

Formulation and Evaluation of Anti-Bacterial Herbal Soap

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Abstract: *The present study focuses on the formulation and evaluation of an antimicrobial herbal soap using natural ingredients such as neem, tulsi, aloe vera, turmeric, rose water, vitamin E, and glycerin soap base. Four formulations (F1–F4) were prepared and evaluated for organoleptic properties, pH, foam stability, moisture content, hardness, total fatty matter, antimicrobial activity, skin irritation, stability, and washability. The results showed that all formulations possessed satisfactory physicochemical properties and were safe for skin application. Among them, F2 exhibited the highest antimicrobial activity, while F3 showed the best moisturizing effect and skin compatibility. The study concludes that the formulated herbal soap is an effective, safe, and eco-friendly alternative to synthetic antibacterial soaps for daily personal hygiene*

Keywords: Herbal Soap, Antimicrobial Activity, Neem, Tulsi, Aloe Vera, Turmeric, Skin Care

I. INTRODUCTION

The human skin is not only the largest organ in the body but also plays a crucial role as the body's primary defense mechanism. It serves as a protective barrier, shielding internal organs, muscles, and bones from external elements such as harmful pathogens, temperature changes, and physical injuries. In addition to its protective function, the skin is home to numerous specialized cells and structures that contribute to various important processes, including regulating body temperature, producing vitamin D, and sensing touch, pressure, pain, and pleasure. Its complexity and versatility make the human skin a remarkable organ that deserves our attention and care. [1] Most outer part of our body is Skin, and it contains largest surface area and weight. The skin or cutaneous membrane covers the external surface of the body and it provides a first line defense mechanism to the body against various pathogens. As the skin interfaces with the environment, it is constantly exposed to different environmental stimuli. This makes the skin damage prone. [2] The skin is composed of three main layers: the epidermis, dermis, and subcutaneous layer, each with distinct structure and function. Epidermis is the outermost layer and serves as the primary protective barrier of the body against environmental factors such as microorganisms, chemicals, and ultraviolet radiation. It is made up of keratinized stratified squamous epithelium and lacks blood vessels, receiving nutrients through diffusion from underlying tissues. The epidermis is organized into several layers—stratum basale, spinosum, granulosum, lucidum (in thick skin), and corneum—each contributing to continuous cell renewal and keratin production. It also contains specialized cells like melanocytes for pigmentation, Langerhans cells for immune defense, and Merkel cells for sensory perception.[3]



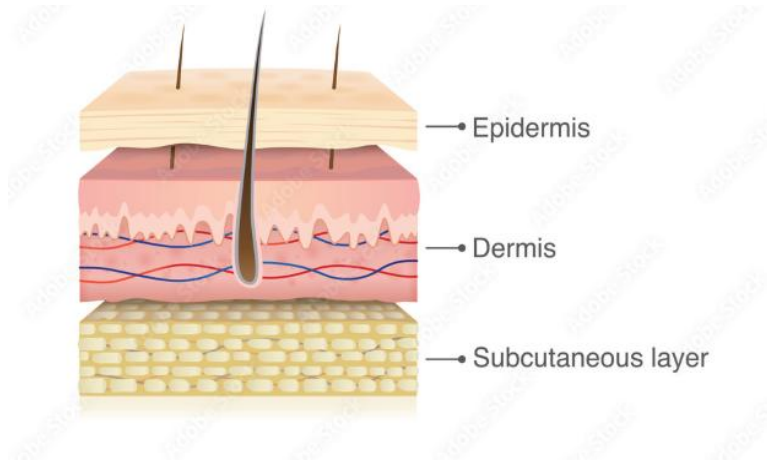


FIGURE NO,01 SKIN

Dermis, a thicker, vascular connective tissue layer composed mainly of collagen and elastin fibers that provide strength, elasticity, and flexibility to the skin. The dermis is divided into a superficial papillary layer and a deeper reticular layer, and it houses important structures such as blood vessels, nerve endings, hair follicles, sweat glands, and sebaceous glands. This layer plays a key role in thermoregulation, sensation, and nourishment of the epidermis. [4]

Subcutaneous layer, also known as the hypodermis, which consists largely of loose connective tissue and adipose tissue. It functions as an energy reserve, provides insulation to maintain body temperature, absorbs shock to protect underlying organs, and anchors the skin to muscles and bones. Together, these three layers work in coordination to protect the body and maintain physiological balance.[5]

SOAP: Soap is the product of a chemical process called saponification, which occurs when acids in the form of animal or vegetable fats are combined with an alkali (a solution of sodium hydroxide and water, called lye) and produce a mixture of soap and glycerine. Quite simply, it's a slippery substance that produces bubbles.[6] Soap making is an ancient craft. Prehistoric people may have discovered soap when fat and ash met and saponified as they cooked over open pits. A soap manufactory was uncovered in the ruins at Pompeii, and the Greek physician Mr. Galen wrote about soap in the second century. It's hard to believe that as recent as the last century, soap had to be labelled as to its use. Also during this time, soap fell out of popularity as some modest Victorians believed "soap baths" as disgraceful and sinful.[7] This book will teach you how to make own "NATURAL SOAP". Starting with a soap bar, you can add your own natural ingredients, creating a product superior to a synthetic chemical blend that is commercially available.[8]

HERBAL ANTIBACTERIAL SOAP Herbal antibacterial soap is a type of cleansing preparation formulated using plant-based ingredients and natural antimicrobial agents to reduce or inhibit the growth of bacteria on the skin. Unlike synthetic antibacterial soaps, it utilizes extracts from medicinal plants such as neem (*Azadirachta indica*), tulsi (*Ocimum sanctum*), tea tree oil (*Melaleuca alternifolia*), and aloe vera (*Aloe barbadensis*), which possess inherent antimicrobial, anti-inflammatory, and skin-soothing properties.[9] Herbal antibacterial soaps are widely preferred due to their milder action, reduced side effects, biodegradability, and eco-friendly nature. They are commonly used for daily personal hygiene, especially for individuals with sensitive skin, as they are less likely to cause irritation compared to synthetic antibacterial agents. [10]

ROLE OF ANTIBACTERIAL SOAP IN PREVENTING INFECTION

Antibacterial soap plays an important role in preventing infections by helping to reduce or eliminate harmful bacteria present on the skin. It contains antimicrobial agents that act against microorganisms by disrupting their cell structure and inhibiting their growth, thereby lowering the overall microbial load. Regular use of antibacterial soap, especially during handwashing, helps prevent the transmission of pathogens from contaminated surfaces to the body and between



individuals. It is particularly useful in environments with a high risk of infection, such as healthcare and food-handling settings, where maintaining strict hygiene is essential. Additionally, antibacterial soap helps in protecting against minor skin infections by reducing bacterial contamination on cuts and wounds. Overall, it contributes significantly to personal hygiene and supports public health by minimizing the spread of infectious diseases when used along with proper handwashing techniques.[1]

II. MATERIAL AND METHODS^[47]

| Sr.no. | Material |
|--------|--------------------|
| 1 | Neem |
| 2 | Tulsi |
| 3 | Aloe vera |
| 4 | Turmeric |
| 5 | Vitamin E |
| 6 | Rose water |
| 7 | Glycerin soap base |

TABLE NIO: 1

Methods

Cut glycerin soap base into small pieces.

Melt the soap base on a water bath at 60–70°C.

Add fine powders of *Azadirachta indica* (Neem), *Ocimum sanctum* (Tulsi), and *Curcuma longa* (Turmeric) with continuous stirring.

Add *Aloe barbadensis* Miller (Aloe vera) gel and mix uniformly.

Incorporate Vitamin E and rose water into the mixture.

Stir gently to ensure uniform distribution and avoid air bubbles.

Pour the molten mixture into clean, dry molds.

Allow it to cool and solidify at room temperature for 24 hours.

Remove the soap from molds and store in a cool, dry place.



Figur 3: Herbal Ingredients Commonly Used In Herbal Soap

III. DRUG PROFILE

1. Neem

Synonyms: Nimba, Margosa

Scientific Name: *Azadirachta indica*

Family: Meliaceae

Biological Source: Leaves, bark, seeds of neem tree

Geographical Source: Native to India; widely found in tropical regions

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Morphological Characteristics:

Medium-sized tree; leaves are pinnate, bitter in taste, green in color

Chemical Constituents:

Azadirachtin, nimbin, nimbidin, flavonoids

Mode of Action:

Antibacterial and antifungal activity by disrupting microbial cell growth

Therapeutic Uses:

Skin infections, acne, antiseptic, dandruff

2. Tulsi

Synonyms: Holy Basil

Scientific Name: *Ocimum sanctum*

Family: Lamiaceae

Biological Source: Leaves and flowering tops

Geographical Source: Widely cultivated in India

Morphology:

Aromatic shrub, small green/purple leaves

Chemical Constituents:

Eugenol, ursolic acid, rosmarinic acid

Mode of Action:

Anti-inflammatory, antimicrobial, immunomodulatory

Uses:

Cough, cold, skin diseases

3. Turmeric

Synonyms: Haldi

Scientific Name: *Curcuma longa*

Family: Zingiberaceae

Biological Source: Rhizomes

Geographical Source: India, Southeast Asia

Morphology:

Yellow-orange rhizome with characteristic odor

Chemical Constituents:

Curcumin, volatile oils

Mode of Action:

Anti-inflammatory (inhibits cytokines), antioxidant

Uses:

Wound healing, skin glow, anti-acne

4. Gulab Jal (Rose Water)

Scientific Name: *Rosa damascena*

Family: Rosaceae

Biological Source: Distillate of rose petals

Geographical Source: India, Middle East

Morphology:

Clear, fragrant liquid



Chemical Constituents:

Citronellol, geraniol

Mode of Action:

Cooling, mild antiseptic, astringent

Uses:

Skin toner, eye wash, cosmetic formulations

5. Aloe Vera

Scientific Name: *Aloe barbadensis* Miller

Family: Liliaceae

Biological Source: Leaf gel

Geographical Source: India, Africa

Morphology:

Succulent leaves with clear gel

Chemical Constituents:

Aloin, aloe-emodin, polysaccharides

Mode of Action:

Moisturizing, wound healing, anti-inflammatory

Uses:

Burns, skin hydration, acne

6. Vitamin E

Synonyms: Tocopherol

Chemical Nature: Fat-soluble vitamin

Biological Source: Plant oils, nuts

Chemical Constituents:

Alpha-tocopherol

Mode of Action:

Antioxidant (prevents lipid peroxidation)

Uses:

Skin repair, anti-aging

7. Glycerine Soap Base

Chemical Nature: Transparent soap base

Source: Derived from vegetable oils

Composition:

Glycerin, water, fatty acids

Morphology:

Transparent/semi-transparent solid

Mode of Action:

Humectant (retains moisture)

Uses:

Soap making, moisturizing skin



IV. FORMULATION TABLE

| INGREDIENTS | F1(% w/w) | F2(% w/w) | F3(% w/w) | ROLE |
|---|-------------|-------------|-------------|-------------------|
| Neem powder (<i>Azadirachta indica</i>) | 3 | 2 | 1 | Antibacterial |
| Tulsi powder (<i>Ocimum sanctum</i>) | 2 | 1.5 | 1 | Antimicrobial |
| Aloe vera gel (<i>Aloe barbadensis</i>) | 7 | 10 | 8 | Moisturizer |
| Turmeric powder (<i>Curcuma longa</i>) | 1 | 0.5 | 0.5 | Anti-inflammatory |
| Vitamin E (Tocopherol) | 0.5 | 1 | 1 | Antioxidant |
| Rose water (<i>Rosa damascena</i>) | 4 | 5 | 4 | Fragrance, toner |
| Glycerin soap base | q.s. to 100 | q.s. to 100 | q.s. to 100 | Soap base |

TABLE NO: 2

V. METHODS

Accurately weigh all ingredients according to the selected formulation (F1–F4).
 Cut the glycerin soap base into small pieces and melt it using a water bath at **60–70°C**.
 Add finely powdered **neem, tulsi, and turmeric** with continuous stirring.
 Add **aloe vera gel** and mix thoroughly until a uniform mixture is obtained.
 Incorporate **vitamin E** and **rose water** into the molten soap base.
 Stir gently to ensure uniform distribution of all ingredients and avoid air bubble formation.
 Pour the prepared mixture into clean and dry soap molds.
 Allow the soap to cool and solidify at room temperature for **24 hours**.
 Remove the soap from the molds and allow it to dry if necessary.
 Pack and store the prepared herbal soap in a cool and dry place.

VI. EVALUATION PARAMETER

| SR.NO | PARAMETER | F1 | F2 | F3 |
|-------|-------------------------|-----------------|-----------------|---------------|
| 1 | Color | Dark green | Greenish brown | brown |
| 2 | Odor | Strong herbal | Mild pleasant | pleasant |
| 3 | Texture | Slightly coarse | Slightly coarse | Smooth |
| 4 | Appearance | Slightly coarse | Slightly rough | Uniform |
| 5 | pH | 6.8 | 7.2 | 6.9 |
| 6 | Hardness | Moderate | Hard | soft |
| 7 | Moisture content | 10.5 | 9.8 | 10.0 |
| 8 | Skin Irritation | No irritation | No irritation | No irritation |
| 9 | Stability study | Stable | Stable | stable |
| 10 | Washability | Good | Good | Good |
| 11 | Initial foam height | 7.0 | 7.2 | 7.5 |
| 12 | Foam height after 5 min | 5.5 | 5.0 | 6.0 |

VII. RESULT

F2 was selected as the optimized and best formulation because it demonstrated the strongest antibacterial activity against both test organisms while maintaining acceptable physicochemical properties, stability, and safety. The higher concentrations of neem and tulsi contributed significantly to its antimicrobial effectiveness, making it the most suitable formulation for an **antibacterial herbal soap**.



VIII. SUMMARY

The present study focused on the formulation and evaluation of antimicrobial herbal soap using natural ingredients such as neem, tulsi, aloe vera, turmeric, vitamin E, rose water, and glycerin soap base. Four different formulations (F1, F2, F3, and F4) were prepared by varying the concentration of herbal components to optimize the properties of the soap.

The prepared soaps were evaluated for various physicochemical, organoleptic, and antimicrobial parameters including pH, foam height and retention, moisture content, hardness, total fatty matter (TFM), skin irritation, antimicrobial activity, stability, washability, and alcohol insoluble matter. The antimicrobial activity was assessed against *Staphylococcus aureus* and *Escherichia coli* using the agar well diffusion method.

All formulations showed acceptable physical characteristics with good appearance, pleasant odor, and smooth texture. The pH of all formulations was within the suitable range for skin (6.5–7.2), indicating mildness and safety. The soaps exhibited good foaming ability, adequate hardness, and acceptable moisture content, suggesting good quality and stability. The antimicrobial study confirmed that all formulations possessed antibacterial activity due to the presence of herbal ingredients.

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