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Formulation and Evaluation of Antibacterial Cream from Azadirachta Indica Extract

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Abstract: *Skin acts as the first line of defense against various environmental factors and pathogenic microorganisms. Bacterial contamination and infection of the skin may occur through cuts, wounds, abrasions, acne, and other minor skin conditions. Conventional antibacterial preparations are effective, but prolonged or inappropriate use of synthetic antimicrobial agents may be associated with irritation, hypersensitivity and, in some cases, antimicrobial resistance. Therefore, there is increasing interest in the development of herbal topical formulations containing naturally derived bioactive substances. Neem (Azadirachta indica), belonging to the family Meliaceae, is a traditionally important medicinal plant known for its antibacterial, antifungal, anti-inflammatory and antioxidant properties. The presence of bioactive constituents such as nimbidin, azadirachtin, limonoids and flavonoids contributes to its potential antimicrobial activity.*

The present project was undertaken with the aim of formulating and evaluating an antibacterial herbal cream containing neem extract for topical application. Neem extract was incorporated into a suitable cream base containing appropriate excipients to provide the required consistency, spreadability, moisturizing properties and stability. The cream was prepared by separately processing the oil and aqueous phases followed by emulsification under controlled temperature and continuous stirring. The neem extract was incorporated at a suitable stage of formulation to minimize possible degradation of its heat-sensitive constituents. The prepared cream was then allowed to cool, homogenized and packed in a suitable airtight container.

Keywords: Azadirachta indica, Neem, antibacterial cream, herbal formulation, topical preparation, antimicrobial activity, skin infection, formulation and evaluation.

I. INTRODUCTION

The skin is the largest organ of the human body and forms an important protective barrier between the internal tissues and the external environment. It protects the body from physical, chemical and biological hazards and plays an important role in maintaining body temperature, preventing excessive loss of water and providing sensory functions. The skin is continuously exposed to microorganisms present in the environment. Although the normal skin barrier and resident microbial flora provide considerable protection, disruption of the skin by cuts, abrasions, wounds, excessive moisture, inflammation or other conditions can allow pathogenic microorganisms to colonize and cause infection [11,13].

Bacterial skin infections are among the common dermatological problems encountered in clinical and community settings. Microorganisms such as *Staphylococcus aureus*, including methicillin-resistant *Staphylococcus aureus* (MRSA), are important bacterial pathogens associated with skin and soft-tissue infections [3,4].

Herbal medicines and plant-based topical preparations have been used traditionally for skin care and the management of various dermatological conditions. Plants may contain alkaloids, flavonoids, tannins, terpenoids, phenolic compounds, glycosides and other constituents that can contribute to antimicrobial, antioxidant or anti-inflammatory effects. However, the effectiveness of a herbal formulation cannot be assumed merely because an ingredient is traditionally used. Proper extraction, standardization, formulation and evaluation are necessary to establish the quality and performance of the final preparation[5,7].

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Neem, scientifically known as ***Azadirachta indica* A. Juss.**, is a medicinal plant belonging to the family Meliaceae. It is widely distributed in tropical and subtropical regions and has a long history of traditional use. Different parts of the neem plant, including leaves, bark, seeds, flowers and oil, have been investigated for various biological activities[8,10]**.**
Neem contains several biologically active constituents, including limonoids and other phytochemicals. Important constituents reported from neem include azadirachtin, nimbidin, nimbin, salannin and related compounds. The composition of neem extracts can vary depending on the plant part used, geographical origin, harvesting conditions and extraction method[8,9,1]**.**

Fig no.1

Aloe vera, scientifically known as ***Aloe barbadensis* Miller**, is a succulent medicinal plant belonging to the family Asphodelaceae. It is widely used in pharmaceutical, cosmetic and dermatological preparations because of its moisturizing, soothing and skin-conditioning properties. The leaves of *Aloe vera* contain a clear mucilaginous gel that is rich in water and contains various biologically active substances, including polysaccharides, vitamins, minerals, enzymes, amino acids and phenolic compounds[12,14]**.**

Fig no. 2

II. LITERATURE SURVEY

Literature Survey

1.Ali and Yosipovitch (2013) reviewed the physiological importance of skin pH and explained the relationship between the skin's acidic environment, epidermal barrier function and normal skin physiology. Their work highlighted that skin pH is an important factor in maintaining barrier homeostasis and protecting the skin from environmental challenges. This provides a scientific basis for considering pH as an important evaluation parameter during the development of topical formulations intended for application to the skin[11].

2.Brooks et al. (2025) provided an updated review of the skin acid mantle and emphasized the role of skin pH in maintaining epidermal barrier function and the skin microenvironment. Their discussion highlighted the importance of maintaining an appropriate acidic environment for normal skin function and microbial balance. This evidence supports careful control and evaluation of pH when developing topical pharmaceutical and cosmetic preparations[13].

3.Naeem et al. (2021) investigated the in-vitro efficacy of *Azadirachta indica* leaf extract against methicillin-resistant *Staphylococci* isolated from skin infections. The study demonstrated antibacterial activity of the neem leaf extract against the tested resistant bacterial isolates, indicating the potential of neem as a plant-derived source of antibacterial compounds relevant to dermatological applications. These findings provide direct support for further investigation of neem extract in topical antibacterial formulations[3].

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III. AIM & OBJECTIVE

AIM

To formulate and evaluate an antibacterial cream using neem extract.

OBJECTIVES

1.To extract active constituents from neem
2.To prepare cream base using suitable excipients
3.To incorporate neem extract into formulation
4.To evaluate physicochemical properties
5.To study antibacterial activity
6.To evaluate stability of formulation

IV. MATERIAL & METHODS

1.Ingredients:

Table 1: Composition of the prepared Antibacterial Cream Formulation

2.Apparatus:

Theapparatususedincludedbeakers,measuringcylinders,glassrods,funnels,filterpaper,droppers,anelectronic weighing balance, stirrer and storage bottles.

Table 1list of the ingredients

INGREDIENTS	QUANTITY	FUNCTION
Neem Extract	5 g	Antibacterial API
Aloe vera gel	10 g	Soothing agent
Stearic acid	12 g	Emulsifying agent
Cetyl alcohol	3 g	Thickener / Emollient
Liquid paraffin	8 g	Emollient
Glycerin	5 g	Humectant
Triethanolamine	1.5 g	Neutralizer / Emulsifier
Methyl paraben	0.15 g	Preservative
Propyl parabin	0.05 g	Preservative
Purified water	q.s to 100 g	Vehicle

Method and Preparation:

Step 1 — Accurate Weighing

- Weigh all ingredients separately
- Oil phase and water phase in separate beakers
- Api separately

Step 2 — Preparation of Oil Phase

- Take clean dry beaker and add stearic acid, cetyl alcohol liquid paraffin
- Heat upto 70-75°C
- Stir gently until oil phase becomes uniform

Step 3 — Preparation of Aqueous Phase

- Take beaker pour purified water
- Add glycerin, methyl paraben, and propyl paraben
- Heat upto 70-75°C
- Add triethanolamine slowly with stirring

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Step 4 — Emulsification (Critical Step)

- Now both phases are at same temperature.
- Slowly add aqueous phase → oil phase
- Stir continuously (same direction)
- 10–15 minutes continuous stirring

Step 5 — Cooling Phase

- Continue stirring while cooling
- Let temperature drop to below 40°C

Step 6 — Addition of Active Ingredients

- At 40°C, add Neem extract & aloe vera gel
- Mix thoroughly until uniform.

Step 7 — Homogenization

- Stir properly to ensure uniform distribution
- Avoid air entrapment.

Step 8 — Final Adjustment

- Texture
- Consistency
- Appearance

V. EVALUATION PARAMETERS:

1. Physical Appearance

- Purpose: To check the visual quality and acceptability of the face wash (color, texture, homogeneity, and presence of particles).
- Method: Take a small quantity of the face wash. Observe visually under good lighting. Note color, smoothness, and presence of any lumps or coarse particles**.**

2. pH Determination

- Purpose: To ensure the formulation is skin-friendly (ideal skin pH: 5.5–7).
- Method: Take 1 g of face wash and dilute with 10 mL distilled water. Dip a pH strip or use a pH meter. Record the pH value.

3. Spreadability Test

- Purpose: To determine how easily the face wash spreads on the skin.
- Method: Place a small amount of sample between two glass slides. Apply slight pressure. Measure the diameter or observe the ease of spreading. Better spreading indicates good usability.

4. Washability Test

- **Purpose:** To check how easily the product can be washed off with water.
- Method: Apply a small amount on the skin. Rinse with water. Observe if it removes easily without residue.

5. Foamability Test

- Purpose: To evaluate cleansing efficiency (foam helps remove dirt and oil).
- Method: Take 1 g of face wash in a test tube with 10 mL water. Shake vigorously for 30 seconds. Measure the foam height and stability

6. Viscosity (Consistency) Test

- Purpose: To determine thickness and flow property of the formulation.
- Method: Observe the flow of face wash when poured from a container. Alternatively, use a viscometer if available. Record whether it is too thick, thin, or ideal.

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7. Skin Irritation Test (Patch Test)

- Purpose: To ensure the product is safe and non-irritating.
- Method: Apply a small amount on the inner forearm .Leave for 15–20 minutes. Observe for redness, itching, or irritation.

8. Stability Study

- Purpose: To check product stability over time under different conditions.
- Method: Store samples at:Room temperature Refrigerated condition Observe for 1–2 weeks. Check for changes in color, odor, texture, or separation.

9. Cleansing Ability Test

- Purpose: To evaluate effectiveness in removing dirt and oil.
- Method: Apply a small amount on oily skin or a surface with dirt.Gently rub and rinse.Observe cleanliness after washing.

10. Odor Evaluation

- Purpose: To assess fragrance acceptability.
- Method: Smell the formulation. Record whether odor is pleasant, mild, or strong

VI. RESULTS

1.Physical Appearance: The prepared antibacterial cream showed a smooth, uniform, and homogeneous appearance with a mild herbal odor. No lumps or phase separation were observed, indicating good formulation quality.

Table 2 physical appearance result

PARAMETERS	OBSERVATION
Colour	Light green
odour	Mild herbal
Texture	Smooth
Appearance	Homogeneous, No lumps

Fig no.3

Fig no.4

2. pH Determination

The pH of the formulated antibacterial cream was found to be within the acceptable range, indicating that it is suitable for topical application and unlikely to cause skin irritation.

Ideal ph range is 5.5-6.5

3. Spreadability

The gel formulation was applied on a glass slide covered with another slide and a 100g weight and spread diameter was measured after 1 min .This formulation exhibited smooth and uniform spreadability. It spread easily on skin with less efforts,Non-gritty texture indicating good consistency and ease of application.

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Fig no.5

Fig no.6

4. Washability

Prepared formulations were easily washed with water. Observation: Easily washable with normal tap water. Residue: No greasy or sticky residue left on skin.

5. Irritancy Test

Small amount of facewash applied on the skin or hand dorsal surface and kept for time interval of 1 to 2hr and found to show redness, oedema, inflammation and irritation during studies. The formulation it"s safe to use.

6. Stability Study

Store at room temperature upto 7-14 days

Observation shows- No phase separation, No colour change, No false odour.

VII. DISCUSSION

The literature reviewed in this study indicates that *Azadirachta indica* (neem) has considerable potential as a herbal ingredient for the development of topical antibacterial formulations. Neem has been traditionally used for various skin-related applications, and scientific investigations have attributed its biological activity to a diverse range of phytoconstituents, including limonoids, flavonoids, tannins and other phenolic compounds. The reported antibacterial, antifungal, anti-inflammatory and antioxidant properties provide a scientific basis for investigating neem as an active herbal component in topical preparations. However, the biological activity of neem is not uniform across all preparations and may vary considerably according to the plant part, extraction method, solvent, concentration and phytochemical composition.

The reviewed literature also demonstrates that the choice of formulation vehicle is an important factor in determining the performance of a herbal topical product. Incorporating neem extract into a cream base provides advantages over applying the crude extract directly to the skin because the cream can improve application, distribution, consistency and patient acceptability. Cream formulations can also incorporate moisturizing and emollient components, which may be beneficial for maintaining skin condition while delivering the herbal active ingredient. Therefore, successful development of a neem antibacterial cream depends not only on the antimicrobial activity of neem but also on appropriate selection and concentration of formulation excipients.

Physicochemical evaluation is consistently emphasized in studies involving topical herbal formulations. Parameters such as appearance, homogeneity, pH, spreadability, viscosity, washability and stability provide important information regarding the quality and acceptability of the final product. A formulation may demonstrate antibacterial activity but still be unsuitable for topical use if it is excessively viscous, difficult to spread, unstable, irritating, or physically incompatible with the skin. Consequently, formulation development and evaluation should be considered together rather than treating antimicrobial activity as the only measure of product quality.

VIII. CONCLUSION

The neem antibacterial cream was successfully formulated using an oil-in-water emulsion system. The formulation showed acceptable physicochemical properties and antibacterial activity. It was found to be stable, safe, and suitable for topical application.

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The present study successfully focused on the formulation and evaluation of a herbal antibacterial cream using Neem as the primary active ingredient. Neem was selected due to its well-established antibacterial, anti-inflammatory, and wound-healing properties, supported by the presence of bioactive constituents such as nimbidin, azadirachtin, and flavonoids.

An oil-in-water (O/W) emulsion system was employed for the formulation of the cream, as it provides better spreadability, non-greasy texture, and improved patient acceptability. Suitable excipients such as stearic acid, cetyl alcohol, glycerin, and triethanolamine were used to ensure proper emulsification, stability, and consistency of the formulation.

The spreadability test demonstrated that the cream could be easily applied with minimal effort, ensuring uniform distribution on the skin surface. The viscosity of the formulation was found to be moderate, which is ideal for maintaining both stability and ease of application. The washability test confirmed that the cream is of oil-in-water type and can be easily removed with water, enhancing user convenience.

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