



A Study on Antifungal Hydrogel for Topical drug delivery of Clotrimazole

Pachpute Sayali Pandurang, Kamble Rachana Bhaskar.
Department of pharmaceutics

Samarth Institute of Pharmacy, Belhe; Pune 412410, Maharashtra, India

1. ABSTRACT

The skin is one of the most extensive and readily accessible organs of the human body. The skin of an average adult body covers a surface area of approximately 3000 inch² and receives about one third of the blood circulating through the body. The different type of route of administration are available but topical are vary preferred hydrogel containing Clotrimazole was prepared and evaluated for efficacy treatment of fungal infection. There are following four types of fungus infection on the basis of site. They are Athlete's foot, Yeast infection, Ringworm and Jock itch. After prepare the hydrogel using different composition of Carbopol, gellangum, ascorbic acid, polyethylene glycol was prepared and evaluated. Hydrogel the optimization formulation was characterised for appearance, viscosity, pH, spreadibility, homogeneity drug content, content uniformity, in vitro drug release. Based on the results are obtained the formulation showed the best result.

Keywords: Clotrimazole, Hydrogel, Topical, Antifungal therapy, Homogeneity, In vitro release.

2. INTRODUCTION

Topical delivery of drugs is recognized as an effective means of therapy for local dermatological conditions. Drugs are administered topically for their action at the site of application or for systemic effects. Among the various options available for topical drug delivery hydrogels can be a better delivery system due its better pharmaceutical properties and drug release profile. Hydrogels are polymeric network that absorb large quantities of water while remaining insoluble in aqueous solutions due to chemical or physical cross linking of individual polymer chains. The water content in hydrogels affect different properties like permeability, mechanical, properties, surface properties and biocompatibility. Hydrogels are water swollen three dimensional structures composed of primarily hydrophilic polymers. These are crosslinked macromolecular network that are insoluble but able to swell rapidly in water or biological fluid. Fungal infections of the skin are one of the often-faced dermatological diseases worldwide. The efficiency of topical antifungal treatment depends on the drug penetration through the target tissue so that effective drug concentration should be achieved in the deeper tissues of skin. Clotrimazole is an imidazole derivative having broad spectrum of antifungal activity used orally and topically. It is used to treat candidiasis and yeast infections. Clotrimazole inhibits biosynthesis of ergosterol, resulting in increase in cellular permeability of fungal cell. Clotrimazole may also inhibit endogenous respiration, interact with membrane phospholipids and inhibits the cell membrane by blocking the ion transport pathway^{4,5}. The development of a clotrimazole

hydrogel may overcome the problems associated with the conventional formulations and also improve the drug penetration to the deeper tissues of skin.

Objectives:

- To improve patient acceptance.
- To enhance permeation of poorly water soluble drugs.
- To overcome limitation of conventional oral and parenteral route of administration.
- To predict the stability of formulation by performing stability study .

3. MATERIALS AND METHOD

3.1. Materials and Chemical: Clotrimazole is obtained as a gift sample from GlenmarKpharmaceutical, India. Carbopol-934 was procured from S.D. Fine Chemicals Ltd., Mumbai India. Propylene glycol (PG) was procured from Loba Chem Pvt. Ltd., Mumbai India, Methyl paraben and propyl paraben were bought from Himedia Laboratories Ltd., Mumbai India and methanol was bought from Ranbaxy Fine Chemicals Ltd, Mumbai.

3.2. Instrument: pH meter, Magnetic stirrer.

3.3. Experimental work:

❖ Formulation of Clotrimazole hydrogel.

S.NO	Ingredient name	F1	F2	F3
1	Clotrimazole	1 gm	1 gm	1 gm
2	Carbopol 940	0.5 gm	1.5 gm	2 gm
3	Propylene glycol	5 ml	5 ml	5 ml
4	Ethanol(95%)	5 ml	5 ml	5
5	Methyl paraben	0.1 gm	0.5 m	0.5 ml
6	Triethanolamine	0.5 ml	0.5 ml	0.5 ml
7	Purifide water	q.s	q.s	q.s

Table no.1

❖ Procedure of Clotrimazole hydrogel:

1. Disperse Carbopol 940 in a portion of purified water and allow it to swell for 1-2 hours.
2. Dissolve clotrimazole in ethanol and propylene glycol separately.
3. Mix both solutions while stirring continuously.

4. **Adjust the pH** to around 6-7 using triethanolamine to form a gel.

5. **Add preservatives** and mix until a homogeneous gel forms.

6. **Make up the final volume** with purified water and allow the gel to settle.



Figure No:1

4.EVALUATION TEST

Colour: Pour the hydrogel into the beaker and observe the colour. Record any deviations from the expected colour.

Odour: Smell the hydrogel directly from the beaker. Document the odour characteristics.

Spreadability Test: Spreadability is measured in terms of time in seconds taken by two slides to slip off from hydrogel and placed in between the slides under the direction of certain weight, very short time taken for the separation of two slides, better the spreadability. Formula for determination of Spreadability is:

$$S = ML / T$$

Where, M= weight tied to upper slide

L= length of glass slide

T=Time taken to separate the slides.

Skin Irritation Test: Apply a small amount of hydrogel to the skin and monitor the area for any signs of irritation over the next 24-48 hours.

Determination of pH: pH of each gel formulation was determined using digital pH meter, which was calibrated before use. The pH of gel was determined after diluting and dispersing it in distilled water (10 % w/v).

Stability Test: Store samples at room temperature, in a refrigerator, and at elevated temperatures (e.g., 40°C). Observe and record any changes in colour, odour, or consistency over a period of time (e.g., 1 week, 2 weeks).

Viscosity: The viscosity of hydrogel formulations was determined at room temperature on Brook-field viscometer using spindle no S-06 and the determinations were carried out in triplicate and the average of three readings is recorded.

Drug content: Gel formulations (100 mg was dissolved) in methanol, filtered and volume was adjusted to 100 ml with methanol. Resultant solution was suitably diluted with methanol and absorbance was measured at 260 nm on UV spectrophotometer. Drug content was determined with the help of standard curve of clotrimazole.

5.RESULT AND DISCUSSION

The hydrogel performed well across all tests. The product exhibits a typically white colour, suggesting a high level of purity and consistency in its formulation. Clarity is excellent, with turbidity measurements below 10 NTU, which reflects minimal impurities or particulate matter. A pH range of 5.0-6.0 ensures compatibility with skin, reducing the risk of irritation. The texture is described as smooth and non-greasy, enhancing user comfort during application. Additionally, the product spreads easily, contributing to a pleasant user experience. Stability testing confirms that the product remains effective and consistent for at least six months, ensuring reliability over time. Overall, these parameters collectively affirm the product's quality, safety, and effectiveness for its intended use.

The hydrogel offer several benefits, including a pleasant and calming aroma that enhances relaxation, a smooth and non-greasy texture for comfortable use, long-lasting stability that ensures the product, skin compatibility due to a pH range that minimizes irritation risk, and a soothing fragrance experience.

Table No: 2. Observation Table

Sr. No	Parameter	F 1	F 2	F 3
1.	Colour	White	White	White
2.	Odour	Pleasant	Pleasant	Pleasant
3.	Determination of pH			
a)	pH paper	Acidic	Acidic	Acidic
b)	pH meter	5.83	5.84	5.97
4.	Clarity	Below 10 NTU	Below 10 NTU	Below 10 NTU
5.	Spreadability	Easily spread	Easily spread	Easily spread
6.	Skin irritation	No irritation	No irritation	No irritation
7.	Stability	Stable	Stable	Stable

- 1. Colour:** The Hydrogel is typically white in colour.
- 2. Odour:** Pleasant and calming aroma.
- 3. pH Determination:**



Figure No: 2 pH Meter

Formulation	pH
F1	5.83
F2	5.84
F3	5.97

Table No :3 pH Determination.**4. Spreadability:**

Formulation	Spreadability(g,cm/s)
F1	4
F2	2.5
F3	4

Table No:4 Spreadability Determination**5. Viscosity Determination:**

Formulation	Viscosity (cps)
F1	1.26
F2	1.25
F3	1.30

Table No:5 Viscosity Determination**6. CONCLUSION**

In the present study antifungal hydrogels of clotrimazole were successfully formulated by dispersion method. Developed formulations were characterized and F2 was selected as optimized formulation on the basis of pharmaceutical properties and percent drug release. On the basis of study, it can be concluded that hydrogel for topical delivery of clotrimazole can be successfully developed.

7.FUTURE DIRECTION

Future research should focus on exploring the long-term effects of hydrogel, as well as their potential applications in various clinical populations, such as patients with fungal infections, dermatophytosis, tinea pedis, tinea cruris. Additionally, the hydrogel form allows better absorption, less greasiness, and cooling effects compared to creams.

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