

Formulation and evaluation of herbal bio-deodorant cream for foot odour and fungal control

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Abstract

Foot odor and fungal infections, such as athlete's foot, are common skincare conditions due to excessive sweating and/or the growth of microbes associated with closed footwear. Conventional deodorants and antifungal creams contain synthetic ingredients. Due to their long-term usage, these agents may lead to skin irritation and/or allergic reactions. This study aims to formulate and assess an herbal bio-deodorant cream made from natural topical compounds that have demonstrated antimicrobial and deodorizing activity. Neem leaf extract and tea tree oil served as active antimicrobial ingredients for their strong antibacterial and antifungal properties. Complementary to neem and tea tree oil, peppermint oil and camphor created a cooling effect or masking odor. Aloe vera gel and coconut oil served as emollients or moisturizers that help hydrate skin and relieve irritation while alum served as a natural astringent and deodorizer. The base formulation included stearic acid, cetostearyl alcohol, glycerin, and triethanolamine to achieve the appropriate texture, stability, and spread ability.

The final formulation was assessed for its physical properties, pH, viscosity, spreadability, homogeneity, washability, stability, and antifungal activity. The cream was confirmed to possess a smooth appearance, pH of 6.5 ± 0.1 , and excellent spreadability, with no phase separation or gritty appearance.

Keywords: Herbal Bio-Deodorant; Antifungal Cream; Foot Odor; Neem; Tea Tree Oil; Peppermint; Natural Formulation

1. Introduction

Herbal cosmetics are formulations that combine natural plant-based ingredients with cosmetic bases to protect, heal, and enhance the skin. In recent years, a wide range of herbal cosmetic and toiletry products inspired by traditional Indian herbs have gained popularity for their safety and effectiveness. Feet, being constantly exposed to friction and environmental stress, require special care since they lack oil glands and depend on sweat glands to maintain moisture. The dryness of foot skin often leads to problems like cracks, infections, and odor, making foot care products such as creams and deodorants essential.

Herbal foot creams possess refreshing, deodorizing, antiseptic, antifungal, and wound-healing properties that help prevent common foot disorders like athlete's foot, nail fungus, and cracked heels. Among various medicinal plants, *Mimosa pudica* Linn., commonly known as touch-me-not, is valued for its anti-inflammatory, antibacterial, wound-

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healing, and antioxidant properties. These qualities make it a promising ingredient for developing effective herbal formulations aimed at maintaining foot hygiene and skin health.

Herbal formulations have gained significant attention as safe and eco-friendly alternatives to synthetic cosmetics. Plants contain a wide range of bioactive compounds such as alkaloids, flavonoids, terpenoids, and phenolics that exhibit antimicrobial, antifungal, antioxidant, and soothing effects. These natural constituents' help in protecting the skin from infections, reducing inflammation, and promoting tissue repair [15]. For foot care applications, herbs like neem, tea tree, peppermint, and aloe vera are particularly effective due to their strong antimicrobial and deodorizing properties. When combined with a suitable cream base, these ingredients not only help in controlling odor and fungal growth but also nourish and soften dry, cracked skin. Thus, herbal foot creams serve a dual purpose—maintaining hygiene and improving the overall health and appearance of the feet.



Figure 1 Various Foot Problems

1.1. Uses

1.1.1. Control of Foot Odor and Infection

The formulation is designed to prevent and control foot odor and fungal infections caused by excessive perspiration and microbial growth in enclosed footwear environments.

1.1.2. Natural and Skin-Friendly Approach

Unlike synthetic deodorants that may cause dryness, irritation, or allergies with prolonged use, this herbal bio-deodorant cream provides a safer and more biocompatible alternative.

1.1.3. Antimicrobial and Antifungal Action

Neem extract, tea tree oil, and alum act as natural antimicrobials, effectively reducing the bacterial and fungal populations responsible for odor and infections.

1.1.4. Deodorizing and Cooling Effect

Peppermint oil and camphor impart a cooling, refreshing, and deodorizing sensation, helping relieve discomfort and mask unpleasant odors.

1.1.5. Moisturizing and Skin-Repairing Properties

Aloe vera gel and coconut oil serve as emollient and hydrating agents, restoring skin moisture, preventing cracking, and maintaining the natural softness of the foot.

1.1.6. Formulation Stability and Texture

Stearic acid, cetostearyl alcohol, glycerin, and triethanolamine function as emulsifiers, stabilizers, and humectants, ensuring smooth texture, good spreadability, and physical stability of the cream.

1.1.7. Environmentally Sustainable and Safe

The herbal base makes the formulation eco-friendly, biodegradable, and free from synthetic chemicals, aligning with the growing preference for sustainable cosmetic products.

1.1.8. Overall Benefit

The combined effect of all ingredients results in a safe, effective, and naturally derived topical preparation for maintaining foot hygiene, preventing odor, and controlling fungal infections while keeping the skin nourished and comfortable.

2. Materials and Methods

2.1. Ingredients

Table 1 List of Ingredients

Ingredient	Quantity	Reason for Selection / Function
Neem leaf extract	0.5 g	Strong antibacterial, antifungal, and anti-inflammatory properties help control odour -causing microbes and foot infections.
Peppermint oil	0.5 mL	Provides cooling, refreshing, and deodorizing effects; also exhibits mild antimicrobial action.
Camphor	0.3 g	Acts as a natural deodorant and mild antiseptic, reduces itching and gives a cooling sensation.
Aloe vera gel	10 g	Serves as a soothing, moisturizing base; enhances skin healing and reduces irritation.
Alum (Potassium alum)	0.5 g	Natural astringent and antimicrobial; helps minimize sweat and control odor by reducing bacterial growth.
Tea tree oil	0.3 mL	Powerful antifungal and antibacterial agent effective against Tinea pedis (athlete's foot).
Coconut oil	1 g	Acts as emollient and carrier, improves spread ability, and has additional antifungal benefits.
Stearic acid	0.8 g	Functions as an emulsifying and thickening agent, providing cream consistency.
Ceto stearyl alcohol	0.4 g	Works as emulsifier and stabilizer, enhances cream texture and smoothness.
Glycerine	0.8 g	Acts as humectant, maintains skin moisture and prevents dryness.
Triethanolamine	0.1 mL	Used as emulsifier and pH adjuster, helps form stable oil-in-water cream.
Distilled water	qs. 100 g	Serves as solvent and dispersion medium for the formulation.

2.2. Preparation of Herbal Extract

- Collect the fresh neem leaves and wash the leaves thoroughly using distilled water.
- Dry the leaves in shade and then grind the leaves into fine powder.
- Extract using suitable solvent.
- Filter the extract and store in an airtight container.

2.3. Preparation of Oil Phase (1st Beaker)

- In a beaker take stearic acid, Ceto stearyl alcohol, camphor and coconut oil.
- Heat on a water bath, at 70 °C, until all ingredients melt.
- Stir gently to obtain a uniform phase.

2.4. Preparation of Aqueous Phase (2nd Beaker)

- In the second beaker take glycerin, triethanolamine (TEA) and distilled water.
- Heat the aqueous phase to 70 °C (the same temperature as for oil phase).
- Stir continuously and dissolve the alum and aloe vera in the aqueous phase.

2.5. Formation of Emulsion

- Slowly add the aqueous phase into the oil phase, and stir continuously (magnetic stirring).
- Leave stirring until cream becomes semi-solid.
- Leave cool to room temperature.

2.6. Addition of Heat-Sensitive Ingredients

- Once cool to below 40 °C; add the neem extract, tea tree and peppermint oil.
- Stir well to ensure that all herbal actives are uniformly distributed throughout cream.
- Check and adjust pH from 6–7 (skin-compatible range)

3. Evaluation of Herbal Bio-Deodorant Cream

- **Physical appearance:** The cream prepared had a uniform consistency, smooth texture, light greenish-white color, and pleasant herbal aroma. The texture was soft and did not leave a greasy residue on the skin
- **Determination of pH:** The pH of the cream was found to be 6.5 ± 0.1 , which is within an ideal skin-friendly pH range and determined to have good compatibility with skin.
- **Viscosity:** The viscosity was good and produced the desired consistency for an easy application and with sufficient adherence to the skin surface.
- **Spread ability:** The cream was noted to have excellent spread ability and when applied, there was a thin and uniform layer of cream following application, without additional pressure on the applicator.
- **Homogeneity:** The cream demonstrated uniformity in partial size, phase separation, no grittiness, and presence of lumps, indicating good stability of the formulation.
- **Washability:** The cream had good washability with plain water, with no observable's remnants of greasy/thick or sticky material adhering to the skin after its removal.
- **Stability studies:** The formulation remained stable in both physical appearance and chemical balance after variations in temperature for 30 days, with no variations in aroma, texture or color. Antifungal activity (zone of inhibition): The cream produced antifungal activity with a zone of inhibition of 18 mm against *Candida albicans* and *Aspergillus Niger*, indicating significant antifungal activity.



Figure 2 Evaluation of Cream

4. Results

The herbal-based bio-deodorant cream that was developed had a smooth consistency and even texture, was light greenish-white in color, and had an appealing herbal scent. It had a pH of 6.5 ± 0.1 , indicating that the cream is compatible with human skin and will not irritate it. The bio-deodorant cream showed appropriate viscosity, the ability to spread easily across the skin, and had homogenous texture with no physical separation of product phases or grittiness noted. The bio-deodorant cream was easy to wash off and retained its color, scent, and consistency after 30 days of stability assessment, indicating good physicochemical stability. In terms of antifungal activity, the bio-deodorant cream was assessed using the agar well diffusion technique and showed a zone of inhibition measuring 18

± 0.5 mm against *Candida albicans* and 16 ± 0.7 mm against *Aspergillus niger* further confirming that the developed bio-deodorant cream exhibits strong antifungal properties. In conclusion, the bio-deodorant cream exhibited excellent stability, antifungal activity, and deodorizing capacity, providing evidence that this bio-deodorizing cream is a safe and effective herbal alternative with the potential to control foot odor and foot fungus.

5. Discussion

The herbal deodorant cream that was prepared has desirable qualities such as a uniform, smooth consistency with a pleasant herbal aroma, and made it easy to spread on the skin. The inclusion of the neem extract and tea tree oil contributed strong antifungal and antibacterial activity as they are known to be effective against microorganisms that cause odor (21-23). The peppermint oil provided a fresh scent while enhancing the formula's cooling and deodorant effects. Aloe vera gel and glycerin added moisturizing properties and soothing effects for the skin. Overall, the combination of these herbal components demonstrates the potential to replace chemical based deodorant creams as it provided efficacy in enhancing foot hygiene while naturally addressing odor and inhibiting the growth of fungi.

6. Conclusion

The formulated herbal bio-deodorant cream demonstrated good physical characteristics, such as smooth texture, homogenous consistency, pleasant herbal fragrance, and good spread ability and stability. The active herbal ingredients including neem oil, tea tree oil, peppermint oil, and aloe vera contributed significantly to antimicrobial, anti-fungal, deodorizing, and skin soothing effects. These characteristics indicate that the formula could be a potential natural skin-friendly choice for foot hygiene, malodor, and fungal prevention. Its low irritancy and easy wash off characteristics would increase the acceptability and ease of use for consumers. Overall, further investigation and long-term stability studies as well as clinical efficacy studies would be useful to ensure its practical application for consumer safety, efficacy, and scalability for large scale production.

Future Scope

The present research explores the efficacy of a naturally derived bio-deodorant cream as a promising treatment for exerting control of unpleasant odors and fungal infections on the skin. Future studies could include optimizing the formulation with enhanced delivery systems like nano emulsions or liposomal creams, enhancing skin penetration and repeat application. In addition to, comprehensive clinical trials will examine the safety, efficacy, and acceptance of the formulation across a spectrum of skin types. The formulation itself will also need longitudinal studies of stability, shelf life, and interaction with packaging to advance the formulation to a commercial-grade product. Future work could also examine sustainable sourcing and green extraction methods.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

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