Formulation and Evaluation of Polyherbal Foot Care Cooling Gel

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Abstract—**Polyherbal foot care cooling gel is a topical herbal formulation developed to provide cooling, soothing, moisturizing, refreshing, and antimicrobial effects for tired, stressed, and unhealthy feet. Feet are continuously exposed to environmental pollutants, excessive sweating, heat, friction, and microbial contamination due to daily activities such as walking, prolonged standing, and use of closed footwear. These conditions may lead to dryness, irritation, unpleasant odor, burning sensation, cracked heels, fungal infections, and foot fatigue. Proper foot care is therefore essential for maintaining hygiene, comfort, and skin health. Herbal formulations have gained significant importance in recent years because they are considered safer, more economical, and associated with fewer side effects compared to synthetic preparations. Polyherbal formulations are especially beneficial because the combined action of different medicinal plants produces synergistic therapeutic effects.**

The present study focuses on the formulation and evaluation of a polyherbal foot care cooling gel using natural herbal ingredients such as peppermint extract, aloe vera gel, neem extract, vetiver extract, almond oil, Carbopol 934, sodium benzoate, and purified water. Carbopol 934 was used as a gelling agent to provide appropriate viscosity, consistency, and stability to the formulation. Peppermint extract, rich in menthol, was incorporated to produce an immediate cooling and refreshing sensation that helps relieve foot fatigue and discomfort. Aloe vera gel was included because of its excellent moisturizing, soothing, anti-inflammatory, and skin-protective properties. Neem extract is widely known for its antimicrobial, antifungal, and antibacterial activities, which help prevent foot infections, itching, and unpleasant odor. Vetiver extract contributes cooling and calming effects along with a pleasant aroma, while almond oil acts as a nourishing emollient that softens and hydrates dry skin. Sodium benzoate was added as a preservative to protect the formulation from microbial contamination and improve shelf life.

The gel was prepared by dispersing Carbopol 934 in water followed by incorporation of herbal extracts and other ingredients with continuous stirring to obtain a smooth and homogeneous preparation. The prepared formulation was evaluated for various physicochemical parameters including appearance, color, odor, pH, viscosity, spreadability, homogeneity, washability, cooling effect, skin feel, and stability. The formulation showed satisfactory physical characteristics with smooth texture, pleasant odor, and good consistency. The pH of the gel was found to be compatible with skin, indicating suitability for topical application without causing irritation. The gel exhibited good spreadability and was easily washable, enhancing patient convenience and compliance.

The cooling effect produced by peppermint and vetiver extracts provided instant freshness and relief from foot fatigue. Aloe vera and almond oil improved skin hydration and softness, preventing dryness and roughness of the feet. Neem extract contributed antimicrobial protection, which may help reduce microbial growth responsible for foot odor and infections. The prepared formulation remained stable during storage and did not show significant changes in color, consistency, or phase separation. The gel was non-greasy, non-sticky, and aesthetically acceptable, making it suitable for routine use.

Index Terms—**Polyherbal gel, Foot care, Cooling gel, Herbal formulation, Peppermint extract, Aloe vera gel, Neem extract, Vetiver extract, Carbopol 934, Antimicrobial activity, Moisturizing effect, Topical preparation, Herbal cosmetics, Skin care, Foot hygiene**

I. Introduction

Foot care is an essential part of personal hygiene and healthcare because feet are continuously exposed to dust, moisture, heat, microbial contamination, and physical stress. Long working hours, continuous walking, inappropriate footwear, and poor hygiene often result in foot fatigue, dryness, cracked heels, sweating, foul odor, and fungal infections. These conditions not only cause discomfort but may also affect the quality of life and mobility of individuals. Therefore, proper foot care products are necessary to maintain healthy, clean, and refreshed feet.

Conventional foot creams and ointments are commonly used for foot care management, but they are often greasy, sticky, and less comfortable for regular use. In recent years, herbal formulations have gained popularity because of their safety, effectiveness, minimal side effects, and better patient acceptance. Herbal products are considered more suitable for long-term use due to the presence of naturally occurring bioactive compounds.

Polyherbal formulations contain a combination of different herbal ingredients that work synergistically to produce enhanced therapeutic activity. The concept of polyherbalism is widely accepted in traditional medicine systems such as Ayurveda because multiple herbs can target different aspects of a disease or condition simultaneously. In foot care preparations, polyherbal combinations provide antimicrobial, cooling, moisturizing, anti-inflammatory, deodorizing, and skin-protective actions.

The present study focuses on the formulation and evaluation of a polyherbal foot care cooling gel using natural ingredients such as peppermint extract, aloe vera gel, neem extract, vetiver extract, and almond oil. Peppermint contains menthol, which provides an instant cooling sensation and helps relieve tired feet. Aloe vera possesses moisturizing, soothing, and wound-healing properties that protect dry and damaged skin. Neem extract is known for its antibacterial and antifungal activities, making it useful in preventing foot infections and bad odor. Vetiver provides cooling and refreshing effects, while almond oil acts as an emollient and nourishes the skin.

The gel dosage form was selected because gels are non-greasy, easy to apply, washable, and provide better patient compliance compared to creams and ointments. Carbopol 934 was used as the gelling agent because of its excellent viscosity and stability characteristics. Sodium benzoate was added as a preservative to prevent microbial contamination during storage.

The prepared polyherbal foot care cooling gel was evaluated for different physicochemical parameters such as appearance, pH, spreadability, viscosity, homogeneity, washability, stability, and cooling effect. The study aims to develop a stable and effective herbal gel that can provide comfort, freshness, and protection to the feet.

Need for Herbal Foot Care Gel

Modern lifestyles expose feet to excessive stress and environmental conditions that lead to several foot problems. People who stand for long hours, wear closed footwear, or travel frequently often experience sweating, irritation, and fatigue in their feet. Excess moisture and poor hygiene promote microbial growth, leading to fungal infections and unpleasant odor.

Synthetic foot care products may contain chemicals that can cause skin irritation, allergies, or dryness after prolonged use. Therefore, there is increasing demand for herbal foot care products that are safer and more skin-friendly. Herbal gels provide therapeutic benefits along with improved cosmetic acceptability. The use of natural ingredients reduces the risk of adverse reactions and provides better compatibility with skin tissues.

A cooling gel formulation is particularly useful because it gives immediate relief from burning sensation, tiredness, and discomfort. Cooling gels also improve blood circulation and provide a refreshing feeling after application. Hence, the development of a polyherbal cooling gel is beneficial for routine foot care management.

Advantages of Gel Formulation

Gels are semisolid dosage forms in which active ingredients are dispersed in a suitable gelling agent. Gels have become increasingly popular in topical drug delivery systems because of their ease of application and patient acceptability.

Advantages of gel formulation:

- Non-greasy and non-sticky
- Easy to spread on skin
- Good cooling effect
- Easily washable with water
- Better patient compliance
- Improved drug release
- Attractive appearance
- Suitable for herbal preparations

Because of these advantages, gels are considered ideal carriers for herbal extracts used in cosmetic and therapeutic preparations.In modern dermatological and cosmetic science, there is a growing shift from synthetic topical preparations toward herbal and plant-based formulations. This transition is mainly driven by increasing awareness regarding the adverse effects of chemical-based products, such as skin irritation, allergic reactions, long-term toxicity, and environmental concerns. Herbal formulations, on the other hand, are considered safer due to their natural origin, biocompatibility, and reduced incidence of side effects. Among various topical dosage forms, gels have gained significant importance because of their non-greasy nature, ease of application, and rapid absorption characteristics.

Feet are one of the most neglected parts of the human body despite being subjected to continuous stress and pressure throughout the day. The skin of the feet is comparatively thicker, yet it is highly susceptible to dryness, cracking, sweating, and microbial infections due to constant exposure to environmental factors. Conditions such as athlete's foot, heel fissures, excessive perspiration, and foul odor are commonly observed in individuals with poor foot hygiene or prolonged use of occlusive footwear. These problems not only cause discomfort but may also lead to secondary infections if left untreated. Therefore, maintaining proper foot hygiene through effective topical formulations is essential for overall skin health.

Herbal medicinal plants have been extensively used in traditional systems of medicine such as Ayurveda, Siddha, and Unani for the treatment of various skin-related disorders. Plants like neem, aloe vera, peppermint, and vetiver possess well-documented pharmacological activities including antimicrobial, anti-inflammatory, antioxidant, cooling, and wound-healing properties. Neem (*Azadirachta indica*) is particularly known for its broad-spectrum antimicrobial action against bacteria, fungi, and viruses, making it highly useful in preventing skin infections. Aloe vera (*Aloe barbadensis*) contains polysaccharides and glycoproteins that promote skin hydration, tissue repair, and inflammation reduction. Peppermint (*Mentha piperita*) contains menthol, which activates cold-sensitive receptors in the skin, producing a cooling sensation and helping to relieve pain and fatigue. Vetiver (*Vetiveria zizanioides*) is traditionally used for its cooling and calming effects on the skin and body, while almond oil provides essential fatty acids that nourish and soften dry skin.

The concept of polyherbal formulation is based on the principle that combining multiple herbs enhances therapeutic efficacy through synergistic action. Each herbal component contributes a specific biological activity, and when combined, they provide a broader spectrum of benefits. In the present study, the combination of cooling, moisturizing, antimicrobial, and emollient herbs ensures comprehensive foot care management. This synergistic approach also helps in reducing the concentration of individual extracts while maintaining effectiveness, thereby minimizing the risk of irritation or sensitivity.

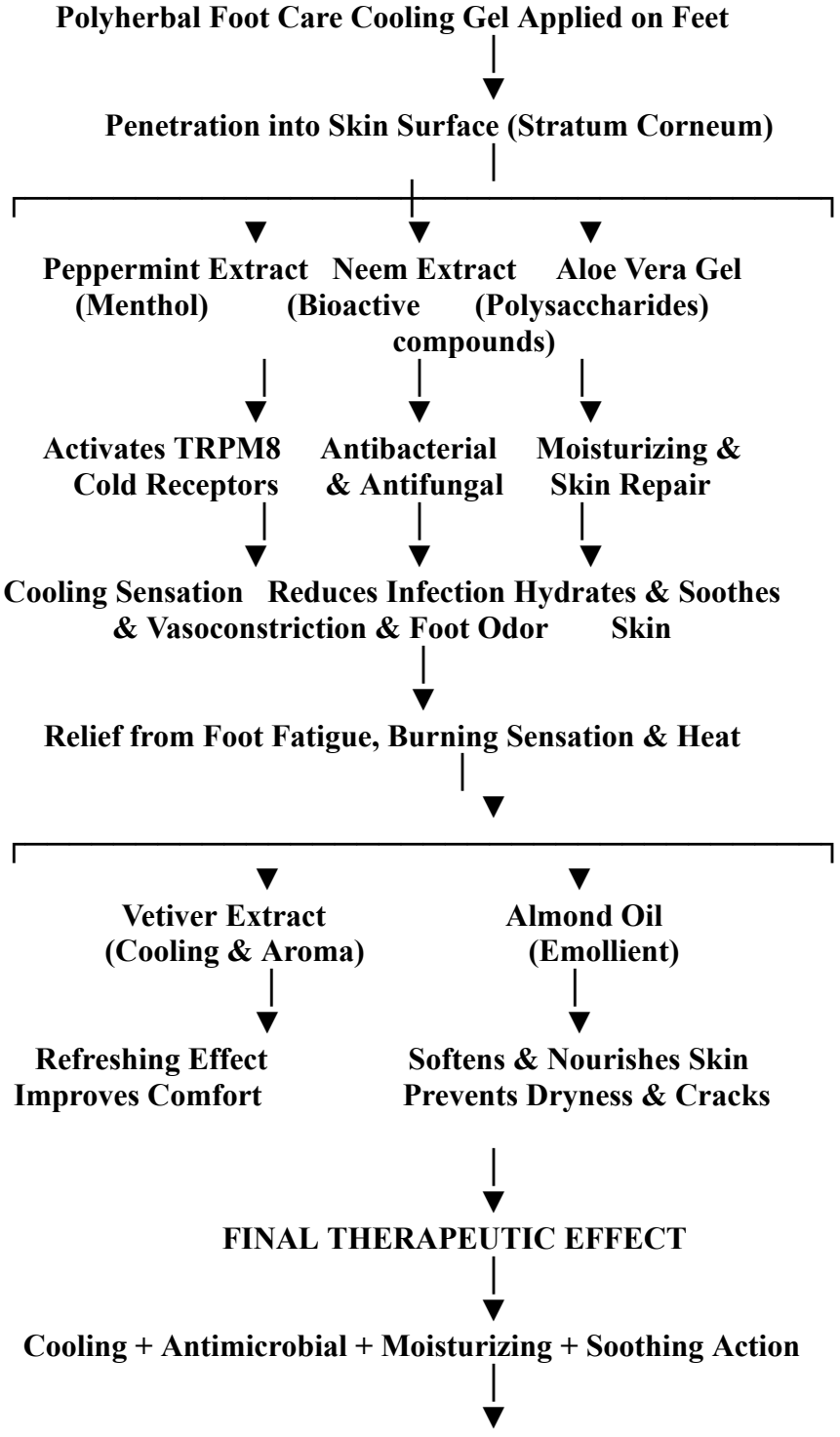
The selection of gel as a dosage form is particularly advantageous for foot care applications. Gels are semi-solid systems composed of a network of polymers that trap liquid within their structure. They provide a smooth, elegant, and non-greasy texture that enhances user acceptability. Unlike creams and ointments, gels do not leave a sticky residue on the skin and are easily washable with water. This makes them highly suitable for daily use, especially for individuals who prefer light and fast-absorbing formulations. Additionally, gels offer better release of active ingredients and improved skin penetration compared to some traditional semisolid dosage forms.

Carbopol 934 is widely used as a gelling agent in pharmaceutical and cosmetic formulations due to its excellent thickening, stabilizing, and suspending properties. It forms clear, stable gels at low concentrations and provides good viscosity and consistency to the formulation. The pH of Carbopol-based gels plays an important role in determining their final texture and stability, which is carefully adjusted during formulation development.

The development of polyherbal foot care cooling gel also aligns with the increasing global demand for herbal cosmetics and personal care products. Consumers are becoming more conscious of product safety, ingredient transparency, and sustainability. Herbal gels are perceived as eco-friendly alternatives that utilize renewable plant resources and reduce dependence on synthetic chemicals. Furthermore, the incorporation of natural essential oils and extracts enhances the sensory appeal of the product through pleasant aroma and cooling sensation.

Thus, the formulation of a polyherbal foot care cooling gel represents an integration of traditional herbal knowledge with modern pharmaceutical technology. It aims to deliver an effective, stable, and user-friendly topical product that addresses common foot-related problems while promoting skin health, comfort, and hygiene.

Figure No 1: Mechanism of Action of Polyherbal Foot Care Cooling Gel (Flow Chart)



II. REVIEW OF LITERATURE

The development of herbal topical formulations has gained significant attention in pharmaceutical and cosmetic research due to their safety, efficacy, and reduced adverse effects. A large number of studies have been conducted on herbal gels and plant-based extracts for skin care applications, particularly for conditions such as dryness, infections, inflammation, and microbial contamination. These studies highlight the importance of medicinal plants in dermatological therapy and support the formulation of polyherbal products for enhanced therapeutic benefits.

Several researchers have reported the effectiveness of peppermint (*Mentha piperita*) in topical preparations due to its high menthol content. Menthol acts on the transient receptor potential melastatin 8 (TRPM8) receptors in the skin, producing a cooling sensation and mild analgesic effect. Studies have shown that peppermint oil and extract can significantly reduce sensations of fatigue and discomfort when applied topically. Its use in gels and creams improves patient satisfaction, especially in formulations intended for foot care and muscle relaxation. Additionally, peppermint possesses mild antimicrobial properties, which further contribute to maintaining skin hygiene.

Aloe vera (*Aloe barbadensis Miller*) has been extensively studied for its wound healing, moisturizing, and anti-inflammatory properties. It contains polysaccharides such as acemannan, which play a key role in skin regeneration and hydration. Literature reports indicate that aloe vera gel enhances fibroblast activity and promotes collagen synthesis, thereby accelerating the healing of minor cuts and cracks commonly found on dry feet. Its cooling and soothing nature makes it an ideal component in topical gels designed for sensitive or damaged skin.

Neem (*Azadirachta indica*) is one of the most widely researched medicinal plants in dermatology. Numerous studies have demonstrated its strong antibacterial, antifungal, and antiviral activities. Neem extracts contain bioactive compounds such as nimbidin, azadirachtin, and quercetin, which are responsible for its antimicrobial effects. Research has shown that neem-based formulations are effective against common skin pathogens, including *Staphylococcus aureus* and *Candida albicans*, which are often associated with foot infections and odor. Because of these properties, neem is frequently incorporated into herbal soaps, creams, and gels for infection control.

Vetiver (*Vetiveria zizanioides*) has traditionally been used in aromatherapy and skin cooling applications. Literature indicates that vetiver oil possesses sedative, anti-inflammatory, and cooling properties that help in relieving stress and promoting relaxation. In topical formulations, vetiver contributes a soothing fragrance and enhances the sensory appeal of the product. Studies also suggest that vetiver may help in reducing excessive sweating and improving skin comfort, making it suitable for foot care preparations.

Almond oil (*Prunus amygdalus*) is widely recognized for its emollient and skin-nourishing properties. It is rich in essential fatty acids, vitamin E, and antioxidants, which help in maintaining skin elasticity and moisture balance. Research indicates that almond oil improves skin barrier function and reduces dryness and irritation. Its use in topical gels enhances spreadability and provides a soft, non-greasy feel to the skin, making it highly suitable for cosmetic formulations.

Carbopol 934 is a commonly used synthetic polymer in gel formulations due to its excellent thickening and stabilizing properties. Literature shows that Carbopol-based gels provide high clarity, good viscosity, and stable drug delivery systems. It forms a three-dimensional network structure that retains water and ensures uniform distribution of active ingredients. Studies also indicate that Carbopol gels enhance the release of active compounds from herbal extracts, thereby improving their bioavailability on the skin surface.

Polyherbal formulations have been widely studied for their synergistic therapeutic effects. Research suggests that combining multiple herbal extracts can enhance pharmacological activity while reducing the required concentration of individual components. This synergy not only improves efficacy but also minimizes potential side effects. In dermatological applications, polyherbal gels have shown better performance in treating infections, inflammation, and dryness compared to single-herb formulations. This approach is consistent with traditional Ayurvedic principles, which emphasize the use of multiple herbs for holistic treatment.

Topical gel formulations are considered one of the most efficient delivery systems for skin application. Studies highlight their advantages, including ease of application, rapid absorption, non-greasy nature, and improved patient compliance. Gels also allow controlled release of active ingredients, ensuring prolonged therapeutic action. In comparison to ointments and creams, gels are more aesthetically acceptable and suitable for cosmetic products intended for daily use.

Overall, the literature strongly supports the use of herbal ingredients such as peppermint, aloe vera, neem, vetiver, and almond oil in topical gel formulations. Their combined pharmacological activities provide a strong scientific basis for the development of a polyherbal foot care cooling gel. The integration of these natural ingredients into a Carbopol-based gel system represents an effective strategy for producing a stable, safe, and user-friendly herbal product for foot care management.

III. AIM & OBJECTIVE OF WORK

AIM

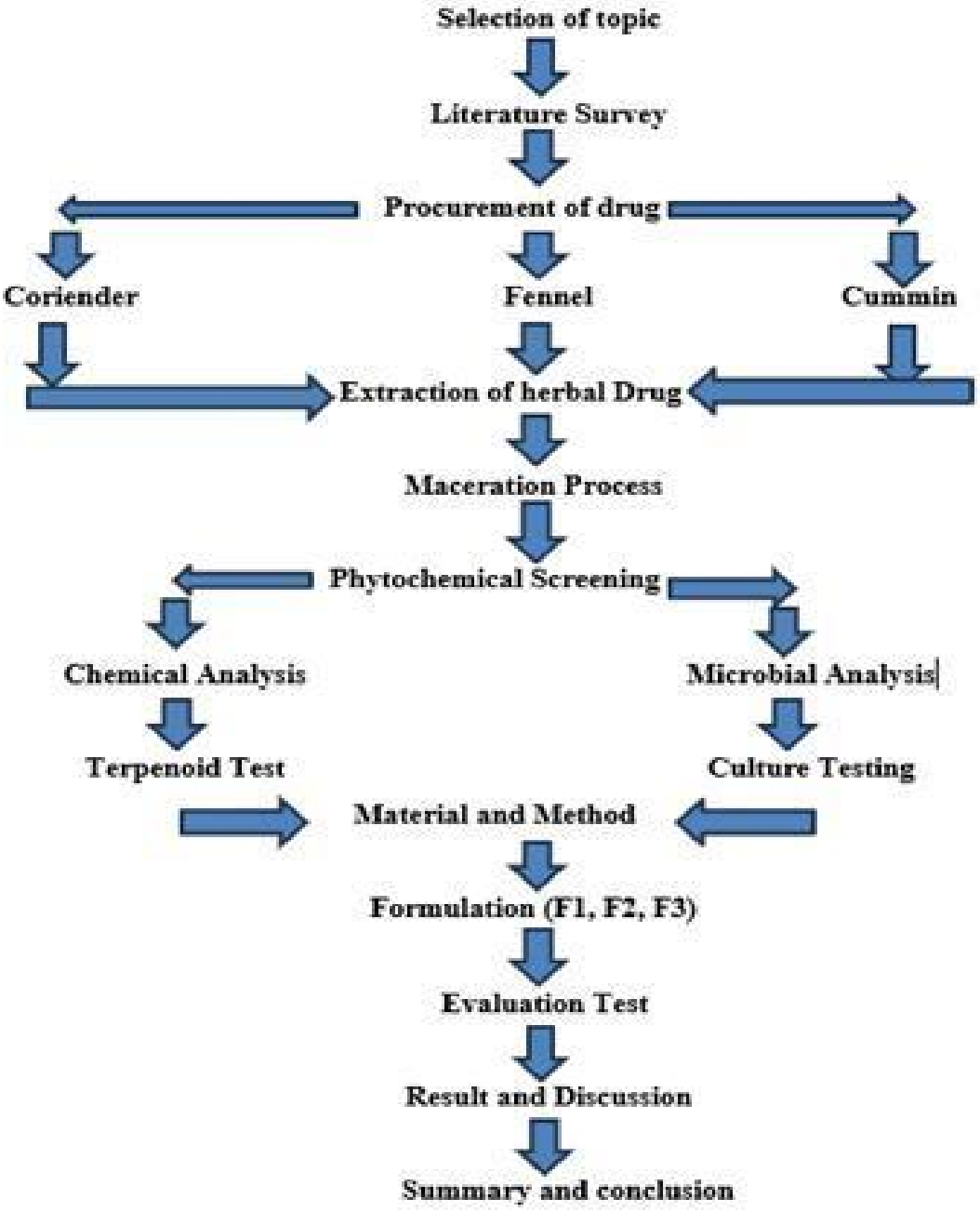
To formulate and evaluate a polyherbal foot care cooling gel using herbal ingredients for effective foot care management.

OBJECTIVE

- To prepare a stable herbal cooling gel formulation.
- To evaluate physicochemical properties of the gel.
- To study spread ability and cooling effect.
- To assess homogeneity and wash ability.
- To evaluate stability of the formulation.
- To develop a safe and effective herbal foot care product.

IV. PLAN OF THE WORK

PLAN OF WORK (FLOW CHART) :



V. MATERIAL AND METHODS

Materials

Table 1: List of Materials Used in Formulation

Sr. No.	Ingredient	Role in Formulation
1	Carbopol 934	Gelling agent
2	Peppermint extract	Cooling agent, antifatigue effect
3	Aloe vera gel	Moisturizing, soothing agent
4	Neem extract	Antimicrobial, antifungal agent
5	Vetiver extract	Cooling, refreshing agent
6	Almond oil	Emollient, skin softening agent
7	Sodium benzoate	Preservative
8	Purified water	Solvent / vehicle (q.s.)

Formulation Composition

Table 2: Formulation Table of Polyherbal Foot Care Cooling Gel

Sr. No.	Ingredient	Quantity
1	Carbopol 934	1 g
2	Peppermint extract	5 g
3	Aloe vera gel	20 g
4	Neem extract	5 g
5	Vetiver extract	3 g
6	Almond oil	2 g
7	Sodium benzoate	0.5 g
8	Water	q.s.

Method of Preparation

Step 1: Preparation of Gel Base

A measured quantity of Carbopol 934 (1 g) was slowly dispersed in purified water with continuous stirring to avoid lump formation. The mixture was allowed to stand for sufficient time to ensure complete hydration and swelling of the polymer, resulting in a uniform gel base.

Step 2: Formation of Uniform Gel Structure

The hydrated Carbopol dispersion was stirred continuously using a mechanical stirrer until a clear and homogeneous gel base was formed with desired viscosity.

Step 3: Preparation of Herbal Mixture

Aloe vera gel, peppermint extract, neem extract, and vetiver extract were weighed accurately and mixed together to obtain a uniform herbal phase.

Step 4: Incorporation of Herbal Extracts

The prepared herbal mixture was slowly added into the Carbopol gel base under continuous stirring to ensure uniform distribution of active ingredients throughout the gel matrix.

Step 5: Addition of Emollient Phase

Almond oil was added gradually into the formulation with constant stirring to ensure proper emulsification and uniform dispersion within the gel system.

Step 6: Addition of Preservative

Sodium benzoate (0.5 g) was dissolved in a small quantity of water and added to the formulation as a preservative to prevent microbial contamination and enhance shelf life.

Step 7: Homogenization

The entire mixture was homogenized using a mechanical stirrer to obtain a smooth, uniform, and lump-free gel with consistent texture.

Step 8: pH Adjustment

The pH of the formulation was checked and adjusted (if necessary) to maintain skin compatibility, ensuring it falls within the acceptable range for topical applicatio

Step 9: Deaeration

The prepared gel was kept undisturbed for a short period to remove entrapped air bubbles, resulting in a clear and stable formulation

Step 10: Packaging

The final polyherbal cooling gel was filled into clean, sterilized containers, properly labeled, and stored under suitable conditions for further evaluation studies.

Flow Diagram: Method of Preparation :

Carbopol 934 Dispersion in Water

⬇

Hydration of Carbopol (Soaking for complete swelling)

⬇

Formation of Gel Base (Continuous stirring)

⬇

Preparation of Herbal Phase (Mixing of Aloe vera, Peppermint, Neem, Vetiver extracts)

⬇

Incorporation of Herbal Phase into Gel Base

⬇

Addition of Almond Oil (Emollient phase incorporation)

⬇

Addition of Sodium Benzoate (Preservative solution)

⬇

Continuous Homogenization (Uniform mixing)

⬇

pH Adjustment (if required for skin compatibility)

⬇

Deaeration (Removal of entrapped air bubbles)

⬇

Final Gel Formation (Smooth, uniform consistency obtained)

⬇

Filling & Packaging in clean, sterilized containers

EVALUATION METHODS

The prepared polyherbal foot care cooling gel was evaluated for various physicochemical and performance parameters to ensure its quality, safety, and suitability for topical application.

[1] Physical Appearance

The formulation was evaluated for color, odor, texture, consistency, and homogeneity.

Apparatus:

White background, visual inspection method

Procedure:

The prepared gel was visually examined under good lighting conditions for its color, odor, texture, and overall appearance. The formulation was also checked for homogeneity and the presence of any particulate matter or lumps.

Observation:

The gel should be smooth, uniform, non-greasy, and free from lumps or phase separation.

1. PH Determination

The pH of the prepared herbal foot care cooling gel was measured using a digital pH meter.

Apparatus:

Digital pH meter (calibrated)

Procedure:

1 g of gel was accurately weighed and dissolved in 10 ml of distilled water. The electrode of the pH meter was immersed in the solution, and the reading was recorded after stabilization.

Figure No: 2 PH Determination

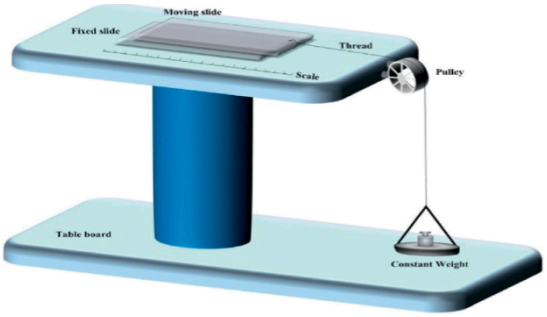
2. **Spread ability**

Spread ability was determined using the glass slide method.

Apparatus:

Two glass slides, 100 g weight, ruler, stopwatch

Figure No: 3 Spread ability



Procedure:

A fixed amount of gel was placed between two glass slides. A known weight was applied on the upper slide. The time required for separation of the slides was noted.

3. **Wash ability Test**

Apparatus:

Water, glass plate / skin surface

Procedure:

A small quantity of gel was applied on a glass plate or skin surface and washed with water to observe ease of removal.

Figure No : 4 Wash ability Test

Observation:

The formulation should be easily washable without leaving any residue.

4. **Foamability Evaluation**

Apparatus:

Beaker, distilled water, glass rod

Procedure:

A small quantity of gel was mixed with water in a beaker and shaken gently. The foam formation and its stability were visually observed and recorded.

5. **. Cooling Effect Evaluation**

Apparatus:

Skin surface / volunteer panel

Procedure:

A small quantity of the gel was applied on the skin surface and the cooling sensation produced after application was observed and noted.

6. **Skin Irritation Test Evaluation**

Apparatus:

Skin surface / patch test area

Procedure:

A small amount of gel was applied on the skin and observed for 24 hours for any signs of redness, itching, swelling, or irritation.

7. **Stability Studies Evaluation**

Apparatus:

Stability chamber / room te

VI. RESULTS AND DISCUSSIONS

1. **Physical Appearance**

The prepared polyherbal foot care cooling gel showed a smooth texture, pleasant herbal odor, light greenish appearance, and good homogeneity. The formulation was non-greasy, elegant in appearance, and free from lumps or phase separation.

Figure No: 5 Physical Appearance

1. **pH Determination**

Table No. 3: pH Determination Observation

Formulation	pH
Polyherbal Foot Care Cooling Gel	6.3

pH of the formulation was found to be suitable for topical application. It lies within the skin-friendly range and did not cause irritation or discomfort.

Figure No : 6 Ph Determination

2. **spread ability**

Table No. 4: - spread ability Observation

Formulation	Spread ability
Polyherbal Foot Care Cooling Gel	Good

The gel spread easily over the skin surface, ensuring uniform application with minimal effort. This property enhances patient compliance.

3. **wash ability**

The prepared formulation was easily washable with water and did not leave any greasy or sticky residue on the skin, indicating good user acceptability.

4. **FOAMABILITY**

Foamability studies were not the primary evaluation parameter for the polyherbal foot care cooling gel; however, a simple comparative foaming observation was carried out to assess cleansing behavior and user acceptability when applied with water.

Table No. 5 Foamability Observation

Parameter	Observation
Foam Formation	Absent / Negligible
Foaming Nature	Low
Foam Stability	Not Applicable
Cleansing Property	Good

Observation

The formulated polyherbal foot care cooling gel did not produce significant foam formation due to the absence of strong foaming agents such as SLS (Sodium Lauryl Sulfate). However, slight lathering was observed during washing, which helped in easy cleansing of the applied gel.

5. Cooling Effect

The formulation provided a noticeable cooling and refreshing sensation immediately after application. Peppermint and vetiver extracts were mainly responsible for this effect, which helped in relieving foot fatigue and burning sensation.

6. Skin Irritation Test

Table No. 6: Skin Irritation Test Observation

Parameter	Observation
Redness	Absent
Irritation	Absent
Itching	Absent

The formulation was found to be safe for topical application with no signs of irritation, redness, or itching observed during the test.

7. Stability Studies

Table No. 7:- Stability Studies Observation

Storage Condition	Observation
Room Temperature	Stable

Refrigerated Condition	Stable
Elevated Temperature	No significant change

The formulation remained stable under different storage conditions. No major changes in color, odor, consistency, or phase separation were observed.

VII. DISCUSSION

The prepared polyherbal foot care cooling gel demonstrated satisfactory physicochemical and performance characteristics suitable for topical application. The combination of herbal ingredients contributed significantly to the overall therapeutic efficacy of the formulation.

Aloe vera gel provided excellent moisturizing and soothing effects, helping to maintain skin hydration and reduce dryness. Neem extract contributed strong antimicrobial and antifungal activity, which is beneficial in preventing foot infections and controlling odor.

Carbopol 934 provided a stable gel base with appropriate viscosity, ensuring good consistency and easy spreadability. Sodium benzoate effectively acted as a preservative, maintaining the stability of the formulation throughout the study period.

The formulation exhibited acceptable pH, viscosity, spread ability, washability, and stability. No irritation or adverse reactions were observed during skin irritation studies, confirming its safety for topical use.

Overall, the results indicate that the prepared polyherbal foot care cooling gel is safe, stable, effective, and suitable for daily foot care application, providing cooling, moisturizing, and antimicrobial benefits.

Peppermint extract provided an immediate cooling and refreshing sensation due to the presence of menthol, which helped in relieving foot fatigue and discomfort. Vetiver extract enhanced the cooling effect and improved the fragrance profile of the formulation, while almond oil acted as an emollient, improving skin softness and smoothness.

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VIII. CONCLUSION

The present research work was successfully carried out to develop and evaluate a polyherbal foot care cooling gel using natural herbal ingredients such as peppermint extract, aloe vera gel, neem extract, vetiver extract, almond oil, and Carbopol 934 as a gelling agent. The formulation was designed to provide a balanced combination of cooling, moisturizing, antimicrobial, and soothing effects for effective foot care management.

The study demonstrated that the incorporation of selected herbal extracts into a Carbopol-based gel system resulted in a stable, elegant, and user-friendly topical preparation. The gel showed satisfactory physicochemical properties including smooth texture, uniform consistency, acceptable pH, good viscosity, and excellent spread ability, which are essential for topical application and patient compliance.

The cooling effect provided by peppermint and vetiver extracts offered immediate relief from foot fatigue, burning sensation, and discomfort, making the formulation highly suitable for individuals exposed to prolonged standing, walking, or use of closed footwear. Aloe vera gel and almond oil significantly improved skin hydration and softness, thereby preventing dryness, cracking, and roughness of the feet.

Neem extract contributed strong antimicrobial and antifungal activity, which is highly beneficial in maintaining foot hygiene and preventing infections and unpleasant odor. The synergistic combination of all herbal components enhanced the overall therapeutic effectiveness of the formulation compared to individual herbal extracts.

The gel was found to be non-irritating and safe for topical application, as confirmed by skin irritation studies, indicating good biocompatibility with human skin. Stability studies further confirmed that the formulation remained physically and chemically stable under different storage conditions without significant changes in appearance or performance.

Overall, the developed polyherbal foot care cooling gel represents an effective, safe, economical, and eco-friendly alternative to synthetic foot care products. It aligns with the growing demand for herbal and natural cosmetic formulations in modern healthcare and personal care industries.

In conclusion, this formulation can be considered a promising herbal topical product for routine foot care, providing cooling, moisturizing, and antimicrobial benefits, and holds significant potential for further development into a commercially viable product after advanced clinical and industrial studies.

IX. FUTURE PROSPECTIVES

The developed polyherbal foot care cooling gel has promising potential for further advancement in both pharmaceutical and cosmetic applications. Based on the present study, several future directions can be considered to enhance its efficacy, safety, and commercial value.

1. **Clinical Evaluation**
   The formulation can be further subjected to detailed clinical trials on human volunteers to evaluate long-term safety, efficacy, and user acceptability in different age groups and skin types.
2. **Antimicrobial and Antifungal Studies**

   Advanced in-vitro studies against common foot pathogens such as *Staphylococcus aureus* and *Candida albicans* can be performed to scientifically validate the antimicrobial potential of the formulation.

3. **Advanced Stability Studies**
   Long-term stability testing under ICH guidelines can be conducted to determine shelf life, storage conditions, and product performance over extended periods.
4. **Optimization of Formulation**
   Further research can be carried out to optimize the concentration of herbal extracts and gelling agents to improve cooling effect, spread ability, and viscosity.
5. **Nano formulation Approach**
   Incorporation of Nano emulsion or phytotomy technology may enhance the penetration, bioavailability, and therapeutic efficacy of herbal actives.
6. **Large-Scale Industrial Production**
   The formulation can be scaled up for commercial manufacturing with proper quality control and Good Manufacturing Practices (GMP).
7. **Product Line Expansion**
   The concept can be extended to develop related herbal products such as foot cream, antifungal gel, deodorizing spray, and medicated socks.
8. **Market and Consumer Research**
   Further studies can be conducted to analyze consumer preference, market demand, and acceptance of herbal foot care products.

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