

Formulation and Evaluation of Medicated Nail Lacquer for the Treatment of Onychomycosis

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ABSTRACT :

This research project develops in to the development and assessment of a novel therapeutic approach for onychomycosis through the “

FORMULATION AND EVALUATION of medicated nail lacquer. Recognizing the limitations of current treatments, the study seeks to optimize a pharmaceutical-grade nail lacquer, integrating antifungal agents and enhancers to improve drug delivery to the nail matrix. The formulation process prioritizes stability, aesthetic appeal, and therapeutic efficacy.

Physicochemical parameters ,including viscosity, drying time ,drug content ,and pH,will be meticulously characterized to ensure the lacquer quality and performance .In vitro drug release studies will simulate the nail environment ,unveiling the susustained release profile of the antifungal agent and providing insights into release kinetics .

The project extends its investigation to assess antifungal activity using microbiological techniques ,while clinical trials involving onychomycosis patients will evaluate the lacquers safety ,tolerability,and therapeutic effectiveness. Compartive analysis with existing treatments will be conducted ,shedding light on potential advantages and improvements. Through patients compliance surveys and interviews ,the study aims to gauge the acceptance of the medicated nail lacquer ,emphasizing factors influencing adherence to the prescribed treatment regimen.

I. INTRODUCTION :

Onychomycosis, a prevalent fungal infection affecting the nails ,poses significant challenges in its treatment .Current therapeutics approaches ,including topical and oral antifungal, have limitations such as prolonged trearment duration and variable success rates. This research

project, titled “FORMULATION AND EVALUATION of medicated Nail Lacquer for Onychomycosis” aims to address these challenges by developing an innovative drug delivery system .The project focuses on optimizing a pharmaceutical-grade nail lacquer, integrating potent anti fungal agents and enhancers to enhance therapeutic efficacy. Through physicochemical characterization and invitro drug release studies,the study seeks to ensure the lacquers stability and sustained release profile. Clinical trials involving onychomycosis patients will assess the lacquer safety, tolerability, and real-world effectiveness, offering a potential breakthrough in onychomycosis management. Comparative analyses with existing treatments aim to highlight the lacquers advantages, contributing valuable insights to the field of onychomycosis treatment.

MATERIALS :

- 1.Miconazole nitrate
- 2.Salicylic acid
- 3.Thioglycolic acid
- 4.Urea
- 5.Hydrogen peroxide
- 6.Ethyl cellulose
- 6.All other chemicals used were of analytical grade.

METHODS :

Nail lacquer is prepared in 10 different formulations. In all ten formulations the weight of Miconazole(2%)is kept constant.

- 1.F1,F3,F4,F5:Different concentrations of salicylic acid is used.
- 2.F6,F7:Enhancers used are 4.5% and 10% urea in hydrogen peroxide .
- 3.F8:5.5% Propylene glycol added.
- 4.F9:Ethyl cellulose at a concentration of 0.27%

5. Ethyl cellulose concentration increased to 0.6% sustaining drug release for 48 hrs.

PREPARATION OF NAIL LACQUER :

- ❖ Miconazole nitrate and Nitrocellulose dissolved in ethyl alcohol using Magnetic stirrer.
- ❖ Salicylic acid, thioglycolic acid, urea in hydrogen peroxide, and propylene glycol thoroughly mixed with the clear solution.
- ❖ The prepared nail lacquer transferred to a narrow-mouthed, plastic screw-capped glass bottle.

EVALUATION OF NAIL LACQUER:

• NON VOLATILE CONTENT:

10 ml of the sample non volatile content was measured and placed in a petri dish, and the initial weights were documented. Subsequently, the petri dish was introduced into an oven set at 105°C for one hour. After this period, the petri dish was taken out, allowed to cool and reweighed. The variance in weights was carefully recorded, and the average of three replicate measurements was documented.

• DRYING TIME :

A layer of the sample was administered onto a petri dish using a brush. The duration required for the formulation of a film that was dry to the touch was observed using a stopwatch.

• SMOOTHNESS TO FLOW:

The sample was dispensed from a height of 1.5 inches onto a glass plate, spread across its surface, and elevated vertically.

• GLOSS:

Nail lacquer sample was administered onto the nail, and the glossy appearance was visually observed, making a comparison with commercially available cosmetic nail lacquer.

• DRUG CONTENT ESTIMATION

Dissolve 200mg of nail lacquer in 50 ml of pH 7.4 phosphate buffer solution. Subsequently, ultrasonicate the solution for 15 minutes. After ultrasonication, filter the resulting solution and adjust the volume to 100 ml using phosphate buffer solution of pH 7.4. Take 10 ml from this solution and dilute it to 100 ml with pH 7.4 phosphate buffer solution. The diluted solution is then quantitatively analyzed spectrophotometrically at

a wavelength of 223 nm to determine the drug content.

• DIFFUSION STUDIES ACROSS ARTIFICIAL MEMBRANE :

Franz diffusion cell was employed for conducting diffusion studies, using an artificial membrane (cellophane) with a pore size of 0.8 μm. The membrane underwent a 24-hour soaking period in the solvent system, and the receptor compartment was filled with the solvent. Application of nail lacquer, equivalent to 200mg, was uniformly distributed on the membrane surface. Following this, the prepared membrane was meticulously mounted onto the cell to prevent the entrapment of air bubbles underneath. The entire assembly was consistently maintained at 37°C, with a constant stirring speed for a duration of 20 hours. At time intervals of 2, 4, 6, 8, 10, 12, 16, and 20 hours, 5ml aliquots of the drug sample were withdrawn and replaced with fresh solvent. Subsequently, the samples were analyzed using a double beam UV spectrophotometer, adhering to the method outlined for drug content estimation. This entire experimental procedure was replicated thrice.

• INVITRO UNGUAL PERMEATION STUDIES :

Hooves obtained from recently slaughtered cattle, devoid of any adhering connective and cartilaginous tissue, were immersed in distilled water for a period of 24 hours. Membranes, approximately 1mm in thickness, were subsequently excised from the distal part of the hooves. In vitro permeation studies were conducted using a Franz diffusion cell, with hoof membrane meticulously mounted onto the cell. Following this, nail lacquer equivalent to 200mg was uniformly applied to the surface of the nail membrane. The receptor compartment was filled with a solvent, specifically phosphate buffer solution with a pH 7.4, and the entire assembly was consistently maintained at a temperature of 37°C with continuous stirring for 48 hours. Drug analysis was performed using a double beam UV spectrophotometer at a wavelength of 223nm.

• DETERMINATION OF ANTI-MICROBIAL ACTIVITY.

Candida albicans were utilized in assessing antifungal activity through the cup-plate method. The culture was sustained on Sabouraud's agar medium, which was inoculated with a 0.2 ml suspension of 72-hour-old *Candida albicans* and left undisturbed for 15 minutes to set. Subsequently

, cups with a diameter of 10mm were perforated in the petri dish and filled with 0.05ml of a sample solution dissolved in DMSO. The plates were subjected to diffusion at +40°C for 1 hour and then incubated at 30°C for 48 hours.

II. RESULTS AND DISCUSSION :

The aim of this study was to develop a nail lacquer for preventing fungal growth on or beneath toenails or fingernails ,aiming to enhance their appearance. The formulation comprised nitrocellulose as a film former ,permeation enhancers like urea in hydrogen peroxide and propylene glycol,salicylic acid as a keratolytic agent ,and the anti fungal agent Miconazole nitrate in ethanol. The preparation method involved a simple mixing approach. All formulations exhibited desired film formation ,smooth flow, and satisfactory drying times ,except for formulation F2 ,which showed increased drying time due to the permeation enhancer thioglycolic acid .

The nonvolatile matter content ranged from 34% to 40%,showing the desired amount after the complete evaporation of volatile components, resulting in a thin film.Drying times ranged from 52 to 65 seconds,except for F2.Formulation F2 ,however, displayed a stickier film due to the film –forming nature of thioglycolic acid compared to marketed cosmetic lacquers.

Smoothness of flow and gloss were satisfactory for all formulations except F2.The drug content for all lacquers was between 90.9-99%,indicating a high amount of drug without compromising the lacquers ideal properties.

In vitro diffusion studies demonstrated excellent drug release ,particularly in F9,attributed to the hydration and permeation properties of propylene glycol.F9 was selected as the optimized nail lacquer due to its superior characteristics. The outcomes reveal a superimposable diffusion release profile ,underscoring that the artificial cellophane membrane effectively emulates the characteristic features of the ex vivo bovine hoof membrane.

III. CONCLUSION :

The Miconazole nail lacquer proved effective in hindering the growth of nail fungi, specifically candida albicans and exhibited desired zones of inhibition,supporting the potential reapplication of the formulation at intervals to sustain a certain level of inhibition for effectively treating the fungal infection. The examined enhancer, propylene glycol, along with the keratolytic agent urea in H₂O₂,facilitated the

permeation and penetration of Miconazole into the nail plate.Stability tests indicated that the formulations remained stable at 40° for a duration of 1 month .Considering all the data ,it can be inferred that medicated nail lacquers serve as a viable tool for ungual drug delivery in onychomycosis treatment .Beyond their therapeutic utility for nail infections ,these lacquers can also be employed for nail beautification ,offering easy application ,thereby enhancing patient compliance and acceptability.

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