Journal of Clinical Advances and Research Reviews (JCARR)
Website: http://www.jcarr.in/
ISSN: 3048-6556
Vol. 3, Issue 2, Apr-Jun, 2026
Page No.: 10--12

Research

Formulation and Evaluation of Mupirocin Loaded Liposomal Hydrogel for Enhanced Topical Therapy of Bacterial Skin Infection

Prem Lata[1], Hakim Singh Rajput[2]*

[1]Department of Pharmaceutics, IPSR Group of Institution
[2]Assisant Professor, IPSR Group of Institution

Received: 01-04-2026 / **Revised:** 05-05-2026 / **Accepted:** 06-05-2026
Corresponding Author: Hakin Singh Rajput
DOI: 10.62896/jcarr.3.2.03
Email: hakim@ipsr.in
Conflict of interest: Nil

Abstract:
Bacterial skin infections are commonly caused by pathogens such as *Staphylococcus aureus*, requiring effective topical therapy for improved management. The present study aimed to formulate and evaluate a mupirocin-loaded liposomal hydrogel to enhance topical drug delivery and therapeutic efficacy. Liposomes were prepared using the thin film hydration method by varying phosphatidylcholine and cholesterol concentrations. The optimized formulation (L5) exhibited desirable vesicle size, high entrapment efficiency, and sustained drug release. The selected liposomal batch was incorporated into a Carbopol-based hydrogel to improve viscosity, spreadability, and skin retention. The prepared liposomal hydrogel showed good physical appearance, suitable pH, uniform drug content, and controlled drug release profile. The combination of liposomes and hydrogel demonstrated improved stability and prolonged drug action compared to conventional formulations. Overall, the developed mupirocin-loaded liposomal hydrogel presents a promising approach for effective and sustained topical treatment of bacterial skin infections.

Keywords: Mupirocin, Liposomes. Hydrogel. Topical drug delivery

INTRODUCTION

Skin infections caused by bacterial pathogens are among the most common dermatological conditions affecting individuals worldwide. These infections are primarily associated with organisms such as *Staphylococcus aureus* and *Streptococcus pyogenes*, which can lead to conditions ranging from mild superficial infections to severe complications if not treated effectively [1]. The increasing prevalence of antibiotic resistance has further complicated the management of bacterial skin infections, necessitating the development of advanced drug delivery systems that enhance therapeutic efficacy while minimizing side effects [2].

Mupirocin is a topical antibiotic widely used for the treatment of primary and secondary skin infections. It acts by inhibiting bacterial protein synthesis through reversible binding to isoleucyl-tRNA synthetase, thereby preventing the incorporation of isoleucine into bacterial proteins [3]. Despite its effectiveness, conventional mupirocin formulations suffer from limitations such as poor skin penetration, short residence time, and the need for frequent application, which may reduce patient compliance and therapeutic outcomes [4].

To overcome these limitations, novel drug delivery systems such as liposomes have gained considerable attention. Liposomes are spherical vesicles composed of phospholipid bilayers capable of encapsulating both hydrophilic and lipophilic drugs. Due to their biocompatibility, biodegradability, and ability to enhance drug penetration through the skin, liposomes serve as an effective carrier system for topical drug delivery [5]. Additionally, liposomes can provide controlled and sustained release of the drug, improving therapeutic efficiency and reducing dosing frequency [6].

However, liposomal dispersions alone may have limitations such as low viscosity and poor retention at the site of application. To address this issue,

Journal of Clinical Advances and Research Reviews (JCARR)
Website: http://www.jcarr.in/
ISSN: 3048-6556
Vol. 3, Issue 2, Apr-Jun, 2026
Page No.: 10--12

incorporation of liposomes into a hydrogel base has been explored. Hydrogels are three-dimensional polymeric networks capable of holding large amounts of water, offering advantages such as improved spreadability, better adhesion to the skin, and enhanced patient acceptability [7]. The combination of liposomes and hydrogels, known as liposomal hydrogel, provides a dual advantage of controlled drug release and prolonged residence time at the site of infection [8].

Therefore, the present study focuses on the formulation and evaluation of mupirocin-loaded liposomal hydrogel for enhanced topical therapy of bacterial skin infections. The objective is to develop a stable and effective delivery system that improves drug penetration, provides sustained release, and enhances overall therapeutic efficacy.

METHODOLOGY

Formulation of Mupirocin Loaded Liposomes

Materials

Mupirocin was used as the active pharmaceutical ingredient. Phosphatidylcholine and cholesterol were used as lipid components. Chloroform and methanol (analytical grade) were used as organic solvents. Phosphate buffer (pH 7.4) was used as the hydration medium.

Composition of Liposomal Formulations

The liposomes were prepared by varying the concentration of phosphatidylcholine and cholesterol while keeping the drug amount constant.

Batch Code	Mupirocin (mg)	Phosphatidylcholine (mg)	Cholesterol (mg)	Chloroform:Methanol (10 mL)
L1	100	200	40	2:1
L2	100	250	50	2:1
L3	100	300	60	2:1
L4	100	350	70	2:1
L5	100	400	80	2:1
L6	100	450	90	2:1

Preparation of Liposomes

Mupirocin-loaded liposomes were prepared using the **thin film hydration technique**.

Accurately weighed quantities of phosphatidylcholine and cholesterol were dissolved in chloroform:methanol (2:1 v/v) in a round-bottom flask. Mupirocin was added to the organic phase and mixed thoroughlyThe solvent mixture was evaporated under reduced pressure using a rotary vacuum evaporator at 40–45°C to form a thin lipid film on the inner wall of the flask. The film was further dried under vacuum for 1 hour to remove any residual solvent.The dried lipid film was hydrated with phosphate buffer (pH 7.4) with continuous rotation for 30–45 minutes above the lipid transition temperature, forming multilamellar vesicles.The liposomal dispersion was sonicated for 5–10 minutes to reduce vesicle size and obtain a uniform dispersion. The prepared liposomes were stored at 4°C until further use.

Preparation of Liposomal Hydrogel

The optimized liposomal formulation was incorporated into a hydrogel base.Carbopol 934 was dispersed in distilled water and allowed to swell for 24 hours. The dispersion was neutralized using triethanolamine to adjust the pH to 6.5–7.0, forming a clear gel base.

The liposomal suspension was incorporated slowly into the gel base with gentle stirring to avoid vesicle rupture. Preservatives such as methylparaben and propylparaben were added.

The final liposomal hydrogel was stored in airtight containers for evaluation.

RESULTS

Evaluation of Liposomes

Physical Appearance

All batches (L1–L6) appeared as milky white suspensions with no visible aggregation, indicating successful liposome formation.

Vesicle Size

Batch	Vesicle Size (nm)
L1	310 ± 6
L2	280 ± 5
L3	245 ± 4
L4	220 ± 5
L5	205 ± 3
L6	215 ± 4

Vesicle size decreased with increasing phosphatidylcholine concentration up to L5, after which a slight increase was observed due to possible vesicle aggregation.

Entrapment Efficiency (%)

Batch	Entrapment Efficiency (%)
L1	65.2 ± 1.3
L2	71.4 ± 1.5
L3	78.6 ± 1.2
L4	84.3 ± 1.1

Journal of Clinical Advances and Research Reviews (JCARR)
Website: http://www.jcarr.in/
ISSN: 3048-6556
Vol. 3, Issue 2, Apr-Jun, 2026
Page No.: 10--12

L5	89.1 ± 1.4
L6	87.5 ± 1.3

Entrapment efficiency increased with lipid concentration, with L5 showing maximum drug entrapment.

***In-vitro* Drug Release (Optimized Batch L5)**

Time (hrs)	% Drug Release
1	16.8
2	30.2
4	46.5
6	61.7
8	74.3
12	90.5

The optimized formulation showed sustained drug release over 12 hours.

Evaluation of Liposomal Hydrogel

- **Appearance:** The hydrogel was smooth, homogeneous, and free from lumps.
- **pH:** The pH was found to be **6.7 ± 0.2**, suitable for skin application.
- **Viscosity:** The formulation exhibited appropriate viscosity for topical application, ensuring good retention.
- **Spreadability:** The hydrogel showed good spreadability, indicating ease of application.
- **Drug Content (%):** The drug content was found to be **97.2 ± 1.1%**, indicating uniform drug distribution.
- ***In-vitro* Drug Release (Hydrogel):** The liposomal hydrogel exhibited **prolonged and controlled drug release** compared to liposomal suspension, confirming enhanced topical delivery.

*****

Conclusion

Batch **L5** was identified as the optimized formulation due to its **minimum vesicle size, maximum entrapment efficiency, and sustained drug release profile**. Incorporation into hydrogel further improved the controlled release and applicability for topical treatment of bacterial skin infections.

REFERENCES

1. Otto M. *Staphylococcus aureus* infections: mechanisms and treatment. **Nat Rev Microbiol.** 2014;12(6):385–396.
2. Ventola CL. The antibiotic resistance crisis. **Pharm Ther.** 2015;40(4):277–283.
3. Hurdle JG, et al. Targeting bacterial membrane function: an underexploited mechanism. **Nat Rev Microbiol.** 2011;9(1):62–75.
4. Benson HA. Transdermal drug delivery: penetration enhancement techniques. **Curr Drug Deliv.** 2005;2(1):23–33.
5. Bangham AD. Liposomes: the Babraham connection. **Chem Phys Lipids.** 1993;64(1–3):275–285.
6. Gregoriadis G. Engineering liposomes for drug delivery. **Trends Biotechnol.** 1995;13(12):527–537.
7. Peppas NA, et al. Hydrogels in pharmaceutical formulations. **Eur J Pharm Biopharm.** 2000;50(1):27–46.
8. Patel RP, et al. Liposomes as a topical drug delivery system. **Int J Pharm Sci Rev Res.** 2010;5(3):67–73.