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Development and Characterization of Herbal Antifungal Cream Using Polyherbal Extracts

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Abstract: *Fungal skin infections are common skin disorders that lead to itching, redness, irritation, and discomfort. While synthetic antifungal medicines are often used for treatment, long-term use can cause side effects, resistance, and the recurrence of infections. Therefore, this study aimed to develop and characterize a herbal antifungal cream using a mix of extracts from Neem (Azadirachta indica), Tulsi (Ocimum sanctum), Aloe vera (Aloe barbadensis), Turmeric (Curcuma longa), and Garlic (Allium sativum). These plants are traditionally known for their antimicrobial and healing properties. The herbal extracts were prepared and mixed into a suitable cream base using the emulsification method. We evaluated the cream for various properties, including appearance, color, odor, pH, viscosity, spreadability, homogeneity, washability, and stability under different storage conditions. We assessed the antifungal activity of the formulation against common fungal strains using standard in vitro methods. The resulting polyherbal cream had good consistency, a smooth texture, an acceptable pH for skin application, satisfactory spreadability, and stability without separation. The formulation showed significant antifungal activity, likely due to the combined effects of the herbal extracts. The results suggest that this polyherbal antifungal cream could be a safe, effective, and cost-efficient natural option for treating fungal skin infections. Further clinical studies are needed to confirm its therapeutic effectiveness and safety in humans.*[4].

Keywords: *Fungal skin*

I. INTRODUCTION

1. General Description of Fungal Skin Infections

Fungal skin infections are the most prevalent type of infectious diseases that infect millions of individuals globally. They are brought about by various fungi, such as dermatophytes, yeasts, and molds, that invade the epidermis, hair follicles, and nails. The fungi require warm, humid, and moist environments for optimal growth; hence, they infect skin folds and sweaty body parts.The common fungal skin infections are Tinea corporis (ringworm), Tinea pedis (athlete's foot), Tinea cruris (jock itch), candidiasis, and onychomycosis (nail infections). These infections are transmissible and occur when one comes into direct contact with an infected person or touches contaminated clothes, towels, shoes, public places such as swimming pools, gyms, and locker rooms.

Common symptoms of fungal skin infections are:

- Itching and irritation
- Inflammation and redness
- A burning sensation
- Skin dryness and cracks
- Scaling or peeling
- Circular rashes
- Unpleasant smell
- Nails become thick and discolored

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Numerous factors predispose people to fungal infections, including poor hygiene, sweating, wearing tight clothes, diabetes mellitus, obesity, compromised immunity, prolonged use of antibiotics, and warm climate. Untreated fungal infections can spread to other body parts and cause frequent relapses.Chikungunya and Zika virus infections, although not as deadly, have made international headlines in recent years because of their quick spread and implication in long-term sequelae of arthralgia and congenital anomalies, respectively. Yellow fever and filariasis also continue to infect millions in spite of the fact that vaccines and prophylactics are available.Global warming, urbanization, and higher travel and migration rates have also helped expand the habitats and disease transmission areas of mosquitoes. It is for this reason that population control of mosquitoes and safeguarding people from bites continues to be an integral part of worldwide health planning.6

2. Limitations of Synthetic Antifungal Medications

Currently, fungal infections can be controlled through the use of man-made antifungals including clotrimazole, ketoconazole, miconazole, terbinafine, fluconazole, and itraconazole. These antifungals are available in forms such as creams, ointments, powder, pills, and shampoos. Although they effectively manage fungal infections, prolonged or repeated usage of these antifungals has certain disadvantages.One of the key drawbacks of synthetic antifungal medications is the possibility of fungi developing resistance to these drugs. Overuse of antifungals may make the fungus resistant to treatment, making it increasingly hard to control infections. In some cases, the infection recurs even after cessation of medication.

Side effects of antifungal creams or ointments are:

- Skin irritation
- Burning feeling
- Redness
- Dryness
- Peeling of skin
- Skin allergy

Some oral antifungals can have systemic side effects like damage to the liver, gastrointestinal discomfort, headache, and drug interaction. Moreover, these treatments can become quite costly over prolonged periods.For these reasons, attention is being paid to herbal remedies that are both effective and inexpensive.2

3. Importance of Herbal Medicines

Various medicinal plants were discovered from the ancient times that had therapeutic uses for treating various diseases, including skin ailments and infections. Several traditional medicine practices such as Ayurveda, Siddha, and Unani have mentioned the use of medicinal herbs for wound healing, protecting the skin, and antimicrobial activity.Herbal drugs are gaining popularity because of their naturally occurring origins and lesser side effects. Herbal medicines are considered safe, cost-effective, available easily, and also accepted socially. Many medicinal plants contain certain chemical components that have medicinal properties and referred to as phytoconstituents.

Some of the significant phytoconstituents that are found in medicinal plants are:

- Alkaloids
- Flavonoids
- Tannins
- Saponins
- Terpenoids
- Glycosides
- Phenolic compounds
- Essential oils

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The above-mentioned chemicals exhibit various biological activities such as:

- Antifungal activity
- Antibacterial activity
- Anti-inflammatory effect
- Antioxidant activity
- Wound healing activity
- Moisturizing effect
- Immunomodulatory effect

Herbal medicines are specifically helpful in the treatment of skin infections because they can target the local site of infection, as well as reduce inflammation and healing. Because of these benefits, topical formulations of herbal medicines such as cream, gel, and ointment are gaining prominence in pharmaceutical studies.7

Selection of Medicinal Plants for the Present Study :

Medicinal herbs have been traditionally appreciated for their therapeutic and protective abilities,

Neem (Azadirachta indica) :

Neem is well known for its strong antifungal, antibacterial, and anti-inflammatory properties. It contains active compounds such as azadirachtin and nimbidin. Neem is widely used in the treatment of skin infections.1

Turmeric (Curcuma longa) :

Turmeric contains curcumin, which has potent antifungal, antibacterial, anti-inflammatory, and antioxidant properties. It is traditionally used for various skin disorders.1

Aloe vera (Aloe barbadensis) :

Aloe vera is known for its soothing, moisturizing, wound-healing, and anti-inflammatory actions. It helps reduce irritation and promotes skin repair.1

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Tulsi (Ocimum sanctum) :

Tulsi possesses antimicrobial, antioxidant, and anti-inflammatory properties. It contains eugenol and other phytoconstituents effective against various microorganisms.1

Garlic (Allium sativum) :

Garlic contains allicin, a sulfur-containing compound known for strong antifungal and antibacterial activity. It is useful against many fungal species.1

Materials and Methods :

Materials used :

Sr. No.	Ingredient	Quantity (% w/w)	Function
1	Polyherbal extract (Neem, Tulsi, Aloe vera, Turmeric, Garlic)	5%	Active antifungal agent
2	Stearic acid	10%	Emulsifying agent
3	Cetyl alcohol	2%	Thickening agent, stabilizer
4	Liquid paraffin	5%	Emollient
5	Glycerin	5%	Humectant (moisturizer)
6	Triethanolamine	1%	pH adjuster, emulsifier
7	Methyl paraben	0.2%	Preservative
8	Propyl paraben	0.1%	Preservative
9	Distilled water	q.s. to 100%	Vehicle

Polyherbal Extracts Preparation

1. Collection and Grinding of Plants

Fresh leaves of Neem (Azadirachta indica), Tulsi (Ocimum sanctum), Aloe vera (Aloe barbadensis), Curcuma (Curcuma longa) rhizomes, and garlic (Allium sativum) cloves were gathered and cleaned with distilled water to get rid of dust particles and any other forms of contamination.

After drying under shades for some days, leaves of Neem, Tulsi, and Turmeric were ground. Leaves of Aloe vera and garlic were collected fresh.

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Neem, Tulsi, and Turmeric Extraction :

Dried powders of all the samples were subjected to Soxhlet extraction technique, ethanol being used as the extracting medium as follows:

- A measured quantity of powder was placed in the Soxhlet apparatus
- Extraction process was performed for 6-8 hours
- Filtered extracts were further reduced using a water bath
- Semi-solid extracts were collected and preserved in closed containers

Preparation of Aloe vera Extract :

- Aloe vera leaf samples were cut, and the inner gel was extracted.
- The gel extract was mixed in a blender.
- Filtration was carried out to eliminate fiber and other impurities.
- The gel extract was stored at cool temperatures.

Garlic Extract Preparation :

- Garlic cloves were peeled and minced at the same time.
- The minced sample was extracted using ethanol.
- The extract was then filtered and concentrated.
- The resulting semi-solid extract was stored for future use.

2. Polyherbal Antifungal Cream Formulation

The preparation of the antifungal cream involved the use of the oil-in-water (O/W) emulsion technique.

2.1 Preparation of Oil Phase

Stearic acid, cetyl alcohol, and liquid paraffin were accurately weighed and melted together in a beaker at 70–75°C until a uniform oily mixture was obtained.

2.2 Preparation of Aqueous Phase

In another beaker, distilled water, glycerin, methyl paraben, propyl paraben, and triethanolamine were mixed and heated to the same temperature (70–75°C) to form a uniform aqueous phase.

2.3 Emulsification

The aqueous phase was slowly added to the oil phase with continuous stirring. Stirring was continued until a smooth and stable oil-in-water emulsion was formed.

2.4 Incorporation of Polyherbal Extract

The prepared polyherbal extract was added gradually into the cream base with constant stirring to ensure uniform distribution of the active constituents.

2.5 Homogenization

The cream was subjected to homogenization using a mechanical stirrer to obtain a smooth, uniform, and stable formulation.

2.6 Cooling

The cream was allowed to cool at room temperature with continuous gentle stirring to avoid phase separation.3

Evaluation of Herbal Antifungal Cream :

1. Physical Appearance

Method:

The formulated cream was visually examined for its color, odor, and texture. A small quantity of cream was taken and observed under normal light conditions to check uniformity, smoothness, and presence of any grittiness or phase separation.

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Properties	Observation
Colour	Greenish Cream
Oduor	Characyeristic Herbal Odour
Appearance	Smooth

2. pH Determination

Method:

The pH of the cream was determined to ensure compatibility with skin. About 1 g of cream was dispersed in 100 mL of distilled water and allowed to stand for 2 hours. The pH was then measured using a calibrated digital pH meter at room temperature.

Test	Observation
pH value	6.2 ± 0.1

3. Irritancy test :

Method:

The cream was applied to a small area of skin and observed for 24 hours for any signs of irritation, redness, itching, or inflammation.

Test	Observation
Irritancy Test	Cream was found to be non-irritant

4. Spreadability test :

Method:

Spreadability was determined by placing a fixed amount of cream between two glass slides. A known weight was placed on the upper slide and the time taken for the slides to separate was recorded. Spreadability indicates ease of application on the skin.

Formulation	Spreadability (gcm/sec)
Anti-fungal cream	6.5 ± 0.3 g·cm/sec

5. Viscosity :

Viscosity is an important parameter in checking how thick or fluid the cream is. It also affects how the cream feels on the skin as well as how long it lasts on the surface without dripping. Viscosity was determined using a Brookfield viscometer at 25°C. Good consistency means the cream should neither be too runny nor too difficult to apply.

Result : The viscosity of the cream was found to be 21,500 cps, which suggests that the cream has a medium consistency, making it thick enough for an effective topical application but not so thick that it becomes difficult to spread.

6. Antifungal Activity Test :

Method:

Antifungal activity was evaluated using the agar well diffusion method. The prepared cream was introduced into wells on agar plates inoculated with fungal strains. After incubation, the zone of inhibition was measured in millimeters.

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Test Organism	Zone of Inhibition (mm)
Candida albicans	18 ± 1.2
Aspergillus niger	16 ± 1.0
Trichophyton rubrum	20 ± 1.5

Results and Discussion :

The findings of the different tests performed on the developed polyherbal antifungal cream reveal that the formulation possesses favorable physicochemical properties such as good homogeneity, suitable pH, adequate viscosity, and excellent spreadability. In addition, the cream exhibited significant antifungal activity against selected fungal strains, indicating its effectiveness for topical application in the management of fungal skin infections.

Sr. No.	Parameter	Result	Sr. No.	Parameter
1	Appearance	Smooth, uniform, light greenish cream	1	Appearance
2	Odor	Characteristic herbal odor	2	Odor
3	pH	6.2 ± 0.1	3	pH
5	Viscosity	28,500 ± 500 cps	5	Viscosity
6	Spreadability	6.5 ± 0.3 g·cm/sec	6	Spreadability
7	Washability	Easily washable	7	Washability

Discussion :

The present study focused on the formulation and evaluation of a polyherbal antifungal cream using extracts of Neem, Tulsi, Aloe vera, Turmeric, and Garlic. The developed formulation showed good physicochemical properties such as smooth appearance, acceptable pH, good viscosity, and adequate spreadability, indicating that it is suitable for topical application.

The pH of the cream was found to be within the skin-compatible range, suggesting that the formulation is unlikely to cause irritation. The viscosity and spreadability results confirmed that the cream has good consistency and can be easily applied on the skin surface. The formulation also showed good stability without any phase separation during storage.

The antifungal activity results demonstrated that the cream was effective against common fungal strains, which may be due to the combined action of the herbal extracts. The presence of bioactive compounds in Neem, Tulsi, Aloe vera, Turmeric, and Garlic contributes to the observed antifungal effect.

Overall, the findings indicate that the developed polyherbal antifungal cream is effective, safe, and suitable for further development as a topical antifungal formulation.

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