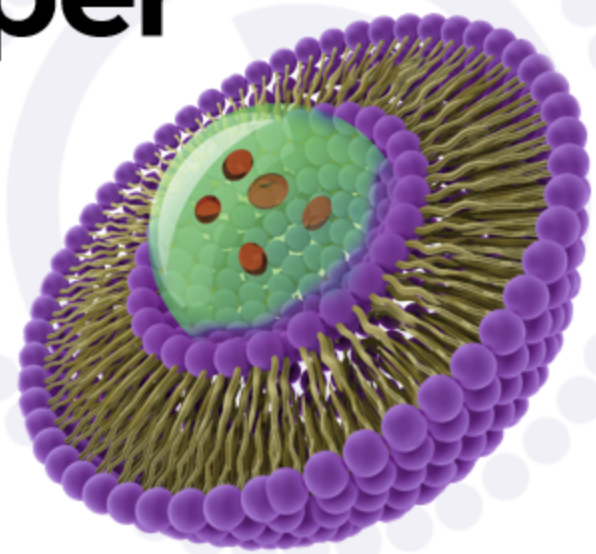
Liposome White Paper



Effepharm Ltd.,

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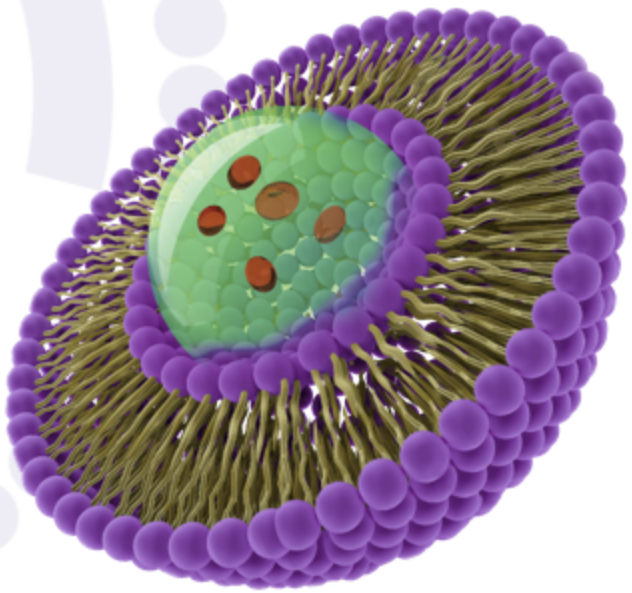


PART 01

Global Liposomal Dietary Supplement Market Overview

Market Size

Steady growth across global markets

The global liposomal supplements market is projected to reach USD 365.2 million in 2024, with a compound annual growth rate (CAGR) of 7.50% from 2024 to 2031.*

Strong Market Potential in Europe and North America

North America currently leads the liposomal market, with a market size of approximately USD 146 million, followed by Europe at around USD 109 million. The markets are expected to grow at compound annual growth rates (CAGR) of 5.7% and 6.6%, respectively, from 2024 to 2031.

	Market Size*(USD)	CAGR
Global Liposomal Supplements Market Sales Revenue	365.2 million	7.50%
North America Liposomal Supplements Market Sales Revenue	146.08 million	5.70%
Europe Liposomal Supplements Market Sales Revenue	109.56 million	6.60%
South America Liposomal Supplements Market Sales Revenue	18.26 million	6.90%
Middle East and Africa Liposomal Supplements Market Sales Revenue	7.30 million	7.20%

Souce: *Cognitive Market Research. (2024, December). Liposomal Supplements Market Report 2025 (Global Edition).*

Popular Liposomal Products

According to research, Liposomal Vitamin C ranks as the most popular dietary supplement in its segment, followed by liposomal glutathione, liposomal curcumin, and liposomal vitamin D.

01 Liposomal Vitamin C

Liposomal Vitamin C is the leading supplement in the global liposomal market segment, with top competitors offering various forms of this product. **Liposomal technology encapsulates vitamin C within lipid bilayers, significantly enhancing its absorption rate.**

02 Liposomal Glutathione

Reduced glutathione, a promising supplement ingredient, supports immune function, provides antioxidant benefits, and aids in liver detoxification. However, its full potential is hindered by instability, as it degrades easily when exposed to light, moisture, and heat, and oral intake fails to protect it from stomach acid and digestive enzymes. **Liposomal technology encapsulates glutathione within lipid bilayers, significantly enhancing its stability, extending shelf life, and improving absorption in the intestinal tract.**

Popular Liposomal Products

03 Liposomal Curcumin

Curcumin is inherently insoluble, which limits its absorption by the body, resulting in low blood concentration and reduced effectiveness. As a result, many curcumin products on the market require high dosages, which can be challenging for consumers. Liposomal encapsulation technology significantly enhances curcumin's absorption rate. **With laboratory-validated improvements in bioavailability, liposomal curcumin stands out as a competitive solution in a crowded market.**

04 Liposomal Vitamin D

Vitamin D is primarily absorbed through passive diffusion, which results in a lower absorption rate compared to active transport mechanisms. The presence of lipids can significantly enhance the absorption process.

As awareness of immune health and overall well-being continues to rise, the demand for vitamin D supplements remains strong. This trend also applies to liposomal Vitamin D, which offers improved absorption. Liposomal Vitamin D3+K2 is a widely available formulation in the market.

Market Trends & Consumer Insights

Market Trends

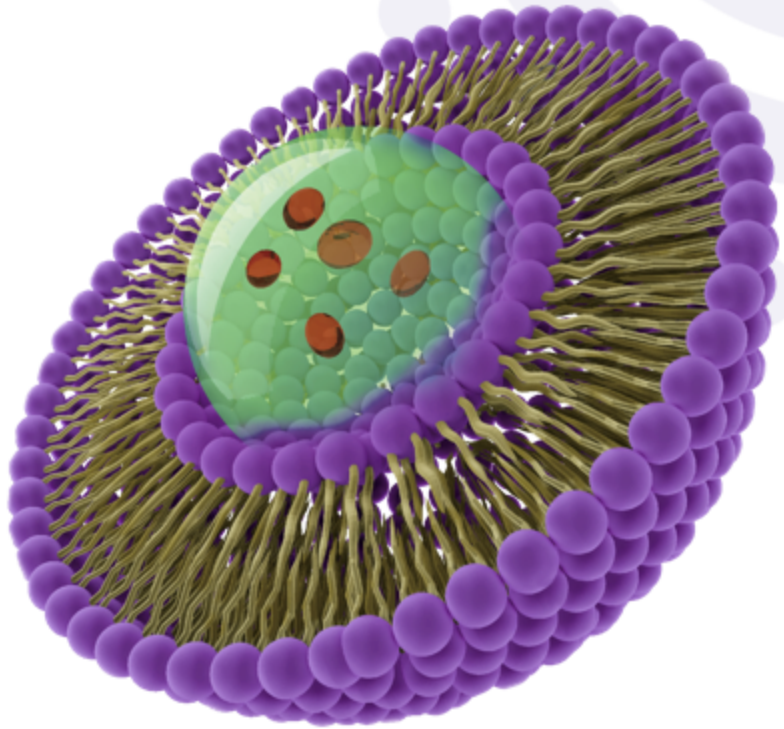
The increasing consumer demand for health and wellness solutions is a primary factor driving the robust expansion of the liposomal market. Liposomal technology offers significant improvements in the absorption rate of supplements, enhancing their bioavailability and overall efficacy. Key market players are actively adopting this technology for product innovation and pursuing strategic partnerships to strengthen their competitive edge. **Liposomal technology is playing a pivotal role in driving the next phase of growth in the supplement industry.**

Consumer Insights

The health-conscious consumer base is a key driver of the current growth in the liposomal market. However, there remains a significant knowledge gap regarding liposomal technology and its benefits, which is often overlooked. **Bridging this gap is essential for empowering consumers to make informed decisions, ultimately fostering further growth in the liposomal supplements market.**

PART 02

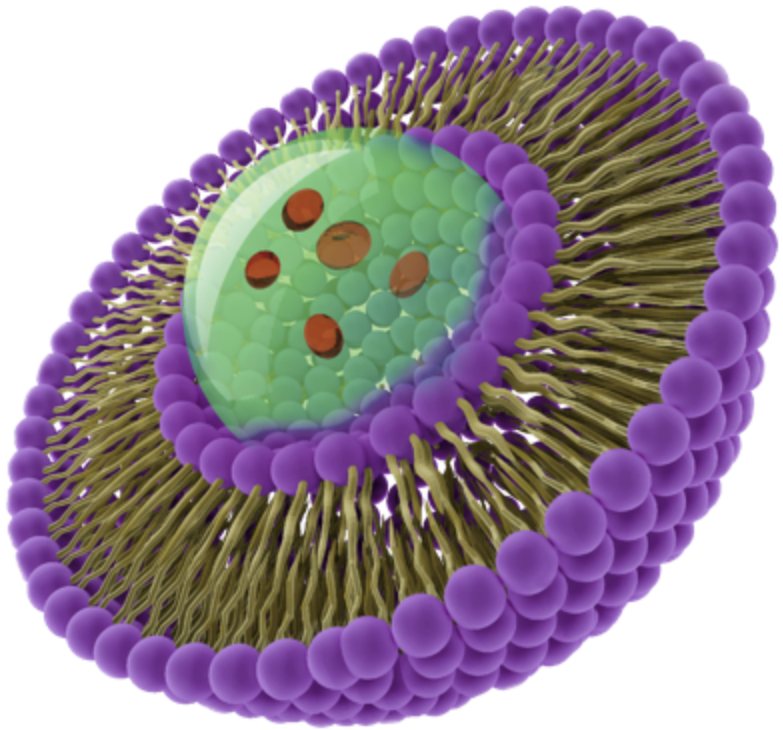
About Liposomal Technology



What Are Liposomes?

Definition

Liposomal technology encapsulates active ingredients within tiny lipid molecules called liposomes.



Discovery of Lipid Bilayer Membremce

In 1961, Alec Douglas Bangham and R.W. Horne, using negatively stained phospholipids and electron microscopy, discovered that phospholipids formed structures resembling cell membranes. Their 1964 publication confirmed that phospholipids, when dispersed in water, form multilayer vesicles with lipid bilayers separated by aqueous phases. They coined the term "liposome" to describe these artificial vesicles, which are enclosed by one or more concentric lipid bilayers.

Types of Liposomes

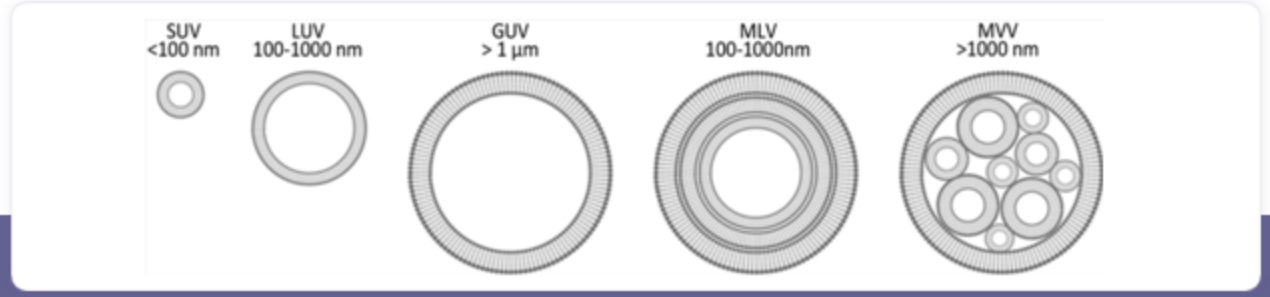
Liposomes are classified based on their structure and size:

Unilamellar Liposomes: These vesicles consist of a single lipid bilayer.

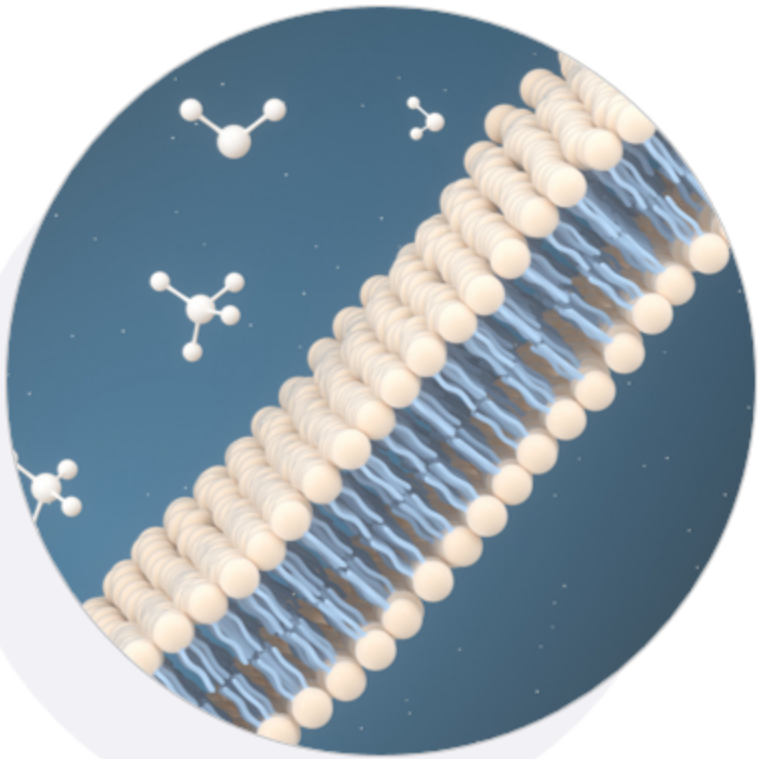
- Small Unilamellar Vesicles (SUVs): Approximately 20–100 nm in diameter.
- Large Unilamellar Vesicles (LUVs): Approximately 100–1000 nm in diameter.
- Giant Unilamellar Vesicles (GUVs): Approximately 1–200 µm in diameter.

Multilamellar Liposomes: These vesicles contain multiple concentric lipid bilayers.

- Multilamellar Vesicles (MLVs): Approximately 100–1000 nm in diameter.
- Multivesicular Vesicles (MVVs): Approximately >1000 nm in diameter.



Types of Phospholipids



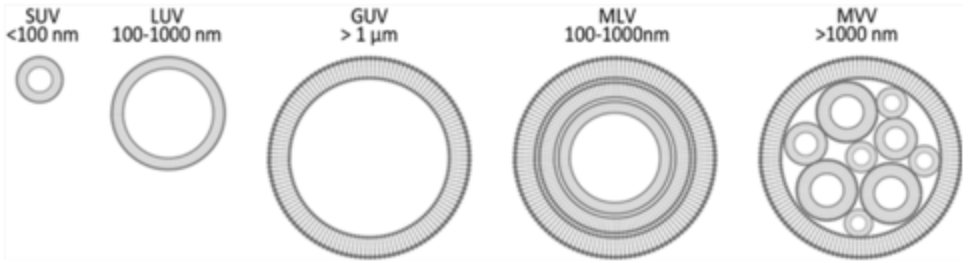
About Phospholipids

Phospholipids are essential lipid carriers in liposome preparation, serving as the primary components of biological cell membranes. As endogenous substances, they exhibit excellent biocompatibility and biodegradability, being non-toxic and non-immunogenic.

Natural and Synthetic Phospholipids

Phospholipids used in liposome preparation are classified into natural and synthetic types. In the field of dietary supplements, natural phospholipids, such as sunflower lecithin and soy lecithin, are commonly used. They are further categorized based on their specifications, such as PC20, PC60, and PC90, where "PC" stands for phosphatidylcholine, and the numbers represent their respective contents.

Liposome Production Process



There are several methods for liposome preparation, with different methods used depending on the type of liposome. The following methods are all passive encapsulation techniques for active substances, each with its unique features.

SUV Preparation Methods

Ultrasonic dispersion, organic solvent injection, freeze-thaw extrusion.

LUV Preparation Methods

Reverse evaporation, freeze-thaw extrusion, organic solvent injection.

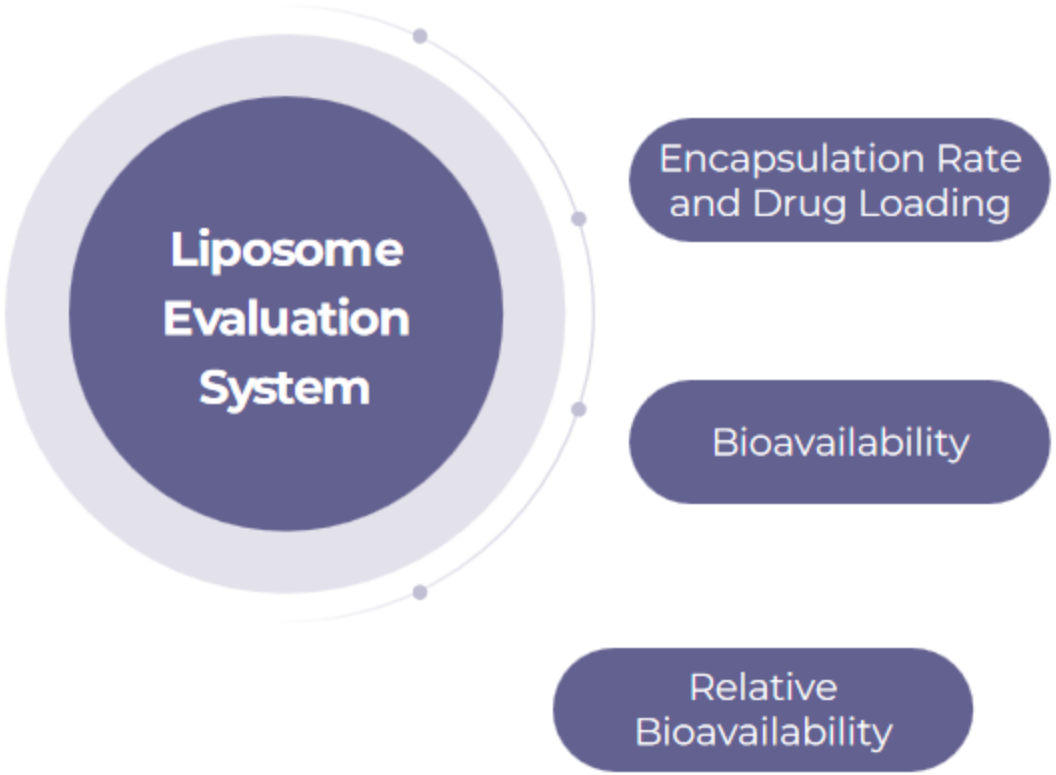
MLV Preparation Method

Freeze-drying.

MVV Preparation Methods

MVV (W/O/W) double emulsion method, used for preparing water-in-oil-in-water type liposomes.

Liposome Quality Control and Efficacy Evaluation



The morphology and particle size are measured using transmission electron microscopy (TEM) and a nanoparticle size analyzer. Depending on the administration route, the required particle size varies. Generally, for oral liposomes, the particle size should be less than 200 nm, with a uniform distribution and a normal distribution pattern, and the size range should be narrow.

Encapsulation Efficiency = (Active substance in liposomes / Total active substance) × 100%. Separation methods like centrifugation and dialysis are used to measure free and encapsulated active substances.
Drug Loading = [Active substance in liposomes / (Active substance + Total carrier)] × 100%. Drug loading affects the administered dose, with an inverse correlation to encapsulation efficiency within a certain range.

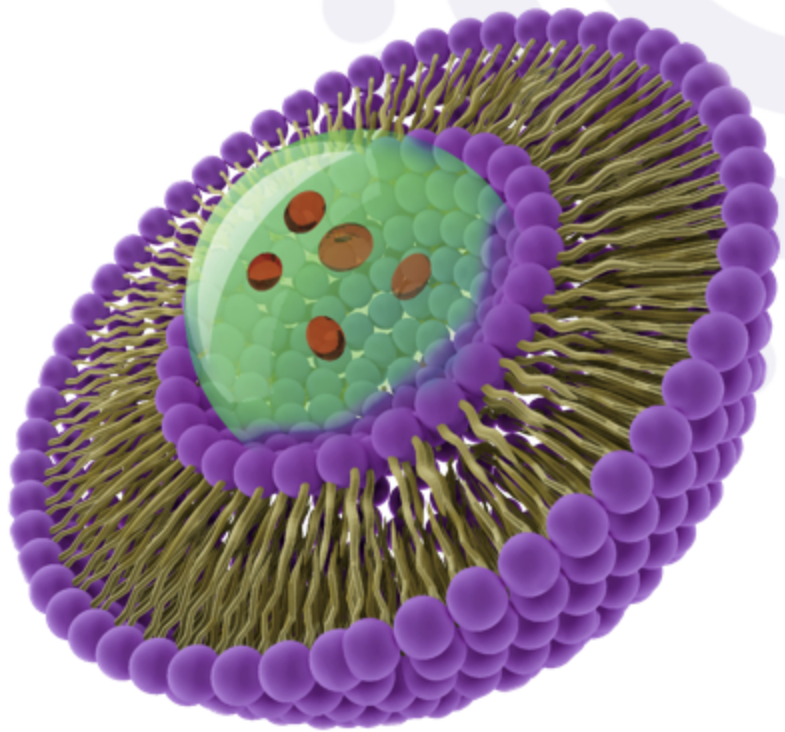
Bioavailability (BA) refers to the rate and extent of active substance absorption into the bloodstream, reflecting the clinical effectiveness of the formulation. It is evaluated using three key parameters: peak concentration (Cmax), time to peak concentration (tmax), and area under the concentration-time curve (AUC0-t), which are essential for bioequivalence assessment.

Relative Bioavailability (RB) refers to the relative amount of active ingredient absorbed into systemic circulation when administered by a non-oral route, compared to a reference formulation. It is the ratio of the AUC0-t between different formulations of the same active substance. RB primarily reflects how factors such as formulation, prescription, and preparation process of the test formulation affect absorption, in comparison to the reference formulation, highlighting the in vivo quality of the test formulation.

PART 03

LipoAvail™

Liposomal Technology

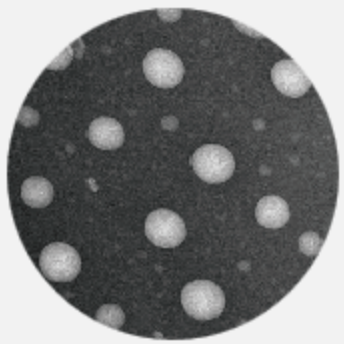


LipoAvail™ Liposome: Authenticity Proven By TEM

Entrapment efficiency, drug loading capacity, nanoparticle size and morphology, formulation process, and various other factors influence the quality and efficacy of liposomal products.

LipoAvail™ technology is the result of extensive research and optimization. Advanced electron microscopy confirms the quality and uniformity of our liposomes, ensuring product integrity.。

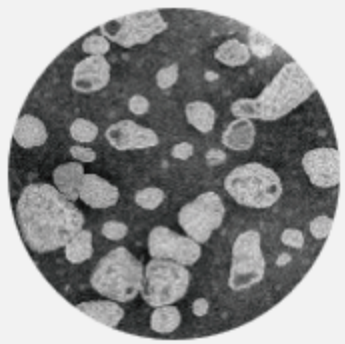
Transmission electron microscopy (TEM) imaging is used to verify the authenticity of liposomes.



LipoAvail™ Liposomes

LipoAvail™ liposomes have a more regular spherical morphology. The active ingredients are encapsulated by phospholipids, resulting in a more uniform particle size distribution.

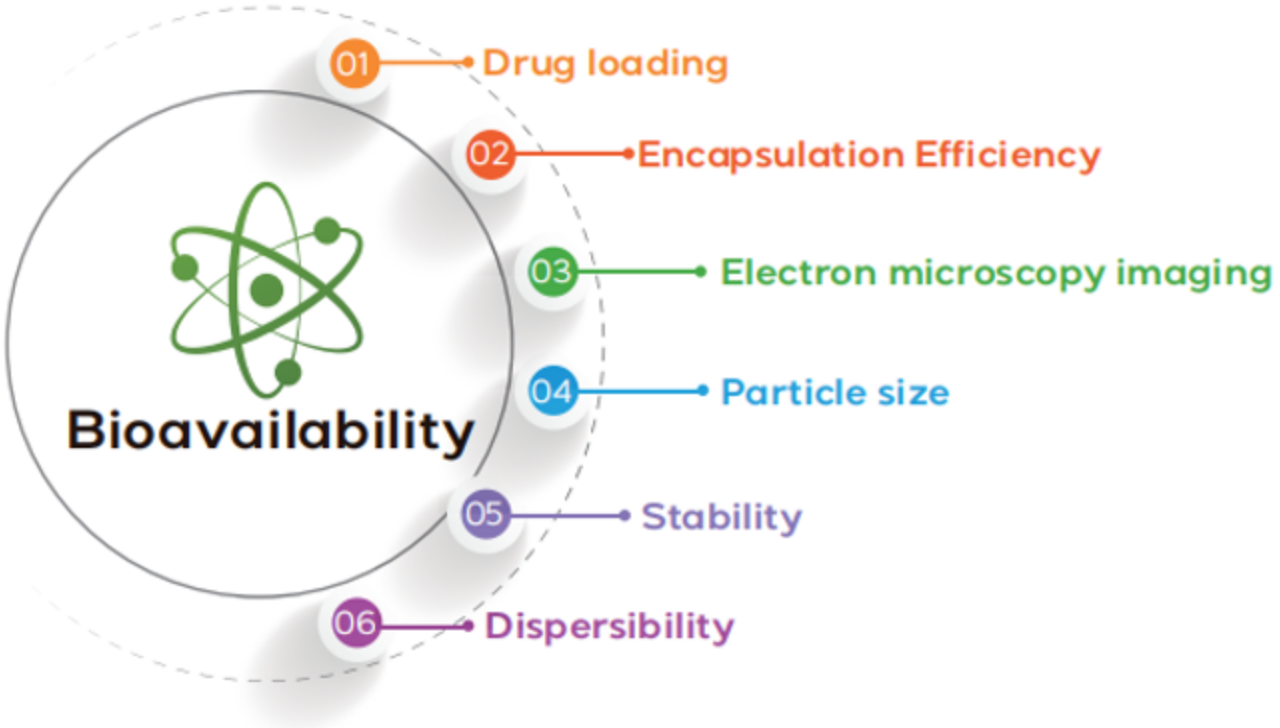
V.S.



Unqualified Liposomes

Unqualified liposomes have irregular shapes, non-spherical morphology, insufficient encapsulation, and poor particle size uniformity.

LipoAvail™ 360° multi-dimensional quality evaluation system

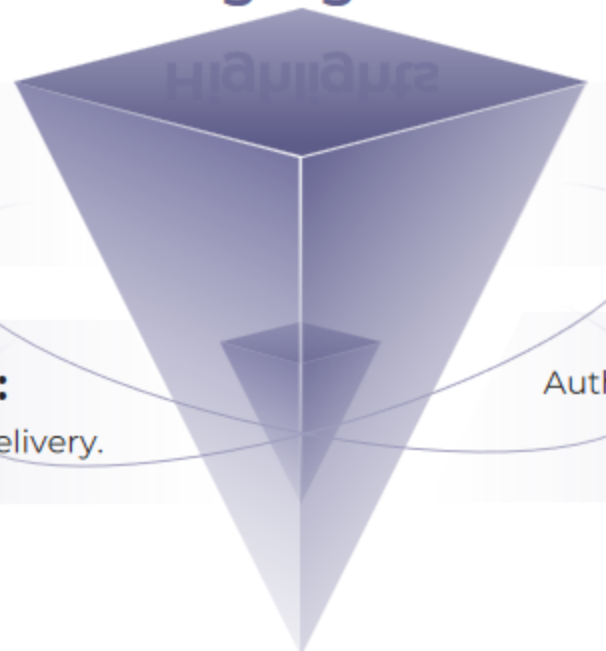


Amount consumed ≠ Amount absorbed

Bioavailability measures how well and how quickly an active ingredient is absorbed by the body and reaches its target. Focusing on bioavailability is crucial because it impacts the ingredient's effectiveness and helps to create better products.

LipoAvail™ Technical Advantages

5 Key Highlights



Nanoscale particle size:
All below 100nm, ensured through homogenization techniques

Versatile applications:
Excellent stability and dispersibility for easy application and absorption

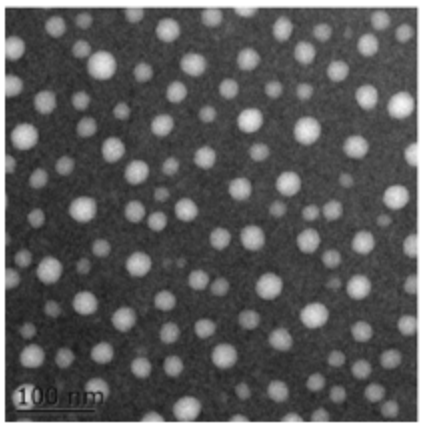
High encapsulation rate:
Maximized active ingredients delivery.

Electron microscopy imaging
Authenticity of liposomes validated by TEM (Transmission Electron Microscope).

Enhanced bioavailability:
Lab-validated bioavailabilityincrement.

LipoAvail™ Vitamin C

LipoAvail™ Vitamin C has a regular spherical morphology with a particle size of around 30 nm. Using allergen-free sunflower lecithin, it boosts Vitamin C relative bioavailability by **7.86** times, ideal for hard capsules, premixes, and other products.



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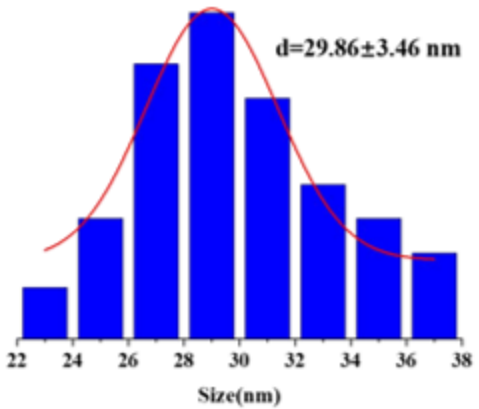
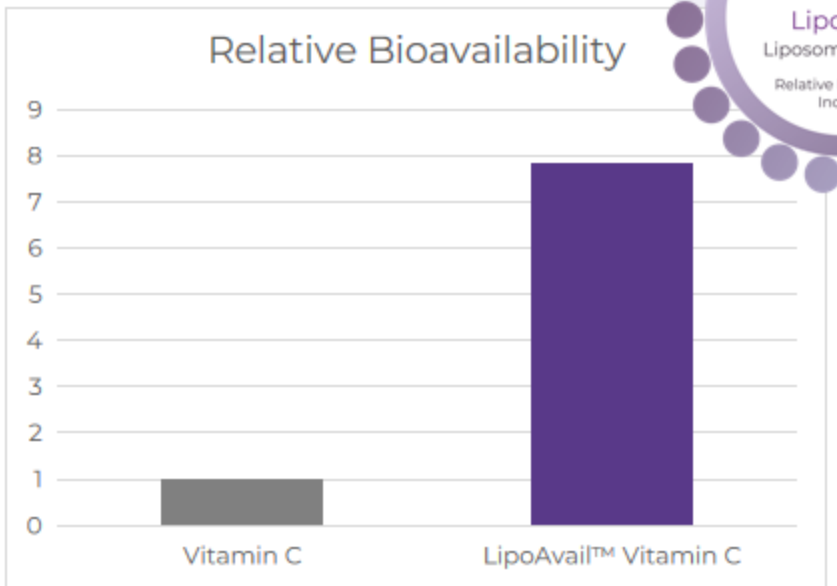
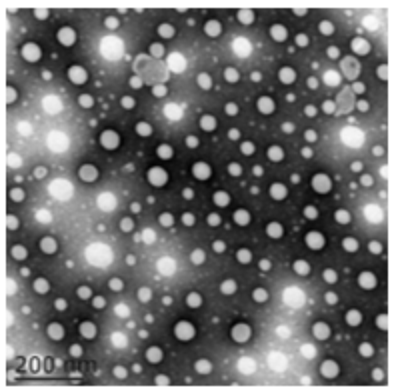


Particle Size Distribution



LipoAvail™ Glutathione

LipoAvail™ glutathione has a regular spherical morphology with a particle size of around 36nm. Using allergen-free sunflower lecithin, it significantly enhances the absorption and bioavailability of glutathione, making it suitable for applications in hard capsules, premixes, and other products. Animal studies show that the bioavailability of LipoAvail™ Glutathione liposomes is **12.9** times higher than that of regular glutathione



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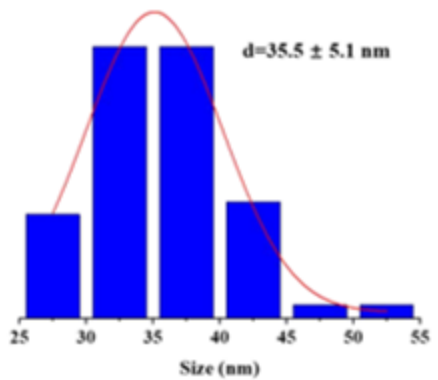
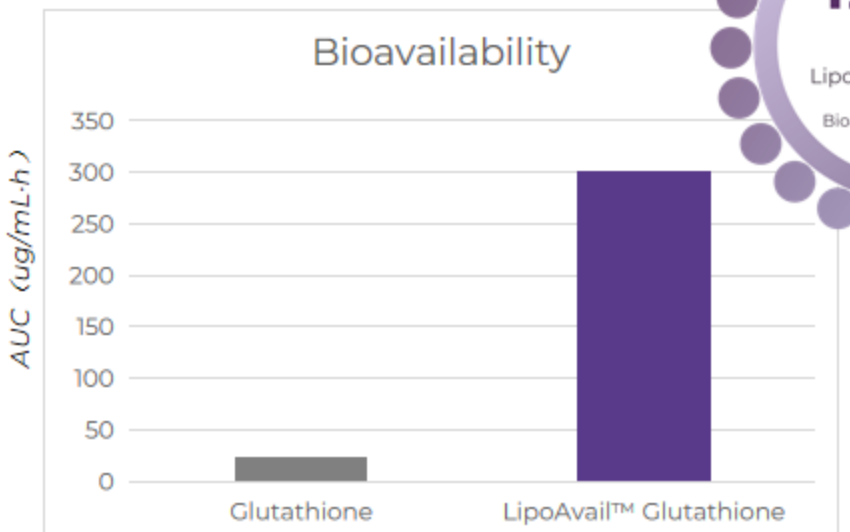
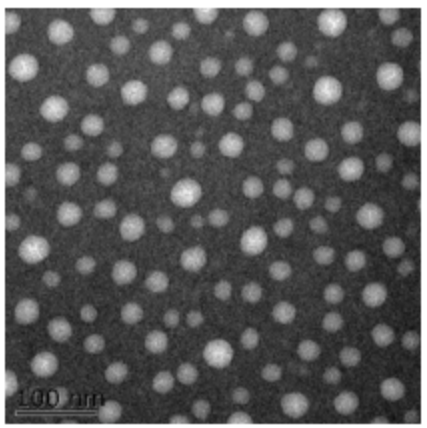


Particle Size Distribution



LipoAvail™ NAD+

LipoAvail™ NAD+ appears spherical under electron microscopy, with a particle size of approximately 29 nm. Using allergen-free sunflower lecithin, it significantly enhances the absorption and bioavailability of NAD+, making it suitable for hard capsules, premixes, and other products. Animal studies show that after 7 days of gavage, the relative level of NAD+ in the liver tissue of mice in the liposomal NAD+ group was **9.31** times higher than that in regular NAD+ group.



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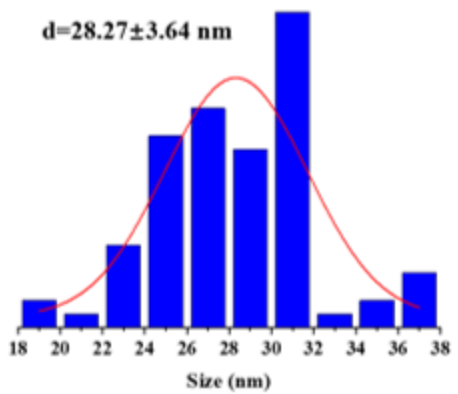
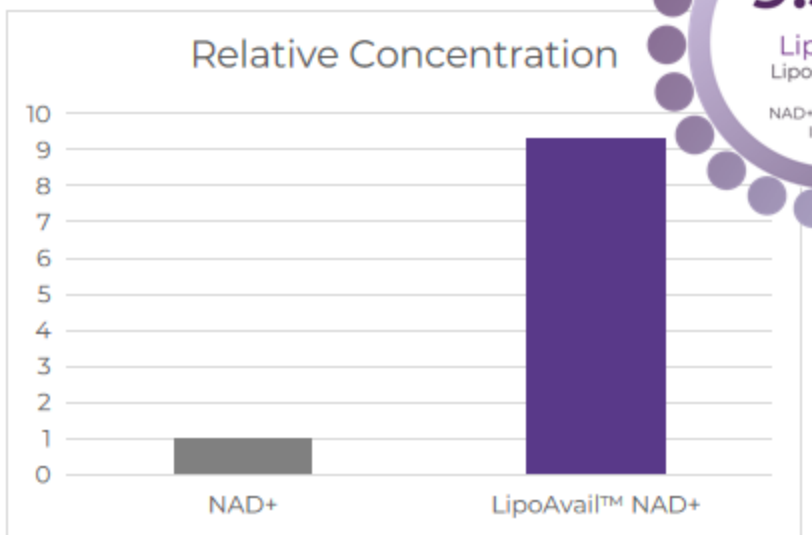
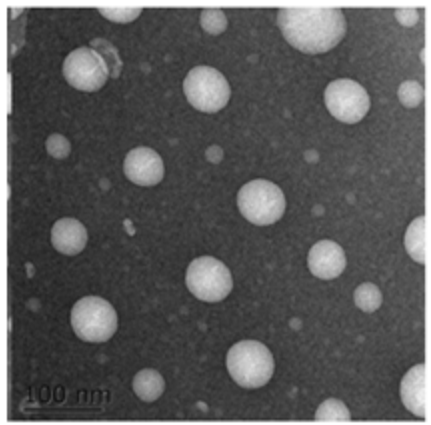


Particle Size Distribution



LipoAvail™ CoQ10

LipoAvail™ Coenzyme Q10 appears spherical under electron microscopy, with a particle size of approximately 70 nm. Using allergen-free sunflower lecithin, it significantly enhances the bioavailability of Coenzyme Q10, making it suitable for hard capsules, premixes, and other products. Animal studies show that the relative bioavailability of LipoAvail™ Coenzyme Q10 is **19.9** times higher than that of regular Coenzyme Q10.



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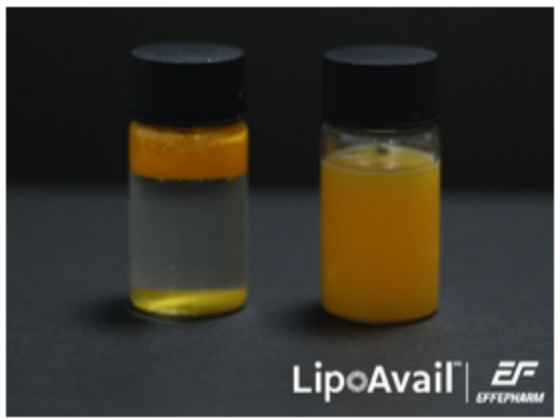
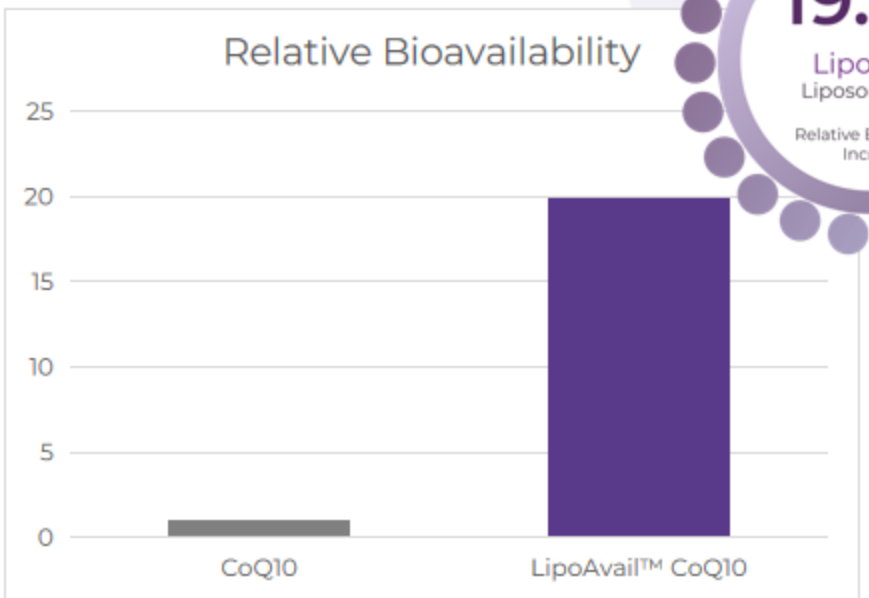
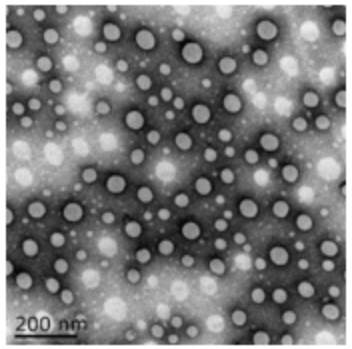


Cold Water Dispersity Comparison
Regular CoQ10 v.s. LipoAvail™ CoQ10



LipoAvail™ Resveratrol

LipoAvail™ Resveratrol appears spherical under electron microscopy, with a particle size of approximately 44 nm. Using allergen-free sunflower lecithin, it significantly enhances the absorption and bioavailability of resveratrol, making it suitable for hard capsules, premixes, and other products. Animal studies show that the relative absorption of LipoAvail™ Resveratrol is **14.02** times higher than that of regular resveratrol.



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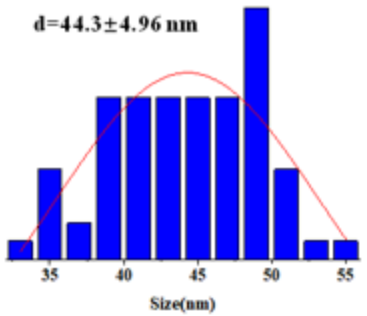
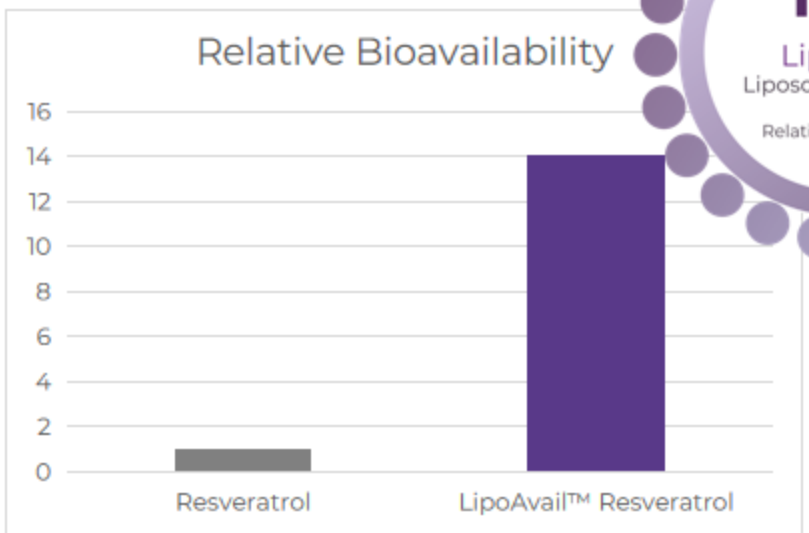


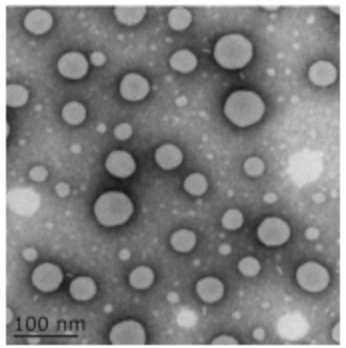
Particle Size Distribution

Cold Water Dispersity Comparison
Regular Resveratrol v.s. LipoAvail™ Resveratrol



LipoAvail™ Curcumin

LipoAvail™ Curcumin appears spherical under electron microscopy, with a particle size of approximately 42 nm. Using allergen-free sunflower lecithin, it significantly enhances the bioavailability of curcumin, making it suitable for hard capsules, premixes, and other products. Animal studies show that the relative absorption of LipoAvail™ Curcumin is **107.5** times higher than that of regular curcumin.



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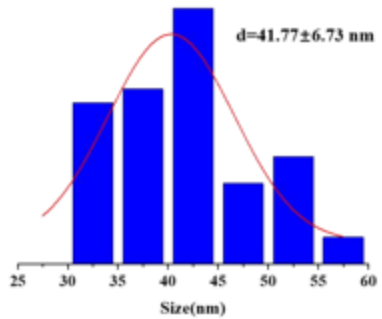
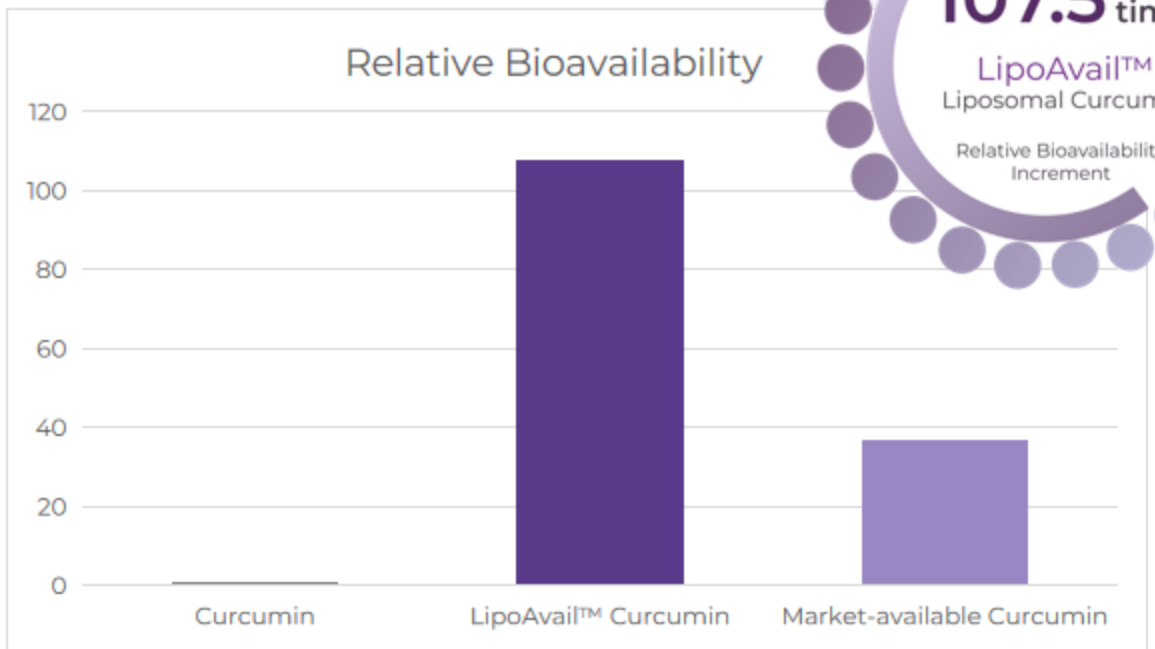


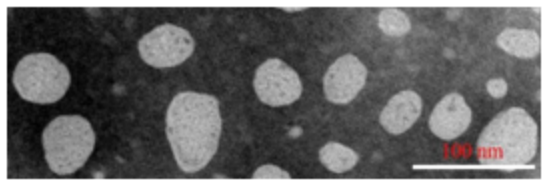
Particle Size Distribution

Cold Water Dispersity Comparison
Regular Curcumin v.s. LipoAvail™ Curcumin



LipoAvail™ NMN

LipoAvail™ NMN appears spherical, with a particle size of approximately 48 nm. Using allergen-free sunflower lecithin, it is suitable for hard capsules, premixes, and other products. Animal studies show that after 14 days of gavage, the NAD+ level in the liver tissue of mice in the liposomal NMN group was **1.74** times higher, and the NAD+ level in skeletal muscle was **5.95** times higher than that in the regular NMN group.



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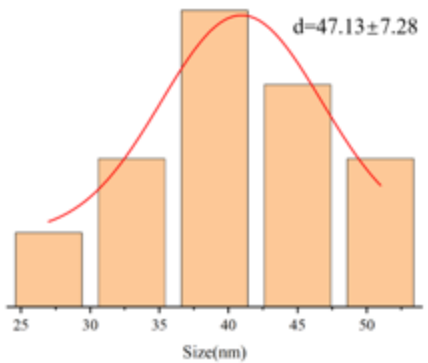
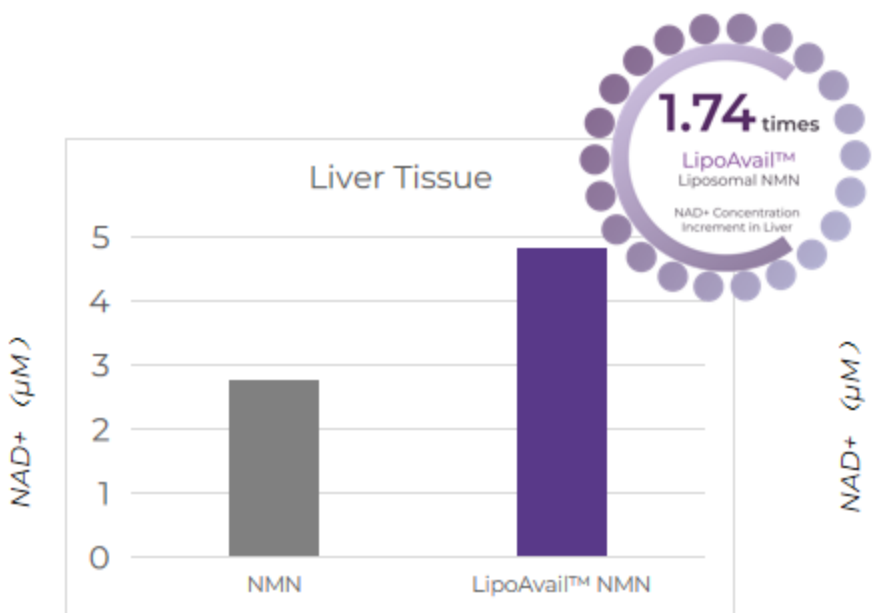
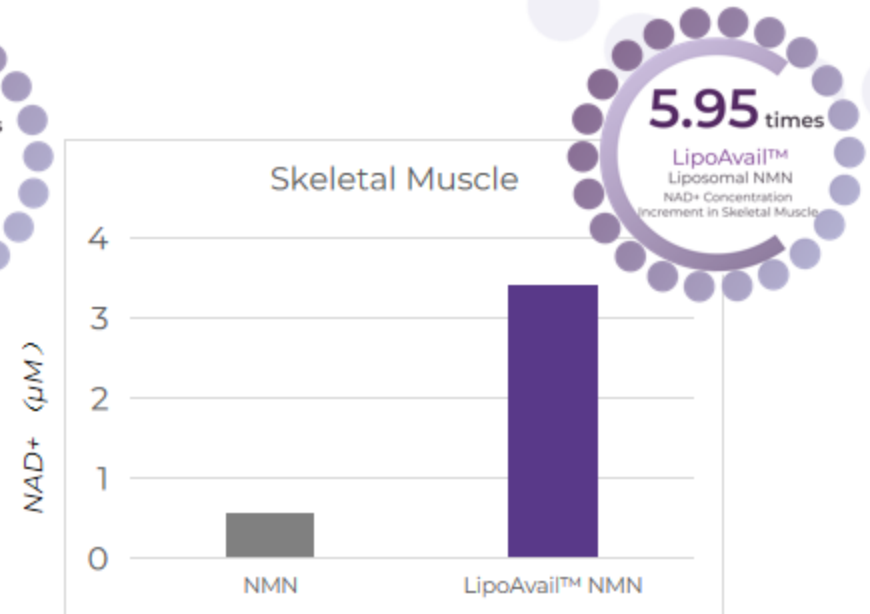


Particle Size Distribution

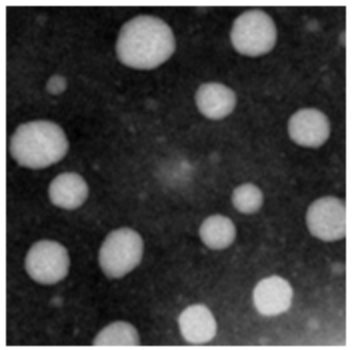




LipoAvail™ Silymarin

The solubility of silymarin is limited to just 0.06 mg/mL, resulting in suboptimal absorption rates. Furthermore, any unabsorbed silymarin is rapidly eliminated from the body. As a result, when consumers take multiple capsules, much of the silymarin is wasted, reducing its potential effects.

LipoAvail™ Silymarin, with a spherical morphology and a particle size of approximately 28 nm, utilizes allergen-free sunflower lecithin to significantly improve its bioavailability. This formulation is ideal for applications in hard capsules, premixes, and other products.



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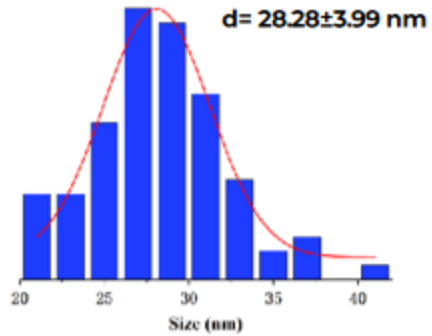
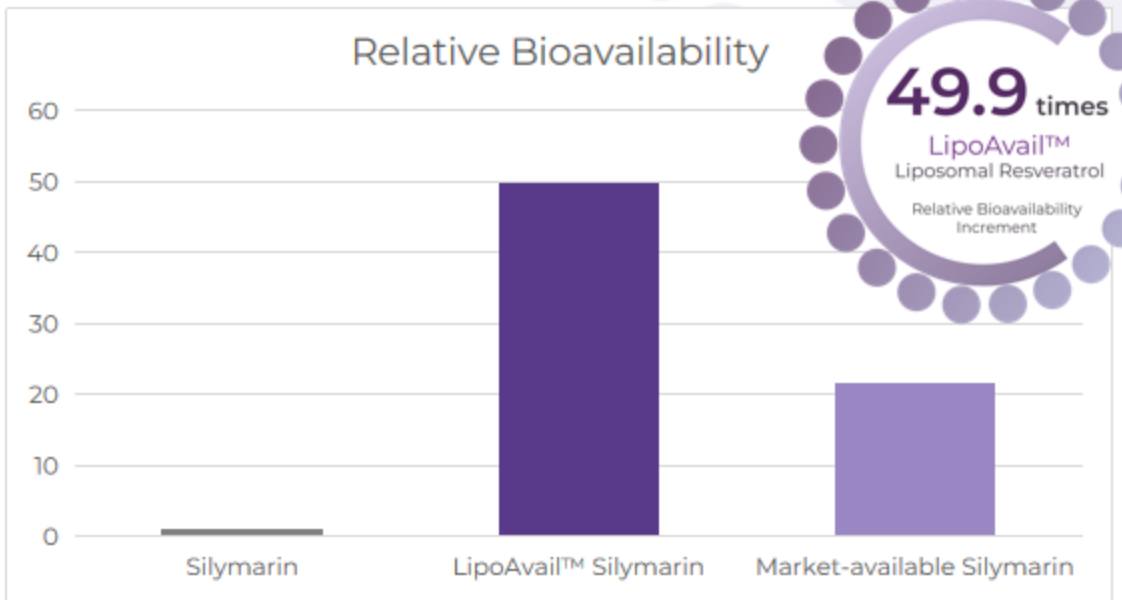


Particle Size Distribution

Cold Water Dispersity Comparison
Regular Silymarin v.s. LipoAvail™ Silymarin



Animal studies show that LipoAvail™ Silymarin enhances relative absorption by **49.9** times, improving the consumer's overall experience.

LipoAvail™ Product Catalogue

Vitamins	Liposomal Vitamin C Liposomal Vitamin D3 Liposomal Vitamin B Complex
Minerals	Liposomal Fe Iron Liposomal Zinc Liposomal Magnesium Liposomal Calcium
Plant Extracts	Liposomal Curcumin Liposomal Silymarin Liposomal Berberine HCL Liposomal Resveratrol Liposomal Quercetin Liposomal Fisetin
Other Active Ingredients	Liposomal L-Glutathione reduced Liposomal CoQ10 Liposomal NMN Liposomal NAD+ Liposomal Spermidine Lipsomal PEA Liposomal AKG-Ca

LipoAvail™ Marketed End Products

LipoAvail™ helps you stand out in the crowded market.

Contact Us

+86-021-57709202
info@effepharm.com
www.effepharm.cn