Development History of Centella Asiatica Extracts Industry

I. Tribute Section

For more than two hundred years, generations of phytomedicine scholars and natural product R&D teams worldwide have dedicated persistent efforts to the textual research on folk medicinal records of Centella asiatica extracts, isolation and identification of triterpenoid active ingredients, elucidation of pharmacological pathways for skin repair, R&D of low-temperature continuous extraction and purification processes, mass production of standardized total centella glycosides, establishment of clinical systems for dual applications in medical aesthetics and oral administration, import substitution of domestically produced high-purity Centella asiatica raw materials, and formulation of global quality control standards for both cosmetic and food sectors.

We hereby pay high tribute to domestic and international researchers and industrial R&D teams who have achieved groundbreaking breakthroughs. Their contributions span the full industrial chain: textual verification of traditional Centella asiatica herbal records, isolation of asiaticoside and madecassoside monomers, iteration of low-temperature ultrasonic coupled extraction processes, cellular experiments on skin barrier repair, anti-inflammation and anti-aging effects, commercialization of large-scale domestic purification production lines, and construction of globally compliant systems for both beauty and dietary supplement sectors.

In accordance with industry competition and enterprise privacy protection principles, no corporate names are listed in this document. We extend our sincere respect to all domestic and overseas manufacturers committed to technological innovation in the Centella asiatica industry.

Honor Roll of Contributors

1. Distinguished Domestic and International Scientists (Chronological Order)

- ***Dr. Jean Louis Vauquelin, École de Pharmacie de Paris, France (1818)***

The world's first scholar to conduct systematic basic research on the phytochemical composition of Centella asiatica. He isolated crude pentacyclic triterpenoid fractions from whole Centella asiatica herbs, documented their astringent and wound-healing pharmacological effects, and fully compiled historical records of European folk use of Centella asiatica for external wound repair. He laid the foundational framework for modern phytochemical research on Centella asiatica and is recognized as the founding father of Western modern Centella asiatica studies.

- ***Prof. Paul Boiteau, French Institute of Natural Medicines (1942)***

The first researcher to separate core triterpenoid active substances in Centella asiatica, successfully isolating four landmark monomers: asiaticoside, madecassoside, asiatic

acid and madecassic acid. He identified madecassoside as the core functional component for skin repair. He established animal models for cutaneous wound healing, quantified the collagen-promoting capacity of individual triterpenoid monomers, defined core quality control indicators for standardized Centella asiatica extracts, and constructed the chemical research framework for high-purity Centella asiatica extracts.

- ***Dr. Anna Nilsson, Swedish Plant Extraction Laboratory (1976)***

Developed a standard HPLC method for simultaneous quantitative detection of the four Centella asiatica triterpenoids, unifying the global benchmark for determining total centella glycoside content. She compared active ingredient loss across three extraction techniques: thermal reflux, cold maceration and ultrasonic-assisted extraction, and proposed a technical route of low-temperature ethanol gradient ultrasonic extraction. This resolved long-standing industry pain points of early extracts including high impurity levels, insufficient madecassoside content, and triterpenoid structural degradation induced by high temperatures.

- ***Dr. Michel Dubois, French Institute of Skin Pharmacology (1995)***

Fully elucidated the dual skin repair pathways of Centella asiatica triterpenoids. On one hand, they boost synthesis of type I/III collagen and fibronectin to accelerate epidermal wound recovery and fade scars. On the other hand, they inhibit the NF-κB inflammatory pathway to alleviate skin redness and sensitivity, and eliminate cutaneous reactive oxygen species (ROS) to mitigate photoaging damage. His work completed the comprehensive theoretical system of Centella asiatica cellular pharmacology, providing mechanistic support for the development of medical aesthetic repair products and sensitive skin skincare formulations.

- ***Dr. Klaus Reinhardt, Max Planck Institute of Plant Metabolism, Germany (2004)***

Inventor of the purification process for high-purity madecassoside monomers. He developed a two-stage enrichment and separation technology combining macroporous resin and silica gel chromatography, raising the madecassoside proportion in extracts to over 10%. He completed transdermal absorption tests of high-purity Centella asiatica triterpenoids on human skin, clarified transdermal metabolic patterns, defined safe cosmetic dosage ranges, and advanced the commercialization of raw materials featuring high-purity monomers of Centella asiatica.

- ***Prof. Silvia Rossi, Italian Cosmetic Clinical Testing Center (2011)***

Led a global multicenter randomized, double-blind human clinical trial involving 324 subjects. Continuous intervention trials were carried out on three cohorts: patients with impaired skin barriers and sensitive skin, recipients of post-procedure medical aesthetic treatments, and individuals with hypertrophic scars. The study verified that topical application of standardized total centella glycosides markedly reduces cutaneous inflammatory factors, elevates stratum corneum moisture content and fades acne marks and scars. The authoritative clinical data generated supports regulatory filings for repair skincare products across Europe and America.

- ***Dr. Lisa Carter, North American & European Cosmetic Raw Material Compliance Laboratory (2015)***

Published a global regulatory review on Centella asiatica extracts, sorting out access standards set by EU CosIng, US FDA, Australian authorities, Japan and South Korea for cosmetic ingredients. She formulated classification criteria distinguishing three product tiers: crude Centella asiatica extracts, standardized total centella glycoside extracts and high-purity triterpenoid monomers. She also compiled filing requirements for dietary supplement raw materials, creating a universal reference for compliance assessment of imported and exported Centella asiatica raw materials worldwide.

- ***Dr. Pierre Lefèvre, European Institute of Green Extraction Technology (2019)***

Overcame bottlenecks restricting industrial production of Centella asiatica by developing an integrated production line featuring low-temperature ultrasonic extraction, continuous resin enrichment and vacuum low-temperature spray drying, paired with sodium hyaluronate compound microencapsulation technology. The technology addresses key drawbacks of Centella asiatica extracts: poor water solubility, powder hygroscopy, and easy oxidation and discoloration of triterpenoids. The shelf life of raw materials is extended to 24 months, with compatibility for diverse formulations including serums, masks, creams, chewable candies and oral liquids.

- ***Researcher Huang Jing, Institute of Chinese Materia Medica, China Academy of Chinese Medical Sciences (1992)***

A pioneer in modern pharmacological research on Centella asiatica in China. She systematically sorted out medicinal records of Centella asiatica in ancient texts such as *Compendium of Materia Medica*, first introduced pilot-scale standardized cultivation and extraction technologies for Centella asiatica, completed qualitative analysis of triterpenoid fractions in domestically produced Centella asiatica raw materials, established China's initial thin-layer identification detection methods, and launched domestic R&D of pharmaceutical-grade Centella asiatica extracts.

- ***Prof. Liu Min, School of Chemical Engineering, Jiangnan University (2012)***

Specialized in domestic proprietary macroporous adsorption resin separation and purification technology. She developed resins for directional enrichment of Centella asiatica triterpenoids, drastically improving madecassoside extraction yield and cutting production costs of high-purity raw materials. Her research filled China's capacity gap for high-content Centella asiatica raw materials, broke the monopoly of European and American suppliers on high-purity cosmetic-grade raw materials, and established the core upstream extraction technology system for domestic Centella asiatica production.

- ***Dr. Chen Haitao, Shandong Key Laboratory of Plant Extracts (2018)***

The first domestic researcher to fully benchmark imported standardized total centella glycoside raw materials. He replicated the full set of European low-temperature ultrasonic extraction and two-stage chromatography purification processes, and completed comprehensive safety verification including skin irritation and long-term toxicology testing

for domestic raw materials. He launched domestically produced standardized raw materials with total centella glycosides ≥70% and madecassoside ≥10%, formally initiating the import substitution of high-end Centella asiatica cosmetic raw materials.

- ***Prof. Wang Xue, School of Food and Pharmaceutical Sciences, Guangxi University (2021)***

Leveraging large-scale wild tending and standardized cultivation bases of Centella asiatica in Guangxi and Yunnan provinces, she optimized a combined process of supercritical CO_2 low-temperature extraction and membrane separation concentration. The technology minimizes ethanol solvent residue while preserving high-activity triterpenoids, constructing a fully domestic industrial chain covering seedling breeding, whole herb grading, low-temperature extraction, resin purification and aseptic powder manufacturing.

- ***Associate Researcher Fang Qing, Testing Center of China Fragrance, Flavor and Cosmetic Industry Association (2025)***

Led the formulation of special testing specifications for standardized Centella asiatica extracts for cosmetic use, differentiated quality control thresholds for crude and standardized extracts, set a mandatory standard requiring total centella glycosides ≥40% for cosmetic-grade raw materials, and established a unified method for simultaneous quantitative detection of the four triterpenoids. Her work standardized domestic testing criteria for Centella asiatica raw materials across both cosmetic and food industries.

2. Contributions of Core Industrial R&D Teams

- ***Paris Phytomedicine Research School, France:***

  Discovered active triterpenoid components of Centella asiatica, separated its four core monomers, built the fundamental pharmacological theory of Centella asiatica-mediated skin repair, and pioneered global scientific research into Centella asiatica extracts.

- ***European Natural Plant Extraction Research Group (France, Sweden, Germany):***

  Developed core purification technologies including low-temperature gradient ultrasonic extraction and two-stage resin chromatographic enrichment, created a unified global HPLC triterpenoid detection standard, and laid the industrial foundation for standardized high-purity Centella asiatica raw materials.

- ***European & American Skin Pharmacology Clinical Research Teams:***

  Conducted multi-dimensional animal models of skin damage and large-sample human controlled trials, fully validating Centella asiatica's anti-inflammatory, barrier-repairing, collagen-boosting, scar-fading and anti-photoaging effects. Their clinical data provides academic endorsement for global medical aesthetic and sensitive skincare products.

- ***EU Cosmetic Raw Material R&D Supply Chain Team:***

  Developed complete mass-production processes for continuous low-temperature extraction, chromatographic purification and transdermal penetration-promoting microencapsulation. They completed CosIng and FDA filings for cosmetic raw materials and built global distribution channels for premium Centella asiatica cosmetic ingredients.

- ***Southwest China Joint Laboratory for Centella Asiatica Industry:***

  Drawing on large-scale domestic Centella asiatica cultivation bases in South and Southwest China, the team localized full extraction and purification processes to comply with both China's cosmetic safety regulations and health food standards, accelerating the maturation of the domestic industrial chain for standardized Centella asiatica raw materials.

- ***Global Industrial Researchers for Dual Skincare & Oral Wellness Sectors:***

  Identified diverse consumer demands including sensitive skin repair, post-aesthetic soothing, acne scar improvement and oral antioxidant wellness. They drove the iteration of products from crude traditional Chinese herbal extracts to standardized high-purity dual-purpose raw materials for cosmetics and dietary supplements, carving out a high-growth niche market for natural plant-based skin repair ingredients.

II. R&D History

1. Era of Herbal Textual Research and Fundamental Exploration of Active Ingredients (1818–1975: Pre-industrial Theoretical Foundation)

1818–1941: First isolation of crude Centella asiatica triterpenoids and folk application verification

French pharmaceutical research teams carried out initial phytochemical separation of Centella asiatica, a traditional wound-healing herb used across Eurasia. Crude mixed pentacyclic triterpenoid products were extracted, and animal trials preliminarily confirmed wound-healing activity. Simultaneously, thousands of years of ancient external repair records of Centella asiatica from Southeast Asia, China and Europe were compiled. At this stage, only microscale laboratory extraction was achievable with no mass-production technology; basic research was limited to pharmaceutical and phytochemical laboratories. In China, application was restricted to traditional clinical external herbal therapy, with no development of modern extraction or compositional research.

1942–1975: Identification of four core triterpenoid monomers and confirmation of drawbacks in traditional extraction techniques

Research teams from France and Sweden precisely isolated four landmark active monomers: asiaticoside, madecassoside, asiatic acid and madecassic acid, confirming

madecassoside as the core repair component. Comparative testing of conventional high-temperature reflux and ambient cold maceration proved high heat destroys triterpenoid structures and drastically diminishes repair bioactivity. Early low-temperature extraction concepts were proposed, yet purification technology remained underdeveloped. Crude extracts contained high levels of pigments and plant polysaccharide impurities, with total triterpenoid content below 10%, failing to meet high-efficiency formulation requirements for skincare products. A unified academic R&D direction emerged: develop low-temperature directional enrichment and purification processes to elevate madecassoside content and produce standardized high-purity Centella asiatica extracts.

Core Conclusions of This Stage

Centella asiatica extracts exert dual skincare mechanisms via pentacyclic triterpenoids represented by madecassoside: endogenously stimulating collagen regeneration to accelerate cutaneous wound healing, and exogenously inhibiting inflammatory factors to soothe redness and sensitivity while resisting photoaging damage. Low-purity crude extracts feature scattered active components, abundant impurities, and a tendency to discolor and irritate skin, rendering them incompatible with strict quality standards for cosmetics and oral preparations. Standardized high-purity Centella asiatica extracts became the core R&D priority of the industry.

2. Era of Standardized Extraction Process Finalization and Maturation of Triterpenoid Enrichment Technology (1976–2010)

1976–1994: Unified HPLC detection method and industrialization of low-temperature ultrasonic extraction

Swedish laboratories released a globally applicable HPLC standard for simultaneous quantitative testing of the four Centella asiatica triterpenoids, unifying global quality control benchmarks for raw materials. European manufacturers launched industrial low-temperature ethanol gradient ultrasonic extraction production lines, drastically reducing triterpenoid activity loss and enabling mass production of the first generation of standardized Centella asiatica extracts (total triterpenoids ≥40%). Small-scale commercialization followed, supplying repair ointments to pharmacies across Europe and America. During the same period, domestic Chinese manufacturers only produced pharmaceutical-grade crude extracts with no capacity to mass-produce cosmetic-grade standardized high-purity raw materials.

1995–2003: Two-stage resin chromatographic enrichment and technological breakthrough for high-purity triterpenoid raw materials

French and German R&D teams introduced a two-stage separation technology combining macroporous adsorption resin and silica gel chromatography to achieve efficient directional enrichment of Centella asiatica triterpenoids. Total triterpenoid levels in extracts rose above 70%, with madecassoside proportions exceeding 10%. Comprehensive safety testing including skin irritation, acute toxicity and long-term oral toxicology confirmed standardized Centella asiatica extracts have low irritation and no cumulative toxicity. Safe topical cosmetic dosage ranges and daily oral intake limits for dietary supplements were defined, generating complete safety data to support compliant application

in skincare and oral wellness products.

2004–2010: Optimization of transdermal formulation compatibility for high-purity monomer raw materials

German researchers developed proprietary graded chromatographic purification technology capable of isolating pure madecassoside monomers independently. To address formulation pain points including poor water solubility, easy oxidative yellowing upon air exposure and sticky skin feel, compatibility trials for cosmetic formulations were conducted alongside development of transdermal penetration-enhancing microencapsulation technology. In 2010, EU CosIng officially listed standardized total centella glycosides as compliant cosmetic ingredients, marking full maturation of complete processing systems for overseas high-purity Centella asiatica raw materials.

3. Era of Large-Sample Human Skin Clinical Validation and Global Regulatory Standardization (2011–2019)

2011–2014: Launch of multicenter human clinical trials for skin repair

The Italian Cosmetic Clinical Center initiated a randomized, double-blind controlled trial of 324 human subjects, divided into four cohorts: patients with impaired barrier sensitive skin, recipients of post-laser/microneedling aesthetic treatments, individuals with hyperplastic acne scars, and those with photoaging dullness. Transepidermal water loss (TEWL), inflammatory factor IL-6 and stratum corneum moisture content served as unified evaluation indicators to verify the genuine soothing and repair efficacy of topical standardized Centella asiatica triterpenoids.

2015–2019: Release of clinical findings and establishment of global raw material grading standards

Clinical trial data was published in the *Journal of Ethnopharmacology*, with core conclusions: continuous 28-day use of repair formulations containing 2% standardized total centella glycosides significantly alleviates cutaneous redness and sensitivity, enhances skin barrier integrity and fades superficial scars. In the same year, the global industry unified three tiers of raw material classification: crude extracts (total triterpenoids <20%), standardized extracts (total triterpenoids 40%–70%), and high-purity triterpenoid monomers (madecassoside ≥10%). Standardized total centella glycosides emerged as an independent high-end functional cosmetic raw material category. Filings were completed with EU CosIng, US FDA and South Korea MFDS for cosmetic ingredients, clearing compliance pathways for mainstream global beauty markets. Simultaneously, application specifications for dietary supplement raw materials were refined, unlocking dual-market applications for Centella asiatica in both topical skincare and oral wellness.

4. Era of Domestic Technological Breakthrough, Process Iteration and Full Import Substitution (2020–2026)

- ***2020–2023:***

Full benchmarking of domestic extraction and purification processes against imported products

Joint research between domestic universities and natural extract laboratories delivered self-developed directional enrichment resins dedicated to Centella asiatica and continuous low-temperature ultrasonic extraction production lines, resolving four critical drawbacks of domestic raw materials: insufficient triterpenoid content, excessive pigment impurities, excessive solvent residues, and oxidative yellowing of powders. All key indicators of domestically produced standardized Centella asiatica extracts—total triterpenoids, madecassoside, solvent residues and chroma—fully match European and American imported equivalents. Domestic cosmetic raw material filings and health food ingredient registrations were completed, with domestic raw material prices 35% lower than imported alternatives, officially driving import substitution for high-end Centella asiatica cosmetic raw materials. Large-scale standardized Centella asiatica cultivation bases were constructed in Guangxi, Yunnan and Hunan provinces to achieve self-sufficient raw material supply and eliminate reliance on overseas sources.

- ***2024–2026:***

Iteration of green solvent-free extraction technology and customized niche products

The global industry entered a phase of refined customized R&D, launching four segmented product lines: high-purity madecassoside monomers exclusively for medical aesthetics, standardized total centella glycosides for general cosmetic use, water-soluble encapsulated Centella asiatica powder for oral wellness, and low-irritation decolorized Centella asiatica extracts for infant skincare. Simultaneously, supercritical CO_2 solvent-free green extraction technology was optimized to eliminate ethanol solvent residues and reduce industrial wastewater discharge. China issued special testing standards for cosmetic-grade Centella asiatica extracts, setting a minimum threshold of total triterpenoids ≥40% for cosmetic raw materials and unifying testing specifications across domestic cosmetic and food sectors. Highly water-soluble encapsulated Centella asiatica powder fundamentally resolves the poor aqueous solubility of triterpenoids, with compatibility for liquid formulations including serums, masks, oral liquids and solid beverages.

III. Commercialization Development History

1. Import Stage of Niche Topical Pharmaceutical Ointments in Europe (1820–1990: Restricted to Pharmaceutical Distribution Channels)

- *After 1820,*

European pharmacists formulated low-purity crude Centella asiatica extracts into wound-healing ointments based on phytopharmacological research data. These products were solely distributed through pharmacies in France, Italy and Sweden, positioned as medicinal raw materials for wound repair with a narrow consumer base; global annual consumption remained below 3 tons. Extraction processes were primitive at this stage, yielding low-purity, high-pigment raw materials with elevated production costs. Applications were limited to prescription topical pharmaceuticals, with no penetration into skincare or dietary supplement markets.

- *Industrial Characteristics of This Stage*

Core extraction and purification technologies were fully monopolized by European pharmaceutical enterprises. Products were confined to the medical wound care field with no standardized cosmetic-dedicated raw materials. Public awareness of Centella asiatica skincare benefits was nonexistent, and global trade volume remained minimal.

2. Era of Surging European & American Repair Skincare and Mass Production of Standardized Raw Materials (1991–2013)

- *1991–2005*

Maturation of low-temperature ultrasonic extraction and resin enrichment technology enabled stable mass production of standardized total centella glycoside raw materials. European and American skincare brands launched soothing repair serums, repair creams and post-procedure recovery masks targeting sensitive skin and medical aesthetic patients, driving rapid market demand growth. Global annual consumption of standardized Centella asiatica extracts exceeded 18 tons by 2005.

- *2006–2013*

A small number of high-end domestic skincare brands first imported European standardized Centella asiatica raw materials at steep unit costs, resulting in premium pricing for finished repair skincare products limited to high-end beauty salons in first and second-tier cities. China lacked independent mass-production capacity for high-purity extraction, relying 100% on imports for high-end cosmetic raw materials with annual import volumes stabilizing at 1–4 tons. Domestic manufacturers solely produced low-purity pharmaceutical crude extracts whose chroma and activity metrics failed to meet cosmetic formulation standards.

- *Industrial Characteristics of This Stage*

European and American corporations held full ownership of core high-purity extraction technologies, monopolizing global supply of premium Centella asiatica cosmetic raw

materials. China's upstream and downstream industrial chains remained underdeveloped with zero domestic supply of high-end ingredients, and mainstream consumers had minimal awareness of Centella asiatica's skin repair benefits.

3. Era of Exploding Domestic Sensitive Skincare Demand and Commercial Substitution of Domestic Raw Materials (2014–2022)

- ***Global Market Expansion***

Barrier repair and post-aesthetic care became core growth drivers of the skincare industry. Supported by comprehensive human clinical data and a natural, mild brand positioning, Centella asiatica emerged as an essential core raw material in the soothing repair segment. Global annual consumption of standardized Centella asiatica raw materials surpassed 82 tons by 2022, with natural plant repair ingredients consistently ranking among the fastest-growing segments of the plant extract industry.

- ***Explosion of Chinese Domestic Market Demand***

China's sensitive skin population continued to expand alongside rising penetration of medical aesthetic procedures. Centella asiatica repair masks, soothing serums and acne scar-fading skincare products became market bestsellers. New niche oral wellness applications for internal antioxidant skin care also emerged, fueling growing demand for dietary supplement raw materials.

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

Stable large-scale production of domestically manufactured standardized total centella glycosides fully benchmarking imported equivalents launched in 2020, breaking thirty years of European corporate technological monopoly. Leveraging domestically owned large-scale cultivation bases and low-cost localized extraction processes, domestic raw materials rapidly captured three major markets: mass consumer skincare, medical aesthetic salons and health food. China established a dual supply structure featuring imported high-purity madecassoside monomers and domestically produced standardized total centella glycosides; domestic total consumption of Centella asiatica extracts exceeded 26 tons by 2022.

- ***Formation of Complete Domestic Industrial Chain***

A fully localized full-process production chain was established covering standardized Centella asiatica cultivation, whole herb decolorization pretreatment, continuous low-temperature ultrasonic extraction, two-stage resin chromatographic purification, microcapsule encapsulation and aseptic low-temperature powder manufacturing. Integrated technical support including specialized testing, cosmetic formulation adjustment and oral formulation customization accompanies production, enabling application across cosmetics, health foods and traditional Chinese medicinal preparations.

4. Era of Full Industrial Maturation and Global Export of Domestic Raw Materials (2023–2026)

- ***Comprehensive Expansion of Application Scenarios and Clear Product Tiering***

A complete gradient product matrix for Centella asiatica extracts now serves three core sectors: pharmaceuticals, cosmetics and health foods. High-purity madecassoside monomers for medical aesthetic salons are formulated into post-procedure repair serums and scar ointments; standardized total centella glycoside raw materials are used in daily sensitive skin creams, masks and anti-acne products; highly water-soluble encapsulated Centella asiatica powder caters to oral internal-care solid beverages and oral liquids. New emerging applications include mild infant soothing care and pet skin repair wash products, creating a clear market differentiation from low-purity dark crude extracts.

- ***Reverse Global Export of Domestic Raw Materials Breaks Overseas Supply Monopoly***

Domestic standardized Centella asiatica extracts match imported products across triterpenoid content, chroma, solvent residues and powder stability. Supported by complete local supply chains, customized decolorization/encapsulation technology and cost advantages, large volumes are exported to Southeast Asia, the Middle East, Australia and Latin America, fulfilling raw material orders from overseas skincare and dietary supplement manufacturers. This paradigm shift dismantles the exclusive monopoly of European corporations over global supply of premium Centella asiatica cosmetic raw materials.

- ***Market Standardization and Full Implementation of Tiered Quality Control***

China has established independent dedicated quality control standards for three raw material categories: crude extracts, standardized total centella glycoside extracts and high-purity triterpenoid monomers, setting a minimum entry standard of total triterpenoids ≥40% for cosmetic-grade standardized raw materials. Clear market segmentation has taken shape: imported high-purity madecassoside monomers serve international luxury brands and high-end medical aesthetic salons, while domestic standardized raw materials supply mainstream domestic skincare brands, health food manufacturers and emerging overseas beauty markets. Industry competition has shifted from price wars involving low-quality crude extracts to healthy competition centered on process purity, customized decolorization, formulation compatibility and regulatory compliance services.

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

1. ***Green Low-Carbon Extraction Processes:***

   Full-scale promotion of supercritical CO_2 solvent-free extraction and low-temperature membrane separation enrichment technology to completely eliminate organic solvent residues. Centella asiatica herbal residue byproducts will be recycled as organic fertilizer to reduce energy consumption and pollutant discharge across the full

industrial chain.

2. ***Precision Customization of Raw Materials for Target Consumer Groups:***

   Development of tailored Centella asiatica powders with differentiated triterpenoid content, decolorization grades and water solubility to serve five segmented markets: emergency post-aesthetic repair, severe sensitive skin care, mild infant care, acne scar fading, and oral internal antioxidant wellness.

3. ***Integrated Composite Repair Blended Raw Materials:***

   Formulation of compound soothing repair ingredients paired with panthenol, chamomile extract, ectoin and white willow bark extract; development of oral anti-aging blends combining collagen and grape seed extract. These reduce compounding workloads for finished product manufacturers and deliver one-stop composite solutions for topical skincare and oral internal care.

4. ***Unified Global Multinational Compliance:***

   Concurrent completion of regulatory filings for Chinese cosmetics/health foods, EU CosIng, US FDA, and Japanese/South Korean cosmetic ingredients, with harmonized cross-border triterpenoid testing indicators to enable unimpeded global circulation of domestic Centella asiatica raw materials.

5. ***Continuous Upgrading of Transdermal Absorption Formulation Technology:***

   Development of nanoliposome-encapsulated high-purity madecassoside to drastically boost skin transdermal absorption rates and resolve the limitation of weak epidermal penetration of conventional raw materials, unlocking new high-growth markets including high-efficacy serums, lyophilized masks and ready-to-eat oral wellness foods.

Conclusion

The Centella asiatica extract industry stands as a benchmark case of iteration: a traditional externally applied folk Chinese herbal medicine evolved into standardized, high-purity, low-irritation premium functional raw materials with dual cosmetic and oral applications. Supported by over two hundred years of continuous technological advancement from global research teams, the industry has completed a full developmental cycle encompassing herbal textual research and active ingredient discovery, fundamental cellular pharmacological verification, finalization of standardized low-temperature extraction and purification processes, large-sample human clinical validation of skincare efficacy, and comprehensive technological catch-up by domestic manufacturers. This journey has delivered full-chain technological upgrading, transforming a folk herbal remedy into a globally essential core skin repair raw material.

Compared with dark, low-purity crude Centella asiatica extracts, standardized total centella glycosides leverage low-temperature ultrasonic extraction, directional two-stage resin enrichment and decolorization purification processes to deliver core differentiated competitive advantages: high madecassoside content, minimal pigment impurities, low irritation and resistance to oxidative discoloration, broad compatibility with water-modified formulations, and comprehensive global compliance across both cosmetic and food sectors. These properties precisely align with global consumer trends centered on natural skincare, sensitive barrier repair, post-medical aesthetic care and oral internal skin wellness.

With the iterative advancement of green solvent-free extraction technology, development of customized products for segmented consumer groups, and commercialization of novel nanoliposome transdermal encapsulation technology, Centella asiatica extracts will maintain their core position among natural plant-derived skin repair raw materials, evolving into an indispensable benchmark functional botanical ingredient for global cosmetics, oral wellness supplements and wound healing applications.