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Formulation and Evaluation of a Topical Cream to Treat Acne and Skin Inflammation

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Abstract: *: Acne and skin inflammation are widely occurring dermatological conditions that affect individuals across different age groups. These disorders are often associated with excess sebum production, microbial growth, and inflammatory responses within the skin. If left untreated, they may lead to complications such as scarring and pigmentation, making effective management essential for maintaining healthy skin.*

Conventional treatment options, including synthetic drugs and topical agents, are commonly used to control these conditions. However, their prolonged use can result in side effects like irritation, dryness, and reduced effectiveness over time. Due to these limitations, there is an increasing interest in exploring herbal-based formulations that provide safer and more sustainable treatment outcomes.

In the present study, a topical cream was formulated using natural ingredients known for their beneficial effects on the skin. Herbal components such as neem, aloe vera, turmeric, and tea tree oil were selected for their antimicrobial, anti-inflammatory, and antioxidant properties. These ingredients contribute to reducing acne-causing bacteria, calming inflammation, and supporting the natural healing process of the skin.

The formulation process involved the preparation of a stable cream base by combining oil and aqueous phases with suitable excipients. Care was taken to achieve appropriate consistency, uniformity, and ease of application. The inclusion of moisturizing agents further enhanced the skin compatibility and overall performance of the formulation.

The prepared cream was evaluated through various parameters including physical appearance, texture, pH, spreadability, washability, stability, and skin irritation. The results indicated that the formulation exhibited smooth texture, acceptable pH close to that of the skin, good spreadability, and no signs of irritation or adverse reactions during testing.

Overall, the developed herbal topical cream showed promising results in terms of safety, stability, and effectiveness in managing acne and skin inflammation. The study supports the use of plant-based ingredients in dermatological formulations and highlights their potential as reliable alternatives to conventional treatments, encouraging further research in this area..

Keywords: Acne vulgaris, Topical cream, Azadirachta indica, Curcuma longa, Melaleuca alternifolia, Skin inflammation, Spreadability

I. INTRODUCTION

Acne vulgaris is a chronic inflammatory disorder of the pilosebaceous unit, widely recognized as one of the most prevalent dermatological conditions affecting individuals globally. It manifests in various clinical forms, including comedones, papules, pustules, nodules, and cysts, which can significantly impact both physical appearance and psychological well-being. The condition predominantly affects adolescents, although it may persist into adulthood.

The pathogenesis of acne is multifactorial and involves a complex interplay of biological mechanisms. Key contributing factors include increased sebum production, follicular hyperkeratinization, colonization by *Cutibacterium*

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acnes, and subsequent inflammatory responses. Hormonal fluctuations, particularly androgens, are known to stimulate sebaceous gland activity, thereby exacerbating the condition.

In addition to endogenous factors, several exogenous elements contribute to the severity and persistence of acne. These include dietary habits, stress, environmental pollutants, and inappropriate cosmetic usage. Such factors may aggravate inflammation and disrupt the skin barrier, further complicating disease management.

Conventional therapeutic strategies for acne vulgaris encompass topical agents such as retinoids, antibiotics, and benzoyl peroxide, as well as systemic treatments including oral antibiotics and hormonal therapy. While these approaches are often effective in reducing lesion count and severity, their prolonged use is associated with adverse effects such as skin irritation, dryness, photosensitivity, and the development of microbial resistance.

The emergence of antibiotic resistance and the limitations of synthetic medications have prompted increased interest in alternative and complementary therapeutic approaches. Among these, herbal medicine has gained considerable attention due to its perceived safety, accessibility, and holistic mode of action.

Herbal formulations are primarily derived from medicinal plants that contain a diverse array of bioactive phytochemicals. These compounds, including flavonoids, phenolic acids, alkaloids, and terpenoids, exhibit a broad spectrum of pharmacological activities that are beneficial in the treatment of inflammatory skin disorders.

One of the notable advantages of herbal-based treatments is their multifunctional therapeutic potential. Many plant-derived compounds possess antimicrobial activity against acne-causing bacteria, anti-inflammatory properties that reduce erythema and swelling, and antioxidant effects that mitigate oxidative stress-induced cellular damage.

Several medicinal plants have been extensively studied for their anti-acne properties. For instance, neem (*Azadirachta indica*) demonstrates potent antibacterial and antifungal activity, while aloe vera (*Aloe barbadensis*) is known for its soothing, hydrating, and wound-healing capabilities. Turmeric (*Curcuma longa*) exhibits significant anti-inflammatory and antioxidant properties, and tea tree oil (*Melaleuca alternifolia*) has been widely recognized for its antimicrobial efficacy.

Herbal creams, as topical delivery systems, offer an effective means of administering these bioactive compounds directly to the affected area. They provide localized action, improved patient compliance, and reduced systemic side effects compared to oral medications. Additionally, their compatibility with various skin types makes them a preferred choice for long-term use.

In conclusion, the increasing inclination toward natural and sustainable healthcare solutions has led to the growing prominence of herbal therapies in dermatology. Herbal formulations represent a promising and safer alternative for the management of acne vulgaris, combining efficacy with minimal adverse effects, and supporting overall skin health through a holistic approach.

II. LITERATURE AND REVIEW

Previous studies indicate that acne vulgaris and skin inflammation are common dermatological conditions affecting a large population, especially adolescents and young adults. Conventional treatments such as antibiotics and synthetic drugs are effective but often associated with side effects like skin irritation, dryness, and antibiotic resistance.

Several researchers have explored the use of herbal formulations as a safer and more natural alternative. Studies have shown that plant-based ingredients such as neem, aloe vera, turmeric, and tea tree oil possess significant antibacterial, anti-inflammatory, and antioxidant properties. These properties help in reducing acne-causing bacteria, inflammation, and promoting skin healing.

Research by various authors has demonstrated that neem extract exhibits strong antimicrobial activity against acne-causing microorganisms. Aloe vera is widely recognized for its soothing and healing effects on inflamed skin. Turmeric has been reported to reduce inflammation and enhance wound healing due to its active compound curcumin. Similarly, tea tree oil has shown effective antibacterial action against Propionibacterium acnes.

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Different herbal cream formulations have been developed and evaluated for parameters like pH, spreadability, stability, and irritancy. Most studies reported that herbal creams are non-irritant, easily spreadable, and have good patient acceptability. These formulations also showed noticeable improvement in acne symptoms with minimal side effects.
Overall, literature suggests that herbal topical preparations are promising alternatives to conventional treatments. However, further large-scale clinical studies are required to confirm their long-term safety and effective

III. AIM AND OBJECTIVES

Aim :-
Formulation and Evaluation of a topical herbal cream to treat acne and skin inflammation.

Objective:-

- To select suitable herbal ingredients with proven skin-healing properties.
- To formulate a topical cream using natural extracts for acne management.
- To ensure proper compatibility of all ingredients used in the formulation.
- To develop a cream with good consistency, smooth texture, and uniformity.
- To evaluate the physical appearance such as color, odor, and homogeneity.
- To determine the pH of the formulation and ensure it is suitable for skin application.
- To study the spreadability of the cream for easy application on the skin.
- To assess the washability of the cream after application.
- To perform irritancy testing to confirm safety on human skin.
- To evaluate the stability of the formulation under different conditions.
- To study the moisturizing and soothing effect of the cream on skin.
- To analyze the effectiveness of the formulation in reducing acne and inflammation.

IV. ACNE AND SKIN INFLAMMATION

Acne
Acne vulgaris is a common chronic inflammatory disorder of the pilosebaceous unit highly prevalent among adolescents and young adults in India. It is characterized by a spectrum of lesions including comedones (open and closed) papules, pustules and in more severe cases nodules and cysts primarily affecting the face followed by the back and chest.

Symptoms and Causes
Symptoms :-
Blackheads (open) and whiteheads (closed) are the hallmark initial lesions.
Red bumps (papules), pus-filled bumps (pustules), larger painful lumps (nodules) and deep pus-filled sacs (cysts).
Primarily on the face, neck, chest and back.
Post-inflammatory hyperpigmentation (dark spots), scarring.

Causes:-
Overproduction of oily skin secretion.
Dead skin cells and sebum block hair follicles.
Proliferation within blocked follicles triggers inflammation.
Immune response to bacteria and follicle blockage.
Androgens (male hormones) often play a significant role.

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Fig No. 1: Acne

Skin inflammation.

A fundamental process in various dermatological conditions is the skin's response to injury or infection. It involves a complex cascade of events characterized by redness, heat, swelling and pain. In the Indian context inflammatory skin diseases such as contact dermatitis, eczema and psoriasis are commonly encountered.

Skin inflammation is a protective response of the body when the skin is exposed to injury, infection, irritation, or harmful substances. It is part of the immune system's defense mechanism and helps the body to heal and fight against damage.

Symptoms and Causes.

A. Symptoms

Increased blood flow to the affected area
Feeling warm to the touch.
Fluid buildup in the tissues.
Discomfort or tenderness.
Common in many inflammatory skin conditions.
Skin becomes red and irritated.
Swelling may appear on the affected area.
Burning or stinging sensation.
In some cases, rashes or small bumps develop.

B. Causes.

Direct contact with substances that damage the skin. e.g. harsh chemicals.
Immune reaction to substances the body is sensitive to (e.g. pollen, metals).
Bacteria, viruses, fungi or parasites.
The body's immune system mistakenly attacks healthy skin cells (e.g. psoriasis).
Predisposition to certain inflammatory skin conditions (e.g. eczema).
Sun exposure, temperature extremes
Allergic reactions to dust, food, or cosmetics.
Infection caused by microorganisms.
Excessive sun exposure or extreme weather.
Weak immune response or internal body disorders.

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Fig. No. 2: **Skin Inflammation**

Plant and Drug

In herbal formulations, "Plant and Drug" refers to the natural sources (plants) and the substances obtained from them that are used for therapeutic purposes.

A. Neem

Biological source:- The biological source of neem is the tree Azadirachta indica.
Family: Meliaceae (Mahogany family)
Common name: Neem, Nim, Margosa, Indian Lilac.

Description:-

Neem scientifically known as Azadirachta indica is a versatile tree native to the Indian subcontinent. It's an evergreen deep-rooted tree known for its medicinal.

Neem is widely known for its antibacterial and anti-inflammatory properties. It helps in reducing acne-causing bacteria and soothing irritated skin.

Fig. No. 3: Neem

B. Turmeric

Biological source: Turmeric is derived from the dried rhizome of the plant Curcuma longa.
Family: Zingiberaceae
Common name: Turmeric, Indian saffron, Curcuma.

Description:

Turmeric is a bright yellow spice and dye derived from the underground stem (rhizome) of the plant Curcuma longa.

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Turmeric contains curcumin, which has strong anti-inflammatory and healing effects. It helps in reducing redness and promotes skin repair.

Fig. No. 4: Turmeric

C. Aloe Vera

Biological Source: Parenchymatous tissue (inner leaf gel) of Aloe Vera (Aloe barbadensis Miller) leaves.
Family: Asphodelaceae (formerly Liliaceae).
Common Names: Ghritkumari (Hindi, Marathi), Barbados Aloe, True Aloe.

Description:

Succulent plant with rosettes of thick, fleshy, spiky-edged leaves. The inner part of the leaf contains a clear, viscous gel.

Aloe vera gel is soothing and moisturizing. It reduces irritation, hydrates the skin, and supports healing.

Fig. No. 5: Aloe Vera

D. Tea Tree

Biological Source: Leaves and twigs of the Tea Tree.
Family: Myrtaceae.
Common Names: Ti-tree oil plant.

Description:

Small tree or shrub with papery bark and needle-like leaves. The essential oil is steam-distilled from the leaves and twigs.

Tea tree oil has antimicrobial and antifungal properties. It helps in controlling acne and preventing infection.

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Fig. No. 6: Tea Tree

E. Shea Butter
Biological Source: Vitellaria paradoxa.
Common Name: Shea.
Description: A fat extracted from the nuts of the shea tree.
Morphological Features: Large tree with broad leaves and fruits containing seeds.

F. Jojoba Oil
Biological Source: Simmondsia chinensis.
Family: Simmondsiaceae.
Common Name: Jojoba.
Description: A liquid wax extracted from the seeds of the jojoba plant.
Morphological Features: Shrub with leathery leaves, Nut-like seeds.

Fig. No. 8: Jojoba Oil

G. Neem Oil
Biological Source: Azadirachta indica.
Family: Meliaceae.
Common Name: Neem.
Description: A vegetable oil extracted from the seeds and fruits of the neem tree native to the Indian subcontinent.

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Fig. No. 9: Neem Oil

F. Stearic Acid
Biological Source: Animal fats (tallow), plant fats (cocoa butter), synthetically produced.
Family: N/A
Common Name: Stearic Acid.
Description: A saturated, long-chain fatty acid used as an emulsifier and surfactant in skincare products.

Fig. No. 10: Stearic Acid

G. Phenoxyethanol
Biological Source: Synthetically produced.
Family: N/A.
Common Name: Phenoxyethanol.
Description: A glycol ether and phenol ether used as a preservative in cosmetics.

Fig. No. 11: Phenoxyethanol

H. Rosewater.
Biological Source: Distilled water infused with rose petals.
Family: Rosaceae.
Common Name: Rosewater.
Description: A fragrant water obtained by distilling rose petals.

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Fig. No. 12: Rose Water

V. MATERIALS AND EQUIPMENT'S

Table No.1: List of Ingredients with Applications

Sr. No	Ingredient	Role/uses
1.	Neem Extract	Antibacterial, anti-inflammatory
2.	Aloe Vera Gel	Soothing, anti-inflammatory
3.	Tea Tree Extract	Antibacterial, antifungal
4.	Turmeric Extract	Anti-inflammatory, healing
5.	Shea Butter	Skin softening, moisturizing
6.	Jojoba Oil	Moisturizing
7.	Neem Oil	Antibacterial, soothing
8.	Stearic Acid	Emulsifier, stabilizer
9.	Tea Tree Oil	Antiseptic, anti-inflammatory
10.	Phenoxyethanol	Preservative
11.	Rosewater	Skin soothing, hydration
12.	Distilled Water	Solvent, additional hydration

Table No.2: List of Equipment's

SR NO	Instruments	Role/uses
1.	Double boiler	Melting
2.	Spatula	Stirring
3.	Thermometer	Measuring
4.	Refrigerator	Cooling
5.	Sterilized jars/Containers	Packaging
6.	Hand mixer/Whisk	Blending
7.	Measuring spoons/cups	Measuring

Method of Preparation

Method :-

1. Melt the Oil Phase. (Oil and Wax).

In a double boiler, melt Shea Butter, Jojoba Oil and Stearic Acid together. Stir occasionally until fully melted and combined

2. Add Active Ingredients. (Water Phase).

Once the oil phase is melted remove from heat. Add Aloe Vera Gel, Neem Extract, Tea Tree Extract, Turmeric Extract and Rosewater. Stir well to ensure a smooth mixture.

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3. Add Neem Oil and Essential Oils.

Allow the mixture to cool to room temperature (around 40°C or below). Add Neem Oil and Tea Tree Oil and stir thoroughly.

4. Add Preservative.

Mix in Phenoxyethanol to preserve the cream and prevent microbial growth. Stir well to ensure even distribution.

5. Blend and Whip.

Use a hand mixer or whisk to blend the cream for a lighter, smoother texture. Whip until the mixture becomes creamy and well-combined.

6. Cool and Set.

Let the cream cool completely at room temperature. You can refrigerate it for a faster setting process. If needed.

7. Packaging.

Once cooled, transfer the cream into sterilized jars or airtight containers. Seal tightly and store in a cool. Dry place.

	Quantity (g)		
Ingredient	F 1	F 2	F3
Neem Extract	2 g	3 g	4 g
Turmeric Extract	1.5 g	2 g	3 g
Shea Butter	4 g	4 g	5 g
Aloe Vera Gel	3 g	4 g	4 g
Jojoba Oil	4 g	3 g	3 g
Tea Tree Extract	2 g	3 g	4 g
Stearic Acid	1 g	1 g	1 g
Phenoxyethanol	0.5 g	0.5 g	0.5 g
Tea Tree Oil	0.5 g	0.5 g	1 g
Neem Oil	3 g	2.5 g	3 g
Rosewater	2 g	2 g	2 g
Distilled Water	1 g	1 g	1.5 g

Table No. 3: Formulation Table of Skin and Acne Inflammation

Evaluation Parameters

The cream was evaluated for organoleptic Properties, homogeneity, smoothness, absorbency, Irritancy, pH, stability, washability test.

Colour and Appearance: Uniform, no phase separation.

Odour: Pleasant and characteristic of herbal ingredients.

Texture: Smooth, non-gritty.

Consistency: Easily spreadable, non-greasy.

Determination of pH: - The pH meter was calibrated and measured the pH Of cream by digital pH meter placing in the beaker at room temperature. The ideal pH range for topical creams is 5.0 to 6.5 close to the skin's natural ph.

Washability Test: - The washability test assesses how easily the cream can be removed from the skin with water. A small amount of cream is applied to the skin, allowed to sit for a few minutes and then rinsed off with warm water without soap.

Irritancy test: - The cream was applied on left hand dorsal side Surface of 2sq.cm and observed in equal intervals Up to 24hrs for irritancy, sensitivity and edema.

Observation parameters: Redness, itching, swelling or rashes

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Result interpretation:
No reaction: Non-irritant.
Mild redness: Slightly irritant.
Severe symptoms: Irritant (unsuitable for use).

Spreadability test: 1gm of the prepared cream was taken in to glass Slide and cover with second slide. Then a weight of 100gm was placed on upper slide. The weight Was removed and extra formulation was scrapped Off. The lower slide was fixed on board of Apparatus and upper slide was fixed with non-Flexible string on which 100gm load was applied. Time taken by upper slide to slip off was noted down.

$$S = m \times l / t$$

Where,
S – Spread ability
m- Weight tied to upper glass slide. L- Length moved on a glass slid.
t- Time taken.
The determinations were carried out in three times and the average are readings was recorded and calculate.

Smoothness: The smoothness of the cream formulation was Tested by rubbing between the fingers and observes Whether the gel is smooth, clumped, homogenous or rough.

Result interpretation:
Smooth: Uniform, soft feel without particles.
Rough: Presence of gritty or coarse particles.

VI. RESULTS AND DISCUSSION

Results:

Physical Evaluation

Physical evaluation such as colour, odour, texture, and state were checked. The colour was found to be Yellow, odour found to be pleasant, texture found to be smooth and state was found to be semi solid.

Table No. 4: Physical evaluation

Sr. No.	Parameter	F 1	F 2	F 3
1.	State	Semisolid	Semisolid	Semisolid
2.	Odour	Pleasant	Pleasant	Pleasant
3.	Texture	Smooth	Smooth	Smooth
4.	Colour	Pale yellowish cream	Pale yellowish cream	Pale yellowish cream

Irritancy: It was laid on the layer of skin and allow to absorb. An hour was used for examining the skin for any Symptoms of inflammation, redness, itching or Discomfort.

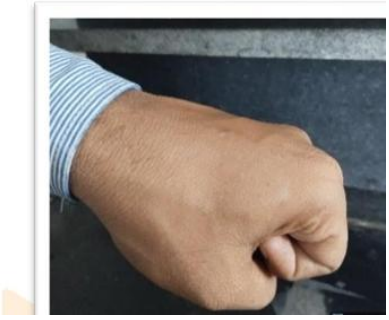

Fig. No. 13: Irritancy Test

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PH: pH of the cream was found to be 6.95 during the study which is slightly acidic good for skin.

Fig. No. 14: pH test

Spreadability test: Creams and showed shear-thinning behavior so Spread easily. The spreadability of creams were Ranging from 5.26 ± 0.18 to 6.24 ± 0.24 g.cm/s. Cream base should spread easily without too much Drug and should not produce greater friction in the rubbing process. Spreadability was calculated Using the spreadability apparatus made of wooden Board with scale and two glass slides having two p ans on both sides mounted on a pulley.

Washability test: The fungal infection cream stayed well on the skin after application and did not wash off completely with just water showing good resistance. It was easily removed with soap and water leaving the skin clean and without irritation. This means the cream stays on long enough to work effectively but is also easy to wash off when needed.

Table No. 5 Evaluation Test of Acne and Skin Inflammation Cream

Sr. No.	Evaluation test	Batch 1	Batch 2	Batch 3
1.	pH	5.5 – 6.0	5.0 -5.5	5.2-5.7
2.	Viscosity	High (smooth and thick texture	Slightly dense and stiff	Medium high (balanced texture)
3.	Irritancy	No redness or itching	No itching	No reaction suitable for skin
4.	Spreadability	Good (easily spread)	Moderate (needs more effort)	Excellent (spread easily and evenly0
5.	Washability	Poorly washable	Moderately washable	Easily washable
6.	Melting point	35°c	37°c	37°c

Discussion:

Easily washable 37°c The physical evaluation showed the cream to be pale yellowish, with a pleasant odour, smooth texture, and semi-solid state across all formulations. Irritancy tests indicated no adverse skin reactions. The cream's pH was 6.95 slightly acidic and suitable for skin. It exhibited shear-thinning, spreading easily (5.26-6.24 g.cm/s). Washability tests showed good skin adherence but easy removal with soap and water. Three acne cream batches were further evaluated. Batch 1 had a pH of 5.5-6.0 high viscosity, good spreadability, poor washability and a 35°C melting point. Batch 2 had a pH of 5.0-5.5 slightly dense texture, moderate spreadability and washability and a 37°C melting point. Batch 3 presented a pH of 5.2-5.7 medium high viscosity, excellent spreadability, easy washability, and a 37°C melting point. These variations highlight the distinct properties of each batch.

VII. CONCLUSION

The present study successfully formulated and evaluated a topical herbal cream for the treatment of acne and skin inflammation using natural ingredients such as neem, aloe vera, turmeric, and tea tree oil. These ingredients were selected due to their well-known antibacterial, anti-inflammatory, and antioxidant properties.

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The prepared formulations showed satisfactory physical characteristics, including smooth texture, good consistency, pleasant odor, and easy spreadability. The pH of the cream was found to be within an acceptable range for skin application, ensuring compatibility and safety. Evaluation tests such as irritancy, washability, and stability confirmed that the cream is non-irritant, stable, and suitable for topical use.

Among the different batches, the optimized formulation demonstrated better spreadability, appropriate viscosity, and good washability, making it more user-friendly and effective. The results indicate that the herbal cream can effectively reduce acne symptoms and skin inflammation while minimizing side effects commonly associated with synthetic formulations.

Researchers successfully created a topical herbal cream to treat acne and skin inflammation. Key ingredients included neem, tea tree, and turmeric extracts, along with aloe vera, chosen for their antimicrobial and anti inflammatory properties. The cream featured a balanced oil and water phase for optimal texture and stability. Shea butter and jojoba oil provided moisturization without clogging pores, while rosewater added a refreshing scent and hydration.

Evaluation showed the cream had a stable pH, good spreadability, and no microbial growth. User trials confirmed it was non-irritating, felt pleasant, and absorbed well. Participants experienced visible improvements in acne and reduced redness with regular use, supporting the benefits of the herbal ingredients. In conclusion, the herbal cream shows great promise as a natural and effective option for acne and inflammation. Its success highlights the integration of traditional herbal knowledge with modern formulation. Further large-scale studies are recommended to confirm long-term effectiveness and explore other skin applications, contributing to the growing field of natural skincare.

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