International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 5 Sept - Oct 2025, pp: 286-292 www.ijprajournal.com ISSN: 2456-4494

Preformulation Studies and UV Estimation of Terbinafine Hydrochloride for Treatment of Fungal Infection

Dr. Gita Chaurasia[1], Snehal Panhalkar[2*], Dr. Swati Deshmukh[3]
[1]*Associate Professor, Department of Pharmaceutics, Siddhant College of Pharmacy, Sudumbare, Pune, Maharashtra, India, 412109*
[2] *Student, Department of Pharmaceutics, Siddhant College of Pharmacy, Sudumbare, Pune, Maharashtra, India, 412109*
[3]*Principal, Department of Pharmacognosy, Siddhant College of Pharmacy, Sudumbare, Pune, Maharashtra, India, 412109*
Corresponding author:[*]Snehal Panhalkar

Date of Submission: 05-09-2025 Date of Acceptance: 15-09-2025

ABSTRACT
Terbinafine hydrochloride (TH), is a broad-spectrum allylamine antifungal agent that inhibits squalene epoxidase, thus disrupting ergosterol biosynthesis as well as the integrity of the fungal cell membrane. The current research work was aimed for Preformulation studies of drug TH for developing the suitable dosage form of the drug to enhance its efficacy and safety. It included Physical characterizations, organoleptic properties such as colour, odour, appearance, and texture, Melting point, partition coefficient, solubility analysis, particle size, SEM study, Loss on drying, FTIR study, λ max determination by preparing Standard curve. In conclusion, it was observed that The TH was a suitable candidate for oral, topical and parenteral preparation for fungal treatment and may be the hope for development of new dosage form in future.

KEYWORDS: Terbinafine Hydrochloride, Antifungal agent, Preformulation study, Terbinafine

I. INTRODUCTION

TH, having IUPAC name of (2E)-6,6-dimethyl-N-(naphthalen-1-ylmethyl)hept-2-en-4-yn-1-amine hydrochloride, molecular formula $C_{21}H_26ClN.Hcl$ and molecular weight 327.89 g/mol [1].Cutaneous fungal infections like dermatophytosis and candidiasis infect almost one-fourth of the world's population, causing severe discomfort, cosmetic dysfunction, and recurrence. TH, is a broad-spectrum allylamine antifungal that works by inhibiting squalene epoxidase, leading to ergosterol depletion and fungal cell death [2]. Although terbinafine is very effective, its formulation into an optimized spray necessitates close adjustment of viscosity, drying time, and drug release so that therapeutic efficacy is maintained. Formulation by design is a logical method of solving such challenges. Present work focussed on Preformulation studies of drug TH to investigate its physicochemical characteristics, colour, odour, appearance, and texture, Melting point, partition coefficient, solubility analysis, particle size, SEM study, Loss on drying, FTIR & DSC study, λ max determination etc. that used to formulation and evaluation of most of the developed dosage forms.

II. METHODS AND MATERIALS

MATERIALS

TH was purchased from authorised dealers in chemicals. Methanol, Ethanol, n-octanol, DMSO, phosphate buffer pH 7.4 tablet, Propylene glycol, acetone and other lab reagents of analytical grade were obtained from research-lab fine chem industries, Mumbai. Freshly prepared distilled water was used under study.

METHODS

Pre-formulation studies

Pre-formulation studies of TH were carried out to evaluate the physicochemical and compatibility characteristics of drug prior to formulation development.

1. **Organoleptic properties**

It involves the evaluation of a formulation's physical characteristics using the human senses, such as colour, odour, appearance, and texture. These parameters are crucial for ensuring patient acceptability, especially in topical formulations [3].

2. Melting point

Melting point of TH was determined using a capillary method with a digital melting point apparatus. A small quantity of the powdered drug

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 5 Sept - Oct 2025, pp: 286-292 www.ijprajournal.com ISSN: 2456-4494

was packed into a capillary tube, which was then placed in a melting point apparatus. The temperature at which it completely liquefied were recorded and it was performed in triplicate [4].

3. **Solubility studies**

It was performed in various solvents including distilled water Methanol, Ethanol, n-octanol, DMSO, phosphate buffer pH 7.4 tablet, Propylene glycol, acetone etc. by UV method. Each solvent was used as blank in TH concentration of 5 mg each. The result was computed statistically at n=3 [5].

4. Partition coefficient (log P)

It was determined using the n-octanol/water system [6].

5. Particle size determination

UV-Visible spectrophotometry was utilized for estimating the size of particles of TH in dispersion. The method relies on light scattering by suspended particles, which imparts a change in absorbance at a certain wavelength. A fixed amount of the drug was dispersed in an appropriate solvent and absorbance was scanned at 283 nm by UV. Increased scattering and turbidity tend to be associated with increased particle size, and decreased absorbance suggests smaller and more uniform particles and recorded [7].

6. Loss on drying

It is a quantitative method used to determine the amount of volatile matter, primarily moisture, present in a pharmaceutical substance [8].

7. Scanning Electron Microscopy

It was utilized in this research to examine the surface texture and particle shape ofTH.A small amount of the drug sample was placed on an aluminium stub and sputter-coated with a thin gold layer for conductivity enhancement. The sample was then examined using the SEM at different magnification, which are significant variables affecting drug dissolution, flow properties, and spray ability in topical applications [9].

8. **Determination of wavelength maxima** (λmax)

It is an essential step in analysis to identify the specific wavelength at which a drug shows maximum absorbance. The UV absorption spectrum of TH was prepared in methanol at concentration of 10µg/mLand scanned for 200-400nm [10].

9. Preparation of calibration curve

It is a plot employed to define the relationship between the drug concentration and its respective absorbance, so that quantitative analysis can be done accurately.A standard stock solution of TH was prepared by dissolving 10 mg of drug in methanol and diluting to 100 mL to obtain a concentration of 100 µg/mL. From this, working solutions ranging from 2–12 µg/mL were prepared by serial dilution. Absorbance was measured at 283 nm using a UV against methanol as blank.

10. Fourier Transform Infrared Spectroscopy (FTIR)

It was for identification of pure TH for formulation development. FTIR scanning was conducted in order to detect the functional groups in the drug by IR instruments [11].

11. Differential Scanning Calorimetry (DSC)

It was carried out to establish the thermal property and purity of TH. A few milligrams of pure drug were precisely weighed and put into an aluminium pan, followed by heating at a rate controlled by the instrument (usually 10°C/min) in a nitrogen atmosphere [12].

III. RESULTS AND DISCUSSION

Pre-formulation Studies

1. Organoleptic Properties

Terbinafine hydrochloride was examined for its organoleptic properties, which include colour, appearance, odour, and taste as shown in table 1.

Table1: Parameters for Organoleptic properties

Sr. No.	Properties	Observation
1	Colour	White to off-white
2	Odour	Odourless
3	Appearance	Crystalline powder
4	Taste	Bitter

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 5 Sept - Oct 2025, pp: 286-292 www.ijprajournal.com ISSN: 2456-4494

2. Melting point Determination

TH, showedan average melting point at 198°C. A sharp and well-defined melting point indicates the purity of the drug and supports for formulation development.

3. Solubility Determination

The solubility of TH was analysed qualitatively in different solvents to know its solubility characteristics and choose suitable solvents for formulation. The solubility of TH was evaluated in various solvents to aid in selecting suitable vehicles for formulation. The drug exhibited poor solubility in water, confirming its lipophilic nature. It was found to be freely soluble in Methanol, moderately soluble in propylene glycol. It also showed good solubility in Ethanol (Table 2).

Table2: Solubility analysis of TH

Sr. No.	Solvent	Solubility in (mg/ml) * (mean±SD), (n=3)	Solubility
1	Distilled Water	1.23±0.62	poorly soluble
2	Phosphate buffer (pH 7.4)	1.41±0.42	poorly soluble
3	Acetone	1.13±0.11	Poorly soluble
4	Propylene glycol	2.31±0.16	sparingly soluble
5	Ethanol	3.92±0.12	Soluble
6	Methanol	4.33±0.76	Freely soluble
7	n-octanol	2.73±0.22	sparingly soluble
8	DMSO	3.04±0.83	soluble

- Initial concentration of drug was 5 mg.

4. Partition Coefficient

Partition coefficient (log P) of TH was calculated by the shake-flask method between phosphate buffer pH 7.4 and n-octanol system. The drug concentration in both phases was measured spectrophotometrically at 283 nm as shown in table 3.

Table3: Determination of P and log P

Phase	Concentration (ug/ml)
n-Octanol	480
Phosphate buffer pH 7.4	120

The partition coefficient (P) was calculated as:
P = concentration in octanol / concentration in aqueous phase = 480/120 = 4.0
Therefore, the log P value was found to be:

$\text{Log P} = \log_{10}(4.0) = 0.602$

The obtained log P value ~0.60, indicates that TH has moderate lipophilicity, allowing appropriate permeation across the lipid-bilayer rich stratum corneum while retaining sufficient aqueous solubility for drug release. The observed value indicates that the drug can partition into both hydrophilic and lipophilic domains, which may facilitate deposition in skin layers without excessive systemic absorption.

5. Particle size determination

The absorbance values were plotted against a standard curve that had been constructed using known sizes of particles. From this, an estimated average particle size of TH of the order of 50–100 µm was recorded, which showed uniformity in the mixture.

6. Loss on drying

The LOD of developed TH was measured by drying samples at 105°C until a constant weight was reached. All values were within 0.70%-0.90%, complying with acceptable limits. (<2%).The low and consistent LOD values confirm effective solvent removal, ensuring product stability and preventing microbial growth. The results indicate that the drying process parameters were optimal, providing stable formulations suitable for use.

7. Scanning electron microscopy (SEM)

The photographs showed that TH crystals were irregular, plate-like with roughened surfaces and sharp edges as characteristic of crystalline drug substances (Figure 1).

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 5 Sept - Oct 2025, pp: 286-292 www.ijprajournal.com ISSN: 2456-4494

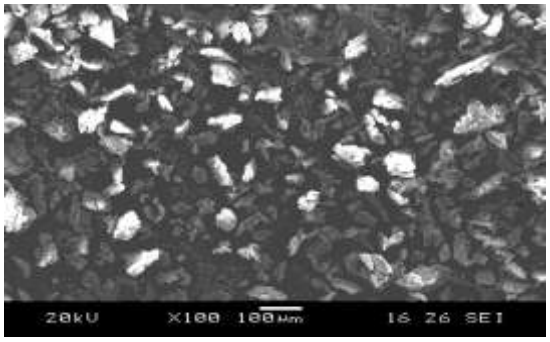

Fig 1 SEM of TH

8. Determination of wavelength maxima (λ max)

The UV absorption spectrum of TH was prepared in methanol that exhibited a characteristic absorption maximum (λmax) at 283 nm**,** which corresponds to the π→π* transition of its aromatic moieties. The sharp and distinct peak confirmed the drug's purity and suitability for quantitative estimation by UV spectrophotometry (Figure 2).

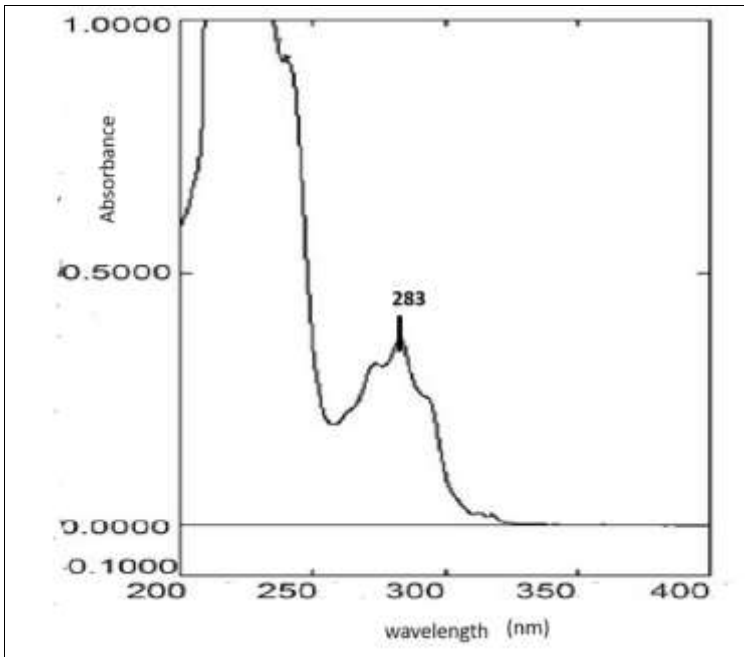

Fig 2 Wavelength maxima of TH

9. Preparation of calibration curve

A calibration curve was plotted between concentration (µg/mL) and absorbance of reported data, and linear regression analysis was performed to determine the correlation coefficient (R^2) as shown in figure 4. Analytical parameters were computed in Table 4.

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 5 Sept - Oct 2025, pp: 286-292 www.ijprajournal.com ISSN: 2456-4494

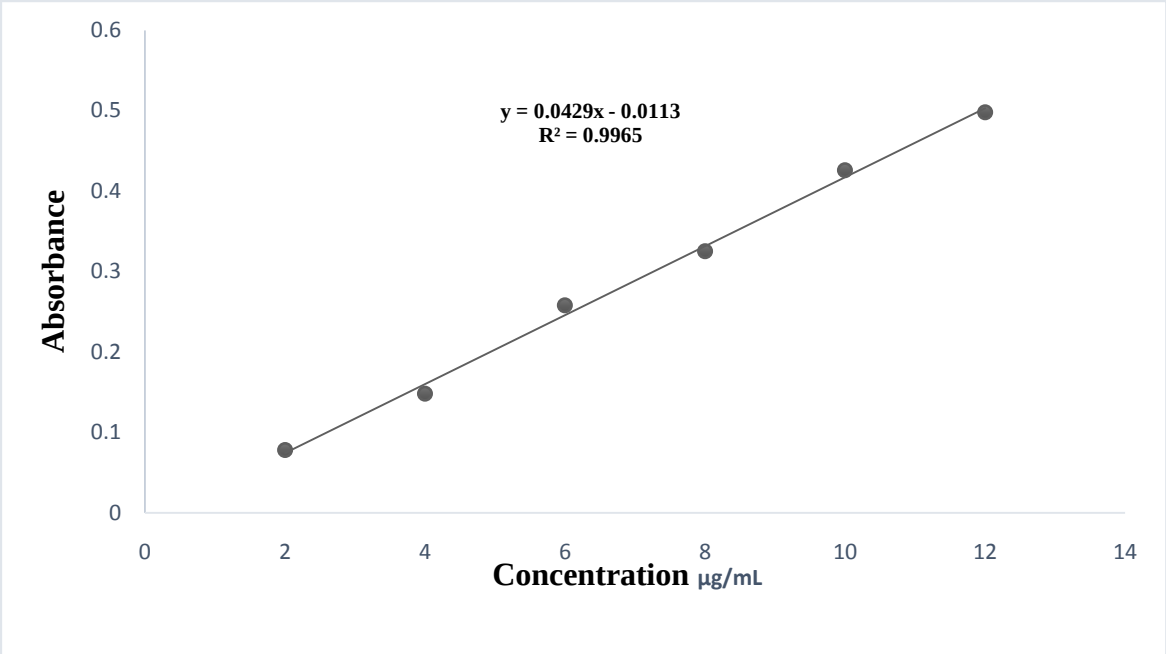

Fig 4 Calibration curve of TH

Table 4Analytical parameters for TH

Parameters	Observed Values
Absorbance (nm)	283
Correlation coefficient µ	0.9965
Regression Equation	y = 0.0429x - 0.0113
Intercept (c)	0.0113
Slope (m)	0.0429

10. FTIR

Drug sample was scanned using an FTIR spectrophotometer between 4000–400 cm^{-1}. The spectra of pure drug exhibited typical peaks at about 3300 cm^{-1} (-N-H stretching), 2940 cm^{-1} (-C-H stretching), 1610 cm^{-1} (-C=C aromatic stretching), and 1450 cm^{-1} (-C-N stretching), establishing the presence of significant functional groups (Figure 5).

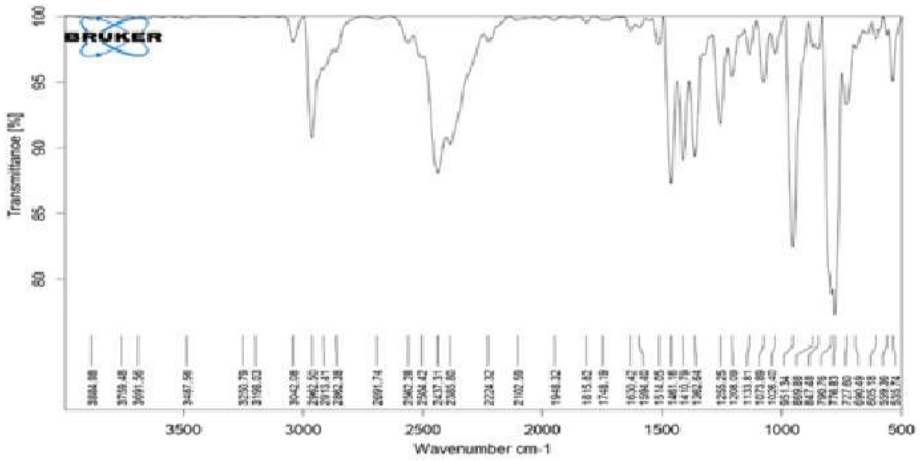

Fig 5: FTIR of pure TH

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 5 Sept - Oct 2025, pp: 286-292 www.ijprajournal.com ISSN: 2456-4494

11. DSC

The DSC thermogram of TH revealed a endothermic peak at 210.12°C. The observation of a single, sharp melting peak for the drug suggests that the drug is in a pure, crystalline state at this temperature (Figure 6).

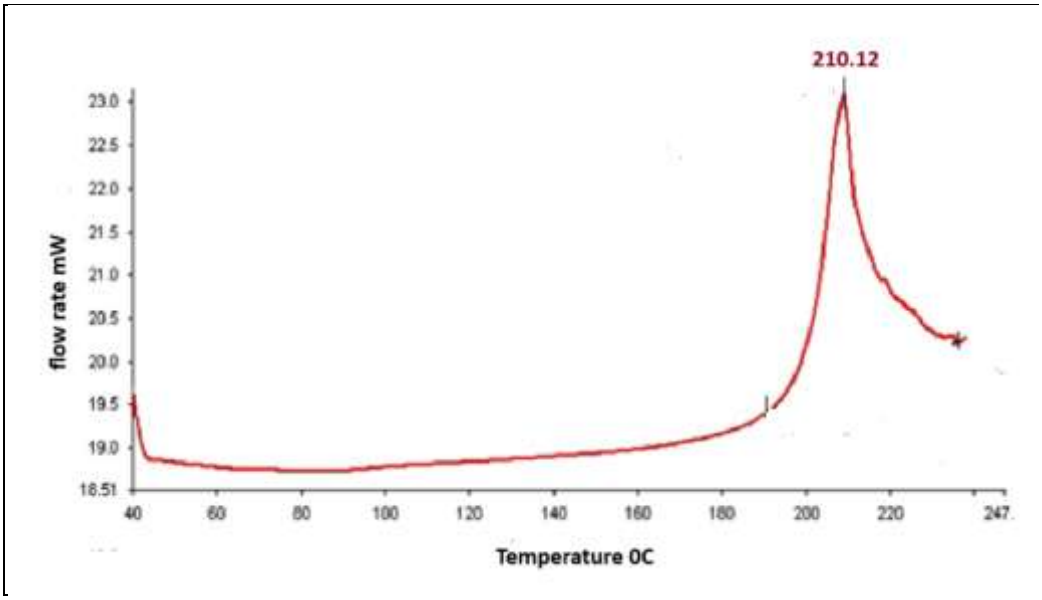

Fig 6: DSC of TH

IV. CONCLUSION

It was concluded that the Preformulation studies of an antifungal drug TH, was carried out for different physicochemical parameters. Identification of drug was done by SEM, DSC and FITR. The drug concentration was estimated via UV-Spectrophotometric method and found to be suitable for further formulation developments.

ACKNOWLEDGEMENT

The authors are thankful to drug provider, Principal and staff, Siddhant college of Pharmacy, Pune for providing necessary facilities and support for completion this work.

REFERENCES

[1]. https://go.drugbank.com/salts/DBSALT000470.
[2]. https://www.druginfosys.com/drug.aspx?drugCode=1053.
[3]. Shivam S. (2020). Development and in vitro evaluation of phytosome of terbinafine hydrochloride for oral drug delivery. Int J Appl Pharm.2(5):85-94.
[4]. AJ, Samuel, and S. A. Mulla. (2019). Preparation of Terbinafine Hydrochloride Cubosomes: Preformulation Studies, International Journal of Pharmacy and Biological Sciences, 9(1): 648-653.
[5]. Arpa MD, Ünükür MZ, Erim ÜC. (2021). Formulation, characterization and in vitro release studies of terbinafine hydrochloride loaded buccal films. Journal of Research in Pharmacy.25(5):667-80.
[6]. Oremusová J, Vitková Z. (2007). Adsorption, partition and release balances of terbinafine hydrochloride, part I. Die Pharmazie-An International Journal of Pharmaceutical Sciences.62(4):273-7.
[7]. Gopan G, Varghese J, Surenderan S, Parthiban KG. (2020). Formulation and Evaluation of Terbinafine Hydrochloride Loaded Nanoparticle Gel. Trends in Biomaterials & Artificial Organs.34(3).
[8]. Hentabli M, Belhadj AE, Benimam H, Dahmoune F, Keskes S. (2021). Vacuum drying of the Terbinafine HCl powder: A kinetics study and mathematical modeling. Powder Technology.383:220-32.
[9]. Shrestha S, Pokhrel S, Sharma S, Manandhar M, Alam I. (2017). Formulation and evaluation of topical microemulgel loaded with terbinafine HCl microemulsion. Int J Pharm Sci Res.8(11):4716-23.
[10]. Jain PS, Chaudhari AJ, Patel SA, Patel ZN, Patel DT. (2011). Development and validation of the UV-spectrophotometric

method for determination of terbinafine hydrochloride in bulk and in formulation. Pharmaceutical methods. 2(3):198-202.

[11]. Amer RI, El-Osaily GH, Gad SS. (2020). Design and optimization of topical terbinafine hydrochloride nanosponges: Application of full factorial design: in vitro: and: in vivo: evaluation. Journal of Advanced Pharmaceutical Technology & Research. 11(1):13-9.

[12]. Phagna M, Badhwar R, Singh M, Alhalmi A, Khan R, Noman OM, Alahdab A. (2023). Development and characterization of terbinafine-loaded nanoemulgel for effective management of dermatophytosis. Gels. 9(11):894.