**Ind. J. Pharm. Edu. Res., 2026; 60(1):96-105.**
https://www.ijper.org

Original Article

# Formulation Development and Evaluation of Transferosomal Gel Using Trifarotene

**Anuradha Prajapati*, Muskan Tandel, Sachin B. Narkhede, Neha Desai, Shailesh Luhar, Kantilal Narkhede**

Department of Pharmaceutics, Smt. B.N.B. Swaminarayan Pharmacy College, Vapi, Gujarat, INDIA.

## ABSTRACT

**Background:** Trifarotene (TFT), a retinoid commonly used for acne treatment, suffers from poor water solubility, limiting its effectiveness and increasing the risk of side effects. Enhancing its bioavailability and providing sustained drug release could improve therapeutic outcomes while reducing side effects. **Objectives:** The study aimed to develop and optimize a transferosomal gel formulation of Trifarotene to enhance drug availability at the target site, achieve sustained release, and minimize side effects. **Materials and Methods:** A $3^2$ factorial design was used to optimize the transferosome formulation, prepared via the thin lipid film hydration method using a rotary vacuum evaporator. The study varied the type and concentration of edge activators and incorporated phospholipids and surfactants into the formulation. The optimized formulation was then converted into a gel and evaluated based on particle size, Polydispersity Index (PDI), zeta potential, entrapment efficiency, and *in vitro* drug release percentage. Additional evaluations included excipient compatibility via Differential Scanning Calorimetry (DSC), surface morphology using Scanning Electron Microscopy (SEM), and the gel's physical characteristics (pH, viscosity, extrudability, Spreadability, and skin irritation potential). Stability studies were conducted as per ICH guidelines. **Results:** The optimized transferosomal gel showed favourable *in vitro* drug release with significant improvement in bioavailability. Independent variables, including edge activator concentration, had a statistically significant impact on the formulation's characteristics ($p<0.005$). Excipient compatibility was confirmed via DSC, and SEM analysis revealed suitable vesicle morphology. The gel was found to be stable, safe, and compatible with skin layers at a low dose, with no signs of skin irritation. **Conclusion:** The optimized Trifarotene transferosomal gel formulation enhanced drug delivery, improved skin penetration, and provided sustained release with minimal side effects, showing promise for safe and effective acne treatment.

**Keywords:** Acne, Thin lipid film hydration, Transferosomal gel, Transferosome, Trifarotene.

**Correspondence:**
**Dr. Anuradha Prajapati**
Department of Pharmaceutics, Smt. B.N.B. Swaminarayan Pharmacy College, Vapi-396191, Gujarat, INDIA.
Email: anupatel03@gmail.com

**Received:** 08-04-2024;
**Revised:** 14-06-2025;
**Accepted:** 22-08-2025.

## INTRODUCTION

Acne vulgaris is the most common form of acne, caused by clogged pores due to oil and dead skin cells, leading to inflammation and bacterial growth on areas like the face, chest, and back.[1] Retinoids, key agents in acne treatment, help by reducing inflammation and normalizing skin cell turnover. Trifarotene, a new potent RAR-γ agonist, faces issues due to poor solubility, limiting its penetration into deeper skin layers and reducing its effectiveness, often requiring higher doses that can cause irritation. Transferosomes, ultra-deformable vesicles, solve this problem by encapsulating Trifarotene, enhancing its solubility and skin penetration. This allows targeted delivery to pilosebaceous units, improves bioavailability, and reduces side effects, making acne treatment more effective.[2]

Acne vulgaris is a persistent inflammatory disorder of the pilosebaceous units, primarily driven by factors such as excessive sebum production, hyper keratinization of hair follicles, bacterial overgrowth, and inflammation. This condition manifests as comedowns, pustules, and papules on areas such as the face, neck, and upper limbs, either persistently or recurrently.[3] Affecting approximately 98% of the global population, acne vulgaris is an inflammatory skin disease ranked as the eighth most common condition worldwide.[4] Effective treatment is often hampered by challenges like hepatic first-pass metabolism, side effects, and patient non-compliance. In response, advanced drug delivery systems such as transdermal methods have gained attention. Transferosomes, first introduced in the 1990s, are promising carriers made of phospholipids and edge activators. These highly deformable vesicles are capable of penetrating the skin barrier and delivering drugs efficiently to target areas.[5]

The rotary evaporation-sonication process, sometimes referred to as the thin film hydration method, is the conventional method used to create transferosomes. Vortexing-sonication, centrifugation, suspension homogenization, reverse-phase evaporation,

**DOI:** 10.5530/ijper.20261010

high-pressure homogenization, and ethanol injection are some alternative techniques. Lipid nano-carrier technologies are widely researched and applied for transdermal and transcutaneous drug delivery through the stratum corneum. Transferosomes, due to their edge activators, exhibit ultra-deformability, allowing them to penetrate deeper into the skin through intercellular and paracellular pathways between corneocytes, offering a significant advantage over other vesicular systems such as liposomes and niosomes.[6]

## MATERIALS AND METHODS

### Materials

Maithri Drugs, Hyderabad, India kindly supplied a gift sample of Trifarotene. Ayushman Scientific, India, provided a complimentary sample of soya lecithin. Span 60 and Triethanolamine were sourced from Triveni Supplier, India, while chloroform, methanol, Carbopol 940, and propylene glycol were obtained from Vishal Chem, Mumbai, India.

### Statistical Modeling to optimize the Formulation of Trifarotene-Loaded Transferosomes

The $3^2$ factorial designs, a tool of Response Surface Methodology (RSM), were employed to optimize the formulation of Trifarotene-loaded transferosomes. This design involves two independent variables, each evaluated at three levels, to examine their effects on the formulation.[7] The detailed variables and levels are presented in Table 1.

### Preparation of Transferosomes formulation Using Thin Film Hydration Technique

The thin lipid film hydration technique was used to create TFT-loaded transferosomes. Using a dry round-bottom flask, phospholipids, Trifarotene, and surfactant (acting as an edge activator) were precisely dissolved in a solution of methanol and chloroform (2:1, v/v). To produce a thin lipid coating on the flask's walls, the solvent was evaporated using a rotary evaporator (Superfit India, Mumbai) set at 100 rpm and 45°C under low pressure. The last traces of solvent were eliminated by using vacuum for a whole night. The resulting dry lipid layer was then allowed to hydrate in room temperature phosphate-buffered saline (pH 7.4) by spinning the flask for an hour at 100 rpm. At about 25°C, the lipid vesicles were left to grow for 2 hr. Using a Sonicator (Labman, India), the Multilamellar Lipid Vesicles (MLVs) were sonicated for 15 min to reduce their size, and then they were kept at 4°C for additional analysis.[8]

### Characterization of Transferosomes

#### *Entrapment Efficiency determination (%EE)*

The Entrapment Efficiency (EE%) of TFT in the produced TFT-loaded transferosomes (TFSs) was ascertained by centrifugation. Using a cooling centrifuge (Adarsh Scientific Industries), 2 mL of each formulation was centrifuged at 14,000 rpm for 45 min in order to separate the unentrapped medication from the entrapped TFT. The supernatant was then analyzed using a UV spectrophotometer (Lab India, Mumbai, India) at 313 nm, after diluting the sample to 100 mL with phosphate-buffered saline (pH 7.4), to detect the unentrapped TFT. The EE% was calculated using the following equation:[9]

$$\% \text{ EE} = \text{Total drug content} - \text{Free drug} / \text{Total drug content} \times 100$$

### Evaluation of Particle Size, Zeta Potential, and Polydispersity Index

The produced TFT-TFS formulations were assessed for their particle size, zeta potential, and Polydispersity Index (PDI). Higher zeta potential values indicate greater physical stability of the dispersion. Zeta potential is the charge at the interface between the nanoparticle and the dispersion medium. Information on the consistency or variance in particle size is provided by the PDI. A Zetasizer (Malvern Instruments Ltd., Malvern, UK) was used for analysis, and each TFT-TFS formulation was diluted to a 1% concentration at 25°C. Dynamic Light Scattering (DLS) was used to conduct measurements at a 90° angle.[10]

### Scanning Electron Microscopy (SEM)

The morphology of the transferosomes was assessed using a scanning electron microscope (ESEM EDAX XL-30, Philips, Netherlands) operating at 15 kV. SEM images were captured at magnifications of 1000X and 2500X.

**Table 1: Factorial Design.**

| $3^2$ Factorial design | | | |
|---|---|---|---|
| **Independent Variables** | **Used Level** | | |
| | **Low (-1)** | **Medium (0)** | **High (+1)** |
| Conc. of Soya Lecithin (mg) (X1) | 30 | 60 | 90 |
| Conc. of Surfactant (mg) (X2) | 25 | 30 | 35 |
| Dependent Variables | Goals | | |
| Y1-Entrapment Efficiency (%) | Maximize | | |
| Y2-Particle Size (nm) | Minimize | | |

## *In vitro* Drug Release of Transferosome Formulations

A Franz diffusion cell device was used to release Trifarotene from the transferosomes in an *in vitro* manner. Studies on drug release were carried out at pH 7.4 in Phosphate-Buffered Saline (PBS). Ten millilitres of PBS (pH 7.4) were placed in the receptor compartment, and two millilitres of each transferosome formulation were placed in the donor compartment. The dissolving media was kept at 37±1°C and swirled at 100 rpm. A cellophane membrane separated the donor and receptor chambers. Samples (1 mL) were taken at regular intervals (every hour), and the same volume was replaced with freshly prepared dissolution medium. The withdrawn samples were analyzed using a UV-visible spectrophotometer.[11]

## Determination of Drug Content

The solid dispersion system was weighed precisely and then dissolved in phosphate buffer at a pH of 7.4. Following a specific dilution protocol, the solutions were filtered and further diluted as needed. The absorbance of these solutions was then measured at 313 nm using a UV spectrophotometer.

%Drug Content=Amount of Drug Obtainedx100/(Initial amount of drug)

## Choosing the TFT-TFS Formulation Optimization

Based on the highest zeta potential, smallest particle size, and highest Entrapment Efficiency (EE%), the best TFT-TFS formulation was chosen for additional research. Version 12 of the Design Expert program was used in the optimization procedure to determine which formulation produced the required results.[12]

## Preparation of TFT-TFS Gel

A 0.005% transferosomal gel was made with a gelling agent of 2% Carbopol 940. A beaker with 60 mL of distilled water was filled with the requisite weight of the polymer. After that, the transferosomal dispersion containing 0.005% TFT was added, and the gel base was continually stirred to guarantee that the TFT transferosomes were distributed uniformly. To make sure the gel was suitable for skin, its pH was adjusted to 5.0.

## Evaluation of Prepared TFT loaded Transferosomal Gel

### *Visual examination*

To assess the homogeneity of the created gel formulations containing Trifarotene, a visual inspection was conducted.

## Calculating the pH Value

A calibrated digital pH meter (Rajdhani Scientific, Mumbai, India) was used to monitor the pH of the TFT transfersomal gels at room temperature. Three measurements of the pH were made, and the average result was noted.

## Spreadability

By sandwiching 0.5 g of each created gel formulation between two circular glass slides, the Spreadability of the gels was evaluated. While the upper slide was movable, the lower slide was fixed in position. For 5 min, the upper slide was subjected to continuous pressure in order to promote the greatest possible spreading of each gel. Three duplicates of the experiment were run, and the mean±SD was computed.[13] The formula below was used to calculate the Spreadability:

M*L/T=S

S=Spreadability in this case,

M=Weight fastened to the top slide,

L=Glass slide length,

T=The amount of time needed to fully separate each slide from the others.

## Extrudability

The transferosomal gel formulations were packaged into collapsible metal or aluminum tubes. The tubes were pressed to

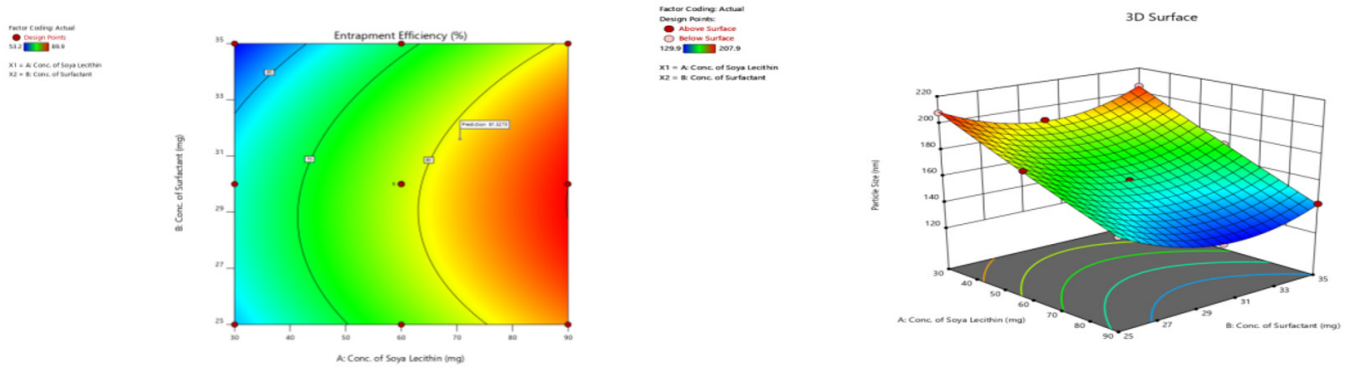


**Figure 1:** A. Contour plot of Entrapment Efficiency B. 3D-response of Entrapment Efficiency.

extrude the gel, and the extrudability of the formulation was then assessed.

## Drug Content

Phosphate-buffered saline at pH 7.4 was used to dilute 0.5 g of the produced gel formulations, which is equivalent to 10 mg of Trifarotene, to 10 mL. Using a blank sample that had the same ingredients but no drug for comparison, the drug content was determined spectrophotometrically. The following formula was used to determine the drug content percentage:

Amount of Drug Obtained x 100/Initial Amount of Drug=%Drug Content

## Viscosity

The viscosity of the formulated gels was measured using a Brookfield viscometer.

## *In vitro* Drug Release

The *in vitro* release of Trifarotene from the transferosomes was performed using a Franz diffusion cell apparatus.

## Stability Study

Stability studies on the optimized formulation were conducted to evaluate the impact of formulation additives on the drug's stability and to assess the physical stability of the formulation under accelerated storage conditions. The transferosomal gel was kept in an aluminium collapsible tube for four weeks at 40°C and 75% relative humidity. At the end of each week, samples

**Table 2: Characterization of prepared TFT Transferosomes.**

| Factorial Batches | Entrapment Efficiency (Y1) (%) | Particle Size (Y2) (nm) | Zeta potential (mv) | PDI | Drug Content (%) |
|---|---|---|---|---|---|
| F1 | 59.9 | 207.9 | -1.72 | 0.453 | 96.78±0.31 |
| F2 | 74.6 | 181.3 | -8.65 | 0.409 | 97.34±0.18 |
| F3 | 84.5 | 153.9 | -17.42 | 0.256 | 98.09±0.24 |
| F4 | 63.5 | 189.9 | -4.17 | 0.225 | 96.92±0.30 |
| F5 | 77.8 | 159.1 | -12.93 | 0.392 | 97.75±0.09 |
| F6 | 89.9 | 129.9 | -22.69 | 0.177 | 98.23±0.13 |
| F7 | 53.2 | 205.4 | -6.42 | 0.425 | 97.29±0.1 |
| F8 | 67.8 | 172.6 | -14.25 | 0.267 | 97.89±0.10 |
| F9 | 81.2 | 142.8 | -20.86 | 0.189 | 98.19±0.09 |
| F10 | 79.4 | 158.6 | -11.44 | 0.396 | 97.78±0.12 |
| F11 | 77.9 | 157.9 | -12.32 | 0.379 | 97.74±0.07 |
| F12 | 78.9 | 158 | -11.69 | 0.386 | 97.79±0.13 |
| F13 | 78.3 | 158.3 | -12.55 | 0.375 | 97.78±0.15 |

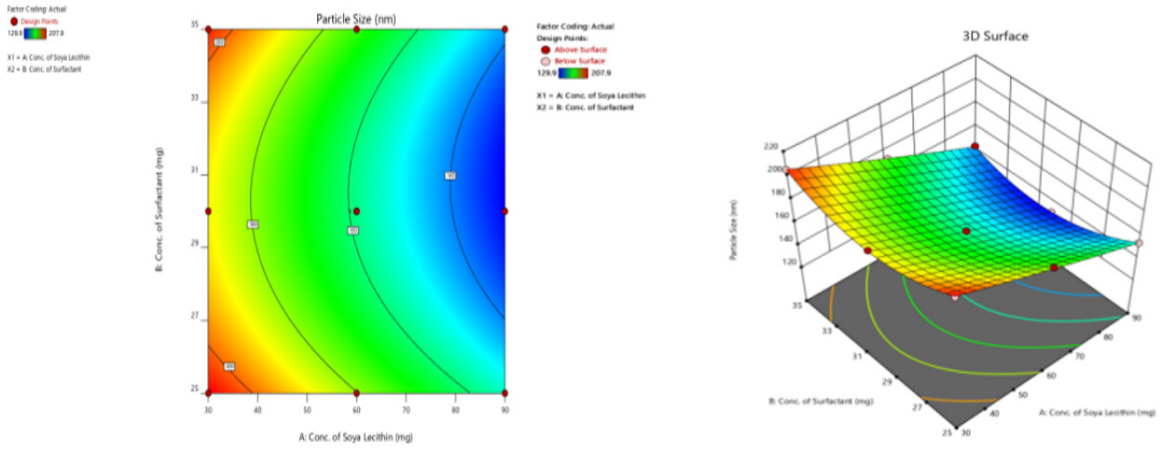


**Figure 2:** A. Contour plot of Particle size B. 3D- response of Particle size.

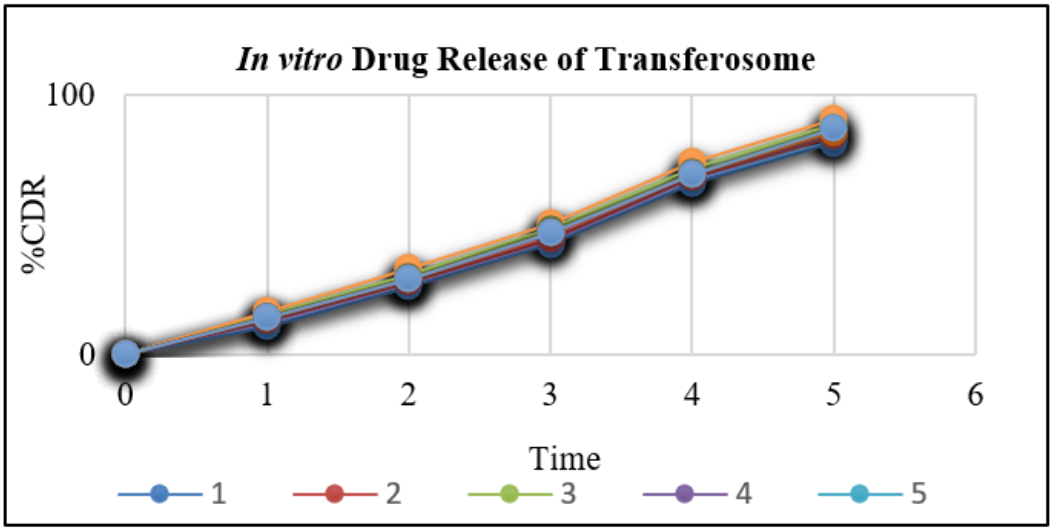


**Figure 3:** *In vitro* Drug Release Study of Transferosome.

**Table 3: Optimization of Formulation Variables.**

| Factorial Batches | Entrapment Efficiency (%) | Particle Size (nm) | Zeta potential (mv) | PDI | Drug Content (%) | % Drug Release |
|---|---|---|---|---|---|---|
| F6 | 89.9 | 129.9 | -22.69 | 0.177 | 98.23± 0.13 | 90.44± 0.031 |

**Table 4: *In vitro* Drug Release of Transferosomal gel.**

| Time (hrs.) | % CDR |
|---|---|
| 1 | 2.64±0.285 |
| 2 | 8.74±0.185 |
| 3 | 15.43±0.215 |
| 4 | 28.224±0.022 |
| 5 | 43.832±0.010 |
| 6 | 54.264±0.030 |
| 7 | 73.112±0.138 |
| 8 | 85.792±0.128 |

were retrieved and analyzed for drug concentration, rheological properties, pH, and physical appearance.

## RESULTS AND DISCUSSION

Characterization of the prepared TFT Transferosomes is presented in Table 2.

### Effect on Entrapment Efficiency (Y1)-Surface Response Study

Encapsulation Efficiency (EE%) of Trifarotene-loaded Transferosomes (TTFs) is affected by independent parameters; these effects are depicted by contour plots and the related 3D response surface graphs. The encapsulation efficiency of the medication rose proportionately from 30 mg to 90 mg of phospholipid, as Figure 1 illustrates. Vesicle size increased initially when a low concentration of Edge Activator (EA) was added; however, additional increases in the edge activator's concentration may cause the bilayers to create pores, which may allow the encapsulated medicine to leak out. Additionally, mixed micelles developed and coexisted with the transferosomes that had been created as the concentration of EA grew.

### Effect on Particle size (Y2)-Surface Response Study

One critical factor that determines the depth of penetration of a transferosome into the skin is its particle size; smaller particles typically penetrate more deeply (Figure 2). An increase in surfactant concentration led to a reduction in particle size, likely due to decreased interfacial tension, resulting in smaller vesicles. The decrease in vesicle size was also caused by the surfactant's solubilization within the lipid bilayer, facilitated by hydrogen bonds between the polar head of the phospholipid and the alkyl chain of the surfactant. Moreover, the addition of additional phospholipid further contributed to the reduction in particle size.

### *In vitro* Drug Release Study of Transferosome

Over a 5 hr period, various time points were tracked during the *in vitro* drug release study of Trifarotene from the prepared transferosomal system. After 6 hr, formulation F6, which contained a medium concentration of Span 60 and high phospholipid content, demonstrated the highest drug release at 90.44±0.031%. In contrast, formulation F7 showed the lowest drug release, 81.424±0.39%, attributed to its high surfactant and low phospholipid concentration. Additionally, at higher surfactant levels (35 mg), the drug release was significantly

reduced, likely due to the formation of rigid mixed micelles alongside the transferosomal vesicles, illustrated in Figure 3.

## Optimization of Formulation Variables

Table 3 presents the results of the optimized formulation (F6), which utilized the ideal ratio of X1 and X2 for Trifarotene-loaded Transferosomes (TTFs) and demonstrated significant efficacy in treating Acne Vulgaris (AV). The TTFs exhibited a vesicle size of 129.9 nm illustrated in Figure 4A, an entrapment efficiency of 89.9%, and a drug release value of 90.44±0.031%, as detailed in Table 3. Scanning Electron Microscopy (SEM) images shown in Figure 5 revealed that the optimized TTFs were spherical, well-defined, and consisted of unilamellar nanovesicles. Following the loading of the Trifarotene into the transferosomes,

| | | | Size (d.nm): | % Intensity: | St Dev (d.n... |
|---|---|---|---|---|---|
| Z-Average (d.nm): | 129.9 | Peak 1: | 151.5 | 100.0 | 50.68 |
| PdI: | 0.117 | Peak 2: | 0.000 | 0.0 | 0.000 |
| Intercept: | 0.957 | Peak 3: | 0.000 | 0.0 | 0.000 |
| Result quality : | Good | | | | |

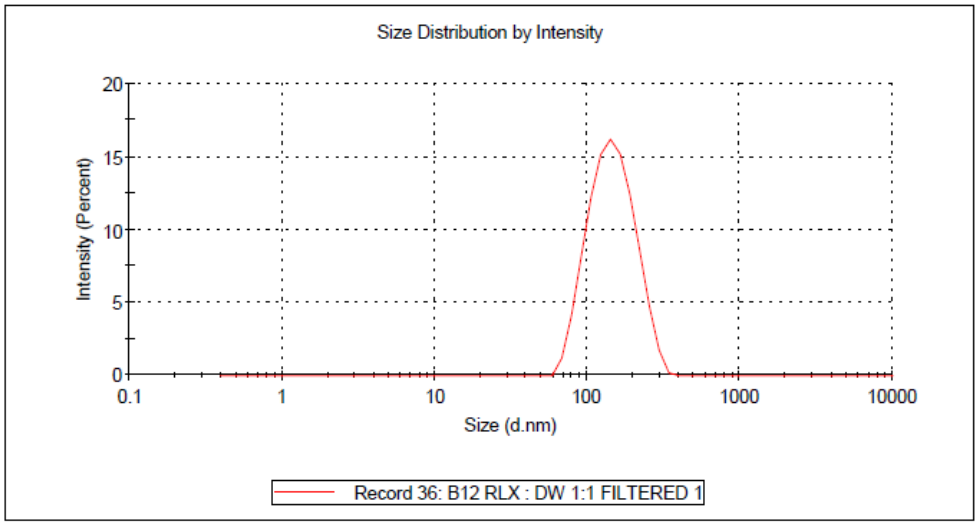


**Figure 4A:** Particle size.

| | | | Mean (mV) | Area (%) | St Dev (mV) |
|---|---|---|---|---|---|
| Zeta Potential (mV): | -22.69 | Peak 1: | -22.69 | 0.0 | 0.00 |
| Zeta Deviation (mV): | 0.00 | Peak 2: | 0.00 | 0.0 | 0.00 |
| Conductivity (mS/cm): | 11.5 | Peak 3: | 0.00 | 0.0 | 0.00 |
| Result quality : | See result quality report | | | | |

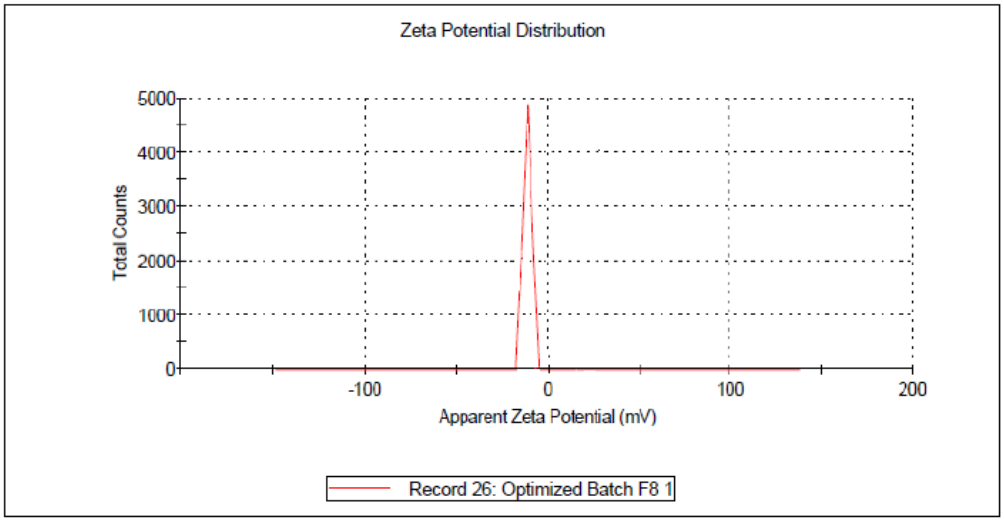


**Figure 4B:** Zeta potential of optimized formulation.

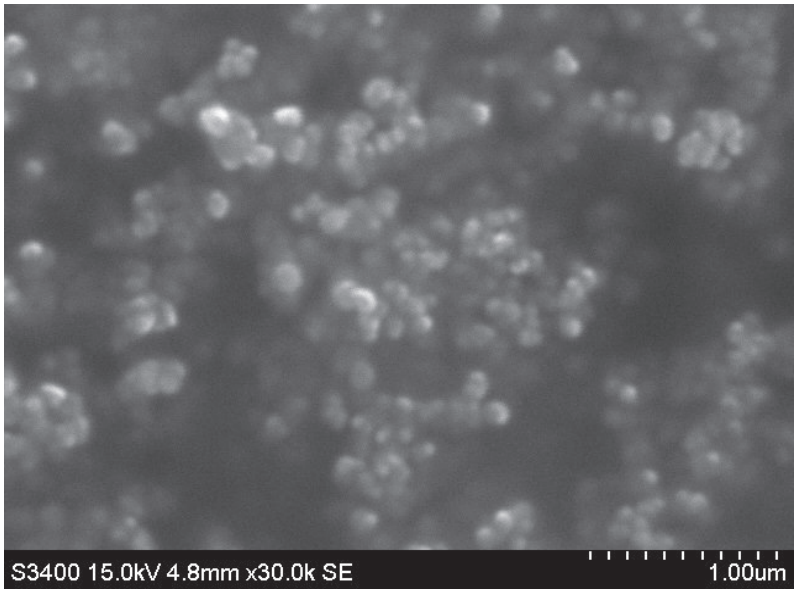


**Figure 5:** Scanning Electron Microscopy (SEM) Analysis of Trifarotene.

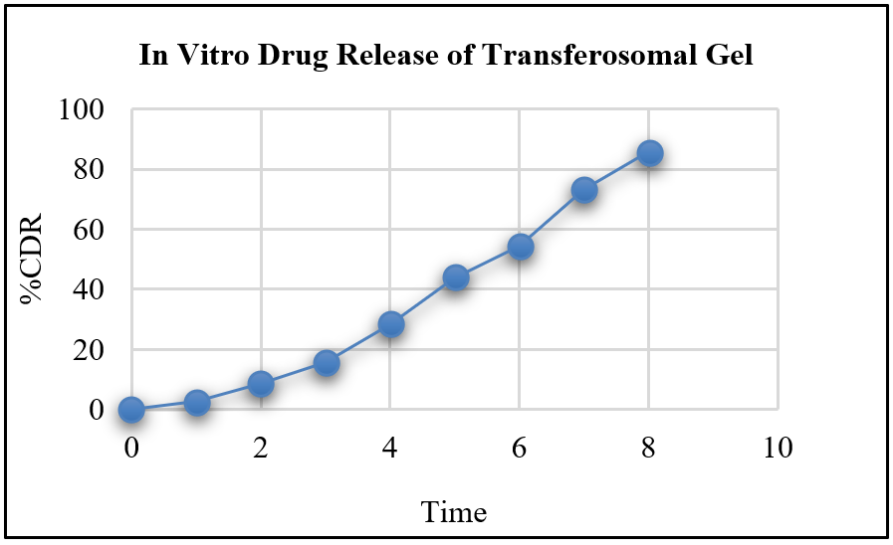


**Figure 6:** *In vitro* drug release of transferosomal gel.

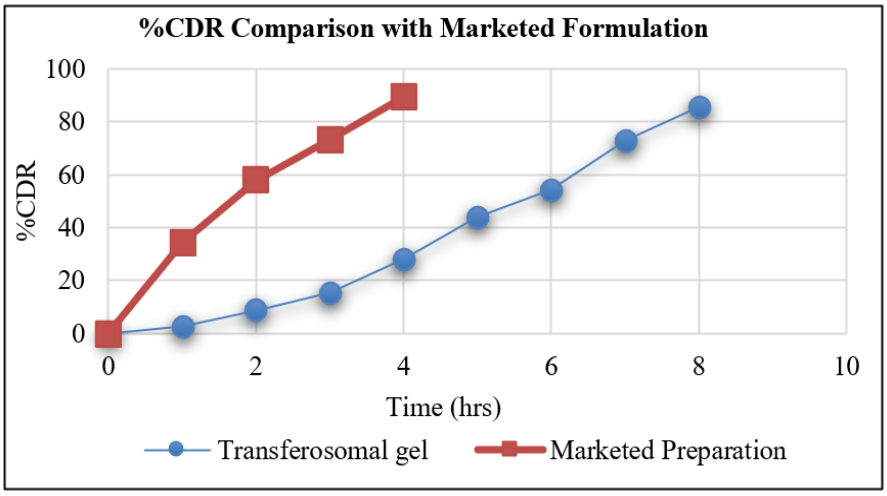


**Figure 7:** %CDR Comparison with Marketed Formulation.

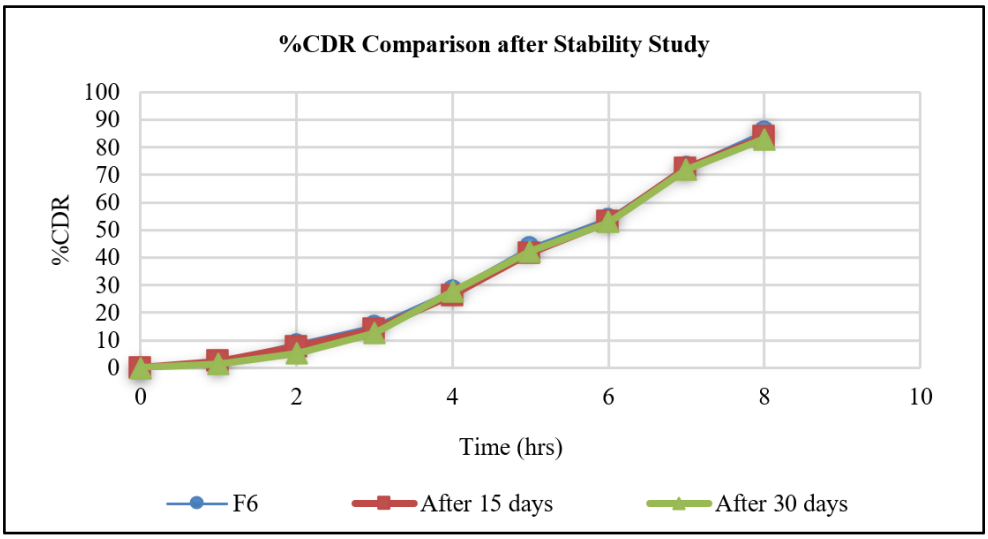


**Figure 8:** %CDR Comparison after Stability Study.

**Table 5: Evaluation of Transferosomal Gel.**

| Visual inspection | pH | Viscosity (cps) | Spreadability (cm/gm) | Drug Content (%) | Extrudability |
|---|---|---|---|---|---|
| Smooth | 5.6 | 4056 cps | 4.6 cm/g | 98.87 | Good |

all batches showed stability with a permanent negative charge, as indicated by their negative zeta potentials, which ranged from -22.69 mV to -1.72 mV. The zeta potential, illustrated in Figure 4B, was measured at -22.69 mV, suggesting good dispersion, as evidenced by a Polydispersity Index (PDI) value of less than 0.5.

## Evaluation of Trifarotene loaded Transferosomal Gel

The formulation demonstrated a smooth texture with a pH of 5.6, a viscosity of 4056 cps, and a spreadability of 4.6 cm/gm. The drug content was 98.87%, and the extrudability was rated as good. The *in vitro* release study showed 85.792±0.128% releases in 8 hr, as presented in Figure 6 and Table 4. Table 5 confirms that all parameters, including texture and viscosity, were appropriate.

However, challenges included achieving a consistent viscosity due to temperature sensitivity during the formulation process, and optimizing the spreadability without compromising the texture. Additionally, maintaining drug stability in the formulation was complex, requiring precise pH adjustments.

A comparison with the marketed Aklief cream (0.005%) revealed a similar Cumulative Drug Release (CDR) profile, with the marketed formulation showing 89.17±0.23% release, and the current formulation achieving 85.792±0.128%, as illustrated in Table 6 and Figure 7. The *in vitro* release indicates that the transdermal-based formulation allows for a longer release period, improving patient compliance and reducing the need for multiple applications.

**Table 6: %CDR Comparison with Marketed Formulation.**

| Time (hr) | Aklief cream (0.005%) | Transfersomal based gel |
|---|---|---|
| 0 | 0 | 0 |
| 1 | 34.124±0.118 | 2.64±0.285 |
| 2 | 51.76±0.234 | 8.74±0.185 |
| 3 | 72.96±0.418 | 15.43±0.215 |
| 4 | 89.17±0.23 | 28.224±0.022 |
| 5 | | 43.832±0.010 |
| 6 | | 54.264±0.030 |
| 7 | | 73.112±0.138 |
| 8 | | 85.792±0.128 |

## *In vitro* Drug Release of Transferosomal Gel

### *Accelerated Stability Study*

The accelerated stability study results, as shown in Tables 7, 8, and Figure 8, indicate that the formulation remains stable under the tested conditions (40°C±2°C/75±5% RH). The evaluation revealed no change in the physical appearance after 15 and 30 days. The pH decreased slightly from an initial value of 5.6 to 5.3 after 15 days and 5.1 after 30 days. The drug content remained high, with a slight reduction from 98.87% initially to 98.64% after 15 days and 98.4% after 30 days. Viscosity increased from 4065 cps to 4995 cps after 15 days and 4977 cps after 30 days.

The *in vitro* release profile also showed minimal changes over time, with 85.792% release initially, 83.657% after 15 days, and

**Table 7: % CDR After Stability Study.**

| Time (hr) | F6 | After 15 Days | After 30 Days |
|---|---|---|---|
| 1 | 2.64 | 2.89 | 1.45 |
| 2 | 8.74 | 7.65 | 5.34 |
| 3 | 15.43 | 13.75 | 12.55 |
| 4 | 28.224 | 26.39 | 27.58 |
| 5 | 43.832 | 41.581 | 42.237 |
| 6 | 54.264 | 52.985 | 52.765 |
| 7 | 73.112 | 72.432 | 71.809 |
| 8 | 85.792 | 83.657 | 83.116 |

**Table 8: Evaluation of Gel after Stability Study.**

| Parameter | Accelerated condition $40^0C \pm 2^0C$/ 75±5% RH | | |
|---|---|---|---|
| | Initial | After 15 days | After 30 days |
| Physical Appearance | No change | No change | No change |
| pH | 5.6 | 5.3 | 5.1 |
| % Drug Content | 98.87 | 98.64 | 98.4 |
| Viscosity (cps) | 4065 | 4995 | 4977 |

83.116% after 30 days. These results confirm that the formulation remains in good condition, with all key parameters maintained effectively throughout the stability period.

## CONCLUSION

The study concluded that the optimized low-dose TFT-loaded Transferosomal gel shows significant promise as an effective treatment for acne, with improved skin penetration and therapeutic efficacy compared to existing products.

## ACKNOWLEDGEMENT

Authors are thankful to Maithri Drugs, Hyderabad for providing gift sample of Trifarotene.

## ABBREVIATIONS

**TTFs:** Transferosomes; **AV:** Acne vulgaris; **DSC:** Differential scanning calorimetry; **SEM:** Scanning electron microscopy; **FT-IR:** Fourier-Transform Infrared; **$H_2O$:** Water; **KBr:** Potassium bromide; **API:** Active pharmaceutical ingredient; **RSD:** Relative Standard Deviation; **UV:** Ultraviolet; **nm:** Nanometer; **cm:** Centimeter; **mm:** Millimeter; **kg:** Kilogram.

## CONFLICT OF INTEREST

The authors confirm that there are no conflicts of interest regarding the publication of this article.

## SUMMARY

A study was conducted to develop and evaluate a Transferosomal gel formulation containing Trifarotene for acne treatment. Using a thin film hydration method and a $3^2$ factorial design, the formulation was optimized for enhanced drug delivery and sustained release. The optimized gel demonstrated high encapsulation efficiency (89.9%), improved skin penetration, and significant *in vitro* drug release (90.44%). Characterization via DSC, SEM, and stability studies confirmed the formulation's safety, stability, and compatibility. The gel showed superior therapeutic efficacy compared to commercial products, offering potential as a safe and effective treatment for acne.

## REFERENCES

1. Santhosh P, Kidangazhiathmana A. Trifarotene–the latest retinoid. Indian journal of dermatology, venereology and leprology. 2021; 87(5): 742-5.
2. Kameswararao K, Sujani C, Koteswararao NV, Rajarao A, Satyanarayanamma PN. A brief review on acne vulgaris. Research Journal of Pharmacology and Pharmacodynamics. 2019; 11(3): 109-19.
3. Bungau AF, Radu AF, Bungau SG, Vesa CM, Tit DM, Purza AL, Endres LM. Emerging insights into the applicability of essential oils in the management of acne vulgaris. Molecules. 2023 ;28(17): 6395.
4. Arooj A, Rehman AU, Iqbal M, Naz I, Alhodaib A, Ahmed N. Development of adapalene loaded liposome based gel for acne. Gels. 2023; 9(2): 135.
5. Opatha SA, Titapiwatanakun V, Chutoprapat R. Transfersomes: A promising nanoencapsulation technique for transdermal drug delivery. Pharmaceutics. 2020; 12(9): 855.
6. Fernández-García R, Lalatsa A, Statts L, Bolás-Fernández F, Ballesteros MP, Serrano DR. Transferosomes as nanocarriers for drugs across the skin: Quality by design from lab to industrial scale. International journal of pharmaceutics. 2020; 573: 118817.
7. Abdallah MH, Abu Lila AS, Shawky SM, Almansour K, Alshammari F, Khafagy ES, *et al.* Experimental design and optimization of nano-transfersomal gel to enhance the hypoglycemic activity of silymarin. Polymers. 2022; 14(3): 508.
8. Qushawy M, Nasr A, Abd-Alhaseeb M, Swidan S. Design, optimization and characterization of a transfersomal gel using miconazole nitrate for the treatment of candida skin infections. Pharmaceutics. 2018; 10(1): 26.
9. Alyahya EM, Alwabsi K, Aljohani AE, Albalawi R, El-Sherbiny M, Ahmed R, *et al.* Preparation and optimization of itraconazole transferosomes-loaded HPMC hydrogel for enhancing its antifungal activity: 2^ 3 full factorial design. Polymers. 2023; 15(4): 995.
10. Kharwade R, Ali N, Gangane P, Pawar K, More S, Iqbal M, Bhat AR, AlAsmari AF, Kaleem M. DOE-assisted formulation, optimization, and characterization of tioconazole-loaded transferosomal hydrogel for the effective treatment of atopic dermatitis: *in vitro* and *in vivo* evaluation. Gels. 2023; 9(4): 303.

11. Vaja PN, Borkhataria CH, Popaniya HS. Development and Characterization of Polyherbal Anti-acne face gel using Liquorice and Palash extract. Research Journal of Pharmacy and Technology. 2023; 16(12): 5691-5.

12. Umalkar D, Saudagar RB, Patel D, Rajesh KS. Formulation and Evaluation of Transferosomal gel of Isotretinoin for severe Acne. Research journal of topical and cosmetic sciences. 2014; 5(2): 39-45.

**Cite this article:** Prajapati A, Tandel M, Narkhede SB, Desai N, Luhar S, Narkhede K. Formulation Development and Evaluation of Transferosomal Gel Using Trifarotene. Indian J of Pharmaceutical Education and Research. 2026;60(1):96-105.