Formulation And Evaluation Of Antifungal Drug Loaded Solid Lipid Nanoparticle For The Treatment Of Dermatitis

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Abstract
One of the most typical causes of skin problems is fungus infections. Infections caused by fungi are becoming more common everywhere. Therefore, solid lipid nanoparticles encapsulating antifungal medications were created in order to increase drug penetration, reduce drug side effects, and provide quick symptomatic relief from fungal infections. For better medication penetration through the stratum corneum and to increase the therapeutic effectiveness of the medicine, terbinafine- and cotrimoxazole-loaded solid lipid nanoparticles were produced and added to aloe vera gel in the current study. Utilizing a straightforward modified solvent emulsification approach, the TBF-SLN and CTZ-SLN were created. The novel excipients made up the TBF-SLN and CTZ-SLN. All the formulations were discovered to be in the nanometric range, spherical in shape, and capable of entrapping the most amount of medication. The TBF-SLN and CTZ-SLN optimized formulations were lyophilized and subjected to DSC, FT-IR, and XRD analysis. The outcomes show that the excipients and drug were complementary, that no interactions occurred, and that the crystalline drug and lipid were converted into amorphous SLN. To increase drug absorption and provide an additive impact in the treatment of a fungal infection, TBF-SLN and CTZ-SLN were added to aloe vera gel. Different physicochemical characteristics of the TBF-SLN gel and CTZ-SLN gel were assessed.

Keywords: solid lipid nanoparticles, terbinafine, cotrimoxazole

1. INTRODUCTION

Any newly developed pharmaceutical formulation must successfully deliver the therapeutic active ingredient to the target site at the lowest effective concentration with the least amount of discomfort, the highest level of patient compliance with the therapeutic use, and the fewest possible side effects. The topical route is the preferred method for delivering a medicinal substance locally among the several administration routes.[1,2] Any newly developed pharmaceutical formulation must successfully deliver the therapeutic active ingredient to the target site at the lowest effective concentration with the least amount of discomfort, the highest level of patient compliance with the therapeutic use, and the fewest possible side effects. The topical route is the preferred method for delivering a medicinal substance locally among the several administration routes.[3,4,5] There aren't many topical drug formulations that are commercially available in the market, despite the fact that transdermal and dermal drug administration have significant advantages over other drug delivery systems. Crossing the stratum corneum, one of the most impermeable epithelia on the human body, is the most difficult stage in the topical delivery process. For the exogenetic chemicals, the stratum corneum acts as a barrier. This feature must thus be taken into account when creating a novel formulation for the topical administration of medication in order to obtain optimum penetration of the medication into the skin without permanently disrupting the function of the skin barrier..[6,7,8]

Penetration of Drugs into Skin

Skin is the most important barriers. These may be penetrated or eliminated various types of substances. Absorption of material is done percutaneously. Sequence of deposition in stratum diffusion through the epidermis and the upper part of dermis papillary. It may metabolise the drug which contains enzymes that deliver the pro-drug. Skin has a heterogenous structure. It provides intercellular, intracellular and follicular pathways for penetration of drugs though stratum corneum. Now a day crystalline state of lipids may use for the drug penetration. It has a control on intercellular penetration routes.[9,10]

Solid lipid nanoparticles

The nanoparticles that contain colloidal drug carriers and are similar to nano emulsions are solid lipid nanoparticles. While emulsions may contain liquid lipids, SLNs may contain solid lipid. Surfactant is utilised in the stabilisation of solid lipid nanoparticles in amounts ranging from 0.05 to 5%. SLNs are employed as a delivery mechanism for both water-soluble and dynamic pharmaceuticals. The range of the particle size is 10 to 1000 nm. These could be produced using polymers. These are employed to deliver lethality and advance medication reduction. Liposomes serve as the drug's delivery system. These could be used to enhance the production, properties, and lethality of polymers as well as their

conveyance. SLNs may have several unique qualities, such as small size, maximum surface area, high medicine stacking, interface communication, and improved pharmaceutical compound execution. These could be the biodegradable solid lipids. SLNs may experience favourable conditions and remain at the disadvantage of colloidal carriers. These medications can be administered orally, parenterally, topically, and in other ways.[11,12]

2. MATERIAL AND METHODS

2.1 Analytical method development (UV Visible spectrophotometric method)

2.1.1 Terbinafine Hydrochloride

Calibration curve for terbinafine hydrochloride was done in methanol for drug content estimation and calibration curve in mixture of phosphate buffer pH 6.8 and methanol (60:40) for estimation of drug in release and diffusion study was done at a wavelength of 283 nm. Terbinafine hydrochloride 1000 g/ml stock solution in methanol, phosphate buffer pH 6.8, and methanol (60:40) was made and appropriately diluted to obtain concentrations ranging from 0-70 g/ml. The produced solutions' absorbance was then tested against a reagent blank.

2.1.2 Co-trimoxazole

Calibration curve for co-trimoxazole was done in methanol for drug content estimation and calibration curve in mixture of phosphate buffer pH 6.8 and methanol (60:40) for estimation of drug in release and diffusion study was done at a wavelength of 283 nm. Co-trimoxazole was made as a 1000 mg/ml stock solution in a mixture of phosphate buffer pH 6.8 and methanol (60:40), which was then appropriately diluted to produce concentrations ranging from 0-70 mg/ml. The produced solutions' absorbance was then tested against a reagent blank.

2.2 Drug characteristics

The physicochemical characteristics of the medication were characterised using a variety of analytical techniques, as well as the potential changes that could take place in the drug following the creation of solid lipid nanoparticles, using the relevant tools.

2.2.1 DSC study

Comparative Scanning Calorimetry was used to identify the melting point, exothermic peak, and endothermic peak of the bulk substance, which is the pure medication Terbinafine Hydrochloride and Co-trimoxazole. For the DSC investigation, a normal aluminium pan that was empty served as the reference. At a heating rate of 10°C/min and in the temperature range of 30°-300°C, DSC scans were captured.

2.2.2 X-ray diffraction (XRD) study

Terbinafine Hydrochloride and Co-trimoxazole were the only substances tested for X-ray scattering. The Philips PAN analytical expert PRO X-ray diffractometer 1780 was used to carry out the XRD investigation.

2.2.3 Fourier Transform Infra-Red (FTIR) Study

Infrared examination of the sample was performed using a Jasco FTIR spectrophotometer. 50 mg of dry potassium bromide was combined with 1-2 mg of sample, and the mixture was then tested in transmission mode across a range of 4000 to 400 cm^{-1}.

2.2.4 Melting Point Determination

The capillary method was used to calculate melting point for Terbinafine Hydrochloride and Co-trimoxazole.

3. RESULTS

3.1 Calibration curve of terbinafine hydrochloride (UV Visible spectrophotometric method)

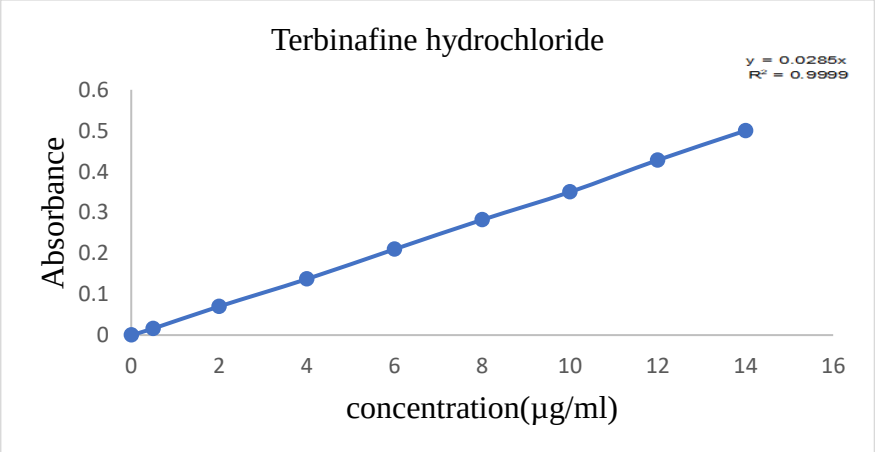


Figure 1. calibration curve of terbinafine hydrochloride in methanol

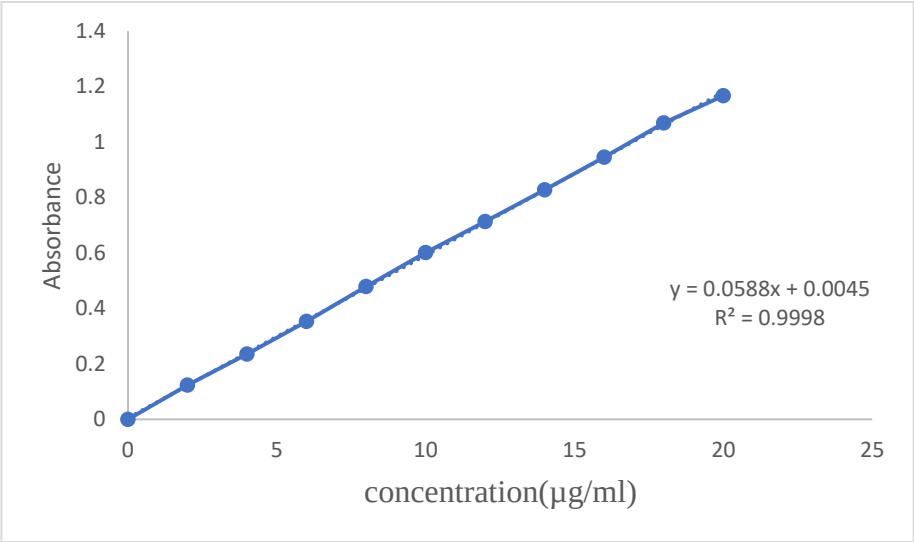


Figure 2. Calibration curve of terbinafine hydrochloride in phosphate buffer pH 6.8

3.2 Calibration curve of co-trimoxazole (UV Visible spectrophotometric method)

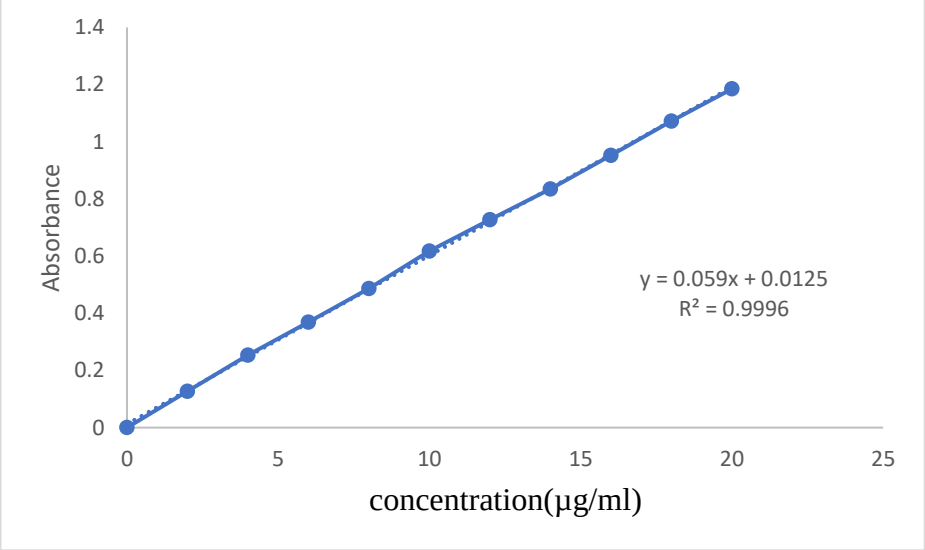


Figure 3. calibration curve of co-trimoxazole in methanol

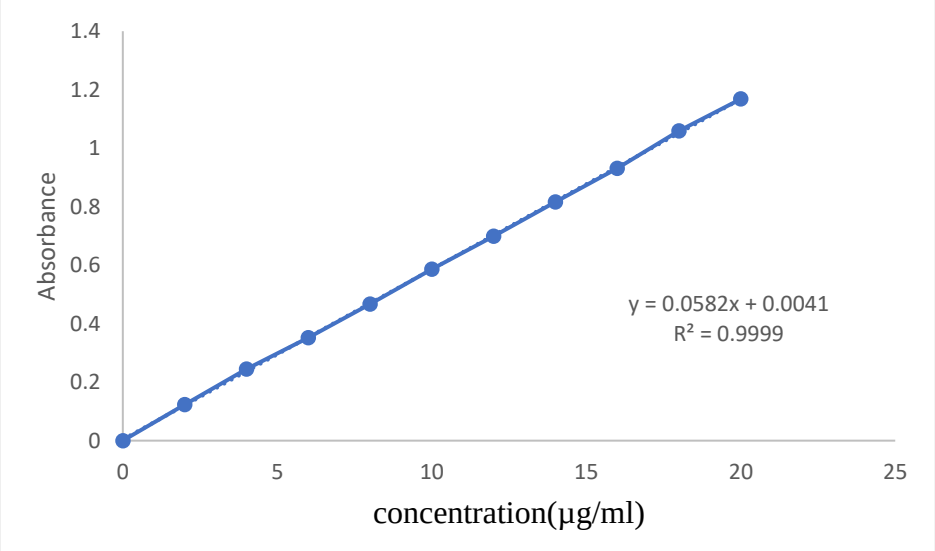


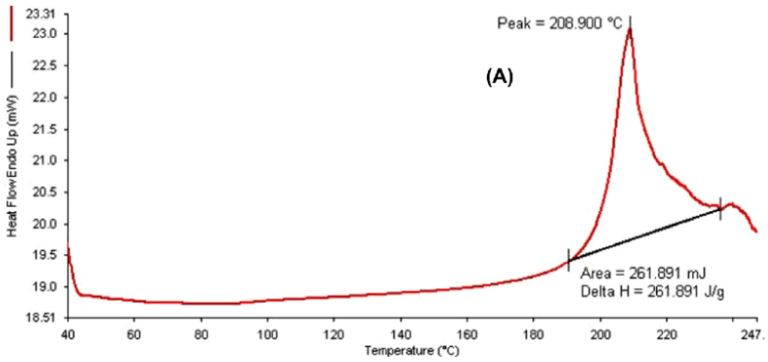
Figure 4. Calibration curve of co-trimoxazole in phosphate buffer pH 6.8

3.3 Analysis of Terbinafine Hydrochloride properties

Terbinafine Hydrochloride's physicochemical characteristics were assessed using a variety of instrumental analytical techniques. Below are the findings of the recent probes.

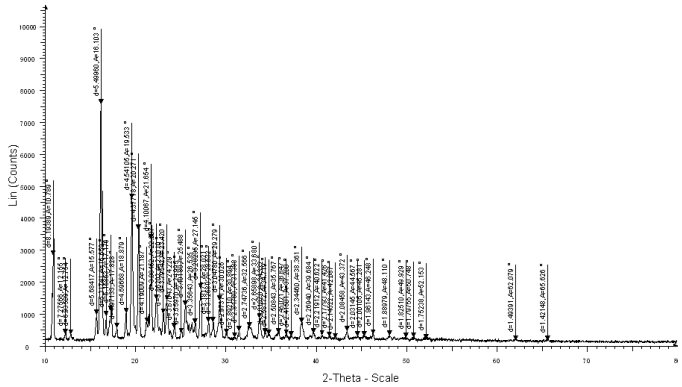
3.3.1 Differential Scanning Calorimetry study (DSC)

A sharp endothermic peak for the medication Terbinafine Hydrochloride was discovered at 217.3°C, which is also its melting point.



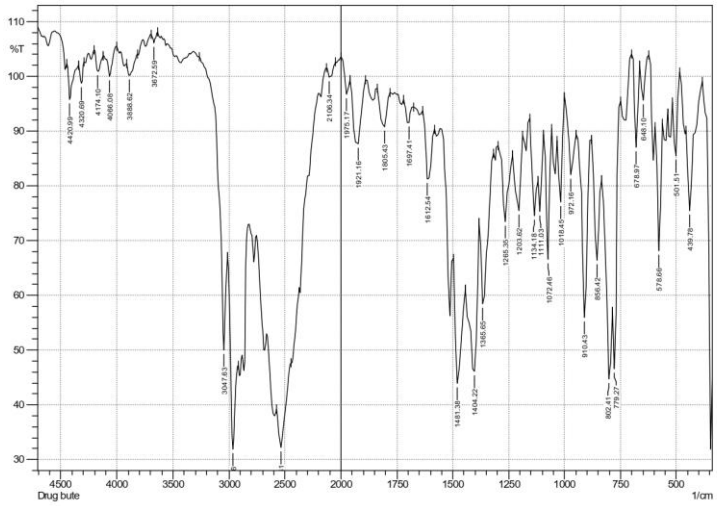
3.3.2 X-ray diffraction study (XRD)

Terbinafine Hydrochloride's pure drug diffraction pattern on X-rays. Terbinafine Hydrochloride was found to be extremely crystalline when a strong primary peak was seen at 2 value of 16.0768.



3.3.3 FTIR Study

The figure displayed the Terbinafine Hydrochloride FTIR spectrum. The characteristic functional peaks of terbinafine hydrochloride may be seen in the spectra. Terbinafine Hydrochloride's FTIR investigation was described in the section below.



3.3.4 Melting Point Determination

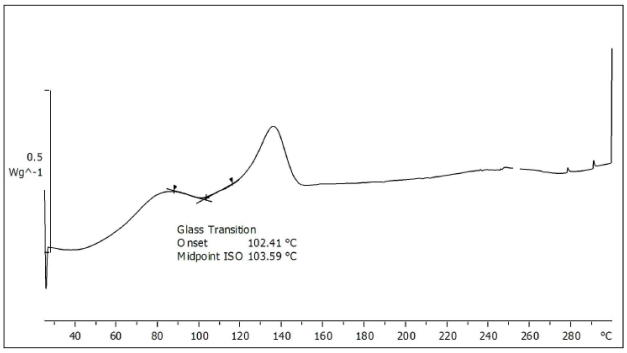
For the pure medication, the capillary technique was used to determine melting point. Terbinafine Hydrochloride medication sample was discovered to have a melting point of 216.670.5113°C.

3.4 Characterization of Co-trimoxazole

Instrumental analytical techniques were applied to examine Co-physicochemical trimoxazole's properties and determine any potential alterations that may occur in the medication following SLN production.

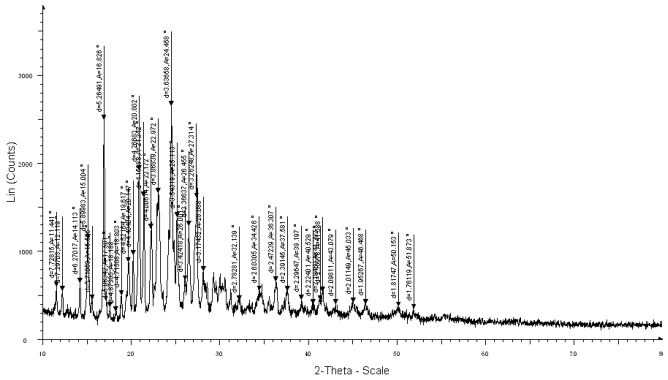
3.4.1 Differential Scanning Calorimetry study (DSC)

Co-trimoxazole showed a clear endothermic peak at 156.98°C. The melting point of crystalline Co-trimoxazole is shown as a prominent peak.



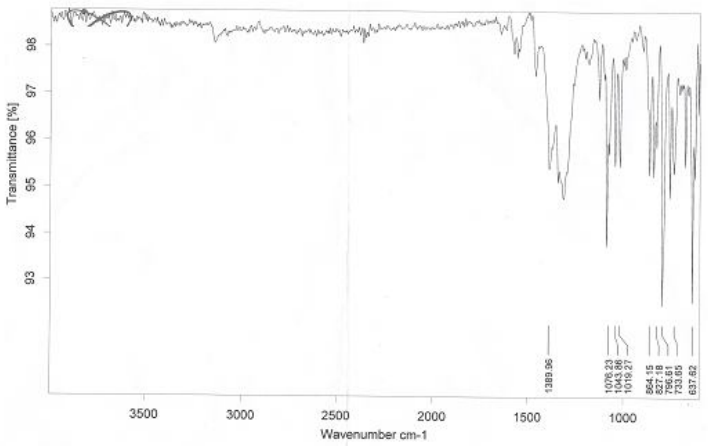
3.4.2 X-ray diffraction study

Utilizing XRD analysis, a solid property of the pure medication Co-trimoxazole was identified. The pure medication Co-trimoxazole appears to be crystalline, according to XRD data. Co-trimoxazole showed two distinct peaks with 2 values of 16.826 and 24.458, respectively.



3.4.3 Fourier Transform Infra-Red (FTIR) Study

It was displayed the Co-trimoxazole FTIR spectrum. 3876.12 cm^{-1} (N-H stretch), 2965.78 cm^{-1} (C-H stretch), 1632.41 cm^{-1} (C-N stretch), 1165.19 cm^{-1} (C-O-C bend), and 637.39 cm^{-1} were the distinguishing distinctive functional group peaks that were seen (C-Cl bend). The Co-distinctive trimoxazole's functional peaks are listed below.



3.4.4 Melting Point Determination

By using the capillary method, the melting point of the pure medication Co-trimoxazole was discovered to be 155.830.7637°C.

4. REFERENCES

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