



L-GSH

L I P O S O M A L

West Bengal Chemical Industries Limited



A USA FDA-Aligned Framework for Quality & Stability Determination

<i>Parameters</i>	<i>Page No.</i>
1. Encapsulation Efficiency & Capacity	
a. Encapsulation Efficiency	4
2. Particle Characteristics & Stability	
a. Zeta Potential	5
b. Particle Size	6
c. PDI	7
3. Structural & Chemical Confirmation	
a. FTIR	9
b. EDAX	10
c. SEM	11
4. Thermal Stability & Integrity	
a. Leakage & Stability	12
b. DSC	13

Challenges with Standard L-Glutathione



Poor Absorption

Native Glutathione is highly hydrophilic and has an oral bioavailability below 10%.



Enzymatic Breakdown

The intestinal enzyme γ -glutamyl transferase (GGT) strike the molecule, cutting it into constituent amino acids



Gastric Degradation

Stomach acid with a pH of 1.5 attacks the peptide bonds, causing structural disintegration before the molecule reaches absorption sites.

WBCIL Liposome: The Guarantee of Purity

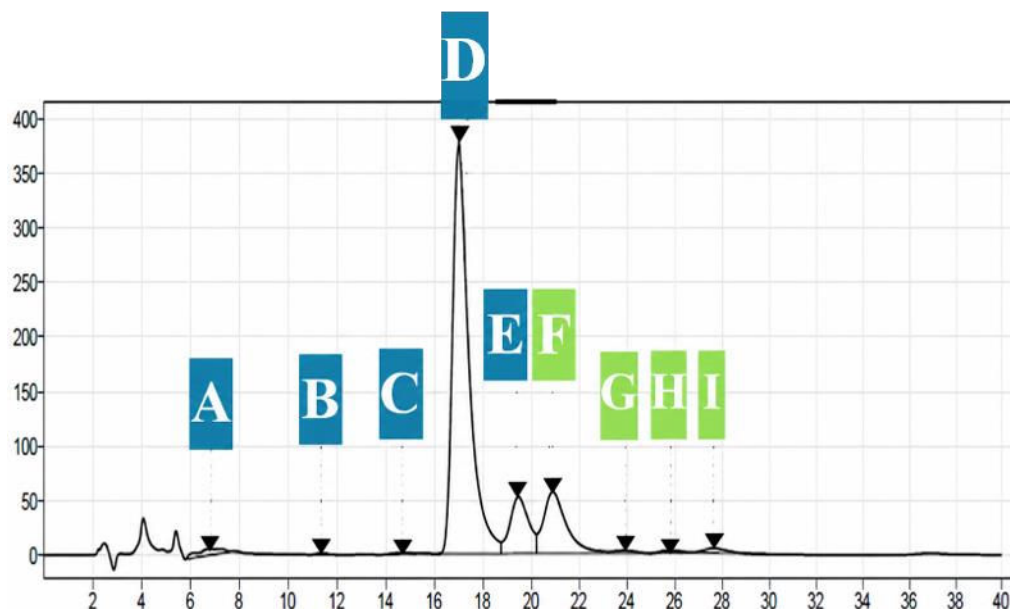


Figure 1 –The chromatogram of a phospholipid constituting a liposome

Phosphatidylcholine (PC-Peak A-E) : 90.07%

Phosphatidylethanolamine (PE-Peak F-I) : 4.39%



Stronger Shells & Cleaner Product

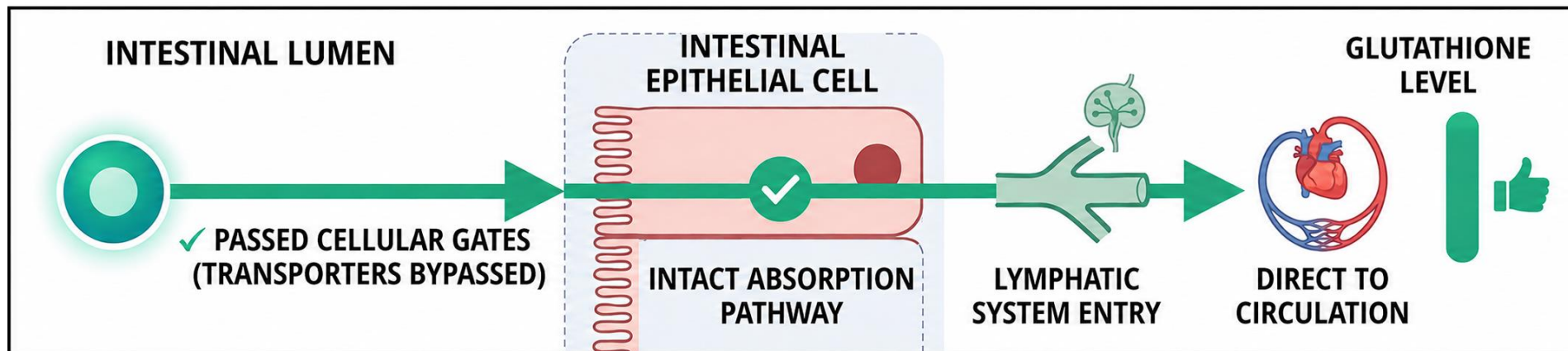
>90% purity ensures liposomal stability
and patient safety by minimising
unwanted lipids



WBCIL Achieved

>94% phospholipid purity with > 90%
PC content

Bypassing Natural Barriers



Bypassing Transporters

Instead of struggling through standard cellular gates, intact liposomes enter directly into the lymphatic system



Direct Entry to Systemic Circulation

By migrating directly into the lymphatic system, liposomal glutathione avoids liver first-pass metabolism, elevating serum glutathione safely and efficiently.



CLINICAL ADVANTAGE: This mimics the efficacy of an IV infusion through a simple, safe oral dose.

Encapsulation Efficiency

Encapsulation Efficiency: The percentage of the active ingredient successfully encapsulated within the protective liposome core.

>70%

ACCEPTANCE CRITERIA

87% Achieved

WBCIL PROPRIETARY PROCESS

KEY ADVANTAGES

- ✓ Improves Bioavailability
- ✓ Prevents Gastric Irritation
- ✓ Protects L-GSH from oxidation
- ✓ Boosts Patient Compliance

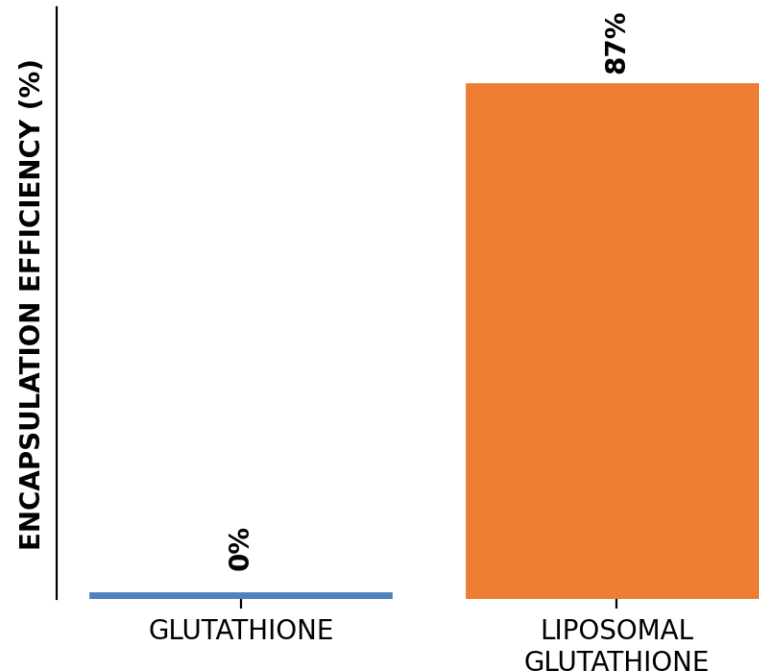


Figure 2: Encapsulation efficiency of Liposomal glutathione

Dynamic Light Scattering Analysis of Liposomal Glutathione

A. Zeta Potential: an indicator of the liposome's surface charge

< -25 mV
ACCEPTANCE CRITERIA

-32 mV
WBCIL ACHIEVED ZP

KEY ADVANTAGES

- ✓ High Zeta Potential creates a strong repulsion between particles, preventing clumping and ensuring stability.

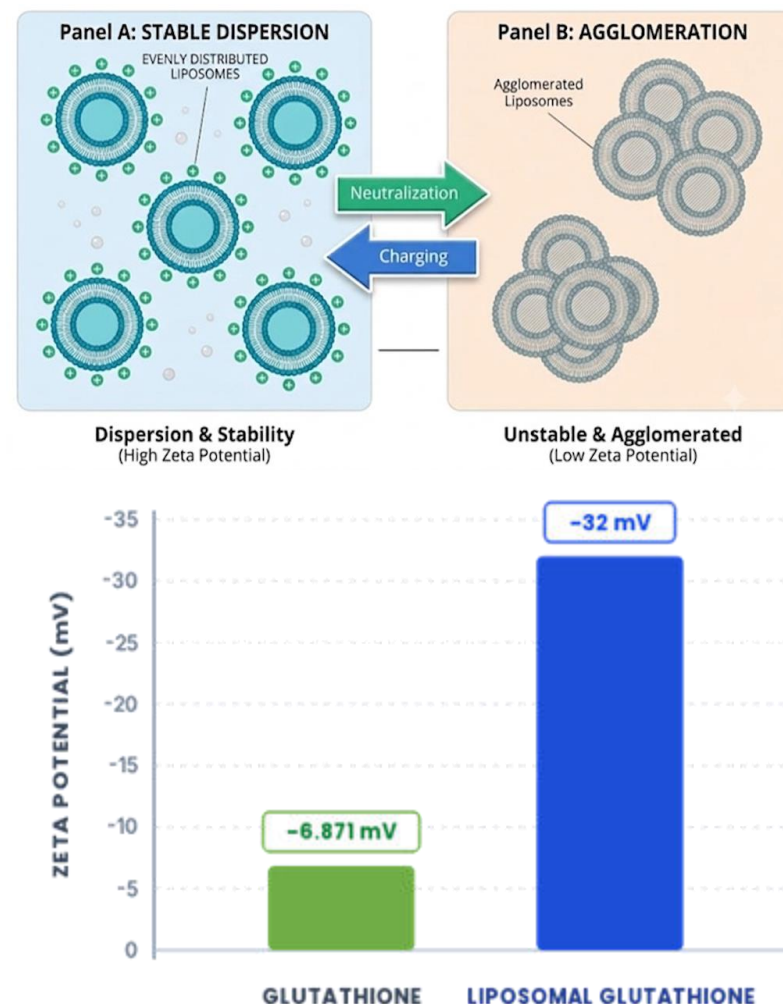


Figure 3: Determination of Zeta Potential

B. Particle Size determination

≤ 300 nm
ACCEPTANCE CRITERIA

262 nm
WBCIL ACHIEVED

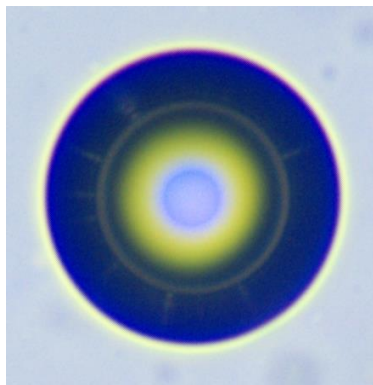


Figure 4A: Microscopic image of a liposomal L-Glutathione

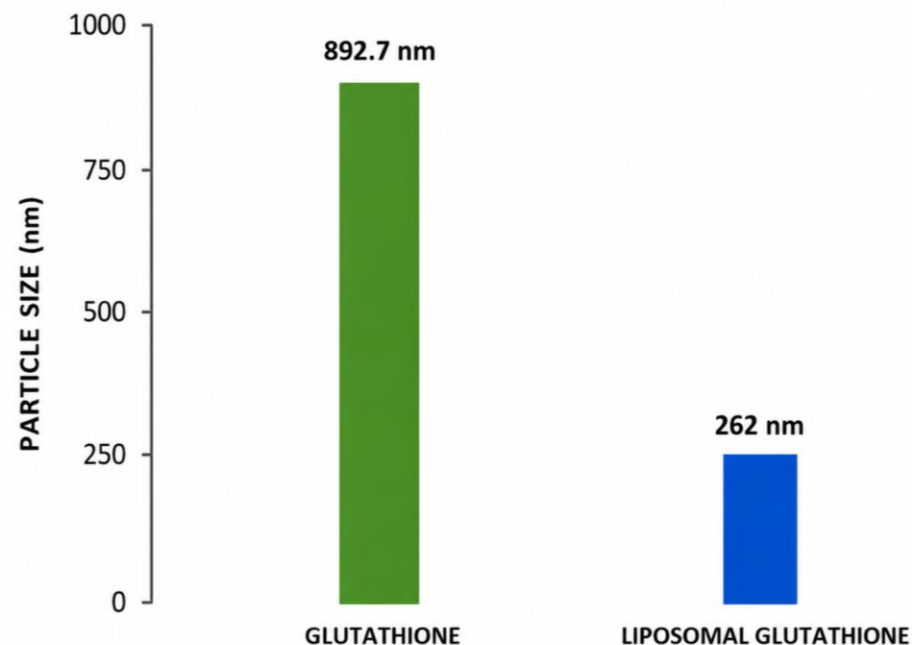


Figure 4B: Particle size of Glutathione API vs Liposomal Glutathione in solution

KEY ADVANTAGES

- ✓ Increased Cellular Uptake

C. Polydispersity Index (PDI): Uniformity in size distribution of liposomes

< 0.50

ACCEPTANCE CRITERIA

0.20

WBCIL ACHIEVED PDI

KEY ADVANTAGES

- ✓ Yields superior colloidal stability in the formulation
- ✓ Directly contributes to an improved and stable shelf life

POLYDISPERSITY INDEX

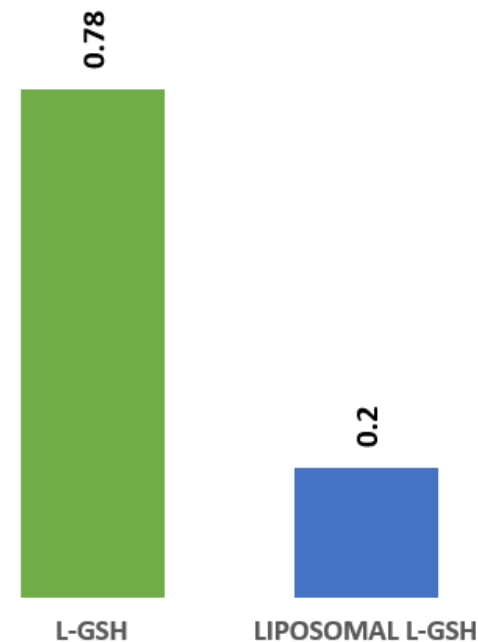
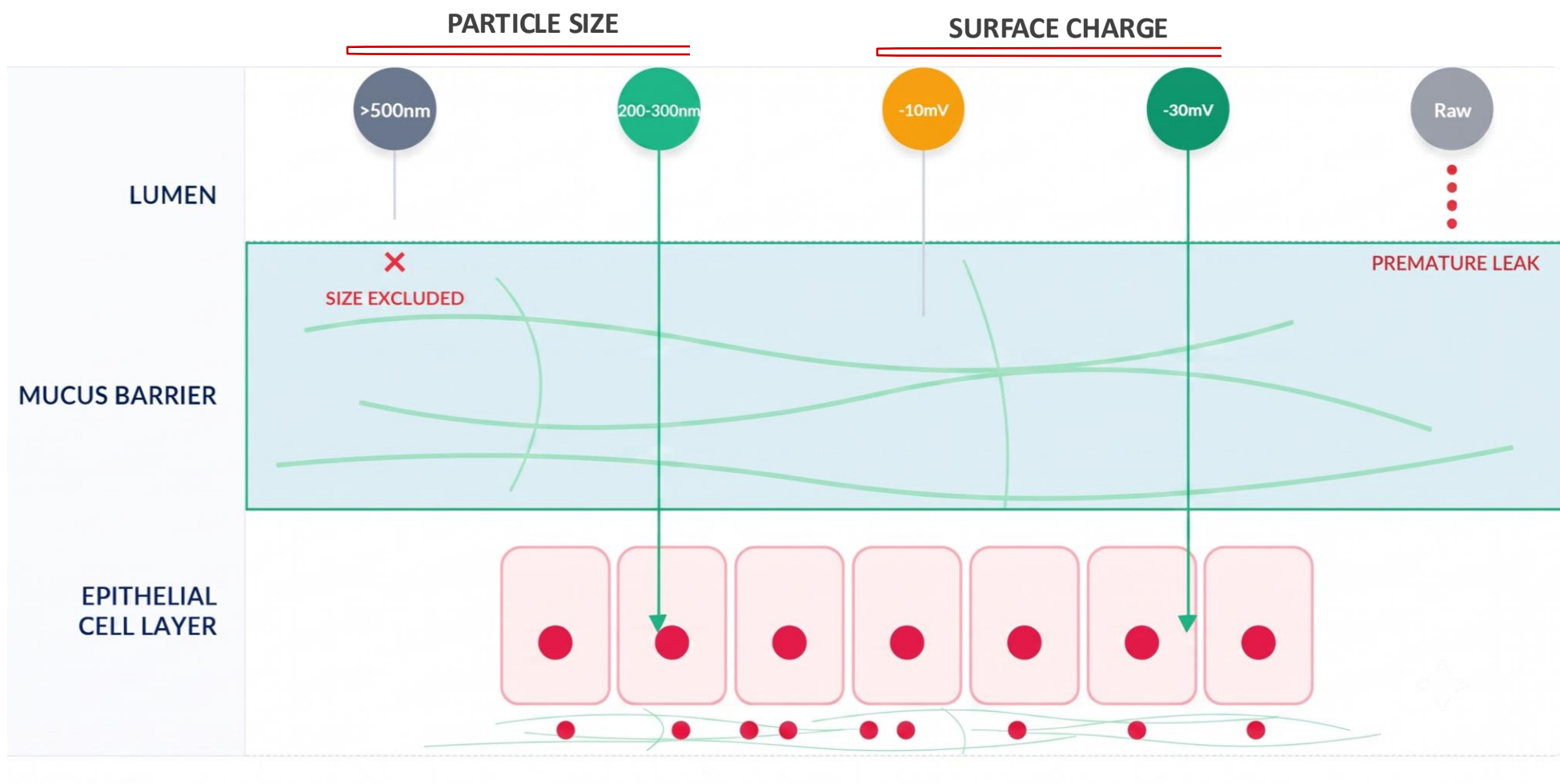


Figure 5: Polydispersity Index (PDI) of Glutathione API vs Liposomal Glutathione in solution

Absorption of Liposomal Glutathione Represented Schematically on a Cellular Cross-Section



The Fingerprint Test: Fourier Transform Infrared Spectroscopy (FTIR) of Liposomal Glutathione

FTIR acts like a “molecular fingerprint”. Every ingredient has a unique signal.

Feature Observed	L-GSH API	WBCIL Liposomal L-GSH
Lipid Bilayer Signal	Absent	Present & Verified
Amide & Carbonyl Regions	Sharp & Well-Defined	Modified & Broadened
Structure Proof	Free Crystalline Powder	Encapsulated within Lipid Bilayer



The "Fingerprint" region $1700-1000\text{ cm}^{-1}$ of liposomal L-Glutathione shows a merged pattern, indicating that the L-GSH is fully encapsulated within the liposome

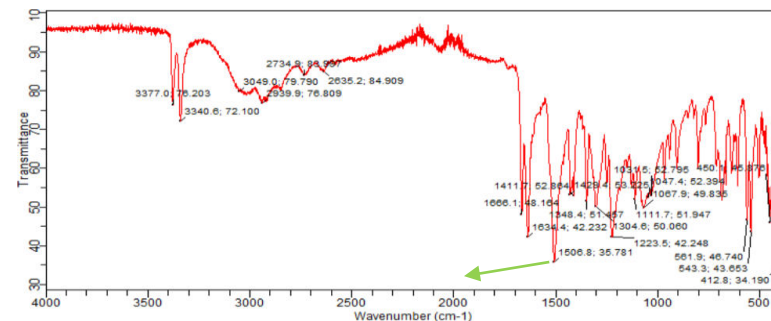


Figure 6A: IR Transmission spectrum of Glutathione API

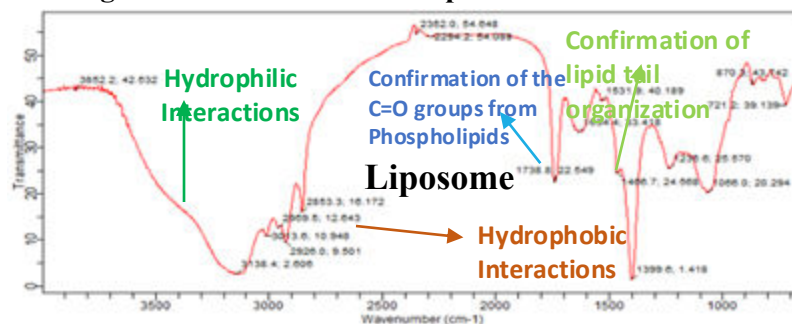


Figure 6B: IR Transmission spectrum of Empty Liposome

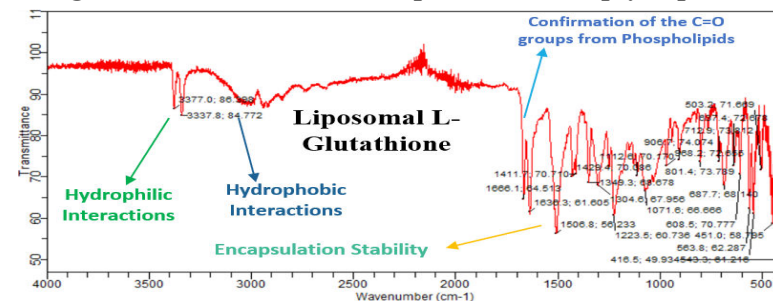


Figure 6C: IR Transmission spectrum of Liposomal L-Glutathione

The Surface Proof: Energy-Dispersive X-ray Spectroscopy (EDAX)

A surface scan using EDAX examines the particle's surface. If glutathione is detectable on the surface, it's not fully encapsulated.

Element Detected	L-GSH API	WBCIL Liposomal L-GSH
Sulphur	Present	Absent
Phosphorous (Lipid Bilayer)	Absent	Present (Lipid Bilayer Verified)

✓ **CONCLUSION: Successful Encapsulation of L-GSH**

Figure 7A: Standard glutathione API

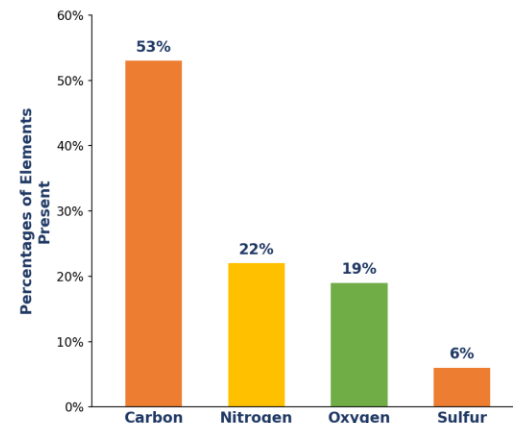
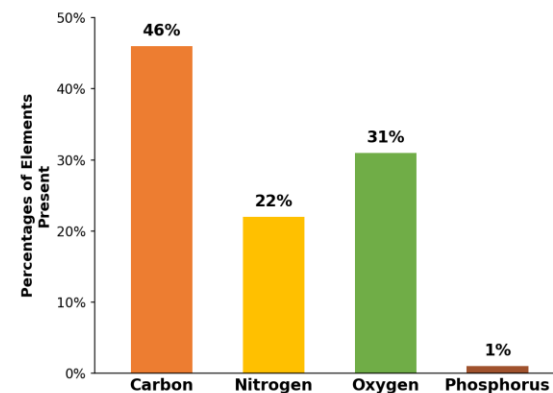


Figure 7B: Liposomal glutathione API



Scanning Electron Microscope (SEM) Image of Liposomal L-GSH

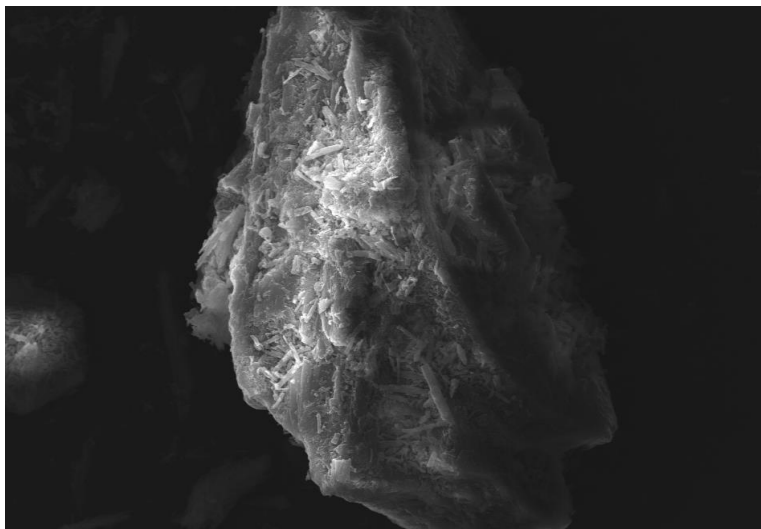


Figure 8A: SEM image of L-GSH API

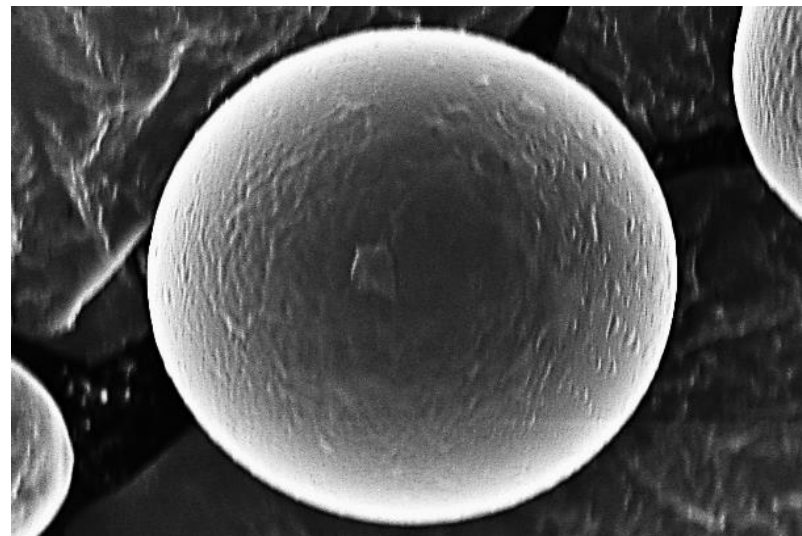


Figure 8B: SEM image of Liposomal L-GSH

WBCIL Liposomes are perfectly smooth spheres. This morphology:

- Enhances overall stability
- Ideal for efficient drug delivery

The Accelerated Stability Test

We tested our **liposomal glutathione** under Extreme Conditions ($40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and $75\% \pm 5\%$ Humidity) for 6 months to see if it would leak or lose power, resulting in a decrease in L-GSH content

99.06%

ACTIVE RETENTION

0.94%

TOTAL ASSAY LOSS



OUTCOME: Complete structural preservation ensures longer shelf-life

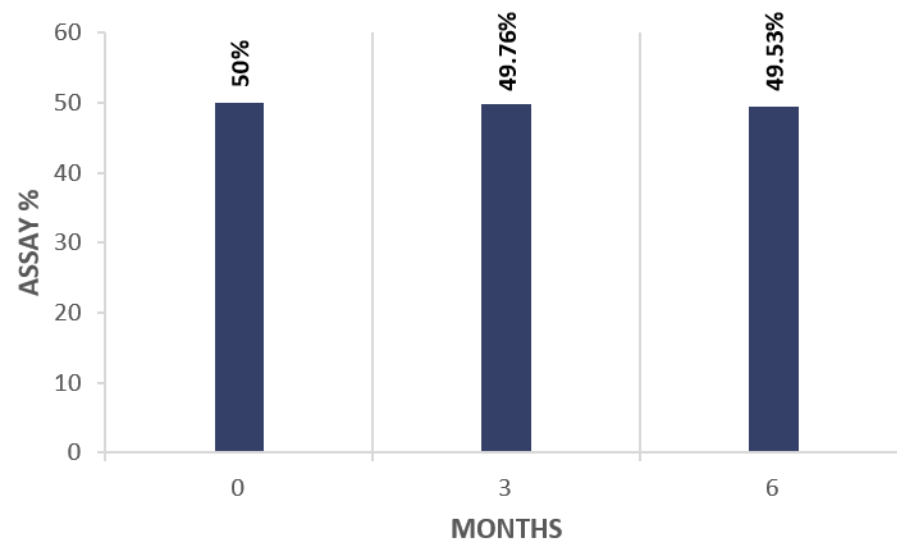


Figure 9: Determination of the Assay% of Liposomal L-GSH observed under accelerated condition ($40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and $75\% \pm 5\%$ Humidity) for 6 months

Differential Scanning Calorimetry (DSC): Molecular Proof of Quality

DSC: A thermal test that provides molecular proof that the active ingredient is successfully encapsulated inside the liposome rather than just being physically mixed

Transition Temperature Peak (T_m)

L-GSH

185-195°C

Empty Liposome

187-295°C

Liposomal L-GSH

166-279°C

Thermal analysis by DSC provides definitive proof that the glutathione is encapsulated, creating a superior and more stable nutrient delivery system.

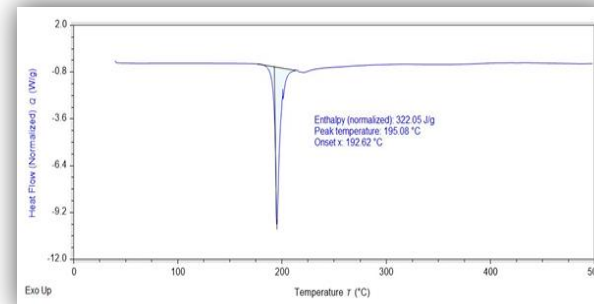


Figure 10A: DSC Thermogram of L-GSH API

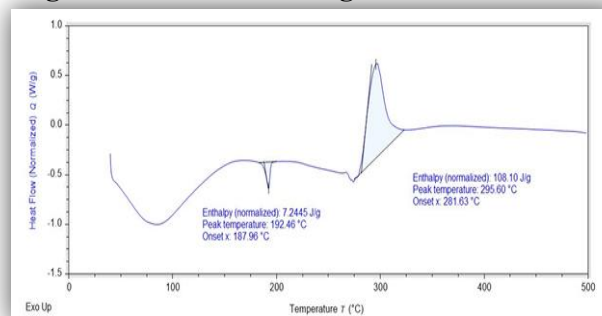


Figure 10B: DSC Thermogram of Empty Liposome

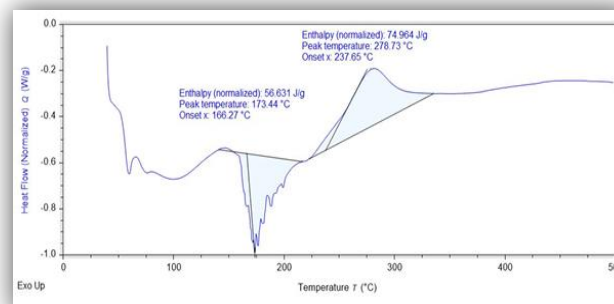


Figure 10C: DSC Thermogram of Liposomal L-GSH

Summary

1. Encapsulation Efficiency & Capacity

a. Encapsulation Efficiency:	87%	Minimal loss & taste masking
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2. Particle Characteristics & Stability

a. Zeta Potential:	-32 mV	Liposomal stability
b. Particle Size:	262 nm	Improved cellular uptake
c. PDI:	0.20	Uniform, stable liposomes

3. Structural & Chemical Confirmation

a. FTIR:	Spectral shift	Glutathione integrated, not physically mixed
b. EDAX:	No surface sulphur	Glutathione encapsulated within a liposome
c. SEM:	Smoother, spherical particle	Successful encapsulation

4. Thermal Stability & Integrity

a. Leakage & Stability:	< 3% leakage	Long-term product stability
b. DSC :	Elevated Tm	Ensures thermal stability

THANK YOU

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