Formulation and Evaluation of Herbal Antifungal Ointment

Ms. Pallavi D Kathar[1], Ms. Khushi S Khade[2], Miss. Priya K Jaware[3], Miss. Ashwini S Pundkar[4], Mr. Kaushik K Kamble[5]

[1,2,3,4,5]*Rajesh Bhaiyya tope collage of B pharmacy Nipani, Bhalgaon, Chh. Sambhajinagar*

Abstract: Antifungal ointments, noted for their natural therapeutic potential and minimal side effects, have emerged as viable alternatives for treating various skin conditions. This study focused on the formulation and evaluation of a herbal ointment designed specifically for its antifungal properties, utilizing Azadirachta indica (Neem) as the primary active ingredient, known for its medicinal advantages. The formulation process involved extracting bioactive compounds from Neem and integrating them into a suitable ointment base. A comprehensive evaluation of the prepared herbal ointment was conducted to assess its antifungal efficacy. The experiments aimed to determine the ointment's effectiveness in inhibiting fungal markers, specifically targeting conditions such as eczema, lichens, and ringworm. The results indicated a substantial reduction in pro-inflammatory markers, suggesting the ointment's potential to modulate the body's response to fungal infections. Additionally, the ointment's safety and skin compatibility were significant considerations; findings demonstrated a noteworthy decrease in inflammation-induced edema and redness following application, further supporting its therapeutic benefits. In summary, the developed herbal ointment employing Azadirachta indica displayed promising antifungal effects, establishing it as a potential natural remedy for fungal skin issues. The extensive evaluation underscored its viability in dermatological care and suggested the necessity for further clinical trials to assess efficacy in human subjects and to optimize the formulation for commercial production. This research adds to the increasing evidence favoring the use of herbal ointments as effective and safe alternatives in dermatological treatments.

Keywords: Antifungal, Azadirachta indica (neem), Bioactive Compounds, Eczema, Lichens, Ringworm.

I. INTRODUCTION

Fungal infections of the skin are prevalent dermatological disorders that affect individuals of all ages globally, caused by various pathogenic fungi like dermatophytes, yeasts, and molds. Common conditions include candidiasis, ringworm, and athlete's foot, which lead to discomfort and have a significant impact on affected individuals' quality of life. The rise in fungal infections in warm, humid climates has elevated these infections to a major public health concern.

Current antifungal therapies primarily rely on synthetic drugs such as azoles, polyenes, and allylamines, often used in topical forms. While effective, these treatments have limitations, including skin irritation, allergic reactions, drug resistance, systemic side effects, and high costs, which have led to a search for safer and more cost-effective alternatives. Herbal medicines, known for their traditional use and lower side effect profiles, have attracted attention. Medicinal plants contain bioactive compounds flavonoids, alkaloids, tannins, terpenoids, phenolic compounds, and essential oils that possess antifungal and other beneficial properties. Traditional medicine systems have utilized these herbal remedies for skin infections, paralleling a global trend toward natural products.

Topical drug delivery systems, particularly ointments, are crucial for treating skin infections, allowing higher local concentrations of drugs and reduced systemic exposure. Ointments are favored for their ease of use and effectiveness in delivering active ingredients directly to affected areas. Herbal ointments combine effective topical bases with the therapeutic potential of plant-derived compounds. The formulation of such ointments requires careful selection of herbal extracts

and excipients to ensure safety, stability, and patient acceptability, while also necessitating thorough evaluation of physicochemical and biological properties[1].

Key evaluation parameters include appearance, spreadability, viscosity, drug content uniformity, moisture content, skin irritation potential, and antifungal activity, measured through methods like the agar well diffusion technique. This study emphasizes the development of herbal antifungal ointments, focusing on the formulation and evaluation of selected herbal extracts renowned for their antifungal impact. The goal is to create an effective and stable herbal preparation that could serve as an alternative to conventional antifungal treatments, thereby contributing to the field of herbal drug delivery systems.

In conclusion, the research on herbal antifungal ointments signifies an essential progression towards effective natural therapies, addressing the shortcomings of synthetic antifungal agents while catering to the rising demand for herbal on eco-friendly medicinal products. The findings may provide a scientific foundation for further exploration into herbal antifungal formulations, promising a viable option for managing superficial fungal infections.

Herbal remedies also known as botanical medicine, are made from a variety of plants, including seeds, roots, leaves, bark and flowers and are used for a variety of therapeutic purpose Herbal medicine has long been used outside of orthodox medicine, but as new analysis and research demonstrate its benefits for both disease treatment and prevention, the practice is becoming more widely accepted. Plants that have long been used medicinally have been documented in history Herbs were used in healing rituals by indigenous cultures, and others were developed in conventional medical systems that employed herbal therapies on a systematic basis. Herbs are frequently combined to increase their efficacy, promote synergistic effects, and lessen their toxicity. They are further divided into three categories based on the degree of action[2]:

- Diadermic
- Epidermatic
- Endodermic

The goal of an antiseptic ointment is to inhibit or eradicate bacterial growth. (Chhetri et al., 1970). Petroleum and mineral oil, petroleum and waxes or petroleum and fatty alcohol combinations are common ointment bases. An ointment base is the vehicle for an ointment. The clinical indication for the ointment. Determines the base to be used. The different types of ointment bases are:

- Absorption base
- Emulsifying base
- Hydrocarbon base
- Vegetable oil base
- Water-soluble base

Evaluation of Ointment Formulations

Colour and Odour Physical parameters like colour and odour were examined by visualexamination.

Consistency The consistency and color of the ointment formulations were visually inspected.

Extrudability: Extrudability is a measure of the ease with which the ointment can be extruded from a tube or applicator. The extrudability of each ointment formulation was determined using a modified texture analyzer (Stable Micro Systems, India). A cylindrical sample of the ointment weighing 2 g and measuring 2 cm in height and 2 cm in diameter was placed in the apparatus. The probe of the texture analyzer was lowered onto the surface of the ointment sample with a force of 5 N, and the distance that the probe traveled into the sample was measured over a period of 30 seconds. The extrudability was calculated as the distance traveled by the probe in centimeters during the 30-second period. The experiment was performed in triplicate, and the mean extrudability value was calculated for each ointment formulation. three times, with the average value being computed[3].

Spread ability: Spreadability was measured using a modified slide method. A glass slide was coated with a thin layer of the ointment, and a second glass slide was placed on top of the first slide. A weight of 100 g was placed on the top slide for 5 minutes to allow the ointment to spread. The diameter of the spread circle was measured using a Vernier caliper. The spreadability was calculated using the following formula

$$Spreadability = (M \times L)\, T$$

Where, M is the weight in grams placed on the top slide, L is the length of the spread circle, and T is the time in seconds taken for the top slide to move a distance of 7.5 cm. Three measurements were taken for each formulation, and the mean value was calculated[4].

Viscosity: The viscosity of the ointment formulations was measured using a Brookfield viscometer (DVII+ Pro). The spindle used was S-64, and the speed was set at 10 rpm. Approximately 10 g of the ointment was placed in the sample chamber of the viscometer, and the spindle was lowered into the sample. The viscosity reading was taken after 30 seconds of immersion. Three readings were taken for each formulation, and the mean value was calculated. The viscosity measurements were reported in centipoise (cps).

Qualities of the Perfect Ointment[5-8]

1. The ointment can be grit-free and smooth.
2. The base for the ointment shouldn't be medicinal in any way.
3. It must possess both chemical and physical stability.
4. The active ingredients in the ointment base should be evenly distributed after being finely split.
5. It should be easily applied and melt and soften at body temperature.
6. It shouldn't stop a wound from healing.

Qualities of the Perfect Ointment Base[9-11]

1. Non-stimulating, non-sensitizing, inert, and odorless
2. Harmonious with the pH of the skin and the integrated medication.
3. Effective emulsifier or solvent.
4. Non-greasy, moisturizing, protective, and readily removable.
5. Easily release medication where it is applied...
6. It should not retard healing of wound.

Table. No 1 Materials and Methods[12-14]:

Ingredient	Uses	Quantity
Neem	Anti-bacterial	5g
Garlic	Anti-oxidant	2.5g
Honey	Treating fungal skin infection	2.5ml
Aloe vera gel	Skin soothing	5ml
Coconut Oil	Moisturizing agent	2tbsp
Beeswax	Thickening agent	4.5g
Camphor	Anti-fungal activity	0.1g
Rose water	Vehicle and fragrance	2.5ml
Propylene alcohol	Antiseptic / disinfectant	6ml
White soft paraffin	Emollient	5.5g
Salicylic acid	Treat skin condition	2.5ml
Cetosteraryl alcohol	Emulsifier	5g
Propyl paraben sodium	Use as preservative	0.15g
Menthol crystal	Soothe skin irritation	2.5g
Liquid paraffin	Treat dry skin condition	4ml
Water	Homogeneous Distribution	2-3ml for 50g

II. METHODS

1. Weigh all ingredients accurately.
2. Separately prepare oil phase & aqueous phase.
3. For aqueous phase add neem, garlic, honey, aloe vera gel, propylene alcohol, rose water into distilled water.
4. For oil phase add white soft paraffin, salicylic acid, menthol crystals, bees wax, camphor into liquid paraffin.
5. Heat both phases till their temperature are same such as 60 to 75°C.
6. Then add aqueous phase into oil phase & add cetostearyl alcohol and mix continuously till thick mixture is formed.
7. Store mixture (ointment) into well closed container.

❖ Evaluation test of herbal antifungal ointment[15-20]

- ➢ Appearance
- ➢ PH determination
- ➢ Spreadability
- ➢ Viscosity
- ➢ Drug content

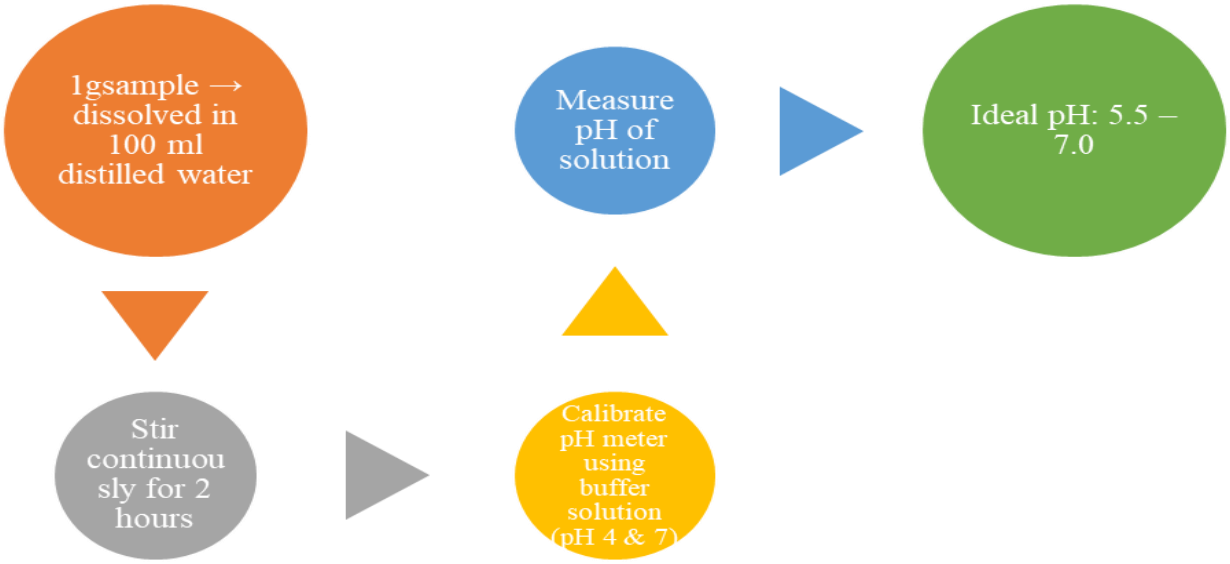
- ➢ Antifungal Activity
- ➢ Skin Irritation
- ➢ Extrudability

❖ Appearance
- No chemical
- Colour, odour, texture
- Rub between fingers to check smoothness

1. Colour : white greenish
2. Odour : Characteristics (herbal)
3. Texture :smooth and creamy consistency
4. Result: Indicate good formulation quality

❖ PH determination :6.8
- Water
- Digital pH meter

❖ Procedure:



1. Result : PH is within skin -friendly rang (5.5-7.0)

❖ Spreadability
- Weigh ointment (20–50 g)
- Place ointment between two glass slides
- Apply known weight on the upper slide
- Measure time taken to move a fixed distance

Where:
- M = Weight applied
- L = Length moved
- T = Time taken

1. Weight = 50g
2. Distance (cm) = 7.5
3. Time (sec) = 12
4. Spreadability (g.cm /s) = 31.25
5. Result: Ointment spread easly on skin

❖ Viscosity
- Fill sample container with ointment
- Fix suitable spindle
- Rotate at specific RPM
- Record viscosity in centipoise (cP)

Table. No 2: Evaluation Parameters of Herbal Ointment[20-23]

Test / Parameter	Details	Result / Observation
Viscosity Measurement	Instrument: Brookfield Viscometer Spindle: S-64 Speed: 10 RPM Viscosity: 18,500 ± 300 cp	Shows good consistency and spreadability
Drug Content Uniformity	Drug content: 98.4 ± 1.2 %	Uniform distribution of herbal extract
Antifungal Activity	Media Used: Sabouraud Dextrose Agar (SDA) Sabouraud Dextrose Broth Normal saline Herbal ointment sample Standard drug (Clotrimazole)	—

Test Microorganisms	Candida albicans Aspergillus niger Trichophyton rubrum	—
Method	Agar Well Diffusion Method Incubation: 25–28 °C for 48–72 hours Measurement: Zone of inhibition (mm)	—
Antifungal Result	Comparison with standard drug and blank base	Herbal ointment shows significant antifungal activity
Skin Irritation Study	Test animals: Albino rats / rabbits Application: Daily for 7 days on shaved dorsal skin Observation parameters: Redness, swelling, inflammation	No redness, swelling, or inflammation observed

RESULT

The present study was carried out to prepare and assess the ointment formulation. The formulation showed no irritation, indicating that it is safe for topical application. Extrudability was evaluated by filling the ointment into a collapsible tube, pressing the tube with a constant weight, and measuring the amount of ointment extruded. The percentage of ointment extruded was found to be 92%, showing easy and uniform extrusion from the collapsible tube. Loss on drying was performed to determine the moisture content of the ointment by weighing 1 g of the sample, drying it at 105 °C for 2 hours, and reweighing it to calculate moisture loss. The moisture content was found to be 1.8% w/w, indicating low moisture content, which helps ensure the stability of the formulation[24-26].

Figure format:

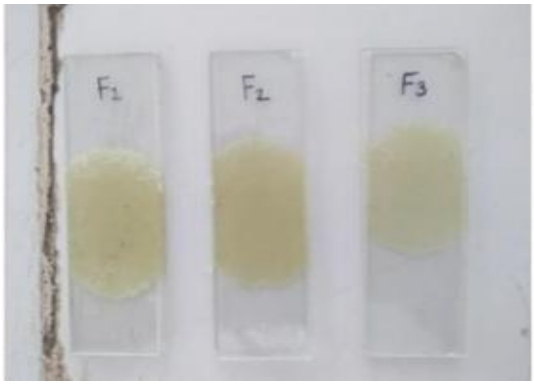


Fig.no.1 = Spreadability

Fig.no.2 = PH determination figure

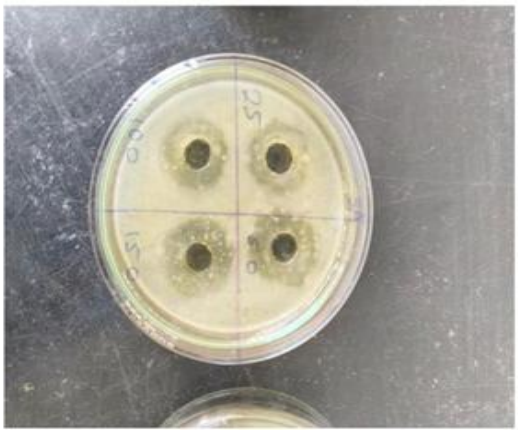


Fig.no.3 = Antifungal Activity figure

Fig.no.4 = Antifungal Ointment

Table. No3: Evalution test[27-29]

Test	Chemicals Used
Appearance	None
pH	Distilled water

Viscosity	None
Spreadability	None
Extrudability	None
Drug content	Methanol / Ethanol
Antifungal activity	SDA media
Skin irritation	Normal saline

III. DISCUSSION

Azardirachta indica (Neem) was used to make the ointment formulestions in various batches. In this instance, a straight forward extraction method was used to create a herbal extract with a good yield and no negative effects chemical constituents or on the were their activity. The ointment was made using the levigation method, which ensured that the herbal extract and ointment base uniformly mixed and would remain stable over time. The study satisfactory sfact of the physiochemical properties produced. by findings regarding the study of solubility. PH. consistency, spread ability wash ability non-irritancy. and viscosity. Extrudability and microbial growth

IV. CONCLUSION

The design, development, and evaluation of the herbal antifungal ointment were successfully carried out using selected herbal ingredients with known antifungal properties. The formulated ointment showed acceptable physical characteristics such as smooth appearance, uniform consistency, suitable pH, good spreadability, viscosity, and extrudability, making it convenient for topical application.

Evaluation studies confirmed that the ointment had satisfactory drug content and demonstrated effective antifungal activity against test organisms, indicating its therapeutic potential. Skin irritation studies revealed that the formulation was safe and non-irritant when applied topically. Stability studies further indicated that the ointment remained stable under specified conditions without any significant change in physical parameters or efficacy.

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