Formulation and Evaluation of a Transdermal Patch for the Treatment of Athlete's Foot (Tinea Pedis)

Nimra Aamir*
Faculty of Pharmacy, Salim Habib University, Karachi, Pakistan.
*E-mail: nimra.nasir@shu.edu.pk

ABSTRACT

Athlete's foot (Tinea pedis) is common and stubborn, often persisting because creams are applied irregularly or removed by sweat and washing. We set out to build a thin transdermal patch that sits on the affected skin and meters terbinafine over several hours. Our aim was practical: use accessible excipients, simple steps a teaching lab can repeat, and demonstrate clear antifungal activity alongside acceptable comfort during wear.

Keywords: Transdermal Patch, Athlete's Foot, Tinea Pedis, Terbinafine, Sustained Release.

INTRODUCTION

Tinea pedis, usually due to Trichophyton species, presents with itch, fissures, erythema, and scaling in toe webs. Patients stop early or miss doses, and moisture inside shoes dilutes or dislodges medication. A patch can anchor drug at the lesion, reduce handling, and improve adherence, especially for busy patients or athletes. We chose a polymer blend that forms smooth films, resists tearing, and slows release without irritating skin. To match daily routines, we targeted comfortable wear times of six to eight hours, allowing use during normal work or training. The PET backing limited stretch and kept edges flat inside footwear.

OBJECTIVES

1. Formulate a flexible HPMC/PCL matrix loading terbinafine as the primary antifungal.
2. Achieve sustained release and meaningful permeation while avoiding maceration or stinging.
3. Characterize thickness, strength, moisture, content uniformity, release kinetics, antifungal performance, and early tolerability in animals.

METHODOLOGY

HPMC was dissolved in ethanol under steady stirring until clear; PCL was dissolved separately in dichloromethane. Solutions were blended at roughly 60:40 (HPMC:PCL) with solids near nine percent by weight. PEG-400, at about seven percent of polymer mass, softened the film; oleic acid, at or below two percent, aided permeation. Terbinafine hydrochloride was introduced to yield one percent in the dry film. The mixture was sonicated for five minutes to remove bubbles, allowed ten minutes to degas, then cast on silicone-coated liner using a doctor blade set near 350 micrometers.

Drying proceeded in a ventilated oven at forty-two to forty-five degrees Celsius for two hours and continued overnight in a desiccator. Films were laminated to PET backing, cut to two to four square-centimeter patches, and inspected for clean edges.

Thickness was read at several points with a micrometer; tensile strength and elongation were measured by a strip test on a texture analyzer to confirm flexibility over curved toe webs. Moisture content was determined gravimetrically; a brief water immersion assessed swelling and maceration risk. For content uniformity, discs from different regions were extracted in methanol and assayed by HPLC using a C18 column with acetonitrile–water mobile phase and ultraviolet detection around two hundred twenty-four nanometers.

Release was studied in Franz cells at thirty-two degrees Celsius with phosphate buffer plus twenty percent ethanol to maintain sink conditions; synthetic membranes were used first, followed by porcine skin. Samples were taken up to eight hours, replaced with fresh medium, and analyzed by HPLC to calculate cumulative release, flux, and permeability coefficients.

Antifungal activity was tested by agar diffusion against Trichophyton rubrum and Candida albicans, reading zones at twenty-four and forty-eight hours. Minimum inhibitory concentration was obtained by broth microdilution using extracts normalized to drug content. A small rodent model with superficial infection, under ethical oversight, was used to observe local tolerability, adherence time, and lesion score. Accelerated stability at forty degrees Celsius and seventy-five percent relative humidity for one month tracked appearance, flexibility, and assay. Adhesion was profiled by a peel test at ninety degrees, recording force needed to lift a corner after two hours. Surface pH was measured by indicator strips to confirm near-skin values.

KEY FINDINGS

Films were smooth, uniform, and easy to handle. Drug content met target uniformity, and release profiles showed sustained delivery across several hours. Porcine skin studies indicated useful permeation. Agar plates displayed clear inhibition zones, and MIC values matched terbinafine expectations. Patches adhered comfortably without notable maceration during typical wear. Short accelerated stability supported physical and chemical robustness.

CONCLUSION

The HPMC/PCL patch carrying terbinafine delivered drug steadily to affected skin and simplified the routine for Tinea pedis. Procedures use accessible materials and reproducible steps, supporting further optimization of enhancer levels, backing choices, and longer stability, followed by clinical evaluation.

REFERENCES

1. PTAK, Anita, and Michał SZYC. "Athlete's Foot: A Common Fungal Infection in Athletes and Beyond. The Use of Terbinafine in Treating Tinea Pedis and Onychomycosis." Quality in Sport 34 (2024): 56195.
2. Li, M., Chen, X., Su, X., and Gao, W. "Hydrochloride Hydrogel Patch with Iontophoresis-Assisted Release of Terbinafine for Transdermal Delivery." Gels 10.7 (2024): 456.