

CO-LOADING LIPOSOMES WHITE PAPER



Natural Field Co., Ltd. was established in 2005 and is committed to providing high-quality ingredients and solutions for global nutrition and health companies.

2005
Founded in 2005

86
Best-selling in 86 countries

39
Over 39 national patents

10
10 Official Certifications Worldwide



Quality Certification

Backed by CNAS, FSSC 22000, ISO 22000, and HACCP certifications, the China Food Production License (SC), 39+ national patents, and around 10 authoritative accreditations worldwide, our products are qualified for entry into premium global markets.

10000⁺

Selected by more than 10,000 nutrition and wellness brands.

30000⁺

Over 30,000 tons sold worldwide.

86

Customers in 86 countries and regions around the world are using raw materials from Natural Field Co., Ltd.



Development History

2005

In 2005, Xi'an Natural Field Bio-Technique Co.,Ltd. was established.

2008

In 2008, Natural Field established a strategic partnership with the FMMU, completed the industrialization of the synthetic paclitaxel precursor 10-DAB, and applied for multiple invention patents with Academician Zhang Shengyong.

2012

In 2012, Natural Field was awarded by the country as the "Industrial Demonstration Base" for the production of paclitaxel.

2013

In 2013, Natural Field obtained the approval from the State Forestry Administration for the production and processing of endangered species.

2014

In 2014, Natural Field passed the French BV certification and won the honorary title of international "Gold Supplier".

2017

In 2017, three 10,000 -level purification GMP workshops were built and put into operation. The SC food production license was obtained, and the project products passed the ISO22000, ISO9001 quality management system certification and obtained HACCP, KOSHER, HALAL certification.

2018

In 2018, Shanghai R&D Center was established.

2019

In 2019, Natural Field carried out a shareholding reform and started the journey of capitalization

2021

In 2021, Xiamen Ginposome Pharmaceutical, invested by Natural Field, obtained the API production license.

2022

In 2022, the construction project of the production base for the health industry of Xi'an Natural Field Bio-Technique Co, Ltd. in Caotang Science and Technology Industrial Park in Xi'an High-tech Zone was completed.

2023

In 2023, Natural Field Inc. in USA was established.

2024

In 2024, the core team invested in the establishment of Xi'an Rongfeng-huixin Partnership Enterprise, and invested in the construction of Yunnan production base together with Xiamen Ginposome.

2024

In 2024, Natural Field Laboratory was certified by CNAS.

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WHITE PAPER

Natural Field Co., Ltd.

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Introduction of Co-loading
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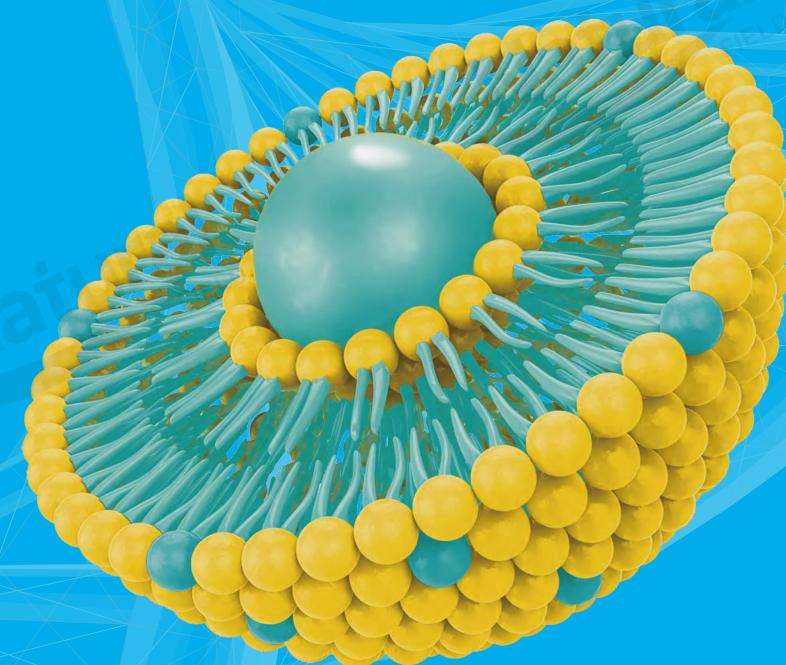
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Advantages of Co-loading
Liposomes Application

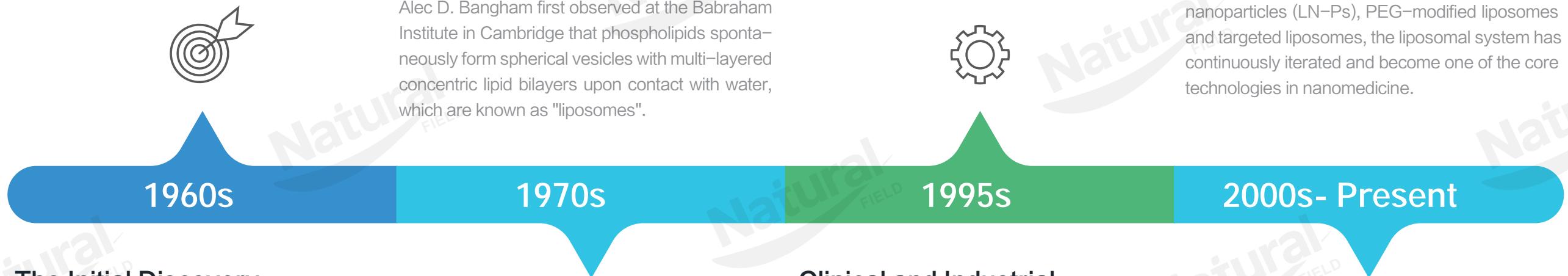
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PART.1

Discovery and Evolution History of Liposomes



The Discovery and Development of Liposomes



The Initial Discovery

Between 1961 and 1964, British hematologist Alec D. Bangham first observed at the Babraham Institute in Cambridge that phospholipids spontaneously form spherical vesicles with multi-layered concentric lipid bilayers upon contact with water, which are known as "liposomes".

In-Depth Academic Research

Between 1961 and 1964, British hematologist Alec D. Bangham first observed at the Babraham Institute in Cambridge that phospholipids spontaneously form spherical vesicles with multi-layered concentric lipid bilayers upon contact with water, which are known as "liposomes".

Clinical and Industrial Applications

In 1995, the world's first liposomal drug, Doxil® (liposomal doxorubicin) has been approved by the FDA, marking liposomal technology has entered a new era of clinical application. Subsequently, there are many liposomal drugs have been successively launched on the market or entered clinical trials.

The Era of Nanomedicine and Precision Delivery

From basic morphological models to modern lipid nanoparticles (LN-Ps), PEG-modified liposomes and targeted liposomes, the liposomal system has continuously iterated and become one of the core technologies in nanomedicine.

The Development of Liposomes in Application Fields



Clinical Research

The initial application of liposomes in the field of pharmaceuticals

In 1995: Doxil® was approved, enabling the commercialization of liposomal drugs. Subsequently, a series of clinical liposomal products for anti-cancer, anti-fungal and other indications have emerged.



Skin Beauty

The wide application of liposomes in cosmetics

In 1986: Dior launched Capture, the first liposomal anti-aging facial cream, marking liposomes' entry into the beauty and cosmetics market. Thanks to their excellent skin-friendliness and improved stability and permeability of active ingredients, liposomes have expanded their applications in the beauty sector to sunscreen, slimming, skincare, and hair care products, among others.



Healthy Nutrition

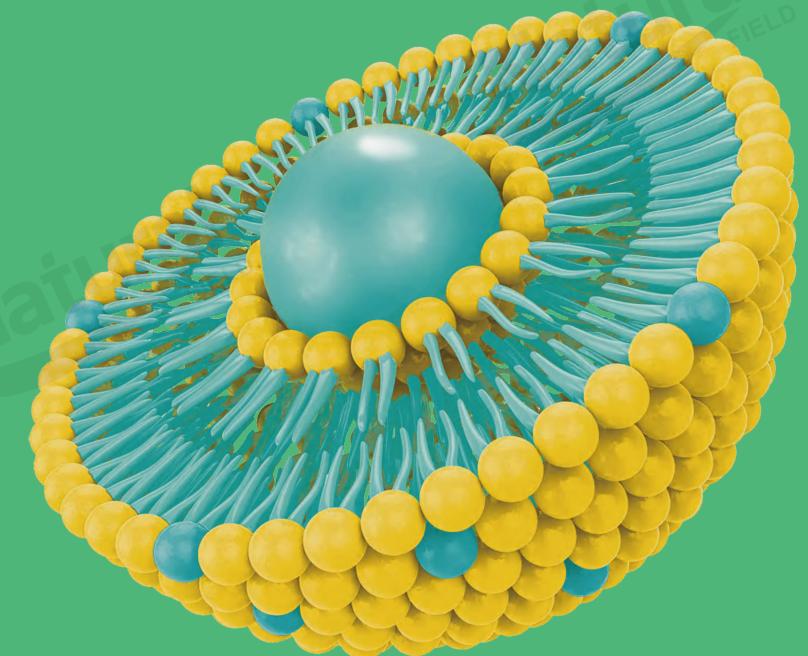
The rise of liposomes in the field of food and dietary supplements

1990s-2000s: Nutritional supplements entered the initial stage of research and market development. Since the end of the 20th century, liposomes have been extensively studied for application in the field of nutritional supplements due to their ability to encapsulate both hydrophilic and hydrophobic components and enhance oral bioavailability.

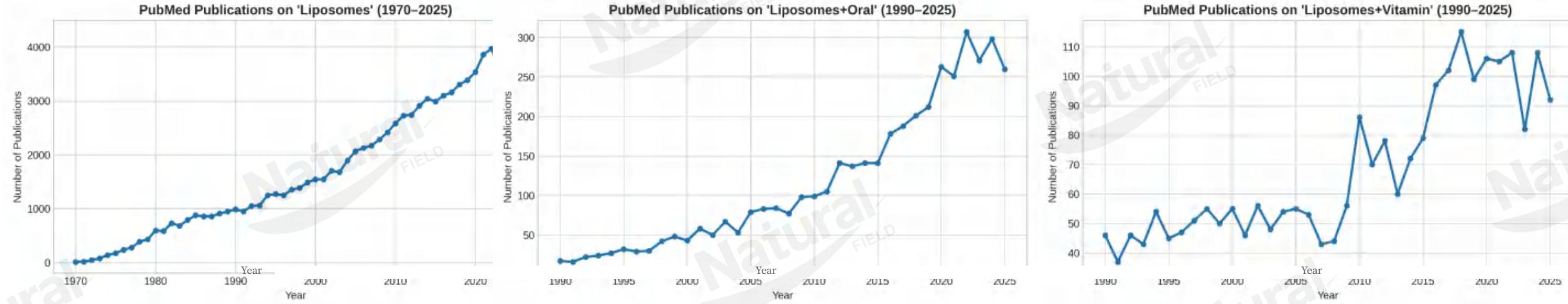
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PART.2

Current Market Situation and
Trends of Liposomes

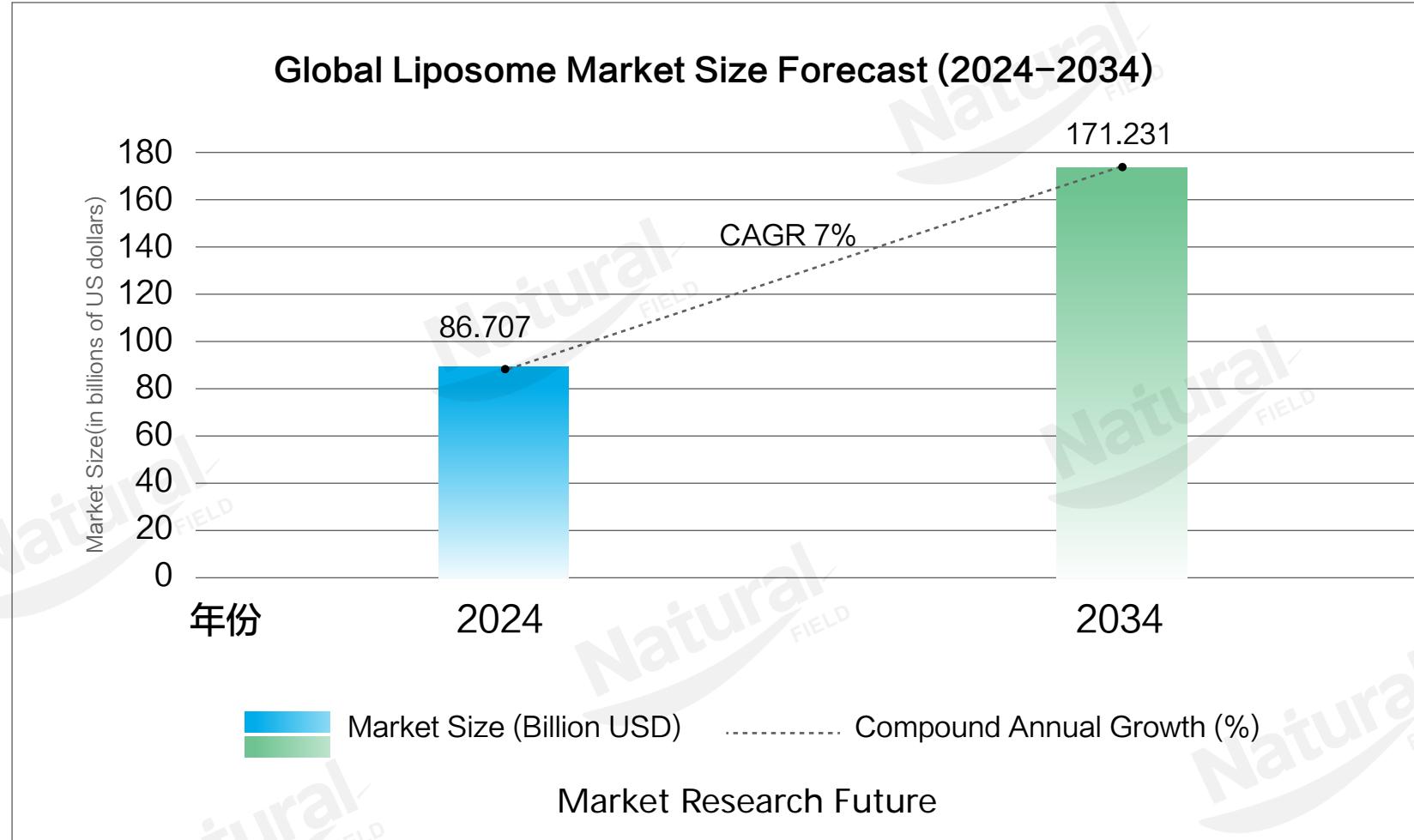


Research Interest in Liposomes Has Steadily Increased over the Years. From 1960 to 2025, the Number of PubMed Publications on Liposomes Shows an Upward Trend.



Since Bangham first reported liposomes in the 1960s, research on liposomes has generally shown a steady upward trend. It began to accelerate in the 1990s and entered a period of substantial growth in the 2000s–2010s. Driven by research on nanocarriers, LNP/mRNA vaccines, and oral delivery over the past decade, the number of relevant literature publications has remained consistently high. Research on oral liposomes (liposome + oral) started relatively late but has also entered a phase of rapid growth since the 2000s, with studies on liposomal vitamin products being particularly prominent.

The Evolution of Liposomes in Application Fields



According to calculations by market research institutions, the global liposome market was approximately USD 86.707 billion in 2024 and is projected to grow at a compound annual growth rate (CAGR) of around 7%, reaching nearly USD 171.231 billion by 2034.

Pharmaceuticals

In 2024, the global liposomal drugs market size was USD 5.5 billion. It is projected to reach USD 12.2 billion by 2033, with a compound annual growth rate (CAGR) of 9.5% during the forecast period.(vered marketreports)

Cosmetics

In 2024, the global liposomal cosmetics market size was USD 2.8 billion. It is projected to reach USD 4.9 billion by 2033, with a compound annual growth rate (CAGR) of 6.4% during the forecast period.(daba horizzon research)

Dietary Supplement

In 2024, the global liposomal supplement market was valued at USD 350 million. It is projected to reach USD 745 million by 2034, with a compound annual growth rate (CAGR) of 7.85% during the forecast period.(precedence research)



Market Segmentation Trend Insight



Market Driving Factors and Challenges

Market Drivers and Challenges

The global liposome supplement market is growing steadily, with marked regional variations—North America remains mature and leading, whereas the Asia-Pacific region demonstrates strong growth momentum.

Vitamins products dominate the market, liquid formulations are favored, and expansion is driven by e-commerce channels. The market continues to offer significant future potential.



Driving Forces

- 1.Rising consumer health awareness drives preference for products with “high absorption” and “high bioavailability” .

Source: Precedence Research TMR Market Research & Consulting

- 2.Increasing scientific validation has strengthened market trust and promotional efforts.

Source: Precedence Research

- 3.Expansion of e-commerce channels and direct-to-brand models enhances market coverage and reach efficiency.

Source: Precedence Research

- 4.Aging population, demand for chronic disease management, and personalized nutrition are driving market upgrades and development.

Source: Lucintel TMR Market Research & Consulting

Challenges

- 1.Liposome technology is relatively costly, limiting consumer acceptance in price sensitive regions.qyresearch.in

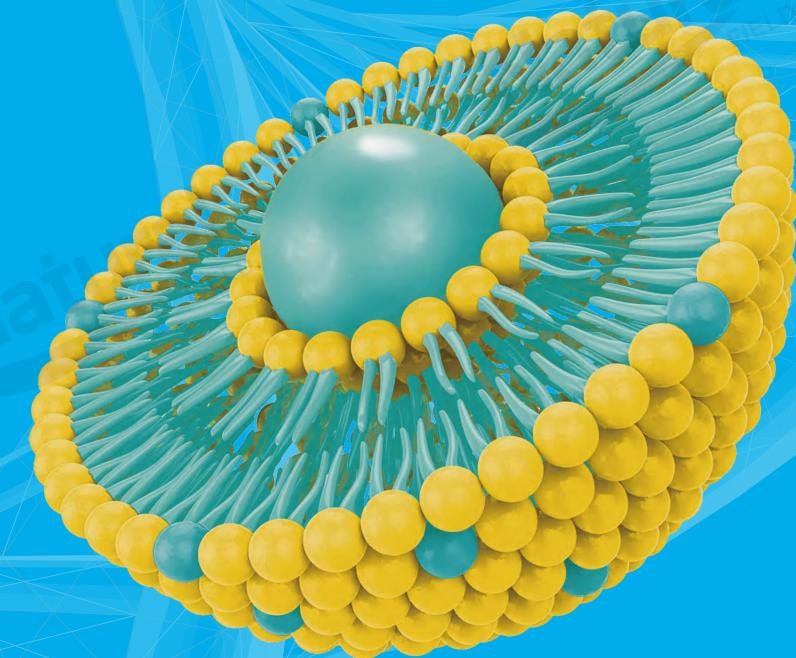
- 2.Clinical evidence is still limited, and some claims lack strong support, so consumer trust needs to be strengthened.qyresearch.in

- 3.Regulatory standards vary across regions, and labeling and functional claims face compliance challenges in cross-border promotion .

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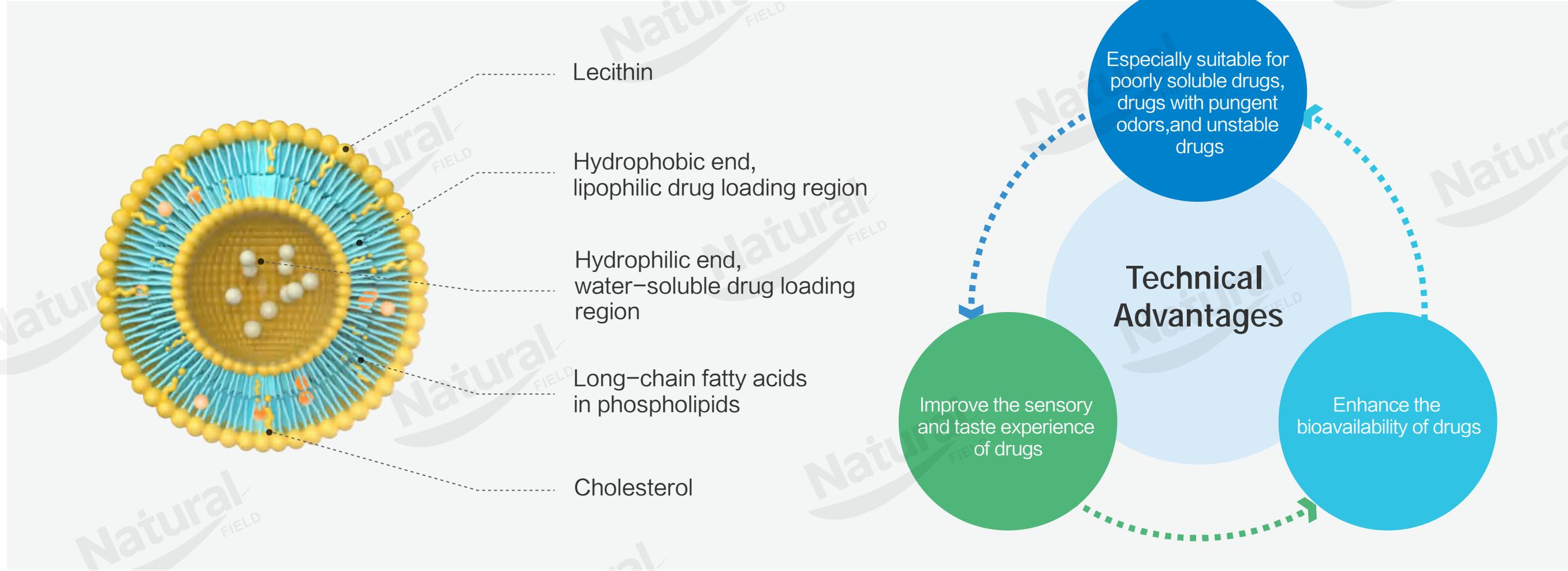
PART.3

Introduction of Co-loading Liposomes



Liposomes Represent an Advanced and Complex Formulation Widely Utilized within the Pharmaceutical Field

Liposomes are nanoscale vesicles composed of phospholipids and cholesterol. Capable of encapsulating both lipophilic and hydrophilic drugs. They serve as a promising drug delivery system.



Novel Co-Loading Liposomal Drug Delivery System (Rare Ginsenosides as Membrane Material): A New Stage of Delivery Technology for Market Demands



Better Absorption
Better Efficiency
Effect
Widely Applied
Good Applicability
Efficient Absorption
Efficient Delivery
Better Absorption
Better Efficiency
Good Taste
Effect Widely Applied
Obvious Effect
Better Absorption
Multinutrient Complex Formulation
Nutritional Compound Formulation
Biological Nutrients



Better Efficiency

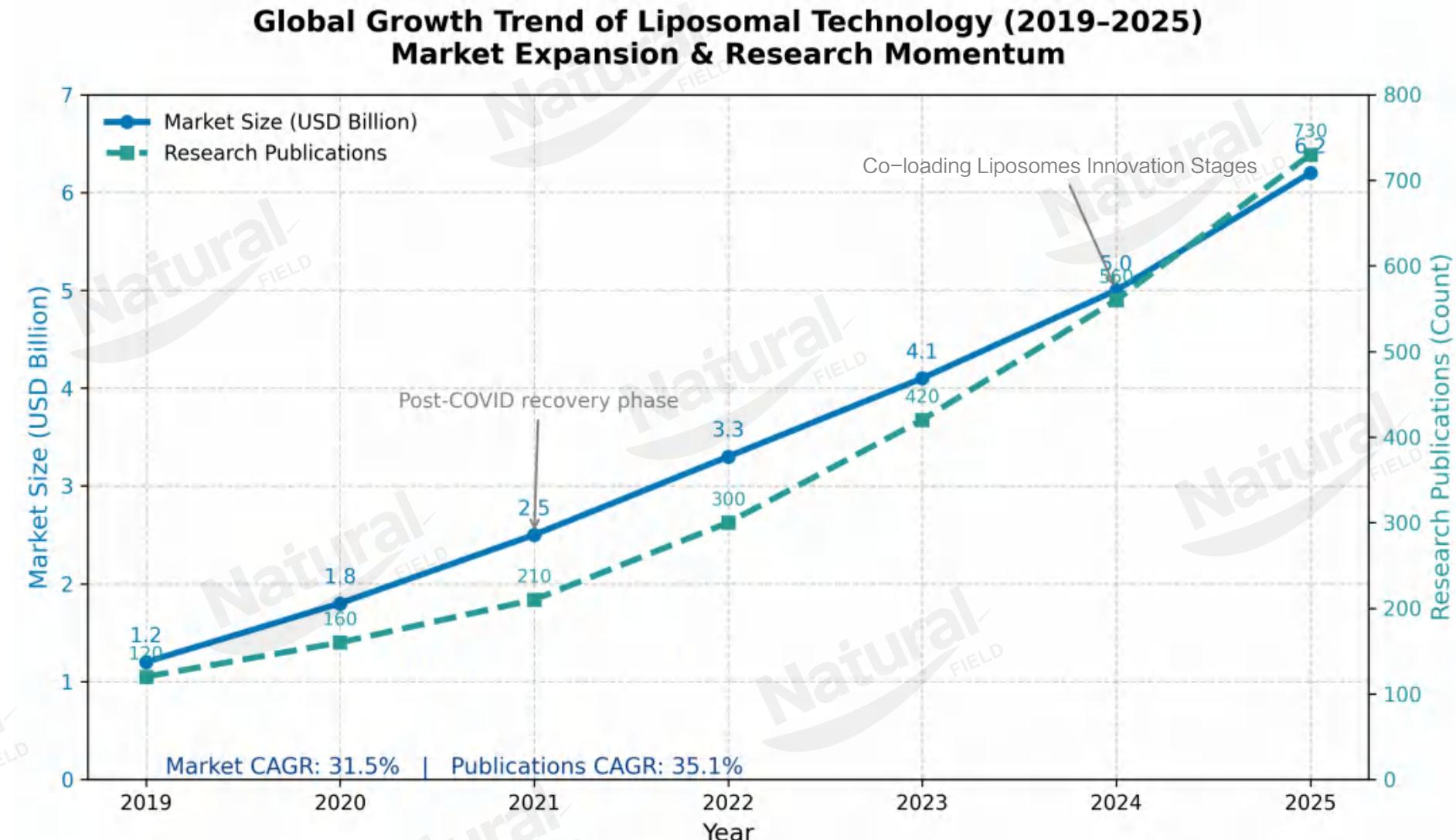


Better Absorption



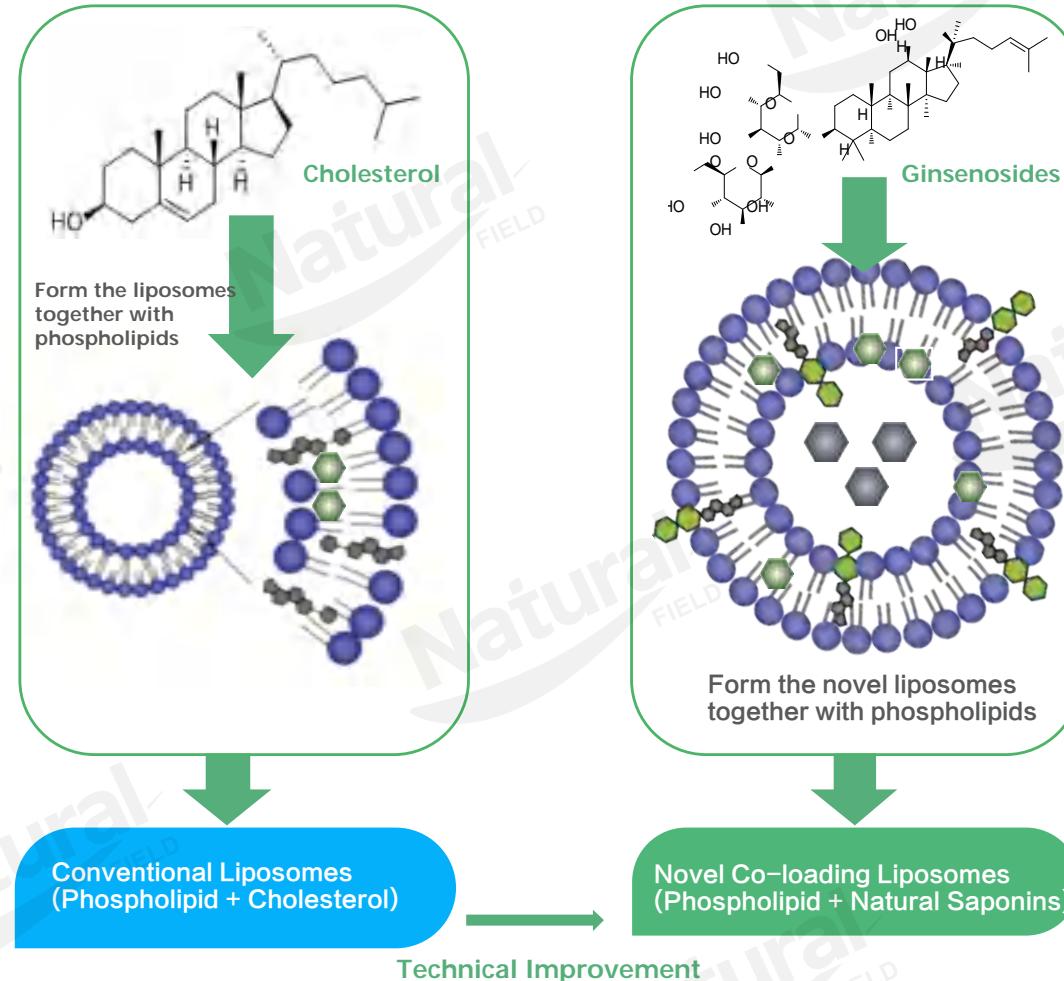
Multinutrient
Complex Formulation

The Novel Co-Loading Liposomal Drug Delivery System Using Rare Ginsenosides as Membrane Material Marks That Delivery Technology Ushers in a New Stage and Can Better Meets Market Demands



Core Technology of Novel Co-loading Liposomes: A New Drug Delivery System Using Rare Ginsenosides as Membrane Material

Structural Diagram of Novel Co-loading Liposomes

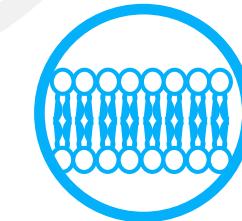


Co-loading ≠ Simple Mixing

Design Concept:
Rare Ginsenosides "Kill Three Birds with One Stone"



Active
Ingredient



Membrane
Material

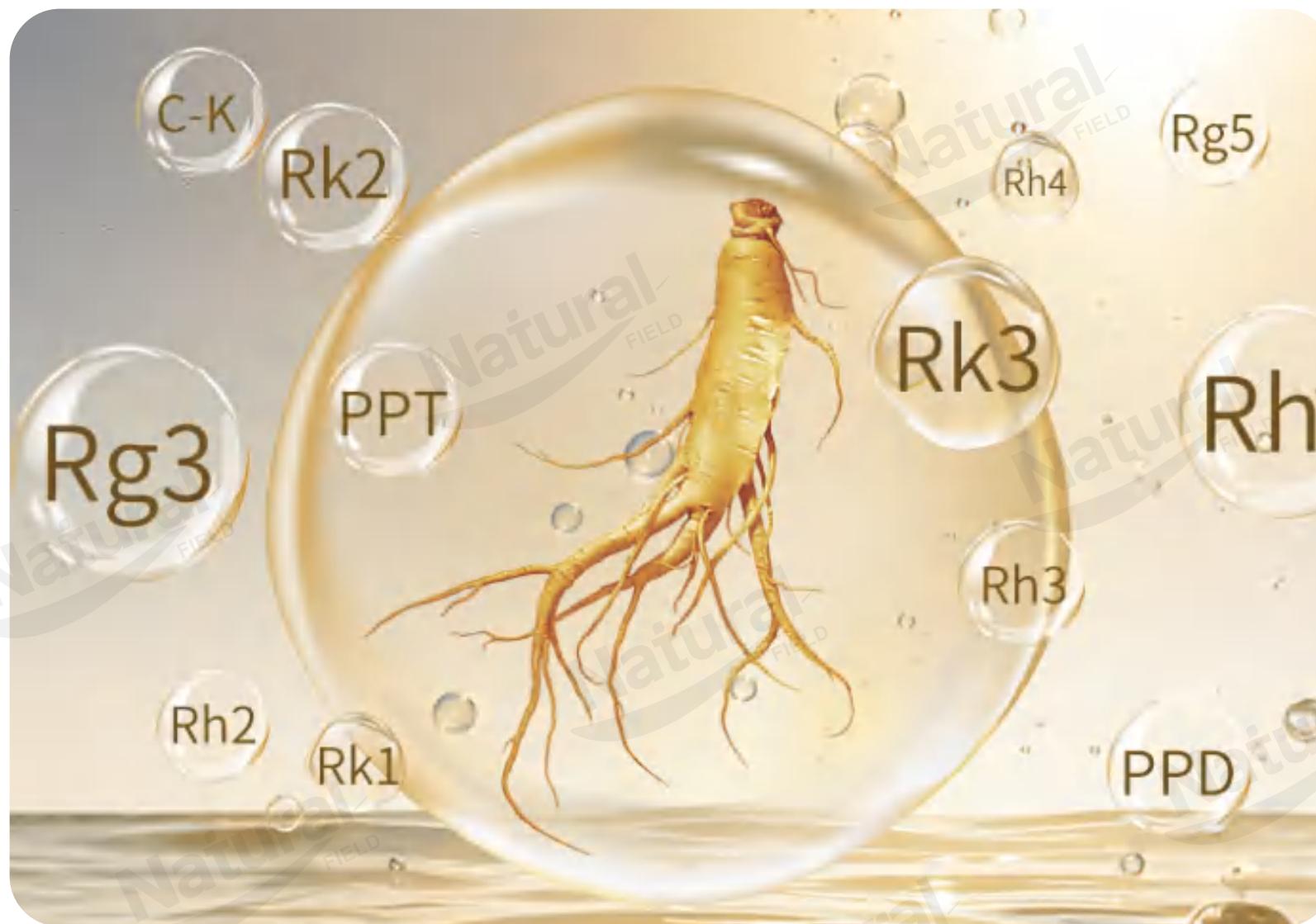


Absorption
Enhancer

Technical Advantages

- Rare ginsenosides act synergistically with drugs, enhancing efficacy.
- Improve liposome stability.
- Avoid contraindications associated with cholesterol.
- Enhance gastrointestinal absorption.

Rare Ginsenosides as Membrane Material: Core Technology of Co-loading Liposomes



Advantages of Rare Ginsenosides

Extremely Rare

Content below 0.001%.

A secondary metabolic saponin that exists in plants

The content is extremely low after refined extraction

Higher Activity

Compared with other ginseng components

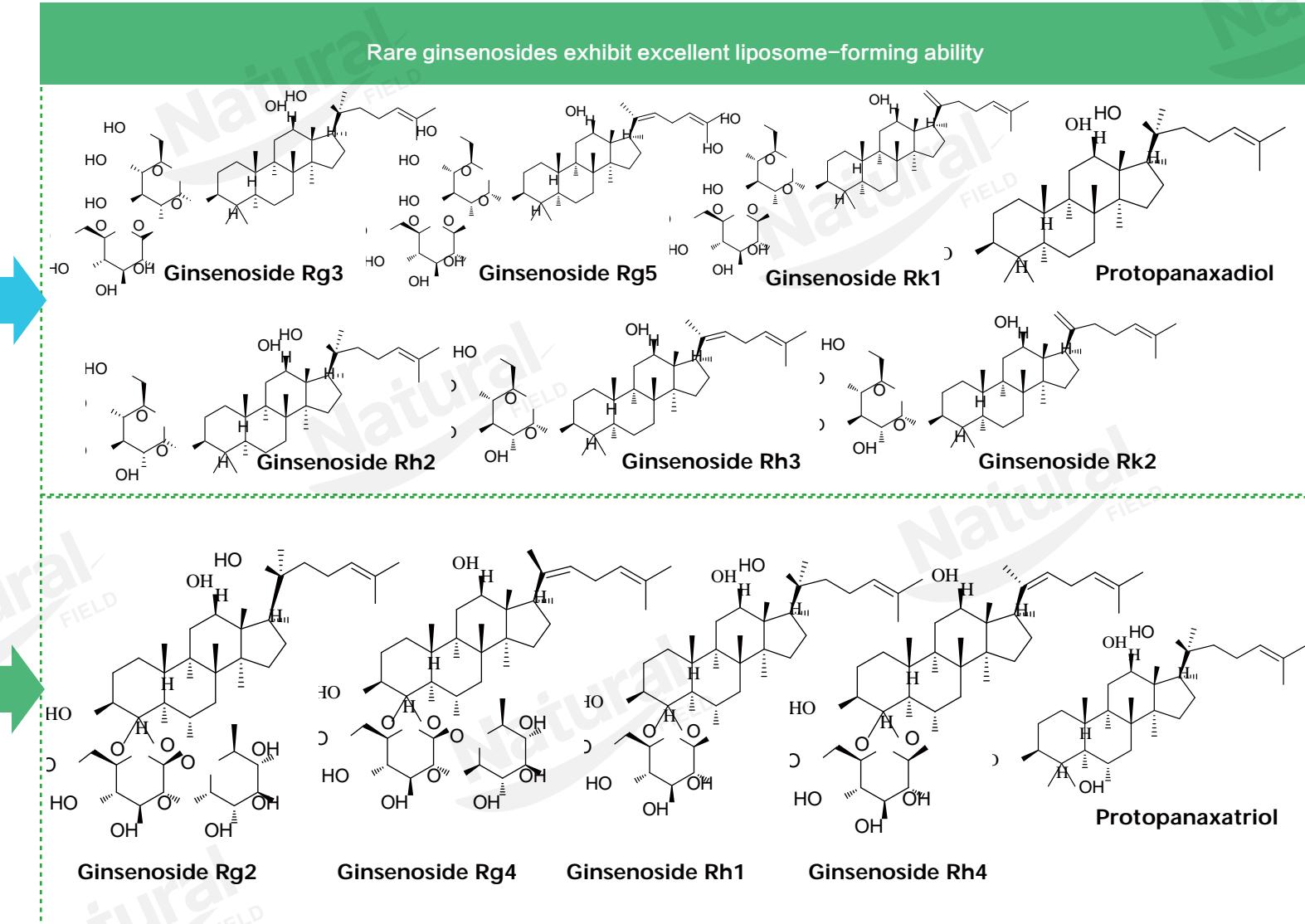
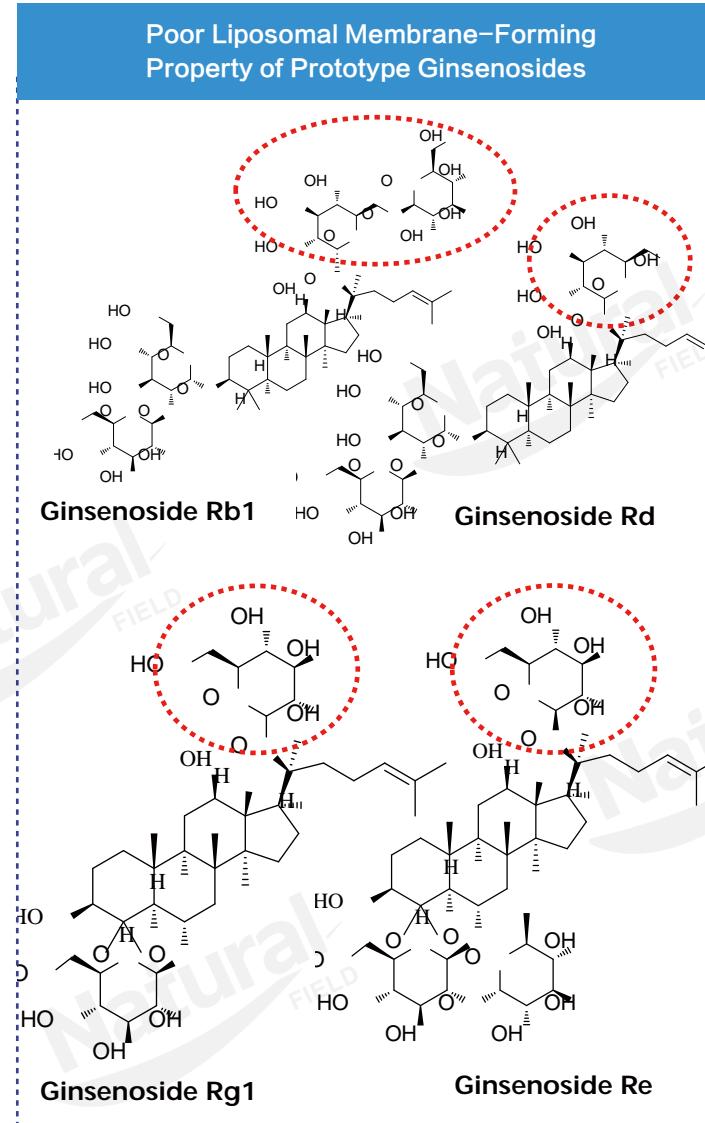
Bidirectional immune regulation

Significantly enhance immunity

Efficacy of Rare Ginsenosides



The High Bioavailability and Excellent Membrane Stability of Rare Ginsenosides: The Fundamental Basis for Constructing Co-Loading Liposomes as Membrane Materials

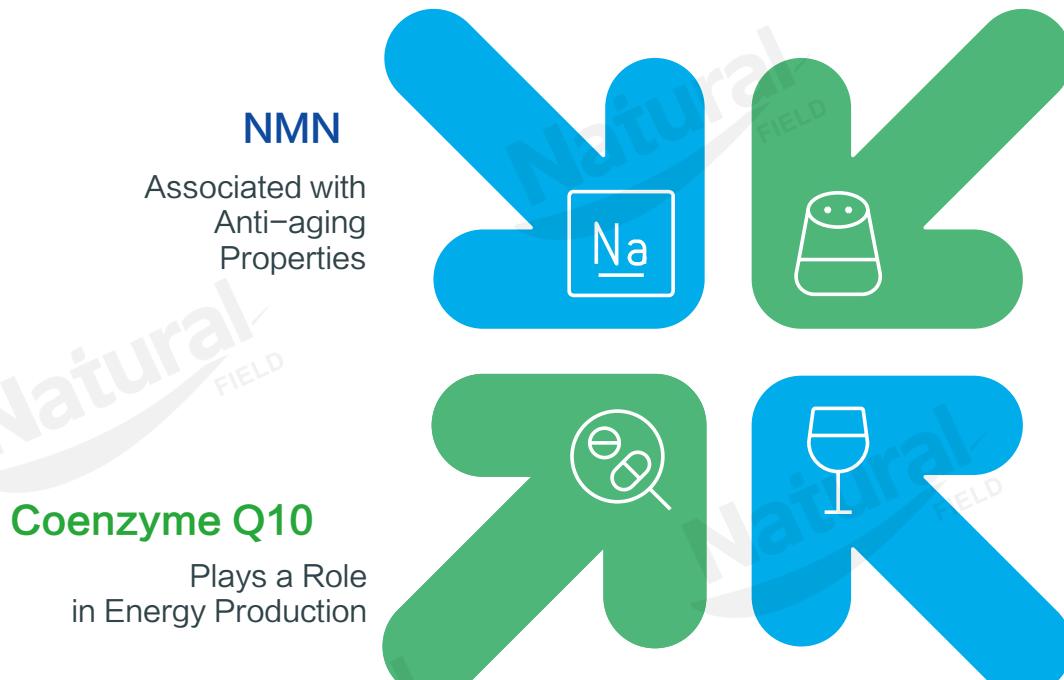


Diol-Type— Rare Ginsenosides

Triol-Type— Rare Ginsenosides

Compound Preparation is an Important Development Direction of Health Food, and Co-loading Liposomes Can Achieve Synergistic Enhancement of Multiple Functional Ingredients.

Competition in the Functional Ingredients Market



Why are Compound Formulations the Future?



Strong Market Growth

9.6% Compound Annual Growth Rate (2024–2027)

Complementary Mechanisms of Action

Complementary Mechanisms of Action
Complementary or Synergistic Targets
Efficacy Superior to the Sum of Individual Ingredients

Diversified Application Scenarios

Diversified Application Scenarios
Replace single-function selling points with scenarios
[Sports Recovery Compound]
[Stress Management Compound]
[Anti-aging Multi-target Compound]

Conducive to Market Brand Marketing

Highly Flexible for Storytelling
Abundant Marketing Highlights
Easier Brand Differentiation

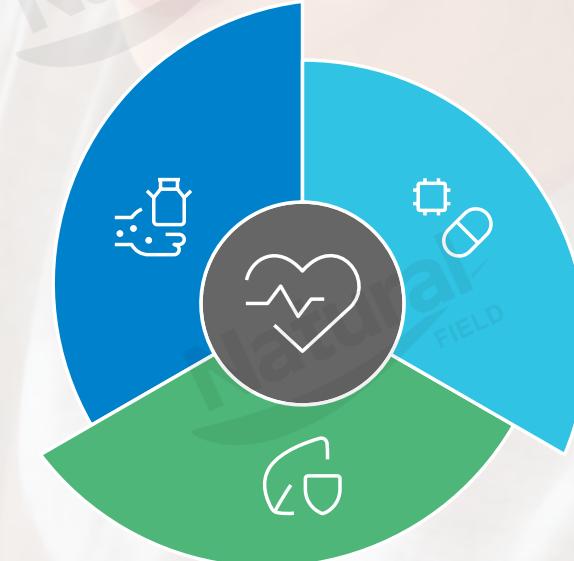
Modern Interpretation of One Drug for Multiple Indications

In modern functional ingredients, through the multi-target synergy mechanism, compound preparation solves the complex health problems of modern people.

Antioxidant + Anti-inflammatory+
Cognitive Protection



Anti-aging + Heart Health +
Immune Regulation



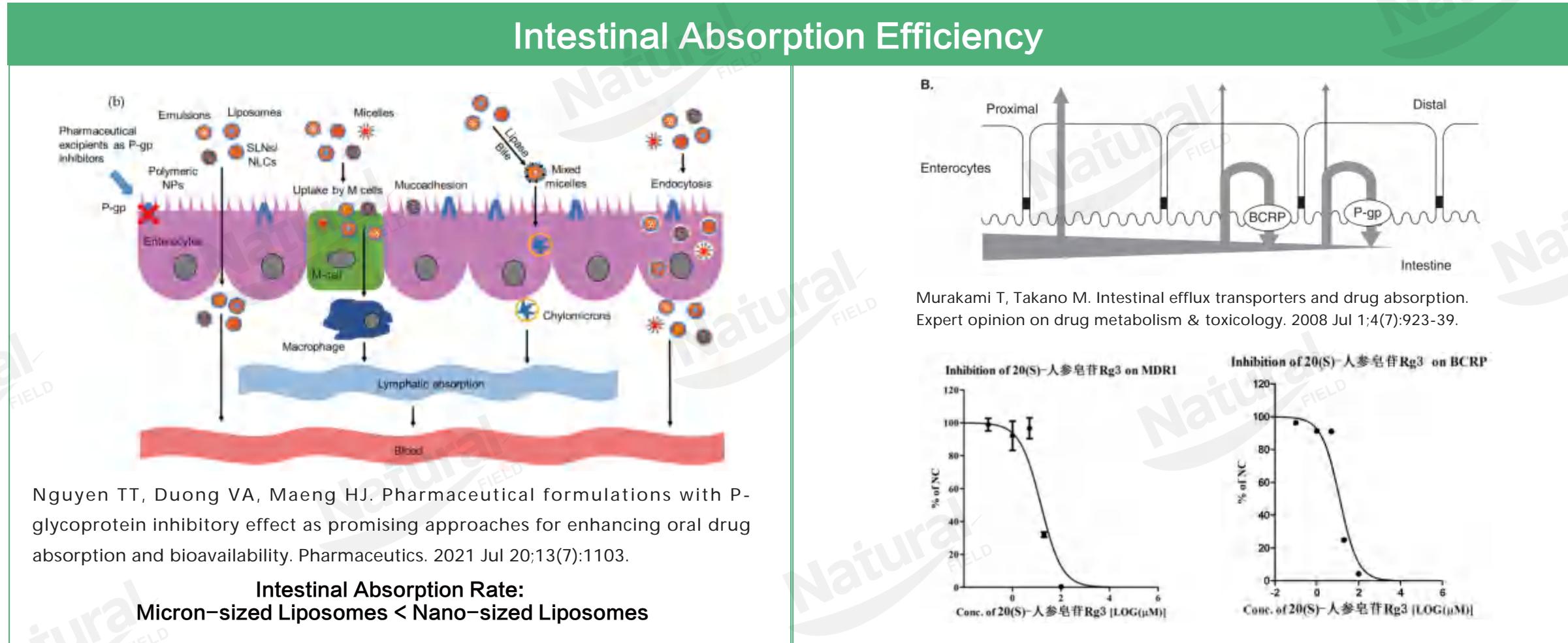
Selenium
Yeast

Coenzyme Q10

Astaxanthin

Product Advantages of Novel Co-loading Liposomes

—Improve Intestinal Absorption Efficiency

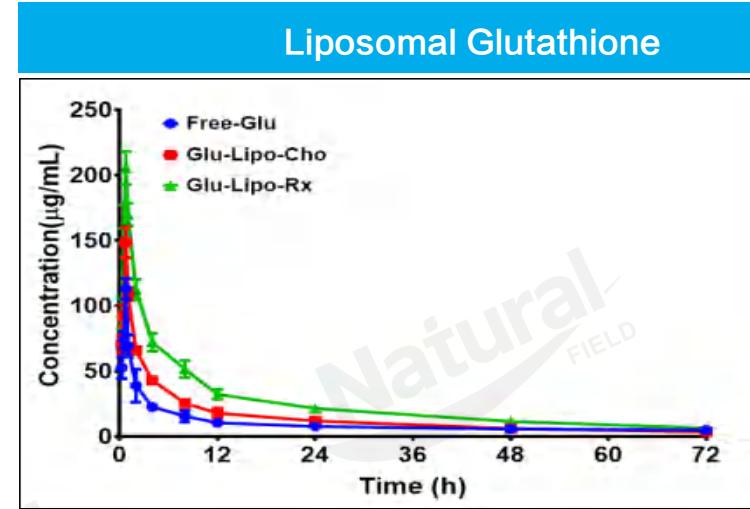


Mechanism of Action 1: Bypass P-gp

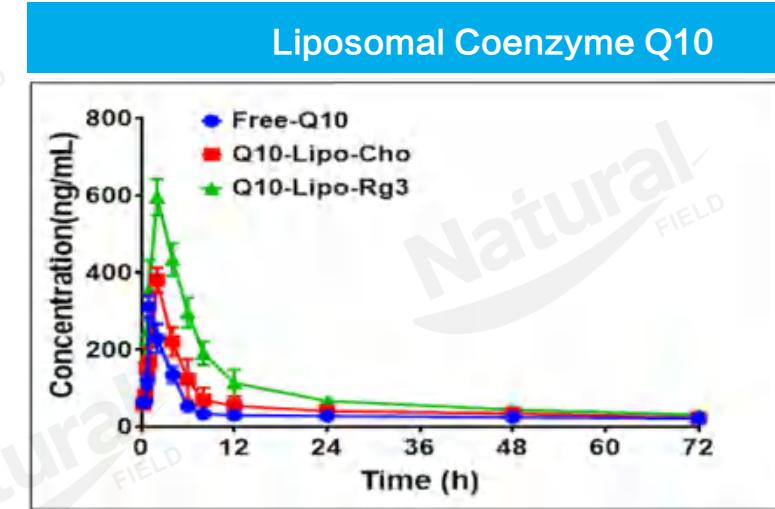
Mechanism of Action 2: Bypass P-gp

Advantages of Novel Co-loading Liposomes

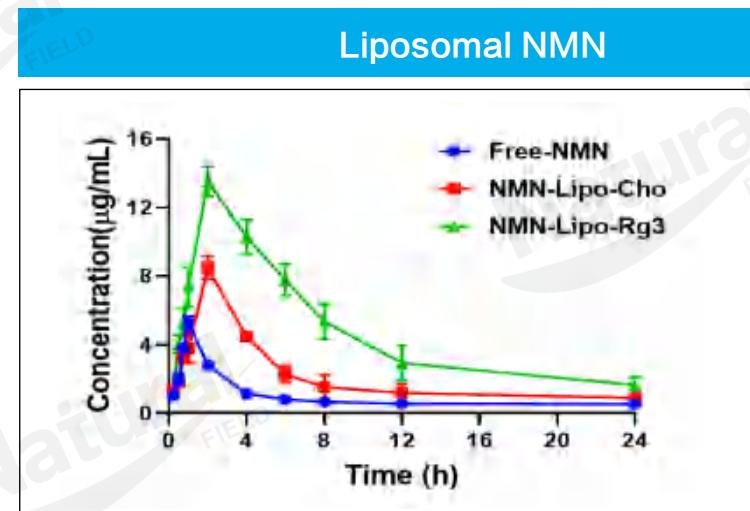
—Improve Bioavailability in Rats



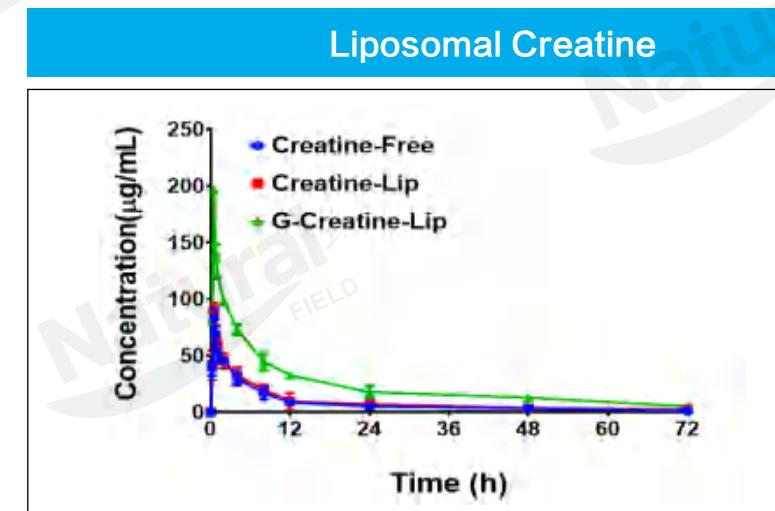
Co-loading Liposomes AUC	= 2.0times
Liposomes AUC	
Co-loading Liposomes AUC	= 4.5times
Free Drug AUC	



Co-loading Liposomes AUC	= 1.8times
Liposomes AUC	
Co-loading Liposomes AUC	= 2.6times
Free Drug AUC	



Co-loading Liposomes AUC	= 2.8times
Liposomes AUC	
Co-loading Liposomes AUC	= 7.7times
Free Drug AUC	



Co-loading Liposomes AUC	= 2.1times
Liposomes AUC	
Co-loading Liposomes AUC	= 2.8times
Free Drug AUC	

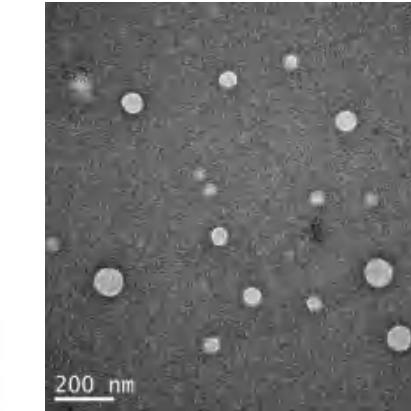
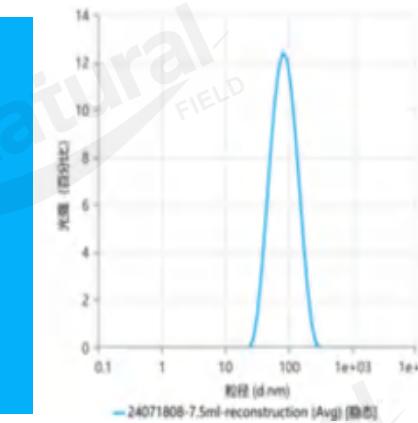
Data Source: Natural Field

Advantages of Novel Co-loading Liposomes

— Easy for Standardized Production and Quality Control

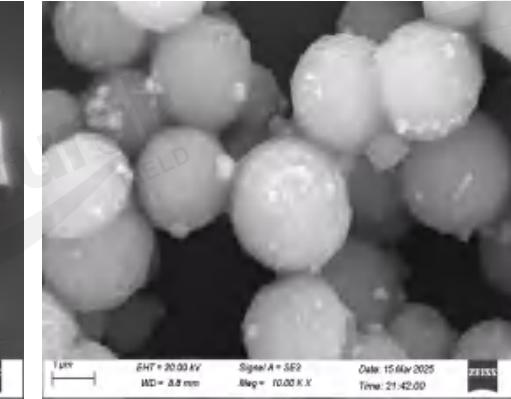
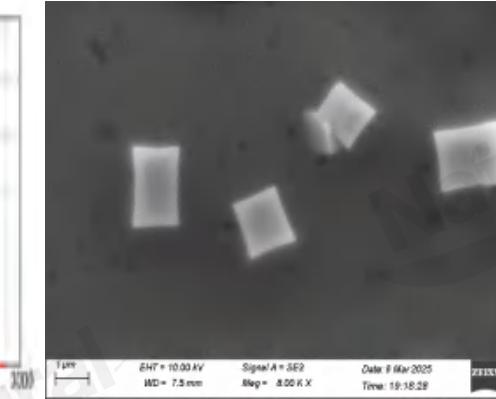
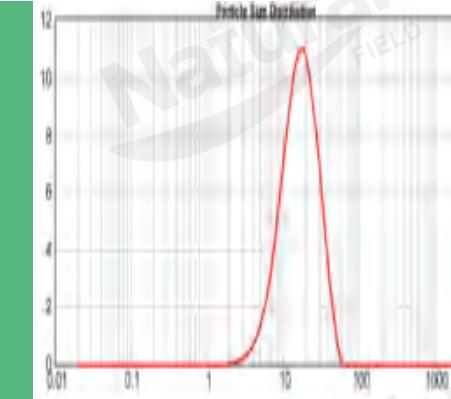
Nanoscale liposomes have an average particle size

50-100nm



Micron-Sized Liposomes have an average particle size

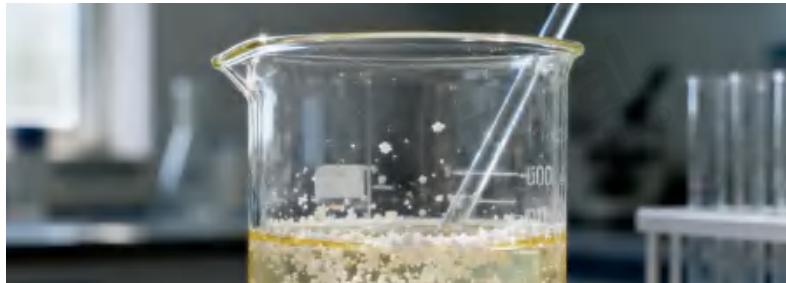
10-30μm



Technical Characterization of Novel Co-loading Liposomes:
Stable Particle Size and Granularity

Data Source: Natural Field

Insights into Market Segmentation Trends



High-end Formulations

Types: Liposomes, Microspheres, Fat Emulsions, etc.

Advantages: Potency Enhancement, Toxicity Reduction, Improved Compliance.

Compound Formulations

Contain 2 or more pharmaceutical formulations, with synergistic potency enhancement ($1+1 > 2$).

Policy Dividends and Industrial Barriers

Policy Dividends: China and the US have introduced multiple policies to support the development of high-end formulations and compound formulations.

Industrial Barriers: High technical threshold, long R&D cycle, complex equipment, and high industrialization investment.

Advantages of Developing Novel Compound Co-loading Liposome Health Products

Over 10 years of technical accumulation, integrating high-end complex formulations and compound formulations. Synergistic potency enhancement of compound formulations, and toxicity reduction & potency enhancement of complex formulations, realizing "one formulation for multiple treatments".

Production Process of Liposomes

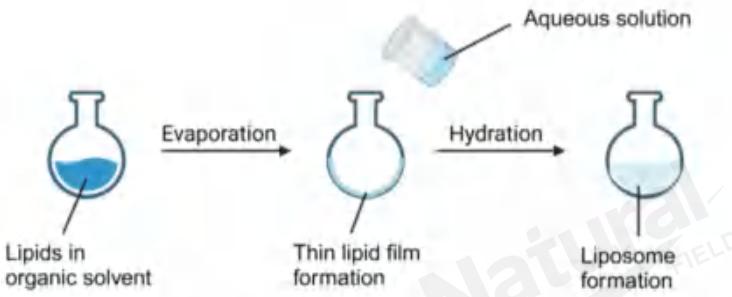
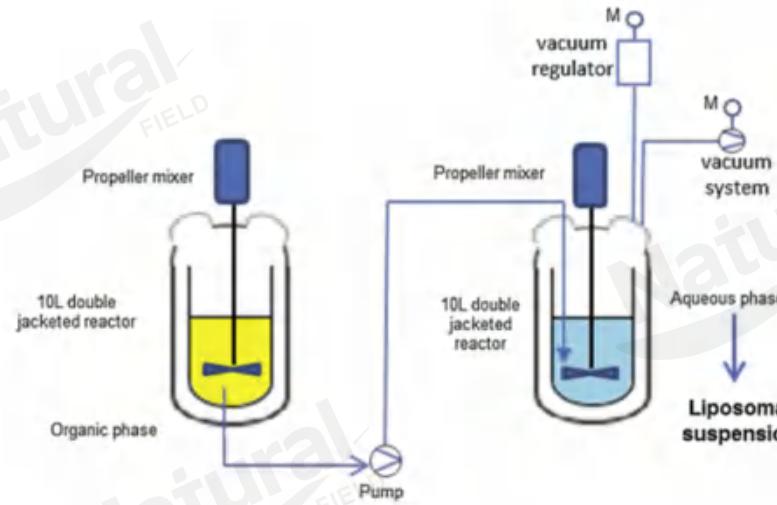


Figure 4. Demonstration of the use of the thin film hydration method to generate liposomes.

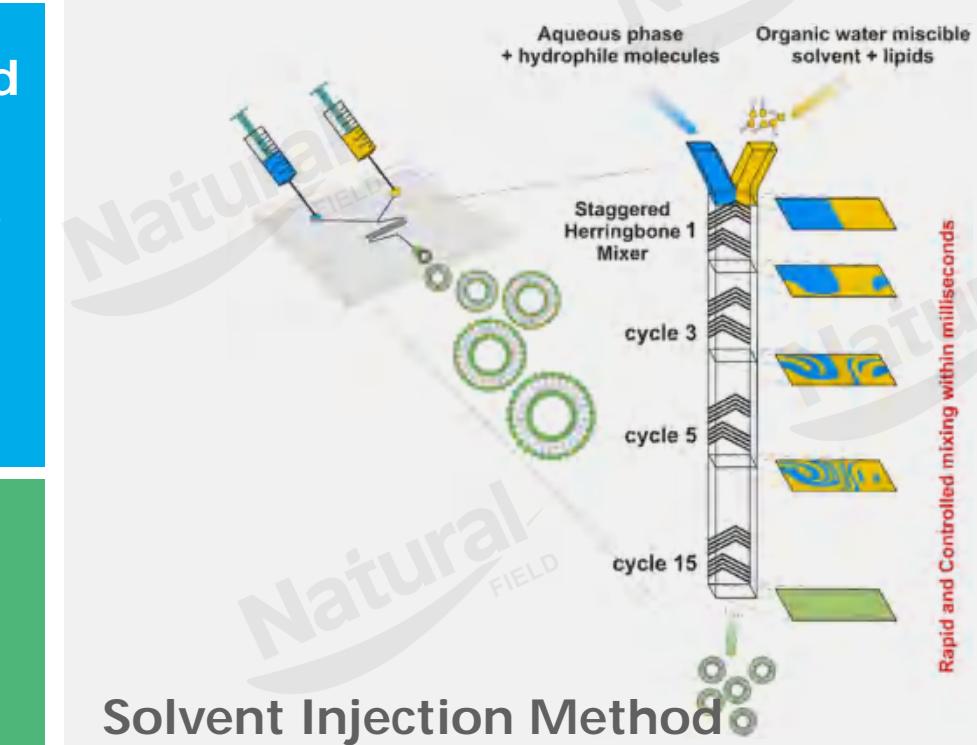


Thin Film Evaporation Method

Evaporate the oil phase to dryness under reduced pressure, hydrate it in the aqueous phase to obtain the initial liposome solution. Then sequentially perform high-speed shearing (micron-scale), high-pressure homogenization (nano-scale), or extrusion through a membrane (nano-scale) to obtain the liposome solution. If necessary, filter and sterilize with a $0.22\text{ }\mu\text{m}$ filter membrane to get the final product.

Solvent Injection Method

According to the process and equipment, mix the oil phase and aqueous phase, then use high-pressure homogenization (nano-scale) or extrusion through a membrane (nano-scale).



Solvent Injection Method

Mix the oil phase and aqueous phase with microfluidic equipment to obtain a nano-scale liposome solution in one step. If necessary, filter and sterilize with a $0.22\text{ }\mu\text{m}$ filter membrane to get the final product.

Liposome Products Types

01

Aqueous Solution



02

Lyophilized Powder



03

Spray-dried Powder



Product Layout of Novel Co-loading Liposomes

Triol-Type Rare Ginsenosides are Mainly Used in Co-Loading Liposomes for Solid Beverages



Image source: official product website

Diol-Type Rare Ginsenosides are Mainly Used in Co-Loading Liposomes for Capsules



Image source: official product website

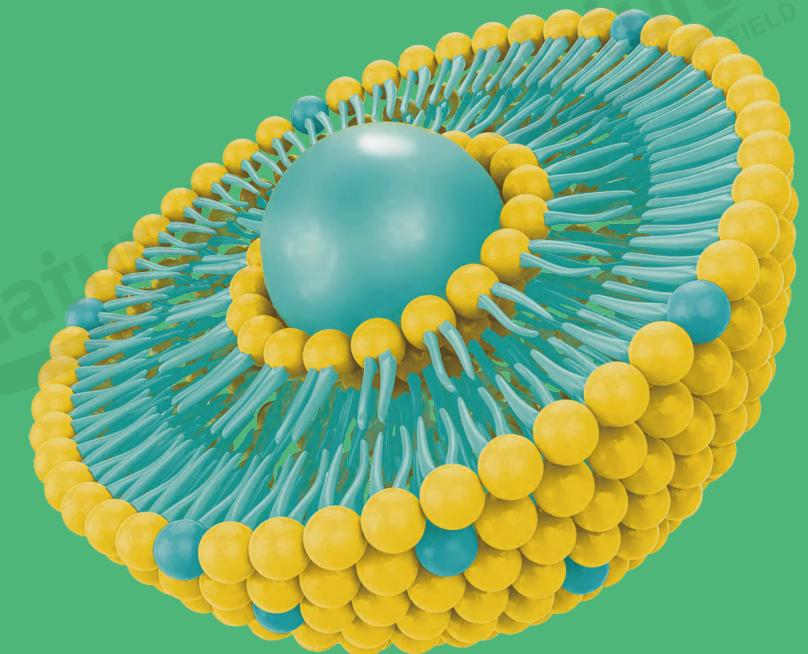
Quality Control and Efficacy Evaluation System of Novel Co-loading Liposomes



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PART.4

Advantages of Co-loading Liposomes Application



Application of Co-loading Liposomes



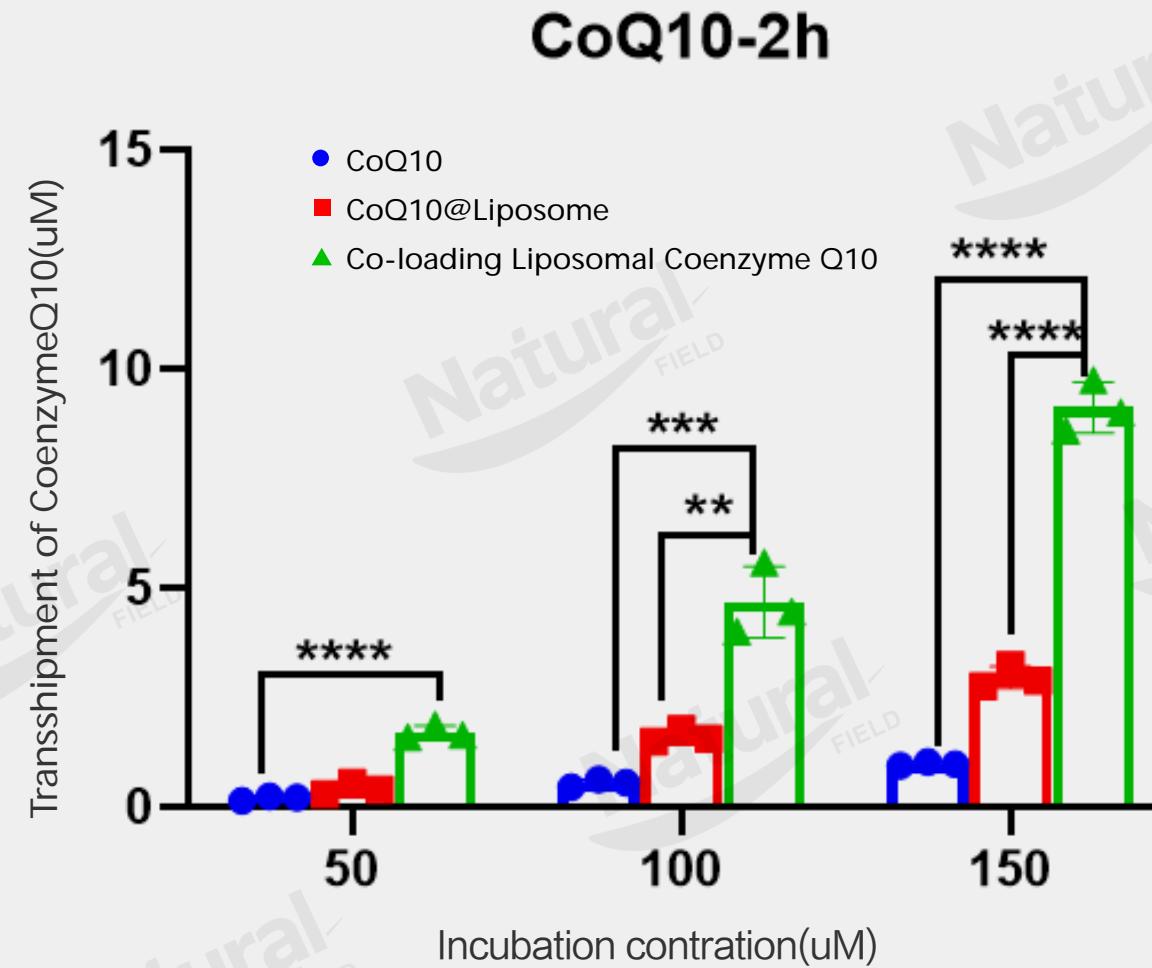
Anti-aging
Support

Cardiovascular
Health

Gut Health



Co-loading Liposomal Coenzyme Q10



The Caco-2 cell experiment demonstrated that the Co-loading liposomal coenzyme q10 significantly enhanced intestinal cellular transport.

Cumulative Transport Amount

Co-loading liposomal Coenzyme Q10

>

Liposomes

Fold increase (co-loading liposomes vs. free drug)

7.56 fold
(Low Dose)

7.33 fold
(Medium Dose)

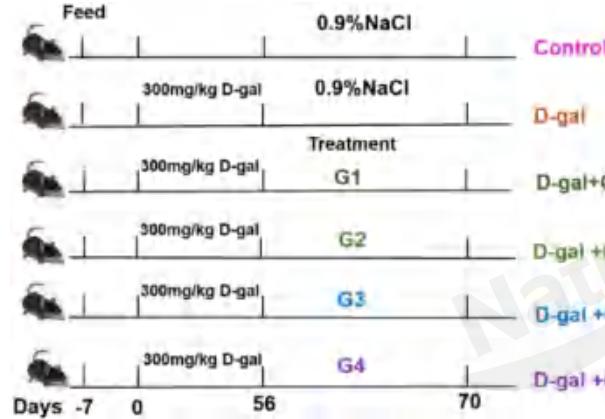
7.86 fold
(High Dose)

Fold increase of co-loading liposomes vs. liposomes:

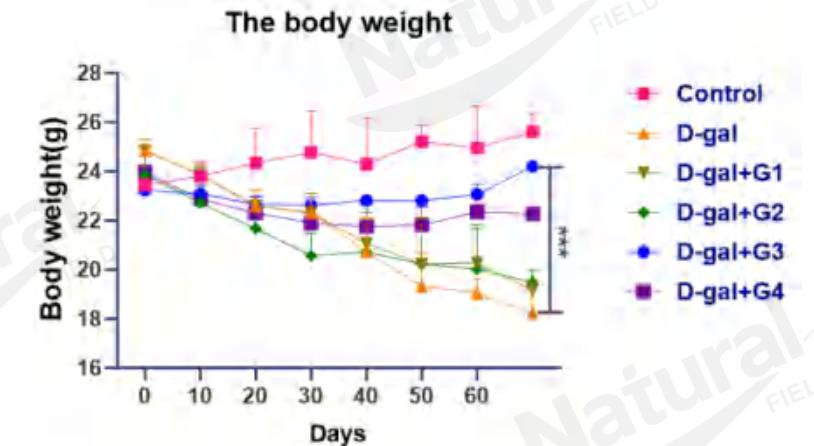
3.71-fold, 1.96-fold, 2.21-fold

Data Source:Natural Field

The Data Validates that Co-loading Liposomal Coenzyme Q10 has a Significant Anti-aging Effect



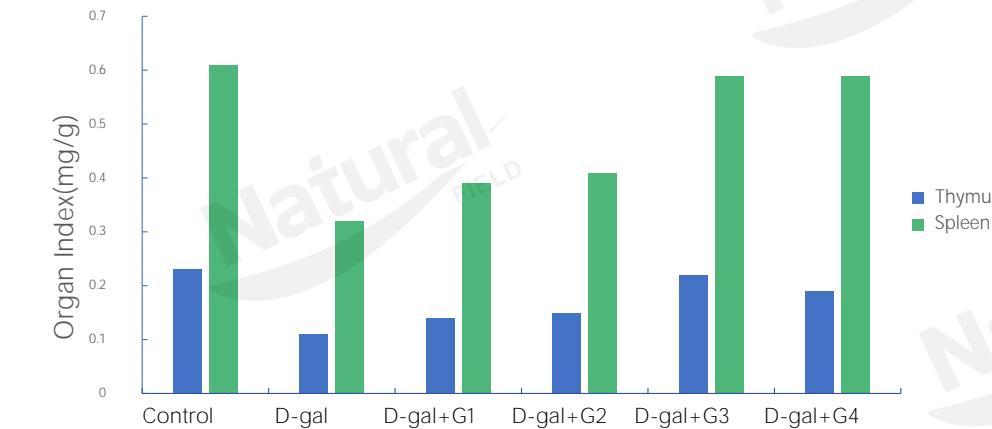
A myocardial injury model was established in C57BL/6 mice.



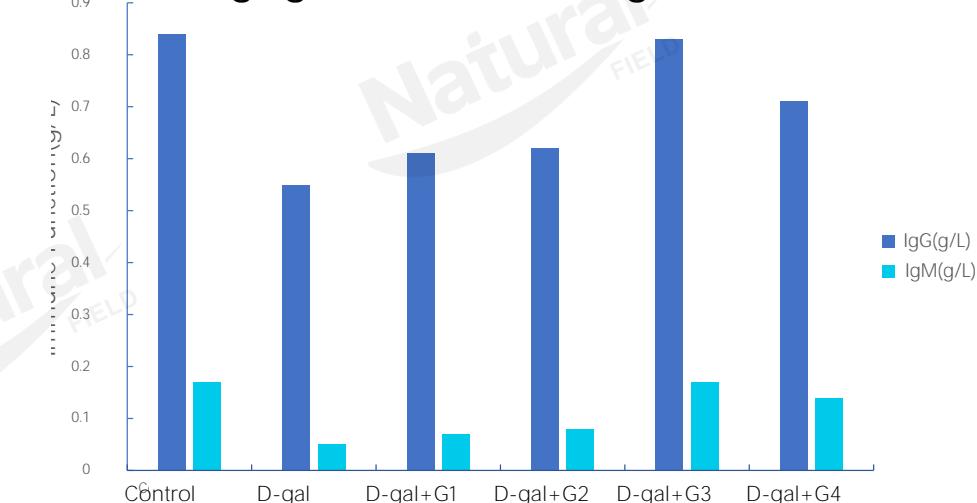
The co-loading liposomal coenzyme Q10 treatment group significantly reversed the weight loss trend compared to the model group ($P<0.001$).

Co-loading Liposomal Coenzyme Q10:
 Significantly upregulated the decrease in spleen and thymus index induced by D-galactose ($P<0.001$)
 Significantly increased levels of IgG and IgM immunoglobulins ($P<0.001$)

Anti-aging Effect — Spleen and Thymus Index

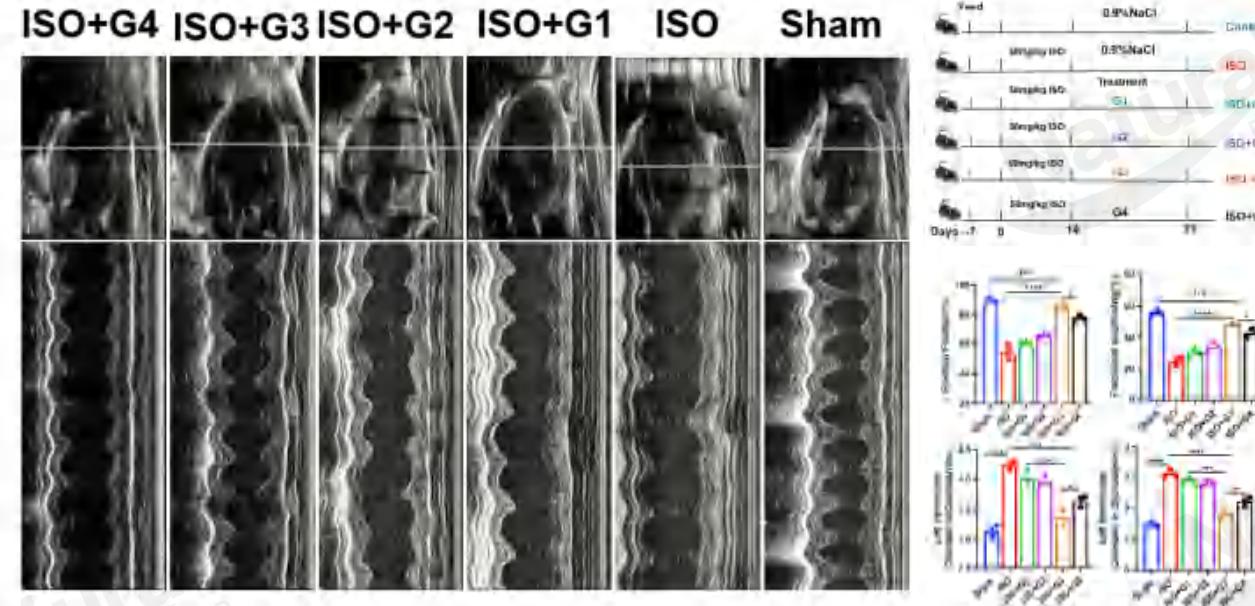


Anti-aging Effect — Immunoglobulin Levels



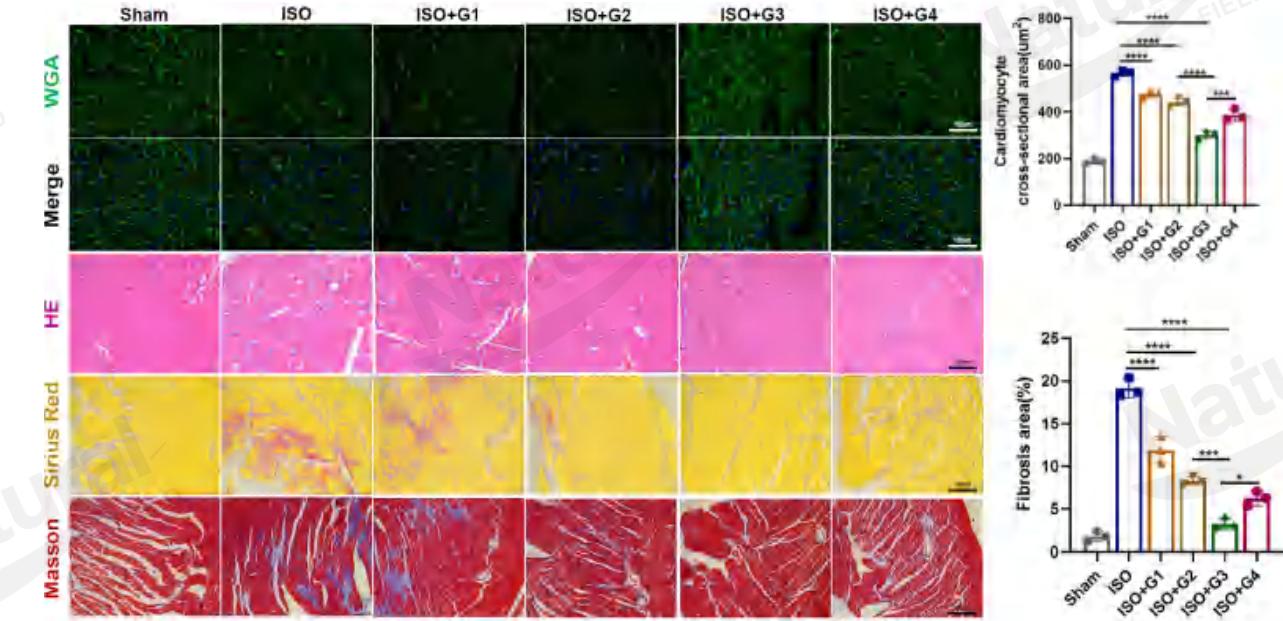
Data Source: Natural Field

The Data Validates that Co-Loading Liposomal Coenzyme Q10 has a Significant Cardioprotective Effect



A myocardial injury model was established in C57BL/6 mice. The mice were randomly divided into the following groups:

Healthy control group (Control),
 ISO model group (ISO),
 Regular liposome treatment group (ISO+G1),
 Saponin liposome treatment group (ISO+G2),
 Co-loading liposomal coenzyme Q10 and ginseng saponin treatment group (ISO+G3), and Coenzyme Q10 softgel positive drug control group (ISO+G4).

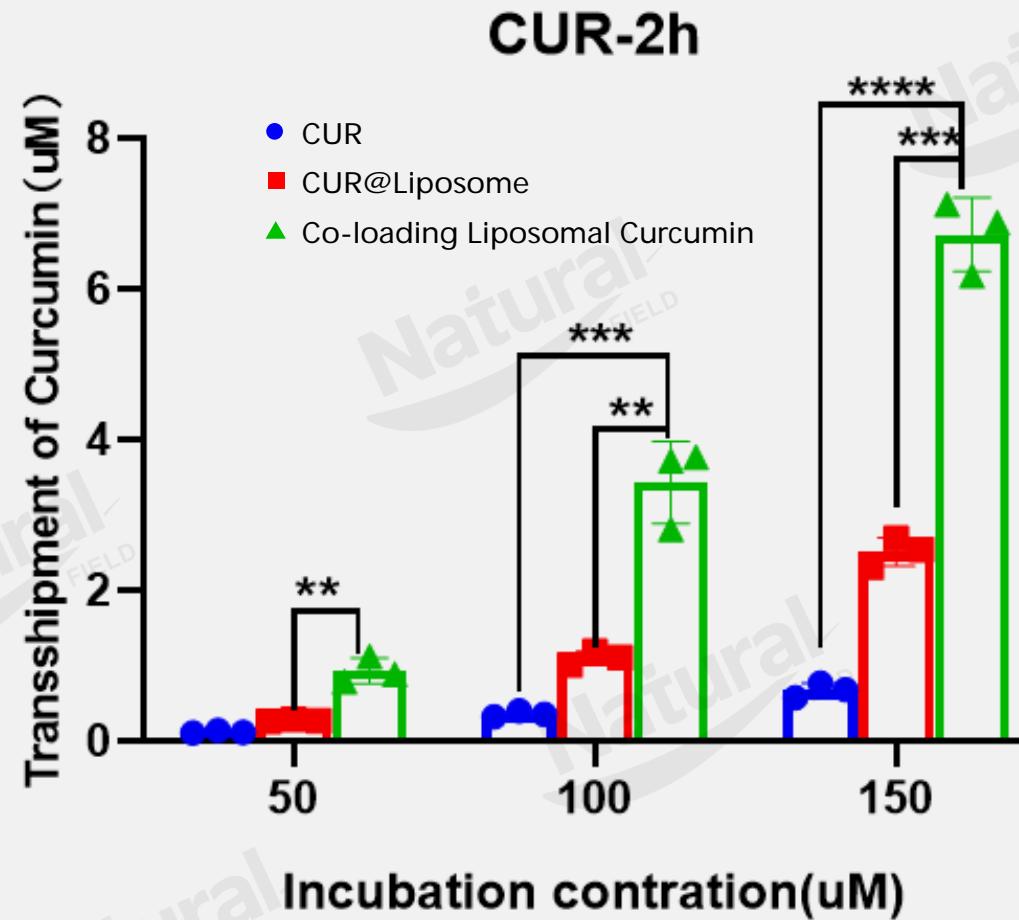


The experimental results showed that

After treatment with co-loading liposomal coenzyme Q10, the fibrotic area was significantly reduced ($P < 0.0001$), indicating that this formulation effectively inhibits collagen proliferation and delays the myocardial remodeling process. Further intergroup comparison demonstrated that its anti-fibrotic effect was significantly superior to the commercial coenzyme Q10 softgels ($P < 0.05$).

Data Source:Natural Field

Co-loading Liposomal Curcumin



The Caco-2 cell experiment shows that co-loading liposomal curcumin can significantly enhance intestinal cell transport.

Cumulative Transport Amount

Co-loading Liposomal Curcumin



Liposomes

Co-loading Liposomes vs. Free Drug Enhancement Factor

6.51 fold

(Low Dose)

8.72 fold

(Medium Dose)

8.08 fold

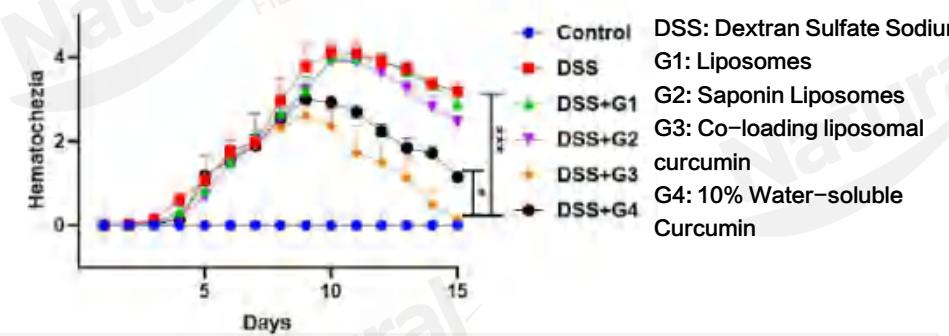
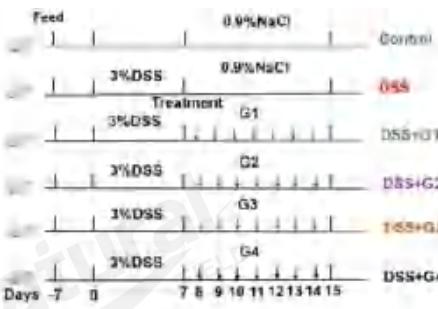
(High Dose)

Co-loading Liposomes vs. Liposomes Enhancement Factor

2.33-fold、2.39-fold、1.75-fold

Data Source:Natural Field

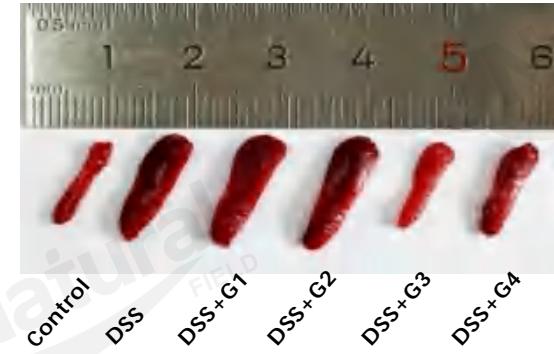
The Data Validates that Co-loading liposomal Curcumin has a Significant Anti-Colitis Effect



Statistical analysis shows that the treatment effect of co-loading liposomal curcumin on mouse colitis is superior to the 10% water-soluble curcumin group ($P < 0.05$).



Co-loading Liposomal Curcumin and 10% water-soluble curcumin significantly alleviated colitis symptoms ($P < 0.001$), as indicated by the restoration of colon length. The effect of co-loading liposomal curcumin was greater than that of 10% water-soluble curcumin ($P < 0.05$).



Co-loading Liposomal Curcumin, as well as 10% water-soluble curcumin, significantly alleviated the symptoms of colitis ($P < 0.001$), including the reduction of spleen congestion and swelling. The effect of co-loading liposomal curcumin was greater than that of 10% water-soluble curcumin ($P < 0.05$).

Data Source:Natural Field

With the In-Depth Research on Co-Loading Liposome Technology, Its Application Areas are Continuously Expanding.



Application in Food and Dietary Supplements

Main Roles:

Phospholipids/lecithin are widely used as emulsifiers, preservatives, and nutritional carriers; liposomal forms (such as nanovesicles) are used for nutrient enhancement and preservation.



Application in Cosmetics and Skincare Products

Key Breakthroughs:

Enhancing the skin penetration, stability, and controlled release of active ingredients; phospholipids serve as natural emulsifiers and carriers with strong skin affinity.



Application in the Pet Nutrition Field

Key Breakthroughs:

With the growing trend in pet health and preference for natural ingredients, the liposomal pet supplement market is expected to become the next growth point.

Trending Products in the Market

The screenshot shows the Amazon search results for "liposome". The search bar at the top has "liposome" entered. Below the search bar, there are several filters and categories: "Popular Shopping Ideas" (Vitamin C, Glucosamine, Deet, MSM, See more), "Customer Reviews" (4.5 stars & up), "Price" (">\$4 - \$165+), "Up to \$20", "Up to \$25", "Up to \$30", "Up to \$40", "Up to \$40 & above", "Deals & Discounts" (All Discounts, Today's Deals), "Form" (Drop, Lotion), and "Seller" (Natural Embrace). The search results display various products including a teal supplement bottle labeled "NAD+", a purple skincare set from "BIOCORTE", a white supplement bottle labeled "LIPOSOMAL VITAMIN C", a white spray bottle labeled "delphyr", and a bag of "Summit Animal Health" pet supplement.

Natural Field Finished Products





Core Products of Co-loading Liposomes



Co-loading Liposomal Coenzyme Q10

Functions: Antioxidant & Anti-aging, Cardiovascular and Cerebrovascular Health, Oral Beauty



Co-loading Liposomal Glutathione

Functions: Antioxidant & Anti-aging, Oral Beauty, Immune Regulation



Co-loading Liposomal Curcumin

Functions: Anti-inflammatory & Antioxidant, Mitochondrial Support, Chronic Fatigue Improvement



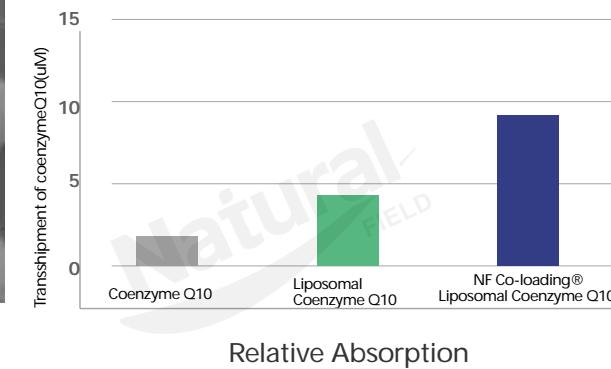
Product Microstructure and Bioavailability

NF Co-loading® Liposomal Coenzyme Q10

NF Co-loading® liposomal coenzyme Q10 appears spherical under electron microscopy, with a particle size of approximately 50nm. It is prepared using non-GMO sunflower lecithin and significantly enhances the bioavailability of coenzyme Q10. It can be used in products such as hard capsules and premixes. The Caco-2 cell in vitro absorption simulation experiment results show that the relative absorption of coenzyme Q10 liposomes is about 3 times that of free coenzyme Q10, while NF Co-loading® liposomal coenzyme Q10 is 7.86 times that of free coenzyme Q10.



NF Co-loading® Liposomal Coenzyme Q10 Transmission Electron Microscope Image

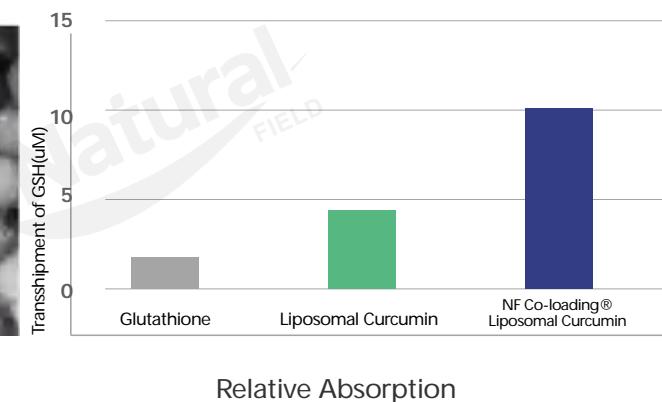


NF Co-loading® Liposomal Glutathione

NF Co-loading® liposomal glutathione appears spherical under electron microscopy, with a particle size of approximately 50nm. It is prepared using non-GMO sunflower lecithin and significantly enhances the bioavailability of glutathione. It can be used in products such as hard capsules and premixes. The Caco-2 cell in vitro absorption simulation experiment results show that the relative absorption of glutathione liposomes is about 3 times that of free glutathione, while NF Co-loading® liposomal glutathione is 5.33 times that of free glutathione.



NF Co-loading® Liposomal Glutathione Transmission Electron Microscope Image



Data Source: Natural Field

Liposomal Products List



[Liposomal NMN](#)

[Liposomal Glutathione](#)

[Liposomal Coenzyme Q10](#)

[Liposomal Creatine](#)

[Liposomal Vitamin C](#)

[Liposomal Vitamin K2](#)

[Liposomal Berberine HCl](#)

[Liposomal Dihydromyricetin](#)

[Liposomal Resveratrol](#)

[Liposomal Fisetin](#)

[Liposomal Quercetin](#)

[Liposomal Silymarin](#)

[Liposomal Curcumin](#)

[Liposomal NAD](#)

[Liposomal Melatonin](#)

[Liposomal PEA](#)

[Liposomal Iron](#)

more.....

