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Development And Evaluation Of An Herbal Antifungal Foot Cream Containing *Biophytum Sensitivum*

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ABSTRACT

The current research examines the preparation and evaluation of an herbal antifungal foot cream integrating *Biophytum sensitivum*, a traditionally treasured medicinal plant. Fungal infections of the feet, comprising athlete's foot, generally require extended topical treatment, while traditional synthetic antifungal agents may cause irritation, dryness, or sensitivity. To investigate a safer alternative, an ethanolic extract of the plant was prepared and subjected to prelim phytochemical screening, which established the presence of flavonoids, biflavones, isovitexin, phenolic compounds, saponins, and tannins affiliated with antifungal and antioxidant activity. Three cream formulations (F1, F2, and F3) comprising variable concentrations of the extract were formulated and evaluated for physicochemical parameters including pH, spreadability, homogeneity, consistency, and stability of all three formulation. Amongst the tested preparations, F3 exhibited ideal stability and adequate antimicrobial performance. The outcome suggest that the advanced herbal formulation retains potential as an efficient and skin friendly substitute for antifungal foot care applications.

Keywords: *Biophytum sensitivum*, antifungal foot cream, herbal cosmetics, phytochemical screening, topical formulation, stability evaluation, foot care formulation.

INTRODUCTION

Skin health is a fundamental element of overall benefit, and its disruption caused by microorganisms indicates a significant challenge in cosmetic. Among these, superficial fungal infections of the skin remain one of the most usual concerns requiring efficient topical administration. The skin of the feet is particularly, susceptible to fungal colonization due to repeated exposure to moisture, friction, and environmental pollution. The formation of safe, stable, and skin compatible topical antifungal formulation is essential to assure potent action, patient adherence, and long-term skin barrier defence.[1]

Fungal infections of the skin create a significant public health concern and are amongst the most repeatedly encountered dermatological conditions globally. In tropical and subtropical countries such as India, fungal foot infections are specifically widespread due to auspicious environmental conditions comprising of high humidity, raised temperatures, increased sweating, and extended blockage of the feet caused by footwear. These components produce an ideal micro habitat for the growth and endurance of pathogenic fungi. Common fungal foot infections include tinea pedis, athlete's foot, interdigital mycoses; they are characterized by itching, scaling, fissuring, erythema, and pain, often resulting in chronic and recurring infections if incorrectly treated.[2] The fungal foot infections go beyond physical symptoms; it may cause constant itching and inflammation significantly impact daily activity, professional application, and general quality of life.

In many cases, furthermore hindering of proper treatment causes secondary bacterial infections in the affected area. Frequent infections are increasingly stated, especially in individuals exposed to humid working circumstances, athletes, diabetic patients, and those with compromised hygiene practices. These issues highlight the necessity for efficient topical treatments that not only remove fungal pathogens but also rebuild and protect the skin barrier.[3]

Topical antifungal treatments containing synthetic chemicals like azoles and allylamines are quite often employed as the primary course of treatment for fungal foot infections. Mainly by inhibiting ergosterol synthesis, these agents break fungal cell membrane structure and activity. Though such formulas show good short-term results, their long term or repeated usage has been related with various drawbacks.[4]

Because of their multi target modes of action, herbal preparations are less likely to produce resistance, therefore presenting interesting substitutes for single molecule artificial medications. In Ayurvedic medicine, the well-known Oxalidaceae family plant *Biophytum sensitivum* (L.) DC. is used traditionally and is somewhat widespread across India.[5]

Biophytum sensitivum extracts have shown antifungal activity against dermatophytes, Aspergillus species, and pathogenic fungus including Candida albicans in a few experimental studies.[6][7]

The wound healing abilities of *Biophytum sensitivum* makes it better suited for regional antifungal preparations. Following local administration of the plant extract, studies have shown faster wound contraction, more collagen deposition, improved epithelialization, and enhanced vascularization.[8] These consequences are especially important in fungal foot infections, where repeated scratching, maceration, and fissuring damage skin integrity and impede healing.[9] By encouraging tissue repair and fortifying the skin barrier, *Biophytum sensitivum* supports all-around management of fungal infections as opposed to only inhibiting microbial development.

Topical creams offer an almost perfect dosage form for delivering antifungal drugs to the afflicted skin from a formulation science viewpoint. Cream formulations give simplicity of use, strong patient acceptability, even distribution of active components, and local effect with little systemic absorption.[3] Incorporation of herbal extracts into emulsion-based cream enables sustained release of phytoconstituents, enhancing antifungal therapeutic efficacy while minimizing irritation, maintain skin compatible pH, and facilitate penetration of active compounds into the stratum corneum.[10]

The current study seeks to create and assess antifungal foot creams including different concentrations of Biophytum sensitivum extract following relevant cosmetic formulation methods. The research emphasizes enhancing the cream foundation, assessing antifungal efficacy and dermal safety, and gauging physicochemical characteristics including pH, spreadability, homogeneity, and stability. This study aims to offer a safe, efficient, and cheap herbal antifungal foot cream suitable for long term control of fungal foot infections by combining conventional medicinal knowledge with contemporary formulation science.

VERNICULAR NAMES

Common name: Life plant, Sensitive plant **Sanskrit:** Lajjalu, Jalapuspa, Krichhraha

Hindi: Lakshmana, Lajalu **Malayalam**: Mukkuti, Nilaccurunki, Tintanali

PHARMACOGNOSY: *BIOPHYTUM SENSITIVUM*

Fig:1 *Biophytum Sensitivum*

Synonym: Little tree plant.	Botanical name: *Biophytum sensitivum*.
Kingdom: Plantae.	Division: Magnoliophyta.
Class: Magnoliopsida.	Order: oxalidates.
Family: Oxalidacea.	Genus: Biophytum.
Chemical constituents: flavonoids, isovitexin, Biflavones, phenolic acids, saponins, pectin, polysaccharides, tannin.	

MATERIALS AND METHODS

Preparation of plant extract

- Collected roots of the plant were washed thoroughly with cold water and were shed dried for about 4 weeks.
- Size reduction was done in electrical grinder and passed through sieve no.10µ to get uniform size.
- About 5g of the powder was taken in a conical flask and the extraction was performed by maceration process using ethanol.
- Now keep the mixture at room temperature for 7 days with an interval shaking. Filter it and boil till the solvent gets evaporated and the extract residue is left.

Fig:2 Preparation of Extract

Preparation of foot cream

Procedure

Step 1: Preparation of oil phase

1.Weigh accurately oil phase ingredients and transfer it into a beaker.

2.Heat the above phase at the temperature 70°C to form uniform liquid.

Step 2: Preparation of water phase

1.Weigh accurately water phase and transfer it into a beaker.

2.Heat the above phase with continuous stirring at the temperature 70°C to form uniform liquid.

Step 3: The contents of oil phase were mixed in the water phase.

1.When both the phases reach the same temperature mix the oil phase and water phase.

2.The *Biophytum sensitivum* extract was added in cream formulation at 35°C. Triturate it till uniform dispersion of the ingredient was achieved.

3.At room temperature, allow the formulation to equilibrate for 24 hrs.

4.Prepared creams were filled and stored in the air tight glass container.

Ingredient Table

Sr NO.	INGREDIENTS	USES	F1(%)	F2(%)	F3(%)
1	Stearic acid	Thickening agent, stabilizer	5	5	5
2	Isopropyl myristate	Emollient, improves spreadability	1	1	1
3	Cetyl alcohol	Emollient, thickening agent	0.5	0.5	0.5
4	Mineral oil	Emollient	2.5	2.5	2.5
5	Triethanolamine(TEA)	Emulsifier, pH adjuster	0.35	0.35	0.35
6	PEG-200	Humectant	2.5	2.5	2.5
7	Glycerine	Humectant	2.5	2.52	2.5
8	Phenoxyethanol	Preservative	0.1	0.1	0.1
10	Distilled water	Solvent	33.45	33.45	33.45
11	Peppermint oil	Fragrance	0.5	0.5	0.5
12	Active(*Biophytum sensitivum*)	Has antifungal property	1.3	1.4	1.5

Table:1Formulation table

Fig: 3 finished product

EVALUATION PARAMETERS

- **Physical Appearance** – creams prepared was tested both organoleptically (appearance, odor, color) and physically (consistency, homogeneity and phase separation) through the naked eye.[11]
- **pH Measurement** – 1g of prepared creams were dispersed in 100 mL of distilled water. pH was measured using a calibrated digital pH meter.[11]
- **Spreadability** – this test is done to find out how easily the cream covers the skin surface.[11]

- **Homogeneity** –To ensure equal distribution of all ingredients without lumps or separation.[11]
- **Washability** – To check how easily the cream can be washed off the skin using water.[11]
- **Accelerated stability study -**The creams were kept at different temperatures such as 8 ± 0.1°C (refrigerator), 25±0.1°C (room temperature), and 40 ± 0.1 °C (oven) with 75% relative humidity over four weeks. The creams were regularly checked for pH, color, texture, odor and consistency.[12]
- **Irritation Test (Patch Test)** – This test is done to ensure the formulation causes no redness, itching, or irritation.[11]
- **Phase separation Test**- The creams were kept in a transparent container and watches for phase separation over time. Good formulation stability was shown by the lack of separation between the oil and water layers.[11]
- **Anti-microbial Test-** A little amount of creams were aseptically applied as a thin coating on a clean glass slide and left to air dry. The smear was stained using crystal violet and examined under a microscope.[13]

RESULT

Three formulations containing different concentrations of *Biophytum sensitivum* extract (F1, F2, F3) were prepared and evaluated to determine the most suitable concentration for antifungal foot cream formulation. The comparative bar graph illustrates the compositional differences among formulations F1, F2, and F3. Most base ingredients remain constant across all three formulations, indicating a stable emulsion system. Distilled water represents the highest percentage (33.45%) in each batch, confirming the formulation as water-based. Minor variation is observed in glycerine content in F2 (2.52%), while the primary difference lies in the concentration of *Biophytum sensitivum* extract, which gradually increases from 1.3% (F1) to 1.5% (F3). This systematic variation allows evaluation of the effect of the active ingredient while maintaining overall formulation stability. All the developed formulations were found to be homogeneous, non-greasy, with a pleasant peppermint odor.

Remaining within the optimum pH range for skin application means the formulation is safe for regular use and won't upset the skin's inherent barrier. The cream was observed to spread readily across the skin during testing spreadability. This amazing characteristic guarantees that users will need just a little to cover bigger sections of the foot, hence enhancing overall user experience and product effectiveness.

Stability tests carried out at ambient temperature and under mildly greater conditions revealed no splitting, syneresis, discoloration, or thinning or thickening of the substance. This suggests that the cream had a long shelf life as the selected emulsifiers, stabilisers, and humectants were in perfect amounts.

Antifungal foot cream sample showed no evident bacterial or fungal cells in the anti-microbial test. The absence of bacterial structures implies the formulation remained uncontaminated and microbiologically stable throughout the study. This implies that the antifungal recipe and preservation method were successful in stopping microbial development during storage.

The studies showed that the F3 formulation met all required physical parameters, including proper consistency, smooth texture, good spreadability, and stability. It performed better than other batches, with no signs of separation or defects, making it the most optimized and suitable formulation. The results clearly support that the ultimate product is truly efficient in controlling fungal infections and maintaining good feet in addition to being cosmetically appealing and simple to apply. As both a preventive and therapeutic foot care solution, it can be recommended.

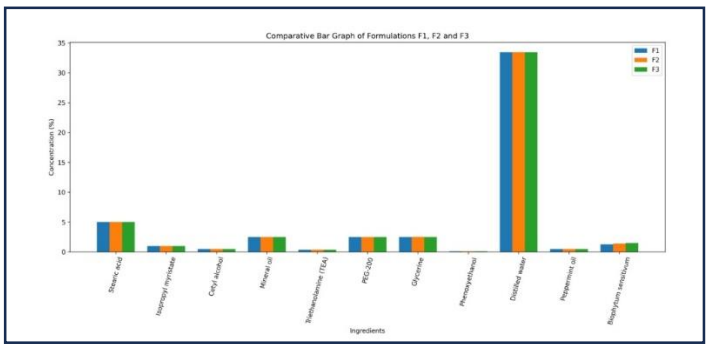

Fig: 4 Graphical representation

Visual Analysis of Physicochemical and Stability Studies

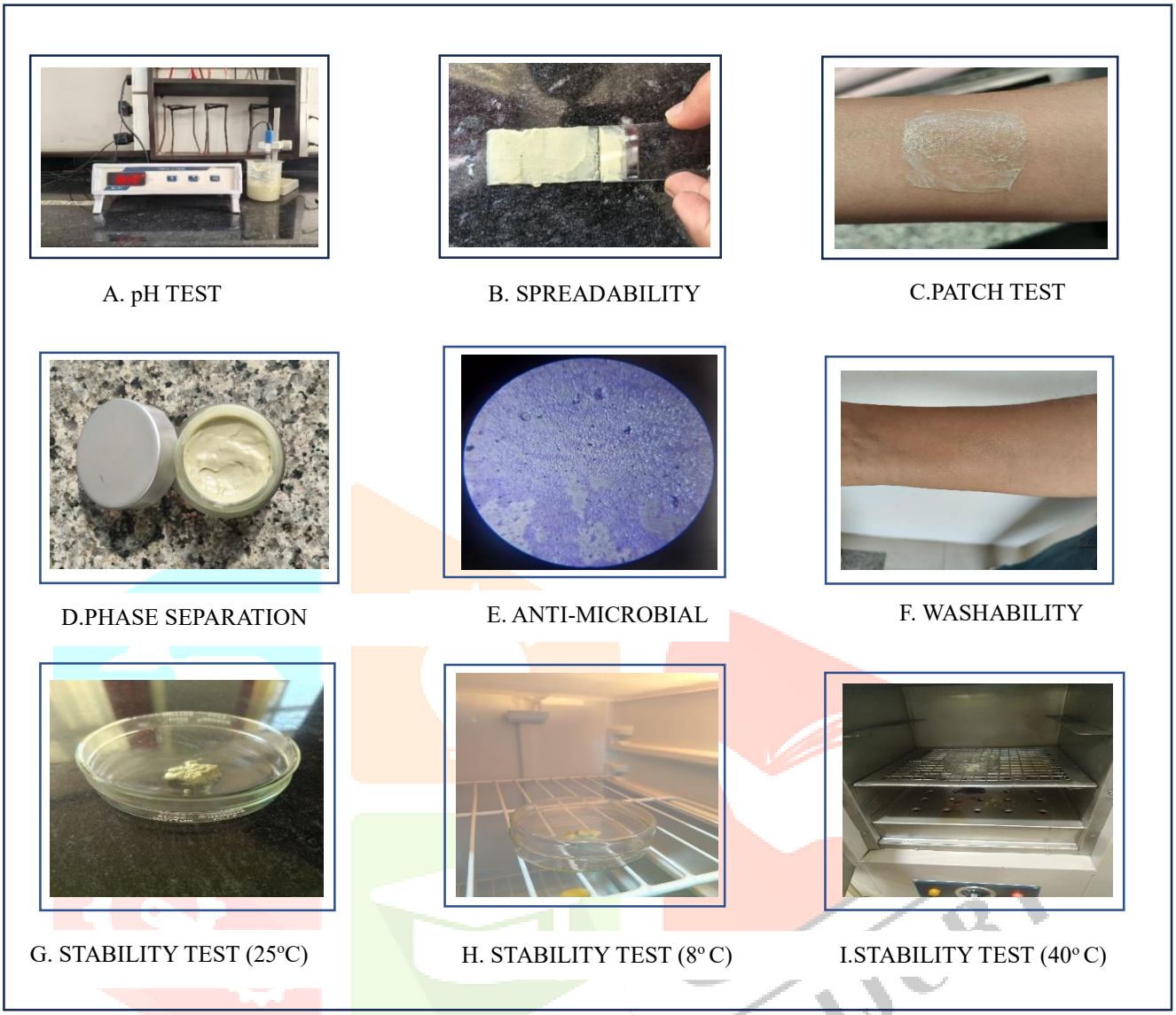

Fig: 5 Visual analysis of physicochemical and stability studies

The images illustrate key visual evaluations of the *Biophytum sensitivum* extract-based antifungal cream formulation (F3), confirming it's homogeneity, microstructural integrity, and performance under stability conditions. Cream prepared exhibited uniform light green color, smooth consistency, and no phase separation or grittiness post-emulsification, with organoleptic appeal maintained after accelerated storage at 8°C, 25°C and 40°C with 75% RH over four weeks. Alongside spreadability tests demonstrating even film formation on glass slides.

FUTURE PROSPECTS

The results of this study suggest a number of exciting possibilities for more investigation and product development based on *Biophytum sensitivum* based antifungal formulations. Although the foot cream demonstrated excellent stability, safety, and antifungal efficacy, expanding the study to include long term stability under different climatic conditions would provide deeper insights into its shelf life and commercial viability. Future research might investigate how to maximize the concentration of the extract in order to establish the minimum effective dose delivering maximal antifungal activity while still maintaining the cost effective formulation.

Another possible path calls for human volunteers undergoing clinical tests to evaluate user acceptance, long term safety, and real world performance. Such studies would provide more support for therapeutic

claims and assist to frame the product as a dependable alternative for treating ailments including athlete's foot, fungal itching, and dry or cracked heels. Modern methods including nano-emulsions or encapsulating might also improve the herbal active's penetration, stability, and regulated release, maybe increasing its antifungal efficacy.

Based on this recipe, there is also potential to increase the product range. *Biophytum sensitivum*'s demonstrated antifungal properties point to its possible inclusion in other topical formulations including powders, sprays, foot gels, and soothing balms intended to prevent and treat fungal infections. Conduct consumer research and market analysis will help one to grasp user tastes, therefore guiding the creation of a full herbal foot-care line. Last but not least, future studies contrasting this herbal cream with artificial antifungal agents will help define its competitive benefits and increase its commercialization possibilities. The good outcomes of this initiative provide a solid base for ongoing research, development, and perhaps commercial usage of herbal antifungal skincare products.

CONCLUSION

The F3 formulation of antifungal foot cream including *Biophytum sensitivum* extract turned out to be a stable, efficient, and cosmetically pleasing one. The preparation procedure effectively created a smooth and homogeneous emulsion with good spreading characteristics, pleasing sensory qualities, and a pH that is skin-friendly. The cream showed great physical and chemical stability over the assessment period; it showed no indications of separation, colour change, or microbial contamination. Assuring product safety and extending shelf life, the preservative worked well. Given the general results, the developed cream presents great promise as a natural, safe, and efficient alternative for regular foot maintenance as well as for the treatment of typical fungal infections including athlete's foot, dryness, and irritation. This work underscores the need of including herbal actives into current topical preparations and encourages additional research of plant-based substitutes for dermatological products and skincare.

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