

# CO-LOADING LIPOSOMES WHITE PAPER

NATURAL FIELD



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<sup>+</sup>**

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

**30000<sup>+</sup>**

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 pacifaxel 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 pacifaxel.

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 Gipro-some Pharmaceutical, invested by Natural Field, obtained the API production license.

2023

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

2022

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

2024

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

2024

In 2024, Natural Field Laboratory was certified by CNAS.

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WHITE PAPER

Natural Field Co., Ltd.

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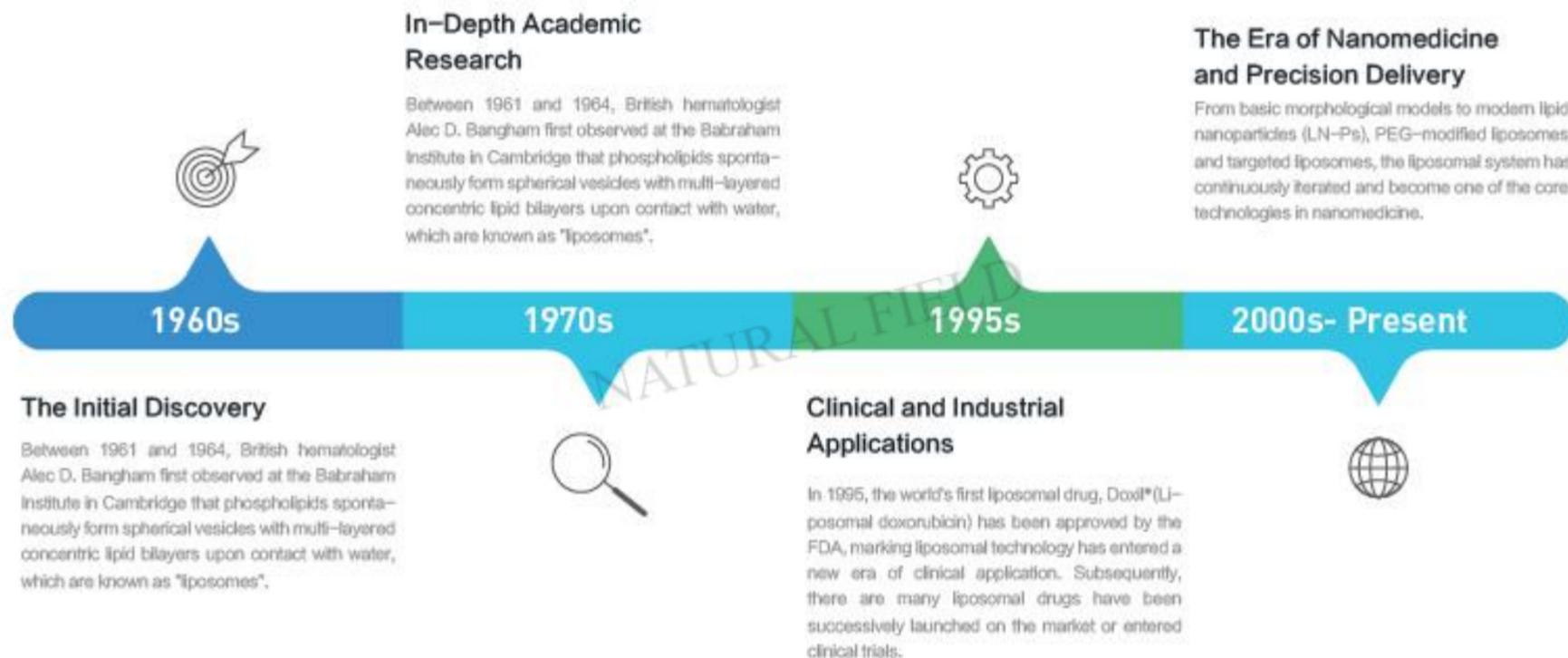
# PART.1

Discovery and Evolution History of Liposomes

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# The Discovery and Development of Liposomes



## The Development of Liposomes in Application Fields



### Clinical Research

The initial application of liposomes in the field of pharmaceuticals

In 1995, Daxil® 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

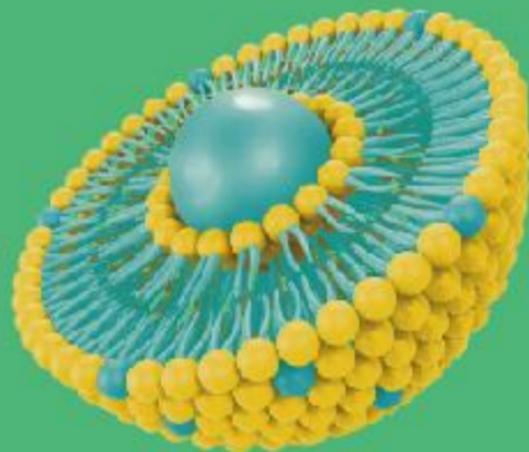
1990s-2000s: Nutritional supplements entered the initial stage of research and market development. Since the end of the 20th century, liposomes have been extensively studied for application in the field of nutritional supplements due to their ability to encapsulate both hydrophilic and hydrophobic components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

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# PART.2

Current Market Situation and  
Trends of Liposomes

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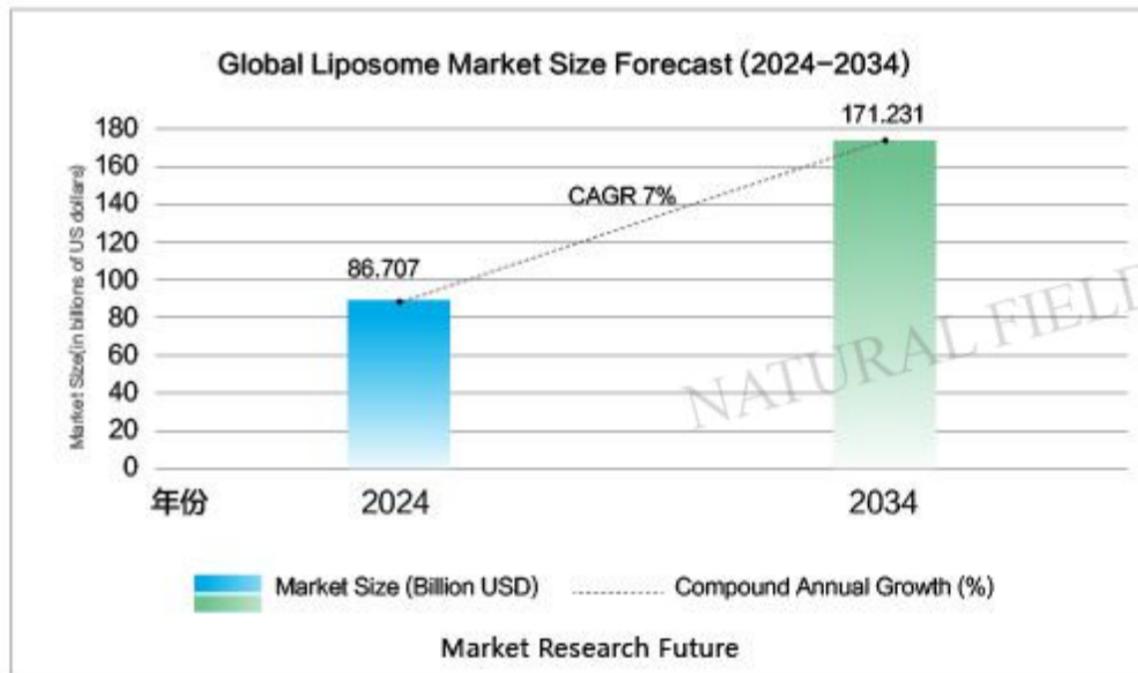


## Research Interest in Liposomes Has Steadily Increased over the Years. From 1960 to 2025, the Number of PubMed Publications on Liposomes Shows an Upward Trend.



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 USD8.6707 billion in 2024 and is projected to grow at a compound annual growth rate (CAGR) of around 7%, reaching nearly USD 17.1231 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. [\(www.marketresearch.com\)](#)

### Cosmetics

In 2024, the global liposomal cosmetics market size was USD 2.6 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. [\(www.marketresearch.com\)](#)

### 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. [\(www.marketresearch.com\)](#)

## Market Segmentation Trend Insight

Dimension	Current Market Landscape & Trends
Types	Vitamins, such as vitamin C, currently hold a dominant position; Glutathione and vitamin D are rapidly gaining traction, while demand for antioxidants continues to grow.
Functions	Immune support is the largest application market at present (~24%); Cognitive support and anti-aging products are growing significantly.
Dosage Forms	Liquid dosage forms are the most popular (~41% market share); Capsules/soft capsules are also growing steadily.
Sales Channels	E-commerce channels hold a dominant position (about 37-40%); Subscription and DTC models are expected to be growth highlights.
Target Users	Adult consumption is the main force (~59%); Fitness enthusiasts and sub-healthy groups show high growth potential.



## 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

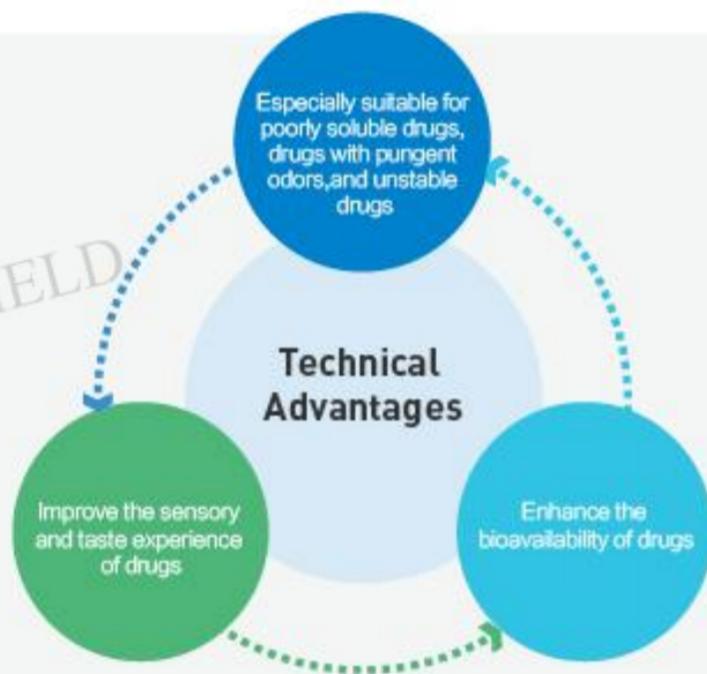
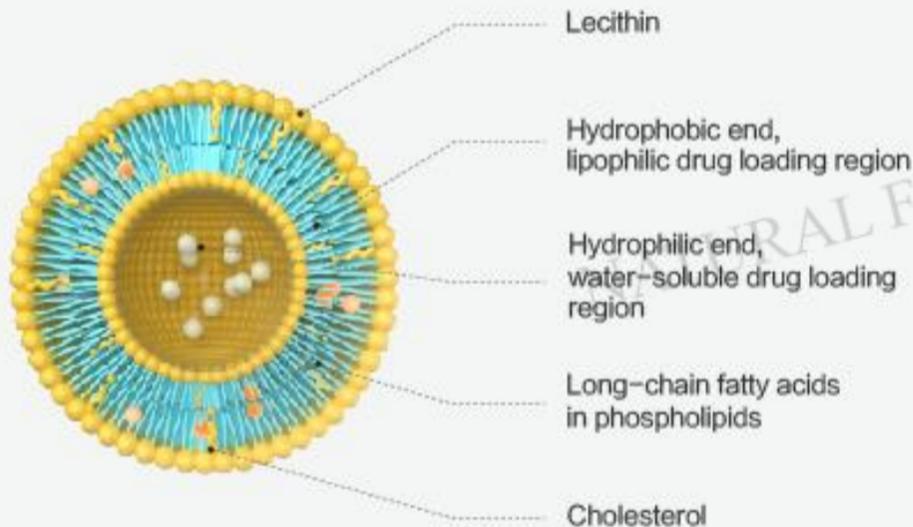
Introduction of Co-loading Liposomes

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

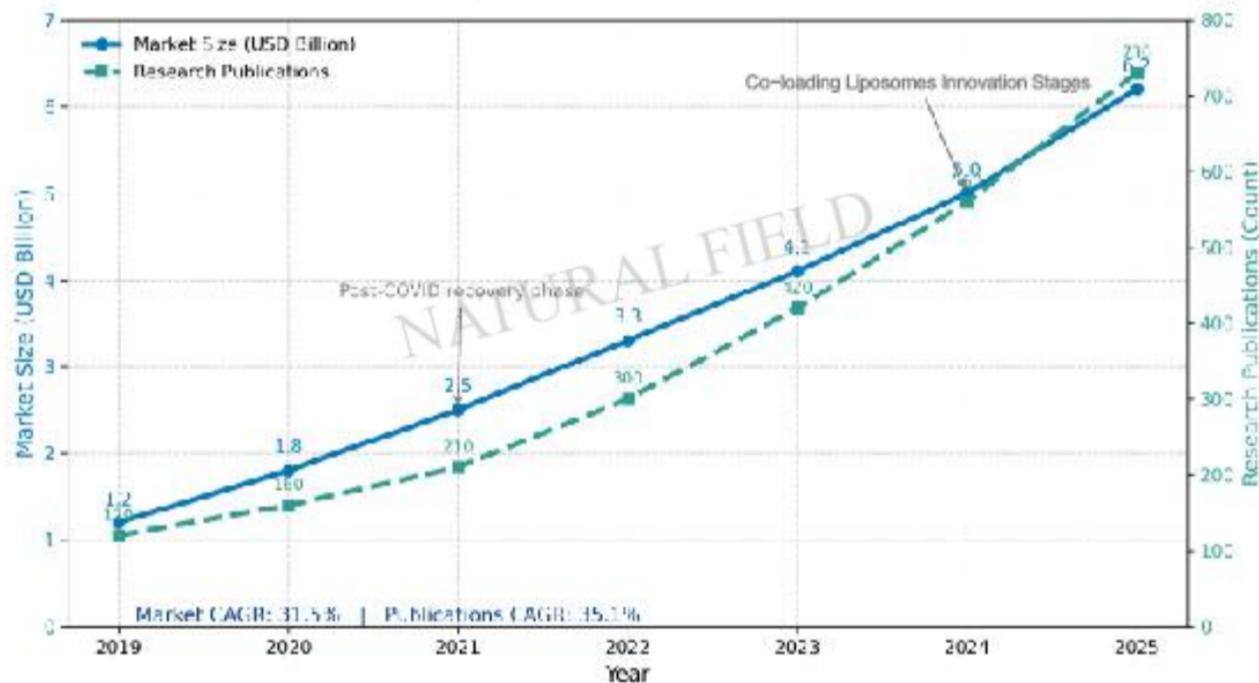
Liposomes are nanoscale vesicles composed of phospholipids and cholesterol. Capable of encapsulating both lipophilic and hydrophilic drugs. They serve as a promising drug delivery system.





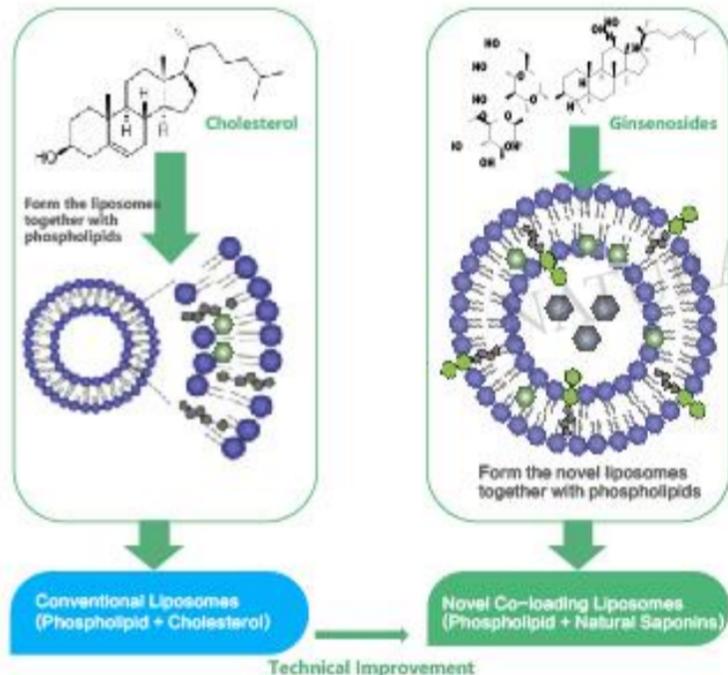
# The Novel Co-Loading Liposomal Drug Delivery System Using Rare Ginsenosides as Membrane Material Marks That Delivery Technology Ushers in a New Stage and Can Better Meets Market Demands

## Global Growth Trend of Liposomal Technology (2019-2025) Market Expansion & Research Momentum



## 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

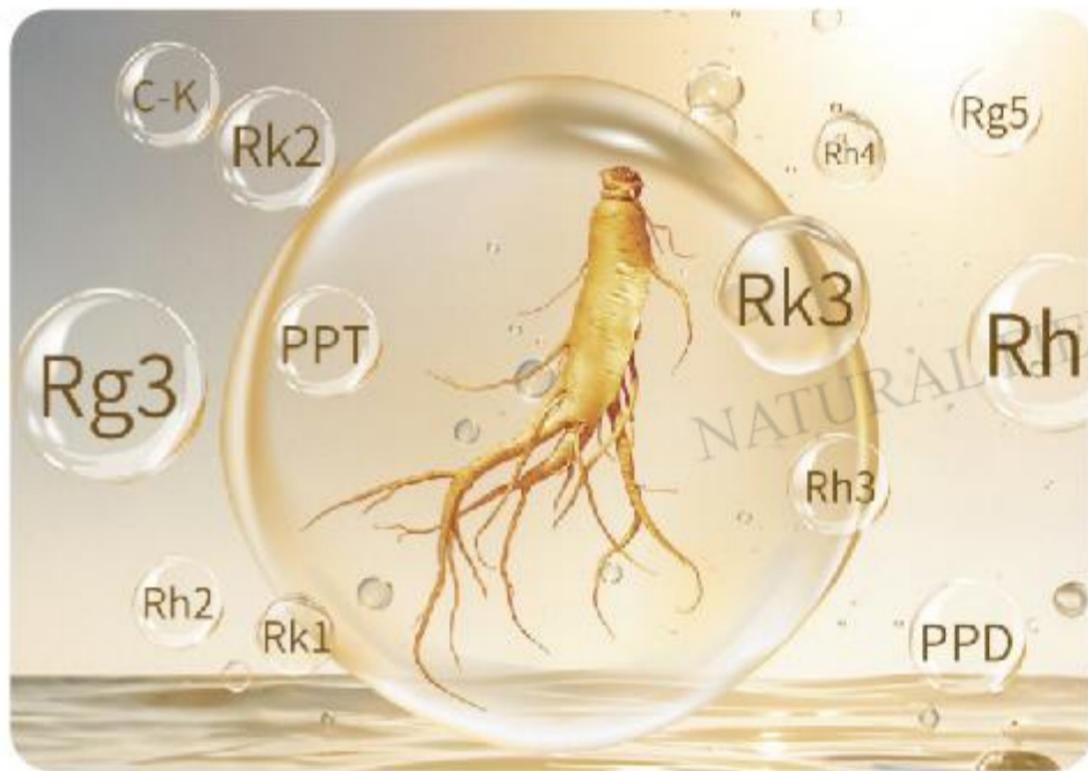


Absorption  
Enhancer

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

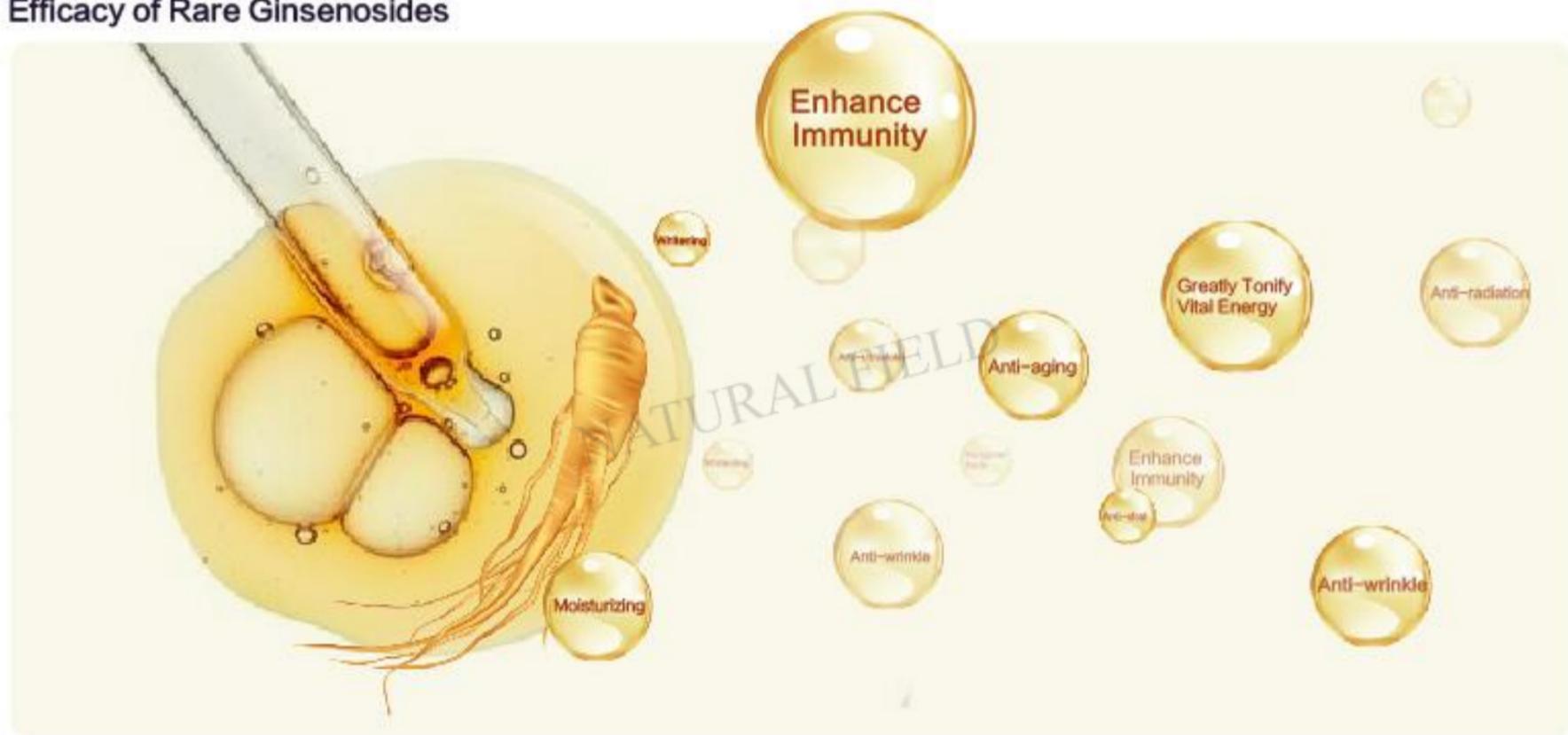
#### Higher Activity

Compared with other ginseng components

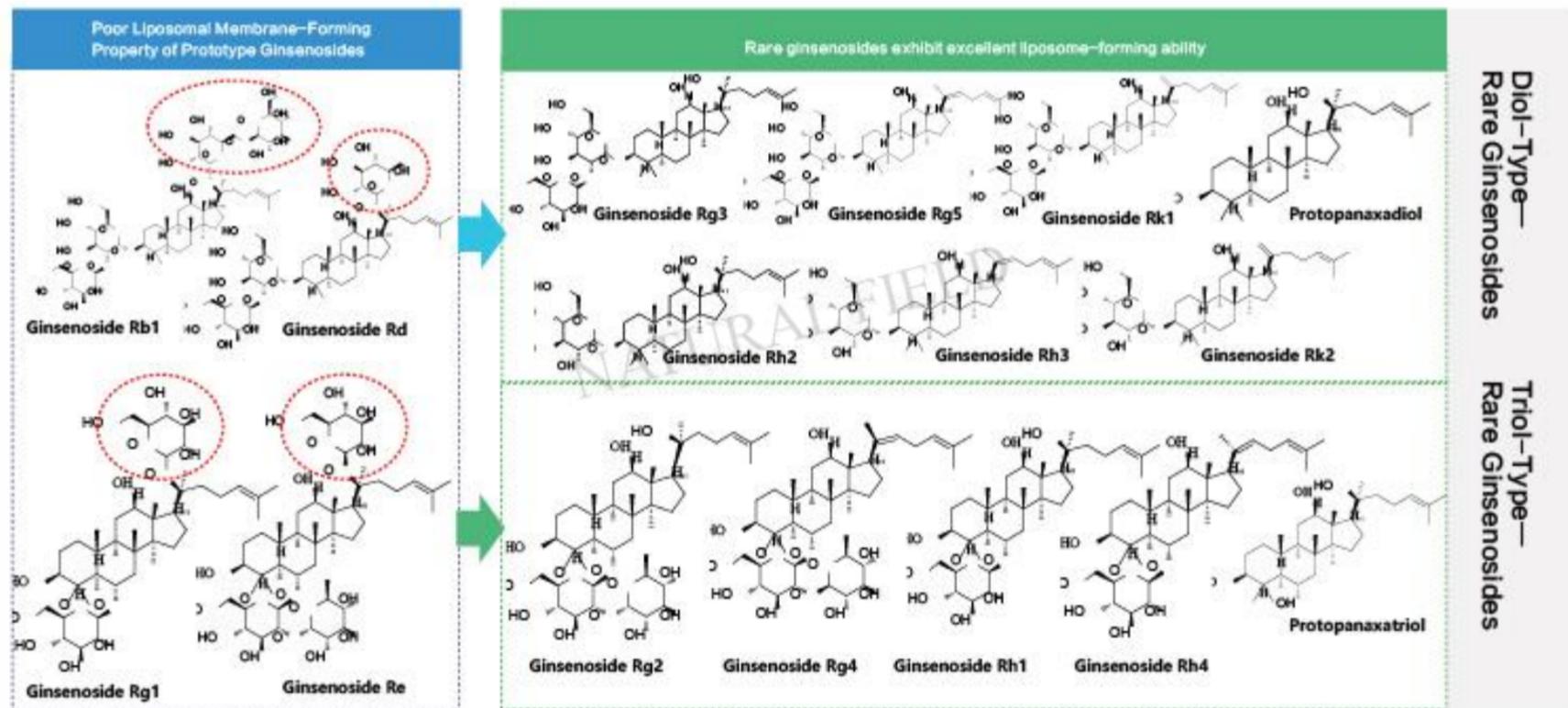
Bidirectional immune regulation

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



# 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

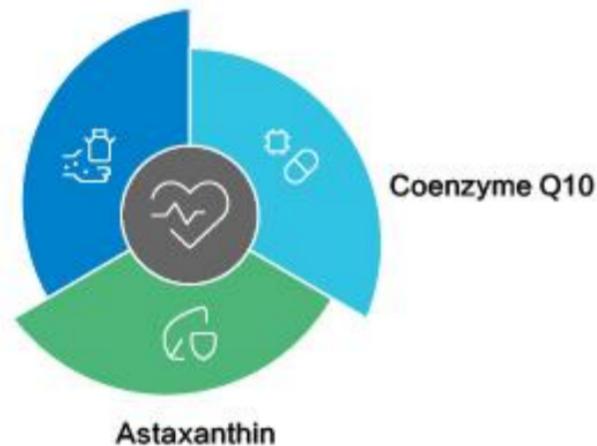
In modern functional ingredients, through the multi-target synergy mechanism, compound preparation solves the complex health problems of modern people.

Antioxidant + Anti-inflammatory +  
Cognitive Protection



Anti-aging + Heart Health +  
Immune Regulation

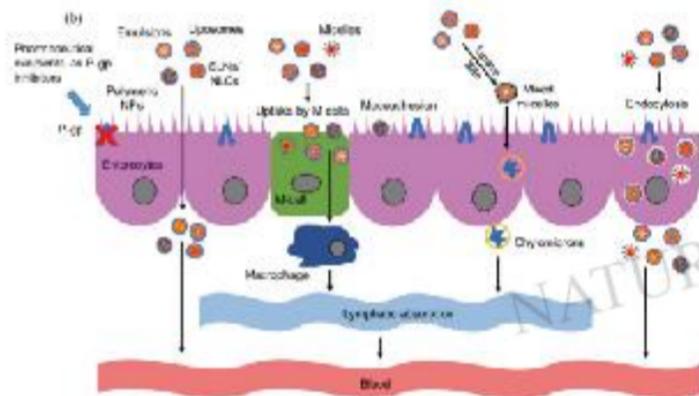
Selenium  
Yeast



# Product Advantages of Novel Co-loading Liposomes

—Improve Intestinal Absorption Efficiency

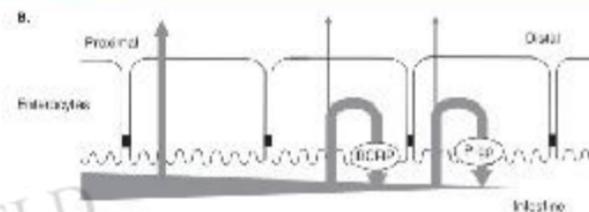
## Intestinal Absorption Efficiency



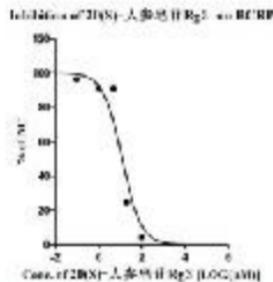
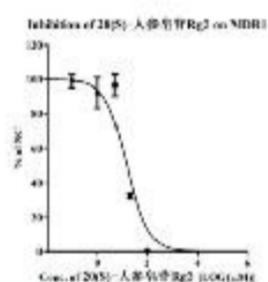
Nguyen TT, Duong VA, Maeng HJ. Pharmaceutical formulations with P-glycoprotein inhibitory effect as promising approaches for enhancing oral drug absorption and bioavailability. *Pharmaceutics*. 2021 Jul 20;13(7):1103.

**Intestinal Absorption Rate:**  
Micron-sized Liposomes < Nano-sized Liposomes

Mechanism of Action 1: Bypass P-gp



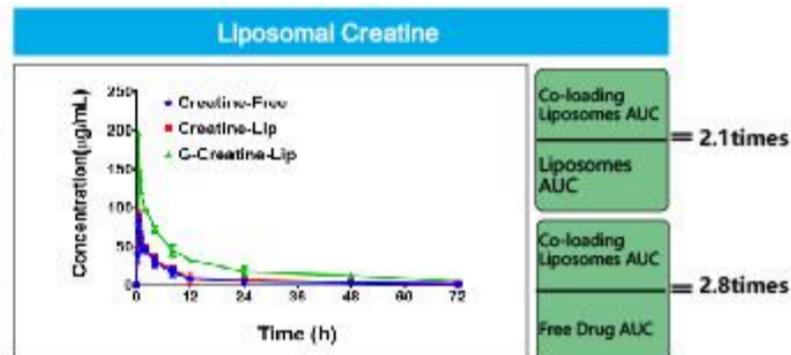
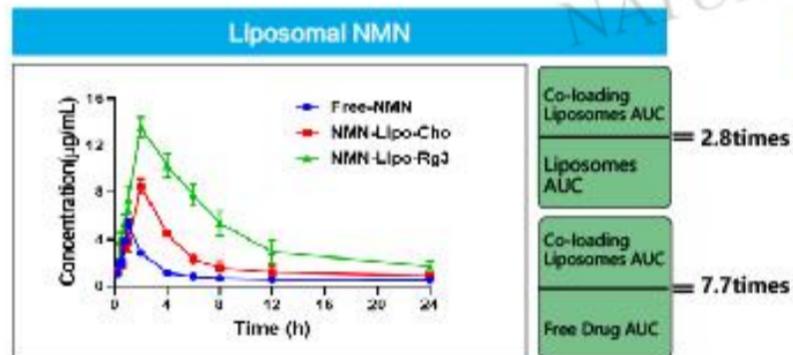
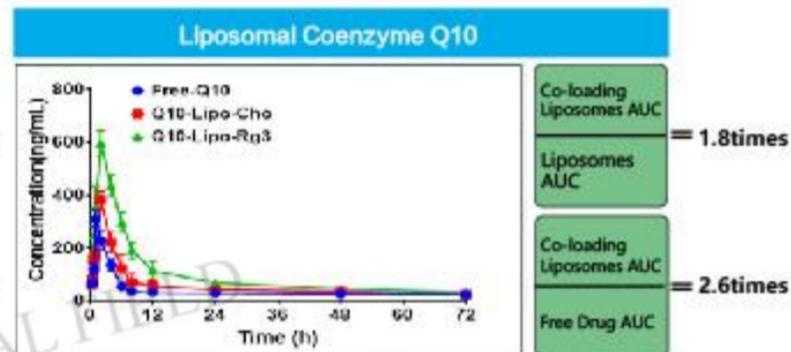
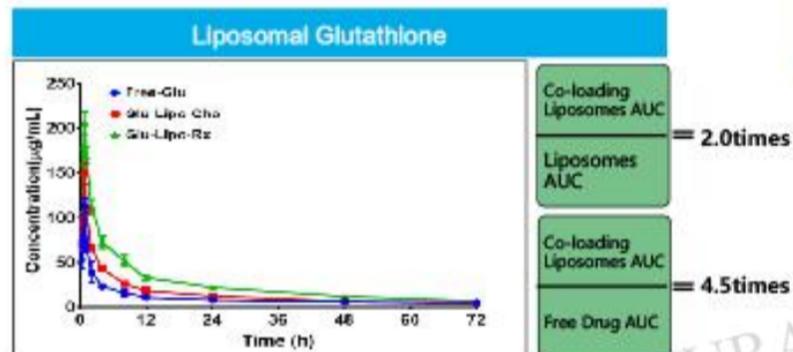
Murakami T, Takano M. Intestinal efflux transporters and drug absorption. *Expert opinion on drug metabolism & toxicology*. 2008 Jul 1;4(7):923-39.



Mechanism of Action 2: Bypass P-gp

# Advantages of Novel Co-loading Liposomes

—Improve Bioavailability in Rats



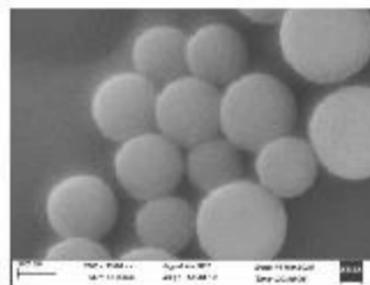
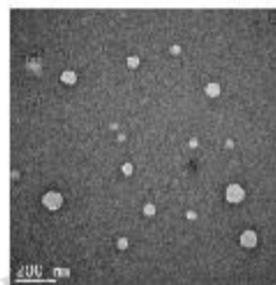
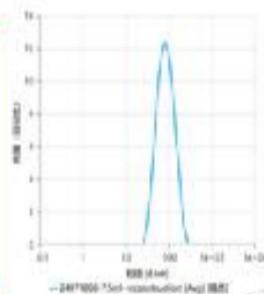
Data Source: Natural Field

## Advantages of Novel Co-loading Liposomes

— Easy for Standardized Production and Quality Control

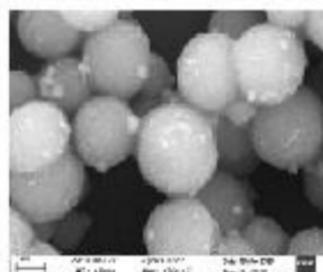
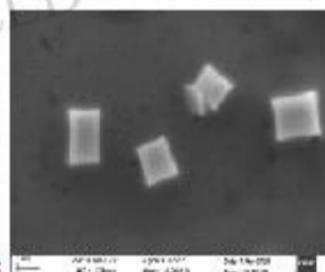
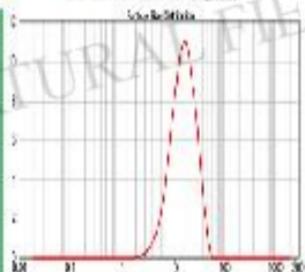
Nanoscale liposomes have an average particle size

**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

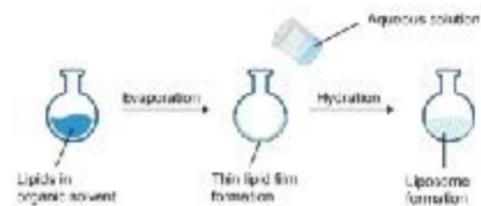
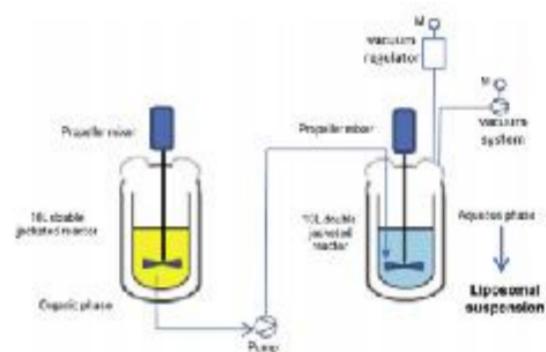


Figure 4. Schematic illustration of the use of the thin film hydration method to generate liposomes.

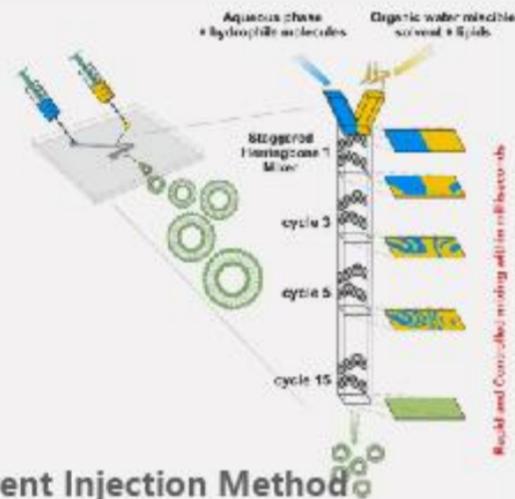


### Thin Film Evaporation Method

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  $0.22\ \mu\text{m}$  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  $0.22\ \mu\text{m}$  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



### Physicochemical Properties

Yellow or yellowish loose powder



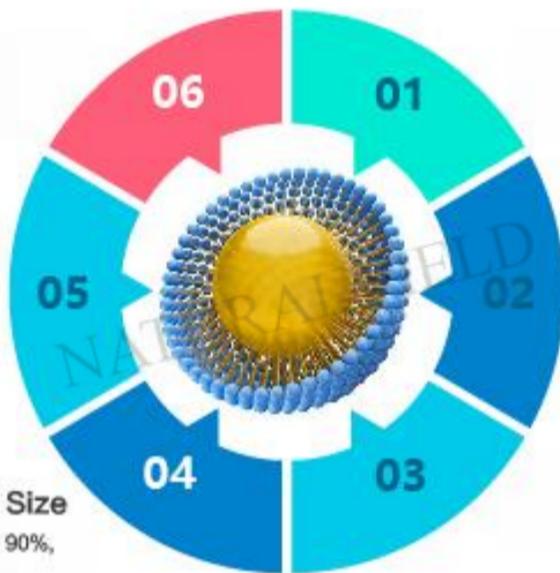
### Formula

Phospholipid (mass ratio) content > 30%,  
Drug loading capacity up to 30%,  
Rare ginsenosides > 5%, other excipients  
can be added



### Encapsulation Efficiency & Particle Size

Encapsulation Efficiency: Liposoluble components > 90%,  
Water-soluble components > 60%;  
Particle Size: Spray drying method < 30  $\mu$  m, Freeze drying method < 500nm



### In Vitro Pharmacodynamics

Compared with ordinary ingredients and liposomes, cell activity is significantly improved



### In Vivo Pharmacodynamics

Compared with ordinary ingredients and liposomes, drug efficacy is significantly improved



### Synergistic Effect

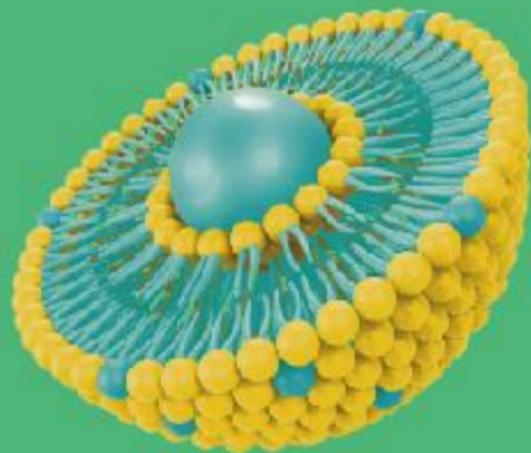
This product is a complex compound formulation with good synergistic effect, which can significantly improve drug efficacy



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# PART.4

Advantages of Co-loading Liposomes Application



## Application of Co-loading Liposomes

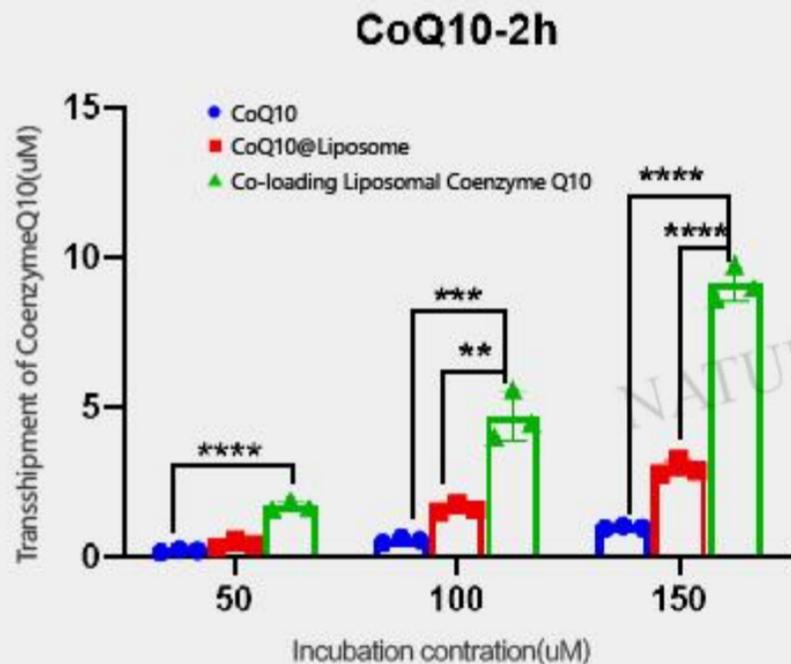


Anti-aging  
Support

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

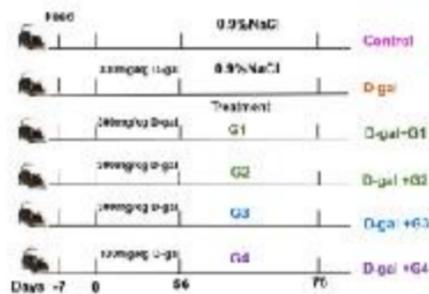
(High Dose)

Fold increase of co-loading liposomes vs. liposomes:

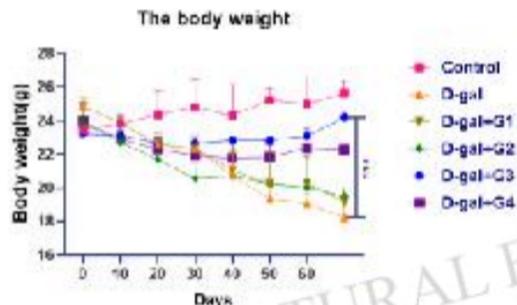
**3.71-fold、1.96-fold、2.21-fold**

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.



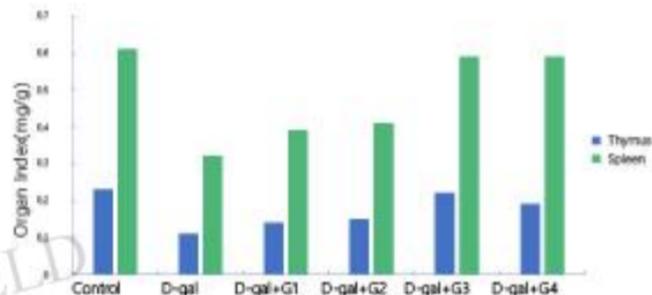
The co-loading liposomal coenzyme Q10 treatment group significantly reversed the weight loss trend compared to the model group ( $P<0.001$ ).

## Co-loading Liposomal Coenzyme Q10:

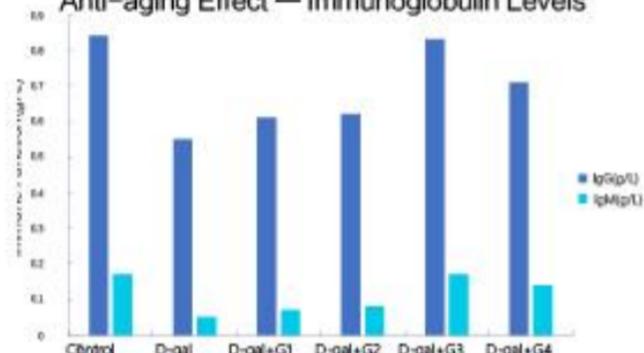
Significantly upregulated the decrease in spleen and thymus index induced by D-galactose ( $P<0.001$ )

Significantly increased levels of IgG and IgM immunoglobulins ( $P<0.001$ )

## Anti-aging Effect — Spleen and Thymus Index

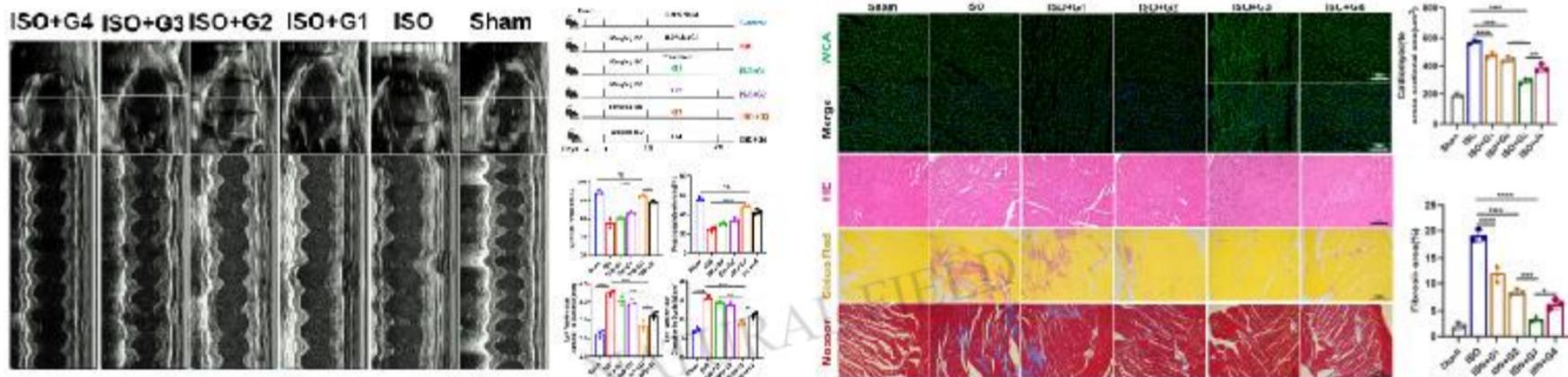


## Anti-aging Effect — Immunoglobulin Levels



Data Source: Natural Field

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



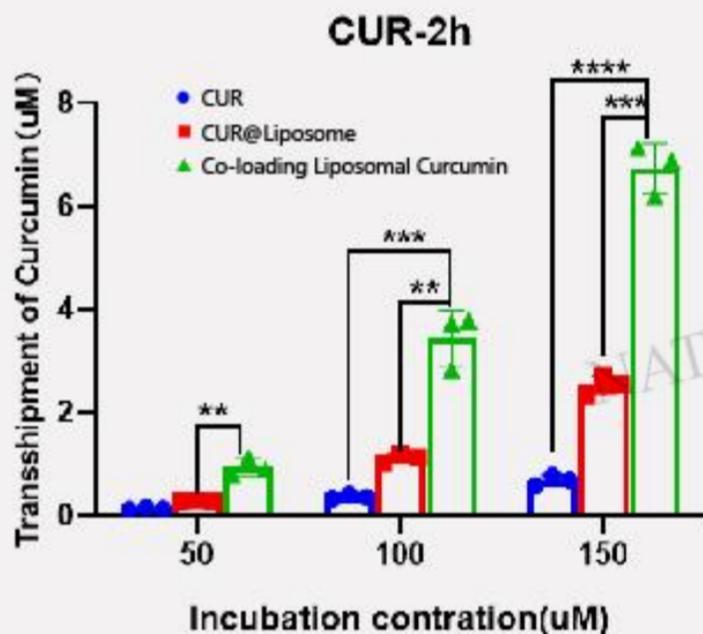
A myocardial injury model was established in C57BL/6 mice. The mice were randomly divided into the following groups:

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 ( $P < 0.05$ ).

## 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

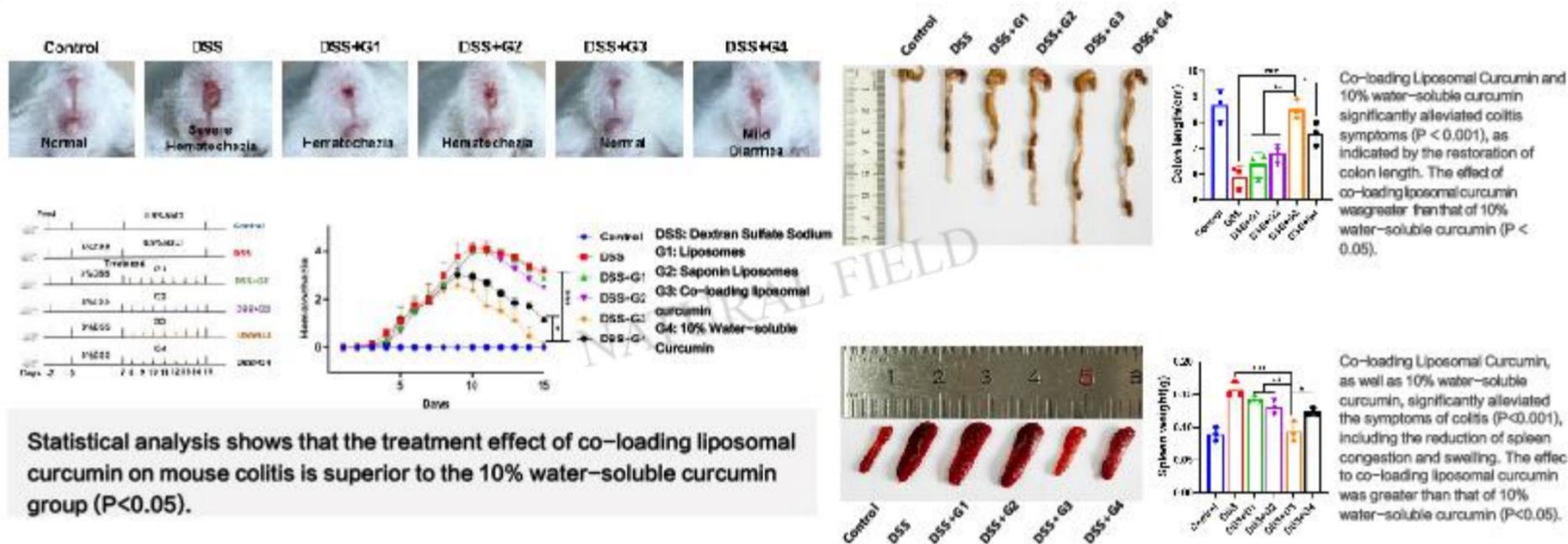
(High Dose)

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



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 an Amazon search for 'liposome' with the following trending products:

- Regular Shipping Item:**
  - Walmart
  - Discounts
  - Gifts
  - More
  - Wish List
- Product 1:** NAD+ Supplement (Liposomal NAD+)
- Product 2:** Purple liposome skincare products (serum and cream)
- Product 3:** Liposome Vitamin C Supplement
- Product 4:** Delphy Liposome Skincare (foaming cleanser)
- Product 5:** Sunmit Pet Health (Liposomal Vitamin C for Pets)
- Product 6:** Sunmit Pet Health (Liposomal Vitamin C for Pets)

Additional filters visible on the left include: Price (Under \$20, \$20 to \$25, \$25 to \$50, \$50 to \$100, \$100 & above), Brand & Mfg. Co., All Brands, and Pet's Sex (Male, Female).

## Natural Field Finished Products





## Co-loading 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

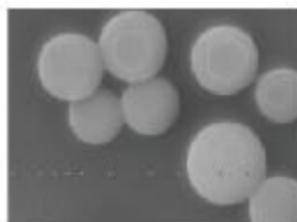
Functions: Anti-inflammatory & Antioxidant,  
Mitochondrial Support, Chronic Fatigue Improvement



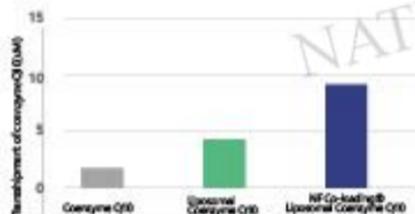
## Product Microstructure and Bioavailability

### 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.



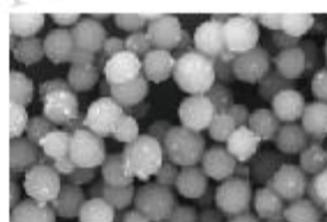
NF Co-loading® Liposomal  
Coenzyme Q10 Transmission  
Electron Microscope Image



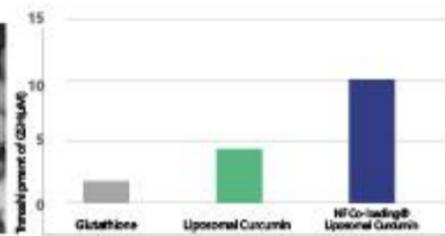
Relative Absorption

### 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



Relative Absorption

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.....