INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: https://www.ijpsjournal.com

OPEN ACCESS

Research Article

Formulation Optimization and Evaluation of Vit.C Loaded Liposomes by Homogenisation Method

Aman Mahagame *, Bajarang More, Bhakti More, Asmita More, Navnath Bendke

Swami Vivekanand College of Pharmacy, Udgir

ARTICLE INFO

Published: 30 Jun. 2026
Keywords:
Vitamin C, Ascorbic acid, Liposomes, Homogenization, Thin-film hydration, Soya lecithin, Cholesterol, Nano-vesicles, Entrapment efficiency, Transdermal drug delivery, Controlled drug release, Scanning Electron Microscopy (SEM).
DOI:
10.5281/zenodo.21071863

ABSTRACT

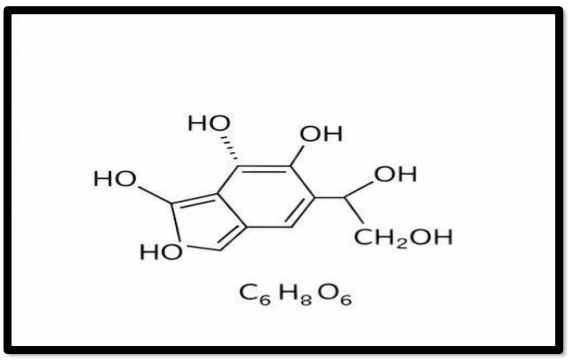
Ascorbic acid (Vitamin C) is a strong topical antioxidant employed for its photoprotective and properties that stimulate collagen. Nevertheless, its elevated solubility in water, quick oxidation, and inadequate Permeation through the stratum corneum restricts its clinical effectiveness. The current research aimed to develop, refine, and assess Vitamin C-encapsulated liposomes through the homogenization technique to improve physical stability and transdermal absorption. Liposomes were created using the method of hydration for thin films utilizing Soya Lecithin and Cholesterol in a 2:1 proportion. The composition was improved by assessing various homogenization parameters. Original trials employing elevated shear homogenization led to aeration and phase separation; consequently, the process was optimized through ultrasonic homogenization to reduce foaming and attain a consistent nano dispersion. The optimized batch was assessed for visual characteristics, vesicle dimensions, zeta. potential, entrapment efficiency (%EE), drug content, and in-vitro release characteristics. Scanning Electron Microscopy (SEM) verified the creation of smooth, spherical nano-vesicles. Sure! Please provide the text you would like me to paraphrase. formulation demonstrated an ideal pH of 6.8, elevated entrapment efficiency, and a prolonged biphasic release profile of the drug over a 24-hour period. To sum up, improving the homogenization

INTRODUCTION

Vitamin C (L-ascorbic acid) is an essential water-soluble micronutrient in the fields of pharmaceutical and cosmetic science, prized for its antioxidant properties, involvement in collagen production, and promotion of wound healing. Although it is effective for addressing hyperpigmentation and photoaging, Vitamin C encounters notable formulation obstacles. It is very unstable, susceptible to quick oxidation when in contact with light or oxygen, and has low skin permeability because of its hydrophilic characteristics (1,2).

***Corresponding Author:** Aman Mahagame.
Address: *Swami Vivekanand College of Pharmacy, Udgir*
Email : amanmahagame@gmail.com

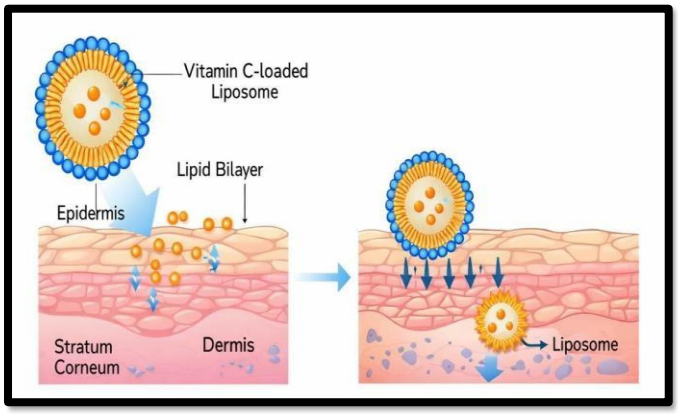
Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



Ascorbic Acid

Traditional topical administration frequently struggles to penetrate the lipophilic stratum corneum, resulting in diminished clinical effectiveness. To address these obstacles, carriers utilizing nanotechnology—particularly liposomes—have developed as an enhanced delivery method. Liposomes are round phospholipid layers that can enclose both water-soluble and fat-soluble substances. Their biomimetic design improves skin absorption and safeguards the encapsulated Vitamin C from environmental deterioration (3).

Enclosing Vitamin C in liposomes protects it from oxidation while allowing for prolonged release and enhanced transdermal absorption relative to typical aqueous solutions. Although various preparation methods are available, the homogenization technique is typically favored for generating consistent, nanoscale vesicles with excellent stability. The effectiveness of these systems relies significantly on factors like lipid-to-cholesterol ratios and mechanical processing parameters.This research concentrates on the creation, refinement, and analysis of Vitamin C-encapsulated liposomes employing the homogenization technique.



Mechanism of liposomal drug delivery through skin

1. MATERIALS & METHODS

❖ Materials

1) Ascorbic Acid(Active)
2) Soya Lecithin(Phospholipid)
3) Cholesterol(Stabilizer)
4) Chloroform and Methanol(Analytical grade detergents)
5) Sodium Phosphate Monobasic
6) Sodium Phosphate Dibasic(Buffer reagents

List of Materials Used in Formulation

Sr.No	Material Name	Category/Role	Description
1	Ascorbic Acid	Active Pharmaceutical Ingredient	Used as the active drug in the formulation due to its antioxidant and skin brightening properties.
2	Soya Lecithin	Phospholipid	Used for formation of liposomal vesicles because of its amphiphilic nature.
3	Cholesterol	Stabilizer	Added to improve membrane stability and rigidity of liposomes.
4	Chloroform	Organic Solvent	Used for dissolving lipid components during preparation of lipid phase.
5	Methanol	Co-solvent	Used along with chloroform to prepare uniform lipid solution.
6	Sodium Phosphate Monobasic	Buffer Reagent	Used in preparation of phosphate buffer solution for pH adjustment.
7	Sodium Phosphate Dibasic	Buffer Reagent	Used with monobasic phosphate to maintain buffer pH

Formulation Design

Batch	Lecithin (mg)	Cholesterol (mg)	Vitamin C (mg)
F1	100	200	200
F2	150	300	200
F3	200	400	200

- **Optimization of Vitamin C Loaded Liposomes**

Optimization of the liposomal phrasings was carried out by varying expression and process parameters similar as phospholipid attention, cholesterol attention, homogenization speed, homogenization time, and medicine- to- lipid rate. Different batches were prepared and estimated to determine the optimized expression with desirable physicochemical characteristics.(15)

- **Evaluation of Vitamin C Loaded Liposomes**

The set liposomal phrasings were estimated for colorful physicochemical parameters including flyspeck size, zeta eventuality, ruse effectiveness, morphology, pH, density, and medicine content. In- vitro medicine release studies and stability studies were also performed to assess the performance and shelf- life of the optimized expression.(16)

- **Characterization of Optimized expression**

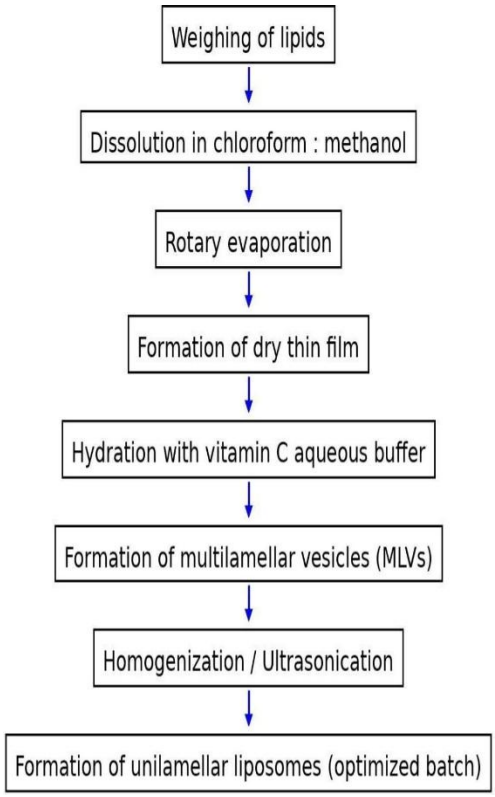
The optimized Vitamin C loaded liposomal expression was further characterized for its physicochemical and morphological parcels to

confirm its felicity for topical delivery. Parameters similar as flyspeck size, zeta eventuality, ruse effectiveness, and face morphology were anatomized using standard logical ways. The attained results were compared to elect the stylish optimized expression with enhanced stability, zniformity, and medicine release profile.(17)

The set liposomal phrasings were stored in watertight glass holders under cooled conditions until farther use to maintain stability and help declination of Vitamin C.(12,13)

Methodology:

- **Storehouse of Prepared expression**



3. RESULT & DISCUSSION

3.1 Physical Appearance and expression Optimization

The formulated Vitamin C loaded liposomes were estimated for their physical characteristics. The original batch prepared via high- speed shear homogenization displayed severe raging and phase separation. Upon optimizing the homogenisation system to ultrasonication, the optimized batch appeared as a livery, translucent to milky-white dissipation(29). No visible summations or phase separation were observed, indicating a largely stable vesicular system.

Physical Appearance of final product

3.2 Percentage Yield

The practical yield of the set Vitamin C loaded liposomal phrasings was determined to estimate the effectiveness of the expression process and recovery of the final product. The chance yield of all set batches was set up to be satisfactory, indicating minimum loss of accoutrements during expression.

Observation Table:

Batch	Theoretical Weight (mg)	Practical Weight (mg)	Percentage Yield (%)
F1	170	150	88.23%
F2	230	210	91.30%
F3	290	260	89.65%

3.3 pH Measurement

The pH of the optimized expression was set up to be(7.44), which falls impeccably within the ideal physiologically compatible range for topical and dermal operation, icing no skin vexation occurs.

pH Dimension

3.4 Vesicle Size and size distribution-

The vesicle size and size distribution of the set Vitamin C- loaded liposomal phrasings were determined. The average vesicle size of the

phrasings was set up to be in the nanometric range, attesting the successful conformation of nanosized liposomes. This size range is suitable for enhanced topical medicine delivery**.**

Observation Table

Batch	Vesicle Size (nm)	Size Distribution
F1	168.2nm	Less uniform vesicles
F2	143.1nm	Better uniformity
F3	181.5nm	More aggregation

3.5 Polydispersity Index(PDI)

- **Result**

3.5 The polydispersity indicator of the set Vitamin C loaded liposomal phrasings was determined using Dynamic Light Scattering(DLS) to assess the uniformity of vesicle size distribution. The attained PDI values indicated a homogeneous dissipation with respectable uniformity among the vesicle population.

Observation Table

Batch	PolydispersityIndex (PDI)	Interpretation
F1	0.312	Moderate Uniformity
F2	0.268	Good Uniformity
F3	0.354	Acceptable Uniformity

3.6 Zeta Potential

- **Result**

The zeta eventuality of the set Vitamin C loaded liposomal phrasings was measured to estimate the face charge and prognosticate the physical stability of vesicular dissipation. The attained zeta eventuality values indicated good electrostatic stabilization of the set liposomal phrasings.

Observation Table

Batch	Zeta Potential (mV)	Interpretation
F1	-2.8mV	Low Stable
F2	-1.5mV	Comparatively Stable
F3	-2.1mV	Moderate Stable

3.7 Scanning Electron Microscopy(SEM)

- **Result**

Scanning Electron Microscopy(SEM) analysis was performed to examine the face morphology and structural characteristics of the set Vitamin C loaded liposomal vesicles. The

SEM images revealed that the vesicles were generally globular in shape with smooth face morphology and well- defined boundaries.

Observation

Scanning Electron Microscopy (SEM)

3.8 Entrapment Efficiency (%EE):

- **Result**

The ruse effectiveness of the set Vitamin C loaded liposomal phrasings was determined to estimate the quantum of medicine successfully reprised within the vesicles. The chance ruse effectiveness was measured using UV-Visible spectrophotometric analysis after separation of unentrapped medicine.

Observation Table

Batch	Efficiency (%EE)	Interpretation
F1	72.45	Good Drug Entrapment
F2	84.68	Highest Entrapment
F3	78.92	Satisfactory Entrapment

3.9 Drug Content

- **Result**

The total medicine content of the set Vitamin C loaded liposomal phrasings was determined using UV-Visible spectrophotometric analysis to insure invariant distribution of the medicine throughout the expression. The results indicated satisfactory objectification of Vitamin C in all set batches.

Observation Table

Batch	Drug Content (%)	Interpretation
F1	89.24	Uniform Drug Distribution
F2	95.67	Highest Drug Content
F3	92.13	Satisfactory Drug Content

3.10In- vitro Drug Release Study

- **Result**

The in- vitro medicine release study of the set Vitamin C loaded liposomal phrasings was performed using Franz prolixity cell outfit in phosphate buffer medium over a period of 24

hours. The accretive chance medicine release of each expression was determined at destined time intervals using UV-Visible spectrophotometric analysis.

Batch	Drug Release after 24 hrs (%)	Interpretation
F1	78.42	Sustained Release
F2	91.56	Maximum Drug Release
F3	84.37	Controlled Release

3.11 Stability Studies

- **Result**

Stability studies of the set Vitamin C loaded liposomal phrasings were carried out at 4 °C and 25 °C for 30 days to estimate the effect of storehouse conditions on expression stability.

The phrasings were periodically observed for physical appearance, vesicle size, pH, and medicine retention.

Observation Table

Parameter	Storage Condition	Day 0	Day 15	Day 30
Physical Appearance	4°C	Off-white milky dispersion	Off-white milky dispersion	Off-white milky dispersion
	25°C	Off-white milky dispersion	Slightly yellowish dispersion	Pale yellow dispersion
pH	4°C	7.4 ± 0.1	7.4 ± 0.1	7.4 ± 0.1
	25°C	7.4 ± 0.1	7.3 ± 0.1	7.2 ± 0.1
Entrapment Efficiency (%)	4°C	84.68 ± 1.25	83.12 ± 1.36	82.25 ± 1.42
	25°C	84.68 ± 1.25	76.48 ± 1.58	68.34 ± 1.74

CONCLUSION

The present study successfully formulated and estimated Vitamin C loaded liposomes using the homogenization system. Different expression batches were prepared by varying the attention of lecithin and cholesterol, and were estimated for colorful physicochemical parameters including vesicle size, polydispersity indicator, zeta eventuality, ruse effectiveness, medicine content, in- vitro medicine release, and stability. Among all set phrasings, the optimized batch displayed desirable vesicle size in nanometric range, invariant size distribution, satisfactory zeta eventuality, high ruse effectiveness, and excellent medicine content, indicating successful expression development. The invitro medicine release study demonstrated sustained and controlled release of Vitamin C from the liposomal vesicles over 24 hours. Stability studies revealed that the optimized liposomal expression remained more stable under refrigerated conditions as compared to room temperature, indicating the significance of proper storehouse due to the oxidation-sensitive nature of Vitamin C.

Overall, the study concludes that liposomal encapsulation is an effective approach for perfecting the stability, medicine retention, and controlled release of Vitamin C, thereby enhancing its eventuality for topical/ pharmaceutical operation.

REFERENCES:

1. Elias PM. Structure and function of the stratum corneum extracellular matrix. Journal of Investigative Dermatology. 2012;132(11):2131-2133.
2. Pullar JM, Carr AC, Vissers MC. The roles of vitamin C in skin health. Nutrients. 2017;9(8):866.
3. Sheraz MA, Ahmed S, Ahmad I, Shaikh RH, Iqbal T, Kazi SH. Formulation and stability of ascorbic acid in topical preparations. Systemic Reviews in Pharmacy. 2011;2(2):86-90.
4. Laouini A, Jaafar-Maalej C, Limayem-Blouza I, Sfar S, Charcosset C, Fessi H. Preparation, characterization and applications of liposomes: state of the art. Journal of Colloid Science and Biotechnology. 2012;1(2):147-168.
5. Mozafari MR. Liposomes: an overview of manufacturing techniques. Cellular & Molecular Biology Letters. 2005;10(4):711.
6. Patil YP, Jadhav S. Novel methods for liposome preparation. Chemistry and Physics of Lipids. 2014;177:8-18.
7. Tai A, Yashiroda Y, Gohda E. Synthesis and characterization of long-chain alkyl esters of ascorbic acid as stable lipophilic antioxidants. Tetrahedron. 2010;66(25):4635-4641.
8. Pinnell SR, Yang H, Omar M, Monteiro-Riviere N, DeBuys HV, Walker LC, et al. Topical L-ascorbic acid: percutaneous absorption studies. Dermatologic Surgery. 2001;27(2):137-142.
9. Almasi L, Zand-Moghaddam A, Ebrahimnejad P. Formulation and evaluation of solid lipid nanoparticles containing ascorbic acid. Journal of Nanoparticle Research. 2013;15(9):1-9.

HOW TO CITE: Aman Mahagame *, Bajarang More, Bhakti More, Asmita More, Navnath Bendke, Formulation Optimization and Evaluation of Vit.C Loaded Liposomes by Homogenisation Method, Int. J. of Pharm. Sci., 2026, Vol 4, Issue 6, 7774-7782. https://doi.org/ 10.5281/zenodo.21071863