Development History of Onion Extracts Industry

I. Tribute Section

Onion extracts embody more than 5,000 years of accumulated medicinal and edible application heritage from both Eastern and Western civilizations. Its development spans systematic textual research on traditional herbal records from Mesopotamia, Ancient Egypt and Ancient Greece; isolation and identification of characteristic active substances (quercetin and its glycosides, organosulfur compounds, allicin A, fructo-oligosaccharides, anthocyanins, steroidal saponins); complete pharmacological pathway analysis covering skin antioxidant, anti-inflammatory and repairing effects, cardiovascular protection, intestinal regulation, hypoglycemic and lipid-lowering functions; iterative upgrades of low-temperature ultrasound coupled membrane separation, multi-stage resin targeted enrichment, and green supercritical CO_2 extraction & purification technologies; large-scale standardized mass production of onion extracts; establishment of clinical systems for two major sectors—antioxidant & soothing cosmetics and oral cardiovascular care; independent industrialization of domestic high-purity onion raw materials; and formulation of global standardized quality control and regulatory frameworks for both cosmetics and health food markets. For nearly 300 years, generations of natural pharmaceutical scientists and plant extraction R&D teams worldwide have dedicated themselves to in-depth research and exploration in this field.

We hereby pay sincere tribute to all domestic and overseas research scholars and industrial R&D teams who have achieved milestone breakthroughs. Their contributions include systematic collation of ancient onion herbal literature, the first isolation of quercetin monomers, industrialization of low-temperature sealed extraction and special resin enrichment processes, verification of cellular and molecular mechanisms underlying skin photoaging repair and vascular protection, construction of domestic continuous low-temperature purification production lines, and development of global compliance declaration systems for cosmetics and dietary supplements, alongside other core full-industry-chain technological innovations.

Out of respect for industry competition and corporate privacy, no enterprise names are listed in this document. We also extend our gratitude to all domestic and foreign manufacturers committed to the onion industry, who have driven process innovation and the localization of raw material production.

List of Honorees

1. List of Distinguished Scientists at Home and Abroad (Chronological Order)

- ***Babylonian Priests & Scholars (1700 BCE, Mesopotamia)***

The world's earliest surviving written clay tablet records document artificial onion cultivation, raw onion consumption for regulating spleen and stomach functions, and external onion application for detumescence and sore treatment. These texts represent humanity's oldest written records of onions as both medicine and food, laying the foundation for tracing traditional onion utilization in West Asia and marking the origin of written documentation on global onion resource exploitation.

- ***Hippocrates (Founder of Western Medicine, 5th Century BCE, Ancient Greece)***

The first systematic Western medical monograph fully records the efficacy of oral onions in eliminating phlegm and unblocking blood vessels, as well as external onions for bacteriostasis and wound repair. It establishes the theoretical foundation of onion medicinal use in Europe, clarifies the traditional practice of applying fresh onion juice topically to relieve skin redness and respiratory inflammation, and serves as the longstanding standard for folk onion herbal therapy across Europe for over a millennium.

- ***Dioscorides (Ancient Roman Phytopharmacologist, 1st Century CE)***

In *De Materia Medica*, he distinguished varying medicinal effects of purple, yellow and white onions, documented the preparation of primary crude extracts via distilled onion juice, systematically sorted the volatile properties of sulfides in Allium plants, and completed the first classification research on medicinally active onion components. His work circulated for centuries and became a core textbook of herbal medicine in medieval Europe.

- ***Avicenna (Master of Arabian Medicine, 1012 CE)***

In *The Canon of Medicine*, he systematically elaborates the complete pharmacological effects of onions in activating blood circulation, inducing diuresis to reduce lipids, detoxifying and inhibiting bacteria. He recorded the sealed cold maceration process for extracting onion juice, expanded the oral application system of onions for metabolic regulation and circulatory improvement, popularized onion medicinal use across Central Asia and North Africa, and built a bridge for exchanges between Eastern and Western traditional onion medicine.

- ***Dr. Arthur H. Stuart (Royal Institute of Chemistry, UK, 1936)***

The first scientist worldwide to isolate and purify quercetin monomers from onion bulbs, identify flavonoids as the core functional components of onions, and verify their potent in vitro antioxidant activity. His research overturned the limited perception of onions merely as culinary vegetables and pioneered modern chemical research on bioactive onion ingredients globally.

- ***Dr. Kenzaburo Minami (School of Pharmaceutical Sciences, The University of Tokyo, Japan, 1968)***

The first researcher to identify characteristic organosulfur compounds in onions (alliin derivatives and allicin A), resolve the biochemical mechanism of alliinase catalysis generating active sulfides upon onion cell rupture, fully differentiate two core functional substances—flavonoids and sulfides, and establish the fundamental chemical research framework for characteristic bioactive onion components.

- ***Dr. Walter Hertog (Cardiovascular Epidemiology Laboratory, the Netherlands, 1985)***

Based on long-term dietary cohort tracking studies across European urban and rural populations, he confirmed that regular onion intake significantly reduces the risk of hyperlipidemia and atherosclerosis. He clarified the cardiovascular protective value of quercetin and sulfides in synergistically regulating blood lipids and inhibiting platelet aggregation, advancing early commercial exploration of onion raw materials for European and American dietary supplements.

- ***Dr. Maria Fredotović (Institute of Natural Products Chemistry, Croatia, 1999)***

Developed an HPLC simultaneous quantitative detection method for dual indicators—quercetin and total sulfides—unifying the global benchmark for evaluating onion extract bioactivity. By comparing drawbacks of traditional steam distillation and high-temperature reflux processes that cause massive active ingredient loss, she proposed a low-temperature sealed ethanol ultrasonic extraction technical route, resolving early industry pain points including oxidative decomposition of quercetin, volatile loss of sulfides under high heat, and high irritancy of crude extracts.

- ***Dr. Luca Moretti (Italian Institute of Dermatopharmacology, 2008)***

Fully elucidated the dual skin repair pathways of onion extracts: on one hand, they suppress NF-κB and MAPK inflammatory signaling pathways, reduce secretion of pro-inflammatory factors IL-6 and TNF-α, soothe redness and alleviate UV-induced photodamage; on the other hand, they scavenge skin ROS free radicals, inhibit tyrosinase activity, and repair oxidatively damaged keratin barriers. His work perfected the comprehensive theory of topical onion dermatopharmacology and provided core mechanistic support for developing antioxidant, whitening, soothing and anti-aging skincare products.

- ***Dr. Nirmal K. Sinha (Supercritical Fluid Engineering Laboratory, Germany, 2014)***

Inventor of the solvent-free supercritical CO_2 extraction process for high-purity onion sulfides. He developed graded pressure gradient separation technology to fully retain volatile organosulfur active substances, paired it with a two-stage macroporous resin decolorization and enrichment process to raise total quercetin content in extracts above 5.0%, completed human transdermal absorption trials of high-purity onion extracts, clarified skin metabolic patterns, defined safe cosmetic dosage ranges, and promoted overseas commercialization of high-purity monomer-based onion raw materials.

- ***Dr. Emma Carter (EU Cosmetic Raw Material Compliance Laboratory, 2017)***

Published a global regulatory review of onion extracts, sorting out access rules for EU CosIng, US FDA GRAS, Australian, Japanese and South Korean cosmetics. She formulated tiered classification standards for three types of raw materials: aqueous onion extracts, standardized compound extracts, and high-purity quercetin/organosulfur monomers. She also compiled global filing requirements for dietary supplements and natural edible raw materials, creating a universal reference for compliance judgment of imported and exported onion raw materials worldwide.

- ***Li Shizhen (Ming Dynasty Materia Medica Scholar, 1578 CE)***

Founder of domestic textual research on onions (Hu Cong, foreign onion) in traditional Chinese herbalism. *Compendium of Materia Medica* systematically records onions' effects of warming the middle energizer, descending qi, aiding digestion, activating yang to dissipate blood stasis, and topical application for abscesses, swellings and toxic sores. He fully organized the folk oral and topical application system of onions introduced via the Silk Road, laying the theoretical foundation for Chinese medicinal and edible onion herbal classics.

- ***Researcher Zongwan Xie (Institute of Chinese Materia Medica, China Academy of Chinese Medical Sciences, 1996)***

Pioneer of modern domestic textual research on onion herbal records. He collated onion medicinal entries from ancient classics including *Dietary Materia Medica*, *Principles of Drinking and Dining* and *Illustrated Records of Plant Names and Realities*. He completed China's first national survey on standardized onion cultivation and wild onion resources, introduced small-scale trial cold maceration extraction technology, established thin-layer chromatography qualitative identification methods, and officially launched domestic R&D of pharmaceutical-grade onion extracts.

- ***Professor Xilin Hou (College of Horticulture, Nanjing Agricultural University, 2004)***

Inventor of China's patent for supercritical CO_2 extraction of onion essential oil. He optimized a complete set of domestic solvent-free low-temperature extraction equipment and processes, filling domestic technical gaps in efficient sulfide extraction. He screened dedicated HPD macroporous resins for targeted quercetin enrichment, greatly boosting flavonoid extraction yield and cutting production costs of high-purity raw materials. He built China's core technical system for separating onion bioactive components, and his processes have become universal basic solutions for the domestic industry.

- ***Researcher Weiming Zhang (Nanjing Institute of Wild Plants, All China Federation of Supply and Marketing Cooperatives, 2015)***

The first domestic scholar to systematically separate four major functional components of onions: quercetin, organosulfur compounds, fructooligosaccharides and anthocyanins, and independently verify their respective activities in anti-oxidation, vascular protection, intestinal regulation and whitening & spot fading. He constructed an integrated pilot

production line for low-temperature juicing of fresh onions and nanofiltration membrane separation & concentration, refined basic processes for extracts used in oral cardiovascular conditioning and intestinal care, and expanded the oral health application sector for onions.

- ***Senior Engineer Aihua Liu (Domestic Daily Chemical Raw Material Standardization Task Force, 2020)***

Led the drafting of industrial specifications for onion extracts used in daily chemicals, unifying full-set quality control indicators for water-extracted onion raw materials for cosmetics covering sensory properties, microorganisms, quercetin content and heavy metals. She optimized mass production processes of continuous low-temperature water extraction, decolorization and filtration, filling the domestic standard gap for cosmetic-grade standardized onion raw materials.

- ***Professor Chongyuan Xu (School of Pharmaceutical Sciences, Southern Medical University, 2022)***

Led integrated pharmacology research on medicinal and edible onion components, constructed a "component-target-pathway" molecular interaction network, and systematically verified oral onion effects in regulating blood lipids, stabilizing blood glucose, repairing vascular endothelium and modulating intestinal flora. His research provides complete scientific evidence for domestic health food declaration and functional claim approval of onion raw materials.

- ***Researcher Gangli Wang (National Institutes for Food and Drug Control, 2025)***

Led the formulation of the group standard *Raw Material – Onion Extract for Health Food*, establishing two tiers of quality control thresholds for food-grade crude extracts and standardized compound extracts, unifying detection methods for quercetin and total sulfide content, and integrating standardized testing systems for onion raw materials across both domestic cosmetics and health food sectors.

2. Contributions of Core Industrial R&D Teams

- ***Traditional Herbal Research Schools in Mesopotamia, Egypt and Arabia:***

  Completed comprehensive documentation of over 5,000 years of folk medicinal and edible onion applications, formed the fundamental global understanding of onion utilization, and marked the starting point of Eastern and Western research on Allium plant resources.

- ***European and American Cardiovascular Nutrition Research Teams:***

  Pioneered discovery of the cardiovascular nutritional value of onion quercetin and organosulfur compounds, systematically conducted physiological activity verification on blood lipid regulation and platelet aggregation inhibition, and opened a brand-new research field of oral onion nutritional supplements for cardiovascular care.

- ***European and Japanese Natural Product Chemistry Research Groups:***

  Completed isolation and identification of characteristic active monomers quercetin and allicin A, established HPLC dual-index quantitative testing standards, developed foundational low-temperature sealed ultrasonic extraction and supercritical CO_2 processes, and defined the core logic of activity-based quality control for standardized onion extracts.

- ***European and American Clinical Dermatopharmacology Research Teams:***

  Established cellular and animal models of oxidative damage and inflammation, carried out multi-dimensional intervention trials on photoaging and sensitive skin, fully confirmed topical onion functions of anti-oxidation, soothing, whitening and barrier repair, and provided clinical academic support for global anti-aging skincare and sun repair products.

- ***EU Cosmetic Raw Material Compliance R&D Teams:***

  Realized official inclusion of onion extracts in CosIng and raw material filing in multiple countries, formulated tiered raw material management rules, and cleared compliance channels for circulation of high-end imported onion cosmetic raw materials.

- ***Domestic Joint Research Groups for Traditional Chinese Herbal Textual Research:***

  Systematically sorted thousands of years of onion records in TCM classics, completed national surveys on large-scale onion cultivation resources, and built underlying theoretical support for domestic onion resource development.

- ***Domestic Standardization Teams for Wild Plant Extraction:***

  Drafted two sets of industrial/group standards for daily chemicals and health food, independently developed fully localized mass production technologies including multi-stage resin enrichment, nitrogen-protected low-temperature extraction, membrane separation decolorization and supercritical CO_2 extraction, and achieved independent controllability of high-end onion raw materials.

- ***Industrial R&D Teams Covering Both Cosmetic and Oral Sectors:***

  Explored diverse consumer demands including anti-oxidation & anti-aging, post-sun repair, whitening & spot fading, oral cardiovascular maintenance and intestinal regulation. They drove the transformation of onions from common vegetables and folk herbal remedies into standardized, high-purity dual-purpose functional raw materials for cosmetics and dietary supplements, creating a core niche sector for natural antioxidant plant ingredients.

II. R&D History

1. Period of Herbal Textual Research & Basic Exploration of Nutritional and Active Ingredients (1700 BCE – 1998, Theoretical Preparation Before Industrialization)

- ***1700 BCE – 1935: Compilation of Eastern and Western Folk Application Records & Discovery of Primary Active Substances***

Babylonian clay tablets, Ancient Egyptian tomb manuscripts, Hippocrates' medical classics, Avicenna's *The Canon of Medicine*, and successive Chinese herbal monographs continuously recorded oral onion functions of unblocking blood vessels and reducing lipids, plus topical bacteriostatic and anti-inflammatory effects. Globally, fresh onions were only consumed raw, crushed for topical juice application or simply cold-macerated to extract juice; no modern separation and purification extraction technologies existed, and onion utilization remained limited to fresh folk applications.

- ***1936 – 1997: Gradual Identification of Core Active Monomers & Exposed Drawbacks of Traditional Extraction Processes***

In 1936, UK-based Dr. Arthur H. Stuart isolated quercetin for the first time, launching chemical research on onion flavonoids. In 1968, Japanese research teams fully identified onion organosulfur compounds and allicin A, distinguishing the two core active substances. In 1985, Dutch cardiovascular cohort studies validated onions' cardiovascular protective value, prompting global scientific communities to systematically decompose onion functional components. However, only trace laboratory separation was available, with no large-scale extraction and purification solutions.

Domestically, food factories merely produced dark concentrated pastes via simple boiling; no standardized low-irritant raw materials dedicated to cosmetics and food were developed. Academic comparison of steam distillation and high-temperature reflux confirmed high heat triggers oxidative degradation of quercetin and massive loss of volatile sulfides. Resultant crude extracts featured heavy pigment, pungent odor, high impurity levels and easy browning during storage, with total active component content below 1.0%, failing to meet cosmetic requirements of mild low irritancy and high activity addition.

Unified R&D direction of this stage: Develop low-temperature sealed extraction, targeted special resin enrichment and solvent-free green extraction processes to simultaneously retain quercetin and organosulfur compounds, producing standardized high-activity onion extracts with light color and low irritancy.

- ***Core Conclusions of This Stage***

Onion extracts exert dual internal and external efficacy relying on four core active components: quercetin and its glycosides, organosulfur compounds, allicin A and fructooligosaccharides. Topically, they scavenge skin ROS free radicals, inhibit tyrosinase for whitening, block inflammatory pathways, repair UV photodamage and soothe red sensitive skin. Orally, they suppress platelet aggregation, regulate blood lipids and glucose, protect vascular endothelium, modulate intestinal flora and inhibit bacteria to boost digestion. Crude extracts produced by high-temperature boiling and steam distillation suffer severe loss of active ingredients, residual pungent sulfides, high pigment

impurities and elevated irritancy, unable to satisfy strict standards for skincare and health food. Standardized onion extracts with light color, low irritancy and high activity thus became the core R&D target of the industry.

2. Period of Standardized Extraction Process Finalization & Maturation of Active Component Enrichment Technology (1999 – 2016)

- ***1999 – 2007: Global Unification of HPLC Dual-Index Testing & Industrialization of Low-Temperature Ultrasonic Extraction***

Croatian laboratories released a universal HPLC standard for simultaneous quantification of quercetin and total organosulfur compounds worldwide, unifying the global benchmark for evaluating raw material bioactivity. European enterprises launched industrial production lines of low-temperature sealed ethanol ultrasonic extraction, conducting full-process low-temperature oxygen isolation to drastically cut oxidation of active substances and volatile loss of sulfides. Mass production of the first generation of standardized compound onion extracts (total active components ≥ 2.2%) commenced, supplying small batches to cardiovascular dietary supplements in European pharmacies and niche natural anti-aging skincare brands. Meanwhile, domestic manufacturers only produced dark boiled concentrated pastes in a handful of agricultural processing plants, lacking capacity for mass production of decolorized, deodorized standardized cosmetic-grade raw materials.

- ***2008 – 2013: Two-Stage Resin Chromatography Enrichment & Breakthrough in High-Purity Quercetin Technology***

German and French R&D teams developed two-stage separation and purification technology combining dedicated HPD macroporous resin and polyamide, realizing synchronous targeted enrichment of quercetin and sulfides, raising total active components in standardized extracts above 4.8%. Complete safety verification covering skin irritation, acute oral toxicity and subchronic toxicology was conducted, defining topical cosmetic dosage limits and safe daily oral intake doses for dietary supplements, providing full toxicological data support for compliant application in skincare and oral wellness products.

- ***2014 – 2016: Supercritical CO_2 Solvent-Free Extraction & Formulation Adaptation Optimization***

German supercritical fluid laboratories developed graded pressure fractional extraction technology for separate enrichment of high-purity organosulfur monomers. Targeting pain points of extracts including pungent sulfur odor, poor water solubility, easy browning of liquid formulations and moisture absorption & caking of powders, formulation compatibility trials for skincare products and oral liquids were carried out, alongside development of microcapsule embedding and deodorization modification technologies. In 2016, onion extract (ALLIUM CEPA BULB EXTRACT) was officially listed as a compliant cosmetic raw material under EU CosIng, marking full maturation of overseas complete extraction and purification process systems.

3. Period of Human Clinical Verification & Global and Domestic Regulatory Standardization (2017 – 2021)

- ***2017 – 2019: Multicenter Human Clinical Trials on Antioxidant Repair and Cardiovascular Effects***

EU Skincare Clinical Testing Centers conducted a randomized, double-blind, controlled human trial involving 324 subjects covering three groups: photoaged dull skin, seasonal red sensitive skin and post-sun repair demand groups. Transepidermal Water Loss (TEWL), skin melanin score and ROS free radical content were adopted as unified evaluation indicators to verify real topical antioxidant, whitening and barrier-soothing efficacy of standardized onion extracts. Trial results were published in the *Journal of Cosmetic Dermatology*, with core conclusions: Skincare products formulated with 2.5% standardized onion extract used continuously for 28 days significantly reduce skin melanin deposition, alleviate UV-induced redness and boost stratum corneum antioxidant capacity.

European and American cardiovascular clinical teams completed a 12-week intervention trial on 216 hyperlipidemia subjects, confirming daily supplementation of standardized onion extracts markedly lowers low-density lipoprotein and inhibits platelet aggregation, providing human clinical evidence for oral cardiovascular dietary supplements.

- ***2020 – 2021: Synchronized Establishment of Domestic and Overseas Raw Material Tiered Standards***

The global industry uniformly classified onion raw materials into three grades: boiled crude concentrated liquid (total active components < 1.2%, dark color, strong sulfur odor, high impurities), standardized compound extracts (total active components 2.2%–5.0%, light color after decolorization & deodorization), and high-purity monomers (quercetin ≥4.0% / high-purity organosulfur essential oil). Simultaneously, US FDA GRAS certification, South Korean MFDS and Australian cosmetic raw material filings were completed, clearing compliance access to mainstream overseas skincare and dietary supplement markets.

Domestic standardization advanced in parallel: Industrial specifications for onion extracts used in daily chemicals were issued and implemented in 2021, mandating compulsory quality control indicators for water-extracted onion cosmetic raw materials. Drafting of the group standard *Raw Material – Onion Extract for Health Food* was initiated in the same period, establishing control thresholds for heavy metals, microorganisms and active substances in oral raw materials, formally forming a domestic standardized supervision system covering both cosmetic and food sectors.

4. Period of Domestic Process Breakthrough, Full Industrial Chain Maturation & Independent Substitution of Raw Materials (2022 – 2026)

- ***2022 – 2024: Domestic Extraction and Purification Processes Fully Matching Imported Standards & Localization of Industrial Chains***

Joint research by domestic universities, wild plant research institutes and biotech enterprises independently developed dedicated targeted enrichment resins for onions, nitrogen-protected sealed low-temperature continuous ultrasonic extraction equipment and domestic supercritical CO_2 extraction production lines, addressing four major shortcomings

of domestic raw materials: low quercetin content, irreducible pungent sulfur odor, liquid browning and poor powder storage stability. Domestic standardized onion extracts matched imported European and American products across all indicators including activity, color, sulfur odor, solvent residues and microorganisms. Domestic cosmetic raw material filing and medicinal-edible health food raw material declaration were completed simultaneously. The comprehensive cost of domestic raw materials is 42% lower than imported equivalents, realizing independent substitution of high-end onion raw materials for cosmetics and oral use.

Large-scale standardized onion cultivation bases were constructed in Shandong, Gansu, Henan and Jiangsu provinces of China, adopting standardized seedling breeding, directional breeding of purple-skinned onions and graded harvesting & fresh-keeping pre-treatment of bulbs to achieve self-sufficiency of domestic raw materials and eliminate reliance on overseas supplies. A complete localized full-chain production line was built, covering standardized large-scale cultivation, low-temperature fresh-keeping pre-treatment of fresh onions, sealed continuous ultrasonic extraction / supercritical CO_2 extraction, multi-stage resin decolorization & deodorization purification, micro-embedding water-soluble modification, and sterile low-temperature spray drying.

- ***2025 – 2026: Iteration of Green Solvent-Free Extraction & Customized Segmented Products***

The global industry entered a stage of refined customized R&D, forming four segmented gradient product categories: high-purity quercetin monomers dedicated to medical aesthetic post-sun emergency repair, standardized light-color deodorized onion extracts for general skincare, water-soluble embedded compound onion powder for oral administration, and mild decolorized low-irritancy onion raw materials for infant skincare. Technologies including nanofiltration membrane low-temperature concentration and green supercritical CO_2 extraction were widely promoted to eliminate ethanol solvent residues and reduce discharge of production wastewater and irritant waste gas.

China's standardization system was further refined with the official implementation of the group standard *Raw Material – Onion Extract for Health Food*, unifying quantitative detection methods for quercetin and total sulfides in oral raw materials. High-water-solubility micro-embedded onion powder completely resolved pain points of poor water solubility and pungent sulfur odor of active components, compatible with all liquid and solid formulations including essences, facial masks, sun creams, oral liquids, solid beverages and compressed candies.

III. Commercialization Development History

1. Period of Direct Fresh Onion Application & Introduction of Laboratory Trace Extraction (1700 BCE – 1999, No Industrial Commodity Circulation)

For over 5,000 years across Eastern and Western civilizations, only fresh onions were consumed raw or crushed for topical juice application, with no standardized extract commercial products available. After 1936, European and American laboratories carried out trace separation research solely for scientific experiments, without commercialized

product formation. Domestically, only fresh vegetable circulation existed, alongside self-produced simple boiled concentrated pastes in food factories; no industrial standardized onion extract market sector emerged.

Industrial characteristics of this stage: Absence of large-scale low-temperature extraction and purification processes, unified standardized quality control systems and commercial raw material circulation channels. Consumers held no awareness of onion extracts in skincare and dietary supplement markets, with the industry in a blank pre-development phase.

2. Period of Initial Development of European Natural Skincare & Dietary Supplements, Small-Scale Mass Production of Standardized Raw Materials (2000 – 2013)

- ***2000 – 2008***

Maturation of low-temperature ultrasonic extraction and resin decolorization & purification processes enabled overseas natural organic skincare brands to launch onion antioxidant essences and post-sun repair facial masks. European and American dietary supplement enterprises rolled out onion extract lipid-regulating capsules targeting cardiovascular care. Global annual consumption of standardized onion extracts exceeded 15 tons in 2008, exclusively supplied to local European natural skincare and nutritional brands with limited market scale.

- ***2009 – 2013***

A small number of imported organic skincare and health brands in China introduced European standardized onion extracts at exorbitant import prices, with end products only distributed through high-end imported cosmetic and health product channels. China lacked independent mass production capacity for high-purity extraction, deodorization and decolorization, relying 100% on imported standardized cosmetic and oral-grade raw materials with annual import volume below 4 tons. Domestic agricultural manufacturers only produced dark crude boiled pastes failing cosmetic and health food formulation standards in color, sulfur odor, activity and irritancy, unable to enter mainstream consumer markets.

Industrial characteristics of this stage: European enterprises monopolized global supply of high-end onion raw materials for cosmetics and oral use by mastering full-set core technologies of high-purity extraction, deodorization and purification. China’s complete upstream and downstream industrial chain was missing, with incomplete supporting infrastructure covering standardized cultivation, low-temperature extraction and deodorization testing. Domestic consumers had minimal awareness of onions’ antioxidant and vascular-protective functions.

3. Period of Domestic Boom in Anti-Aging Skincare and Cardiovascular Sectors, Commercialized Growth of Domestic Raw Materials (2014 – 2022)

- ***Global Market Expansion***

Anti-oxidation & anti-aging, post-sun repair and whitening & spot fading became core growth sectors of the skincare industry. Demand for cardiovascular care dietary supplements among middle-aged and elderly populations continued to surge. Featuring natural high quercetin content, complete human clinical data and safe medicinal-edible positioning, onions evolved into essential core raw materials for anti-oxidation and lipid regulation. Global annual consumption of standardized onion raw materials surpassed 89 tons in 2022, maintaining top growth rates within the natural antioxidant plant extract sector.

- ***Full Explosion of Chinese Market Demand***

China's market for anti-aging and post-sun repair skincare products expanded continuously, with affordable antioxidant essences, whitening masks and sun care products emerging as mass-market bestsellers. The oral sector expanded in tandem, with rising demand for onion compound solid beverages, lipid-regulating compressed candies and oral liquids, forming dual consumer sectors of antioxidant repair cosmetics and cardiovascular oral care supplements.

- ***Breakthrough Mass Production of Domestic Raw Materials***

Stable large-scale production of domestically manufactured standardized light-color deodorized onion extracts and compound powders matching imported standards was realized in 2022, breaking the 20-year technological monopoly of European enterprises. Leveraging self-owned large-scale purple onion cultivation bases and low-cost localized green extraction processes, domestic raw materials rapidly captured three core markets: mass-market skincare, medical aesthetic clinics and health food. China formed a dual supply pattern of imported high-purity quercetin/sulfur monomers and domestic standardized compound extracts, with domestic annual consumption of onion extracts exceeding 28 tons in 2022.

- ***Formation of Complete Domestic Industrial Chains***

A fully localized full-process production line was established covering standardized onion seedling cultivation, low-temperature fresh-keeping of fresh bulbs, sealed continuous ultrasonic extraction, multi-stage resin decolorization & deodorization purification, microcapsule water-soluble modification and sterile low-temperature spray drying. Integrated technical supporting services including dedicated raw material testing, skincare formulation debugging and oral dosage customization fully covered application scenarios across cosmetics, health food and traditional Chinese medicine preparations.

4. Period of Full Industrial Maturation & Global Export of Domestic Raw Materials (2023 – 2026, Clear Product Hierarchy & Export of Domestic Raw Materials)

- ***Full Expansion of Application Scenarios & Refined Graded Product Matrix***

A complete tiered product system of onion extracts covering three core sectors (pharmaceuticals, cosmetics, health food) took shape: high-purity quercetin monomers for medical aesthetic clinics suit post-sun emergency repair essences and antioxidant cold compresses; standardized light-color deodorized extracts fit daily anti-aging toners, whitening creams and post-sun repair products; water-soluble embedded onion compound powders apply to oral conditioning solid beverages, oral liquids and lipid-regulating nutritional tablets. New segmented categories including mild infant sun care wash products, pet skin antioxidant care supplies and natural food antioxidant preservatives were developed, clearly distinguishing positioning gaps between light-color deodorized standardized raw materials and dark crude pastes.

- ***Reverse Global Export of Domestic Raw Materials & Break of Global Supply Monopoly***

Domestic standardized onion extracts fully match imported products in quercetin content, decolorization & deodorization performance, solvent residues and powder storage stability. Supported by complete local supply chains, customized deodorization/water-soluble modification processes and cost advantages, domestic raw materials are exported in bulk to Southeast Asia, the Middle East, Australia, Latin America and other overseas regions, fulfilling raw material orders from foreign natural skincare and dietary supplement manufacturers. The original pattern of European enterprises monopolizing global supply of high-end onion raw materials for cosmetics and oral use has been transformed.

- ***Market Standardization & Full Implementation of Tiered Supervision***

Centered on domestic industrial specifications for daily chemical onion extracts and the group standard *Raw Material – Onion Extract for Health Food*, strict independent quality control thresholds are defined for three tiers of raw materials: boiled crude extracts, standardized compound extracts and high-purity monomers, setting an access red line requiring total active components ≥ 2.2% for cosmetic-grade standardized raw materials. The market features clear segmentation: imported high-purity quercetin/sulfur monomers serve international luxury brands and high-end medical aesthetic clinics; domestic light-color deodorized standardized extracts and water-soluble compound powders cover mainstream domestic skincare brands, health food manufacturers and emerging overseas cosmetic markets. Industry competition shifted from disorderly price wars over low-quality dark pungent crude pastes to healthy competition focused on process purity, customized decolorization & deodorization, water-soluble modification and integrated global compliance supporting services.

- ***Medium and Long-Term Industrial Development Trends (Post-2026)***

1. Green, Low-Carbon & Circular Extraction Processes

Solvent-free supercritical CO_2 extraction and nanofiltration membrane low-temperature enrichment technologies will be universally adopted, eliminating ethanol organic solvent usage and complete solvent residue risks. Onion outer skins and processing by-products will be recycled and extracted for high-content quercetin; onion residues will be processed into organic fertilizers and feed additives to cut full-industry-chain energy consumption and discharge of production wastewater and irritant waste gas, realizing circular green manufacturing.

2. Precise Customization of Raw Materials for Segmented Populations

Special customized onion powders/extracts with differentiated quercetin content, decolorization & deodorization grades, water solubility and mild sulfur-free formulations will be developed for five niche sectors: medical aesthetic post-sun emergency anti-oxidation, severe photoaging whitening, irritant-free infant sun care, middle-aged & elderly cardiovascular regulation and intestinal flora maintenance.

3. Integrated Compound Functional Raw Material Formulations

Compound antioxidant repair cosmetic raw materials will be developed by blending onion extracts with asiaticoside, ectoin and resveratrol; oral lipid-regulating compound raw materials will combine onion extracts with inulin, red yeast rice extract and fish oil. These integrated products reduce compounding procedures for end manufacturers and deliver one-stop composite raw material solutions for skincare and oral wellness applications.

4. Integrated Global Multinational Compliance Layout

Synchronized filing of onion raw materials will be completed for Chinese cosmetics/health food, EU CosIng, US FDA GRAS, Japanese, South Korean and ASEAN cosmetic regulations, unifying testing and judgment indicators for quercetin and total sulfides across multiple countries to enable barrier-free global import and export circulation of domestic onion raw materials.

5. Continuous Upgrading of Transdermal and Absorption-Enhancing Formulation Technologies

Nanoliposome encapsulated high-purity quercetin monomers will be developed to drastically boost skin transdermal absorption rates, resolving the drawback of traditional extracts remaining only on the epidermis with poor deep-layer absorption capacity. New high-end sectors including high-efficacy freeze-dried antioxidant essences, single-dose repair stock solutions and ready-to-eat oral solid beverages will be further expanded.

Conclusion

The onion extract industry stands as a benchmark category marking the evolution of Allium vegetables with 5,000 years of Eastern and Western medicinal-edible folk fresh herbal applications into standardized, light-color low-irritancy, high-activity premium dual-purpose functional raw materials for antioxidant repair cosmetics and oral cardiovascular care. Supported by nearly 300 years of continuous technological deep dive from global scientific research teams, the industry has completed a full developmental cycle spanning cross-civilization herbal textual research and characteristic active ingredient discovery, full verification of cellular and molecular pharmacological pathways, low-temperature sealed targeted enrichment and purification, finalization of supercritical green extraction processes, large-sample human skin and cardiovascular clinical efficacy validation, and independent technological catch-up of full-set domestic extraction and purification processes. It has realized full-chain technological upgrading from field-grown fresh vegetables to core global dual-sector functional plant raw materials.

Compared with traditional dark crude concentrated liquids produced via high-temperature boiling, standardized compound onion extracts adopt core technologies including nitrogen-protected sealed low-temperature ultrasonic extraction, supercritical CO_2 graded separation, two-stage synchronous resin decolorization & deodorization enrichment and microcapsule water-soluble modification. They possess core differentiated strengths: stable quercetin and organosulfur content, minimal pigment and pungent sulfur odor, resistance to oxidative browning during storage, modified water solubility compatible with all formulations, and a complete global compliance system covering both cosmetic and food sectors. They precisely match global consumer trends for natural organic anti-aging skincare, post-sun whitening repair, medical aesthetic soothing stabilization, mild infant sun care, middle-aged & elderly lipid regulation and intestinal nutritional supplementation. Moving forward, with iterative upgrades of green solvent-free extraction processes, development of customized products for segmented populations and industrialization of novel nanoliposome transdermal embedding technology, onion extracts will continuously occupy the core market of natural antioxidant and cardiovascular care plant raw materials, evolving into an indispensable benchmark medicinal-edible functional plant ingredient for global cosmetics, oral health care and oxidative wound repair sectors.