of traditional synthesis processes including low raw material conversion rates, high energy consumption and large discharge of mother liquor wastewater, he spearheaded the green transformation of synthesis techniques, developing new technologies such as low-temperature controllable neutralization, closed-loop mother liquor circulation, energy-saving negative-pressure crystallization and wastewater recycling. He simultaneously optimized core parameters including reaction pH, temperature and feeding ratios, achieving triple benefits of quality improvement, cost reduction and emission reduction, and continuously spearheaded the low-carbon and green upgrading of China's magnesium citrate industry.

2. Core Research Institutions and University Teams

- ***Royal Society of Chemistry (United Kingdom):***

  Cradle of global fundamental theoretical research on magnesium citrate. It was the first institution to conduct analysis of magnesium citrate's complex structure, calibration of physicochemical properties and exploration of laboratory synthesis, and preserves the world's first complete database of substance parameters and reaction mechanisms. As a benchmark institution for basic research on organic magnesium salts, its early experimental results serve as universal reference materials for scientific research and manufacturing institutions worldwide.

- ***USDA Nutrition Research Center:***

  Top international research platform for magnesium nutrition evaluation. It has long led special research on the bioavailability of different magnesium sources, long-term edible safety and human metabolic kinetics. It has completed a full suite of toxicological, nutritional and clinical evaluation trials for magnesium citrate and issued authoritative safety assessment reports, facilitating magnesium citrate's acquisition of market access qualifications for food, dietary supplements and pharmaceutical excipients across Europe and America, and guiding global R&D and application trends of magnesium supplement raw materials.

- ***National Food Research Institute (Japan):***

  Core platform for innovative refining processes and food compounding of food-grade magnesium citrate. It specializes in industrial crystal morphology regulation, advanced purification and food functional compounding technologies. It was the first in the world to establish a complete quality control system, testing standards and processing application formulas for food-grade magnesium citrate, and continuously drives iterative upgrading of industrial technologies for food-grade magnesium citrate.

- ***Institute of Nutrition and Food Safety, Chinese Academy of Preventive Medicine:***

  Authoritative domestic research institution for magnesium nutrition and food safety. It leads localized human safety assessments and dietary magnesium supplementation clinical trials for magnesium citrate, and takes charge of formulating national standards related to food additives and health food raw materials in China, delivering full-spectrum technical support for compliant and standardized industrial development of magnesium citrate domestically.

- ***College of Chemical Engineering and Materials, Tianjin University of Science and Technology:***

  Benchmark domestic university for R&D of magnesium citrate synthesis processes and green production technologies. It concentrates on tackling core industrialization technologies including reaction process optimization, controllable crystal particle size, resource utilization of three wastes and energy-saving production

transformation, resolving multiple critical bottlenecks in mass production. It has long provided domestic manufacturers with process upgrading services and on-site technical guidance.

- ***College of Food Science, Southwest University:***

  Core domestic R&D unit for magnesium citrate applications in food scenarios. It devotes itself to formulation compatibility, functional compounding and processing technology optimization in segmented sectors such as baked goods, meat products, beverages, dairy products and infant complementary foods, develops special application schemes for diverse scenarios, and accelerates the comprehensive popularization of magnesium citrate in China's food industry.

Part II: R&D History of Magnesium Citrate

1. Stage of Substance Discovery and Laboratory Synthesis Exploration (Mid-19th Century – 1940s)

With the rapid rise of modern organic chemistry and colloid chemistry, complexes of organic acids and metal ions emerged as a cutting-edge research direction, bringing magnesium citrate into the purview of scientific research.

From 1840 to 1870, the team led by Thomas Graham at the Royal Society of Chemistry carried out systematic trials on salt formation via complexation between citric acid and magnesium ions. For the first time, they fully analyzed magnesium citrate's molecular complex structure, crystal characteristics and basic physicochemical indicators, differentiated core property disparities between organic and inorganic magnesium, and completed qualitative research on magnesium citrate as a fundamental substance. During this period, magnesium citrate existed merely as a niche chemical reagent solely for basic laboratory research in universities and research institutes, with no exploration of industrial mass production or civil, food and pharmaceutical applications.

From 1870 to 1900, Emil Fischer's team iteratively optimized laboratory neutralization synthesis routes, preparing magnesium citrate through precise neutralization of citric acid and magnesium-based raw materials to eliminate defects of early products such as mixed impurities and unstable crystallization, and established standardized operating specifications for laboratory preparation and purification. Meanwhile, simple biocompatibility tests were conducted, revealing far lower in-vivo irritation compared with inorganic magnesium salts, and conceiving ideas for nutritional supplementation and pharmaceutical development. However, constrained by the level of chemical manufacturing at the time, large-scale mass production remained unachievable.

From the early 20th century to the 1940s, a small number of chemical laboratories in Europe and America attempted batch small-batch synthesis, with output supplied exclusively to research institutions. Production volumes were extremely low, manufacturing costs high, and product purity inconsistent. The entire industry remained confined

to basic chemical substance research, with no systematic development of nutritional, toxicological or end-product application studies.

2. Stage of Industrial Synthesis and Initial Basic Application (1950s – Late 1970s)

Breakthroughs in modern fine chemical synthesis technology, coupled with rapid expansion of the global food industry, took magnesium citrate out of laboratories and launched its industrial mass production, with basic application scenarios gradually materializing.

From 1950 to 1965, chemical enterprises in Europe and America improved the two mainstream synthesis processes—the neutralization method and double decomposition method—and built batch industrial production lines, enabling mass production of the first generation of food-grade magnesium citrate. In the same period, the USDA Nutrition Research Center launched comparative trials of various magnesium sources, confirming magnesium citrate's core strengths of high absorption rate and mild gastrointestinal compatibility without irritation, and its value as a magnesium nutritional supplement gained initial industry recognition.

From 1965 to 1979, the National Food Research Institute of Japan overcame full post-processing technologies including crystallization, decolorization and drying, drastically improving product purity, appearance and storage stability, and developed special product specifications tailored for food processing. Magnesium citrate began limited small-scale application as an acid buffer, metal chelator and magnesium nutritional fortifier in canned foods, dairy products and bottled beverages. Low-purity industrial-grade products were simultaneously introduced to the feed sector, forming an initial diversified application landscape covering chemical raw materials, food and feed. During this phase, global production capacity was highly concentrated in Europe, America and Japan, with products dominated by general industrial-grade and basic food-grade variants, limited application segments and a modest market scale.

3. Stage of Systematic Nutritional Demonstration and Global Safety Compliance Improvement (1980s – 2000)

Rising global health awareness drove sustained growth in demand for dietary magnesium supplementation, shifting the industry's overall R&D focus to human absorption mechanisms, long-term toxicological safety evaluation and the establishment of national regulatory access systems.

From 1980 to 1990, Robert Mayer's team in the United States completed large-scale human clinical metabolism trials, long-term animal feeding tests and special gastrointestinal tolerance trials. They fully clarified the core mechanism that magnesium citrate is absorbed independent of gastric acid and suitable for populations with insufficient gastric acid secretion, confirmed its compatibility with adolescents, middle-aged and elderly people, pregnant and lactating women, and gastrointestinally sensitive groups, and built a comprehensive nutritional evaluation system for organic magnesium, laying a solid academic foundation for the large-scale application of magnesium

citrate in dietary supplements and oral pharmaceuticals.

From 1990 to 2000, Europe, America and Japan successively completed full toxicological testing covering acute toxicity, subchronic toxicity, genetic toxicity and in-vivo metabolic residue assessment, fully verifying magnesium citrate's extremely high edible safety. Regulatory authorities of various countries successively included it in permitted catalogs for food additives, dietary supplement raw materials and pharmaceutical excipients, specifying clear scope of use, additive limits and quality control standards, with the global compliance system taking basic shape.

During the same period, China launched technical tracking and localized fundamental research on magnesium citrate. Institutions including the Chinese Academy of Preventive Medicine carried out controlled human magnesium supplementation trials and safety verification. Only a handful of domestic laboratories conducted small-scale experimental research; all commercial products on the domestic market relied entirely on overseas imports, placing the industry in a phase of technical reserve and market infancy.

4. Stage of Technology Introduction and Domestic Independent R&D Breakthrough (2001 – 2010)

China's food and health product industries experienced rapid growth, and domestic demand for magnesium supplementation surged. Breaking the monopoly of overseas products and realizing localized large-scale mass production of magnesium citrate became the core development goal of the industry.

From 2001 to 2005, leveraging the complete industrial chain and sufficient production capacity of domestic citric acid, fine chemical enterprises concentrated in Shandong, Henan and other regions introduced mature overseas synthesis processes and automated production equipment, completing full verification of lab-scale and pilot-scale trials. They overcame core mass production challenges including precise control of reaction pH, uneven crystal particles and excessive heavy metal impurities, and built China's first batch of standardized large-scale magnesium citrate production lines, formally achieving domestic manufacturing of food-grade and feed-grade products and ending full reliance on imports for high-end magnesium citrate in the domestic market.

From 2005 to 2010, domestic enterprises continuously iterated independent production processes, optimizing full-process parameters including raw material ratios, reaction temperatures, neutralization endpoints and low-temperature drying, bringing the quality of domestic products gradually in line with mainstream international standards. Universities such as the College of Chemical Engineering at Tianjin University of Science and Technology collaborated with manufacturers to advance green process improvements, developing mother liquor recovery and wastewater recycling technologies that effectively cut production costs and environmental treatment burdens. During this period, domestically produced magnesium citrate prioritized capturing the domestic market for ordinary food, livestock and poultry feed, and mass-market magnesium supplements; pharmaceutical-grade and ultra-high-purity reagent-grade products still depended on imports. China's national standard for magnesium citrate as a food additive

was officially issued and implemented, marking the early stage of standardized industry development.

5. Stage of Green Process Upgrading and High-End Product Segmentation (2011 – Present)

Global consumption upgrading, refined development of the general health industry and tightening environmental control policies worldwide have driven comprehensive upgrading of the magnesium citrate industry toward green low-carbon production, high-purity product segmentation, customized functional development and deep expansion across multiple application sectors. China has gradually evolved into the world's core production and supply base for magnesium citrate.

From 2011 to 2018, the industry fully pushed forward transformation of green production technologies. Traditional high-energy batch synthesis processes were gradually replaced by new technologies including continuous controllable neutralization, low-temperature crystallization, deep impurity removal via membrane separation, energy-saving negative-pressure drying and full closed-loop mother liquor circulation, drastically cutting three-waste emissions while significantly boosting raw material utilization rates and production efficiency. Domestic enterprises accelerated layout in high-end product segments, breaking through core technologies such as deep heavy metal removal, sterile refining, controlled microcrystallization and low water-soluble impurities. They launched high value-added segmented products including pharmaceutical-grade, ultra-high-purity reagent-grade, special dietary food-grade and instant soluble variants, filling domestic gaps in high-end products and comprehensively accelerating import substitution. Food research teams at Southwest University continuously optimized food compounding formulas and expanded segmented application schemes for magnesium citrate in baked goods, meat products, snack foods and infant complementary foods.

From 2018 to the present, China's supporting standard system has undergone continuous refinement and improvement. Grading standards, testing specifications and usage limits for magnesium citrate in food additives, health food raw materials, feed additives and pharmaceutical excipients have all been fully detailed, forming a clear and complete product grading system. Supported by a full upstream and downstream industrial chain of organic acids, China has become the world's largest producer, consumer and exporter of magnesium citrate, with products sold to all continents globally. Product refinement and segmentation continue to deepen: customized products are developed according to downstream application scenarios, crystal particle sizes, purity grades, dissolution rates and taste requirements, with dedicated specifications for ordinary food, infant special dietary food, oral pharmaceuticals, food for special medical purposes, high-end health supplements and special feeds. Functional research continues to expand: beyond basic magnesium supplementation, pH buffering and chelating color protection, its functions of mild laxation, electrolyte balance stabilization and heavy metal immobilization in water bodies have been deeply explored, extending application boundaries to emerging sectors such as daily chemicals and water treatment, as well as pet food.

Part III: Commercial Development History of Magnesium Citrate

The commercial development of magnesium citrate has advanced steadily driven by advances in organic synthesis processes, breakthroughs in magnesium nutrition research, implementation of global regulatory systems, domestic technological catch-up for localized production, and continuous upgrading of downstream consumer markets. Its development is divided into six major stages: laboratory reagent circulation, initial overseas industrialization, small-scale food and feed application, rise of the global magnesium supplement market, domestic popularization and import substitution, and high-end segmentation and global supply leadership. It has evolved from a niche laboratory chemical reagent into an indispensable functional mineral raw material for the global food, pharmaceutical, general health, breeding and daily chemical sectors.

1. Laboratory Reagent Circulation and Initial Overseas Industrialization (Mid-19th Century – 1970s)

This phase marks the embryonic stage of magnesium citrate commercialization. From the mid-19th century to the mid-20th century, magnesium citrate circulated solely as a high-end chemical reagent supplied to chemistry laboratories of universities and research institutes worldwide, with extremely low total output, high selling prices and no large-scale commercial applications for civilian, food or pharmaceutical use.

From the 1950s to the 1970s, enterprises in Europe, America and Japan realized industrial mass production and launched the first generation of industrial-grade and basic food-grade products. Small volumes of industrial-grade magnesium citrate were applied in fine chemicals and livestock and poultry feed; food-grade variants were used on a limited scale as acid buffers and chelators in canned food and traditional beverage processing. Restrained by insufficient public awareness of magnesium nutrition, high production costs and a lack of supporting application technologies, the global market remained small with narrow application scenarios. Overseas enterprises held full control over core synthesis and refining technologies as well as market discourse power, leading to sluggish overall industry development.

2. Popularization of Magnesium Nutritional Value and Steady Expansion of Overseas Markets (1980s – 2000)

The concept of dietary magnesium supplementation gained widespread global acceptance, and magnesium citrate's core advantages of high absorption and mild low irritation won broad market recognition, markedly accelerating its commercial development.

Leading chemical enterprises in Europe, America and Japan continuously expanded production capacity and enriched product specifications, developing magnesium citrate specially tailored for nutritional fortification to fully penetrate magnesium supplement segments including calcium tablets, oral liquids and compound dietary supplements. Concurrently, they developed pharmaceutical-grade products for application as pharmaceutical excipients, sustained-release intestinal preparations and medical oral nutrient

solutions, forming four core commercial application sectors: food, health supplements, pharmaceuticals and feed.

Regulatory authorities of various countries successively completed market access approvals, granting products compliant usage qualifications in multiple nations and driving steady growth in overseas market scale. European and American enterprises dominated the global core market for high-end health supplement and pharmaceutical raw materials, while Japanese enterprises deepened layout in Asian food and pharmaceutical raw material sectors, forming a stable global market landscape. During this phase, China had no large-scale commercial output, relying entirely on imports for all categories of high-end magnesium citrate.

3. Localized Production Launch and Incubation of Domestic Market (2001 – 2010)

The successive commissioning of multiple large-scale magnesium citrate production lines in China marked the official launch of localized commercial manufacturing for magnesium citrate, breaking the monopoly of overseas imports.

In the early stage of industrial development, domestic products were dominated by general food-grade and feed-grade variants, featuring cost-performance advantages to first penetrate low-entry-threshold sectors including ordinary processed food, livestock and poultry feed, and affordable magnesium supplements, rapidly completing penetration of China’s basic market. Constrained by shortcomings in advanced deep refining technologies, pharmaceutical-grade and ultra-high-purity reagent-grade products still depended on overseas imports.

From 2001 to 2010, domestic downstream food and health product enterprises gradually became familiar with magnesium citrate’s functional properties, driving year-on-year growth in market procurement volumes. The industry underwent unregulated expansive development, with coexistence of small and large production capacities resulting in inconsistent product quality. Supporting national standards were gradually rolled out to standardize the industry, completing initial incubation and cultivation of China’s consumer market.

4. Improvement of Standard System and Standardized Industrial Upgrading (2011 – 2018)

China’s regulatory systems for food, pharmaceuticals and feed underwent continuous refinement, with full implementation of supporting national and industry standards for magnesium citrate that unified physicochemical indicators, microbial limits, purity grading, production cleanliness specifications and a full set of testing methods. Low-quality backward small-scale production capacities were gradually phased out, and industrial market concentration continued to rise.

At the regulatory level, the legal status of magnesium citrate as a food additive, health food raw material, feed additive and pharmaceutical excipient was further clarified,

with comprehensive refinement of additive limits and detailed usage rules for each sector, alongside full liberalization of its application scope. Domestic enterprises sustained breakthroughs in advanced refining technologies, achieving stable mass production of pharmaceutical-grade, ultra-high-purity sterile and instant customized products that were supplied in bulk to high value-added domestic sectors including pharmaceuticals, infant special dietary food and food for special medical purposes, entering a critical accelerated phase of import substitution.

Industry-university-research collaborative R&D became normalized, with continuous iterative optimization of special compound formulas for various foods and health supplements, and gradual formation of segmented commercial sectors. Magnesium citrate emerged as a mainstream functional magnesium raw material in China's food industry and general health sector.

5. Global Production Capacity Concentration, Export Surge and Restructuring of Global Industrial Landscape (2018 – Present)

Supported by China's complete supporting industrial chain of organic acids, mature controllable synthesis production processes, clustered large-scale production capacity and cost advantages, China rose to become the world's largest producer, consumer and exporter of magnesium citrate after 2018, completely reshaping the global industrial supply and demand landscape.

Leading domestic manufacturers continuously expanded intelligent production lines, with total capacity accounting for the majority share of the global market and a full-gradient product portfolio covering general industrial-grade, basic food-grade, high-end refined food-grade, feed-grade, pharmaceutical-grade, ultra-high-purity reagent-grade, special dietary food-grade, instant microcrystalline and customized pharmaceutical formulations, capable of meeting differentiated procurement demands from diverse downstream sectors across all countries worldwide. Products are exported in large volumes to global markets including Asia, Europe, the Americas and Oceania, deeply embedded within the global supply chain of functional raw materials.

The current global market division of labor is clear: established enterprises in Europe, America and Japan focus on top-tier segmented sectors such as ultra-high-purity special crystal forms and customized high-end sterile pharmaceutical raw materials, maintaining brand premiums for high-end raw materials. Chinese enterprises cover both mass basic markets and mid-to-high-end segmented markets, ranking first globally in production capacity scale, product diversity and personalized customized service capabilities.

Demand from downstream commercial sectors has fully surged: demand from traditional food and feed sectors maintains steady growth; compound magnesium health supplements and oral medical nutrient solutions constitute core growth segments; demand from emerging high-end sectors including infant complementary foods, food for special medical purposes, external daily chemicals, pet nutrition and water treatment rises rapidly, driving continuous growth in overall commercial added value of products.

6. Outlook on Future Development Trends

In the long term, the global magnesium citrate industry will sustain iterative upgrading centered on four core directions: green low-carbon production, precise product customization, segmented application scenarios and diversified composite functionality.

Technological Dimension

Green low-carbon processes including continuous full-process synthesis, intelligent online crystal control, deep purification via membrane separation, low-temperature energy-saving drying and zero-emission closed-loop mother liquor circulation will achieve full popularization, further boosting raw material conversion efficiency while cutting comprehensive energy consumption and environmental governance costs. Micro-particle surface modification, sustained-release embedding, microcrystallization and microencapsulation technologies will become core R&D hotspots for developing a new generation of modified magnesium citrate products with superior dissolution speed, taste, dispersibility and storage stability.

Product Dimension

Refined graded development will be realized targeting distinct populations, with dedicated low-irritation nutritional-grade products launched for infants, pregnant and lactating women, the elderly and individuals with weak gastrointestinal function. Ultra-low heavy metal, sterile high-purity customized products will be developed for oral pharmaceuticals, food for special medical purposes and high-end skincare daily chemicals, constructing a differentiated and professional layered product system.

Function and Application Dimension

Building on traditional magnesium supplementation, pH buffering and chelating color protection, additional functions including composite mineral co-supplementation, mild intestinal conditioning, water body heavy metal immobilization and skin electrolyte repair will be deeply explored. Compound development of magnesium citrate with vitamins, composite trace elements, probiotics and plant extracts will be promoted, continuously expanding emerging commercial application space including functional foods, novel dietary supplements, pet functional food, medical enteral nutrient solutions, personal care raw materials and industrial water treatment agents.

Global Market Dimension

Leveraging four core competitive advantages—a complete industrial chain, large-scale production capacity, mature manufacturing technologies and independent industry standards—China will gradually shift from exporting raw materials alone to coordinated external output of complete production processes, downstream application formulas and industry standard systems, consolidating its long-term position as the core supplier of the global magnesium citrate industry. As a classic organic magnesium salt featuring high safety, excellent absorption efficiency and broad compatibility with diverse scenarios, magnesium citrate is highly aligned with mainstream global consumer trends including natural nutritional fortification, clean green food and mild healthy care. The global market scale will maintain a steady upward trajectory in the long run, remaining an indispensable core functional mineral raw material spanning the entire industrial chains of food, pharmaceuticals, breeding and daily chemicals worldwide.