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Formulation and Evolution of Herbal Antimicrobial Soap

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Abstract: *Theophrastus, a Greek philosopher, classified plants into three categories: trees, shrubs, and herbs. Three categories of herbs were originally recognized: sweet herbs (like thyme), salad herbs (like wild celery), and pot herbs (like onions). Pot herbs started to be referred to be vegetables around the seventeenth century as a result of selective breeding that altered the plants' size and flavor away from those of the wild plant. At that point, they were no longer only thought to be fit for pots.*

Keywords: Theophrastus

I. INTRODUCTION

Theophrastus, a Greek philosopher, classified plants into three categories: trees, shrubs, and herbs. Three categories of herbs were originally recognized: sweet herbs (like thyme), salad herbs (like wild celery), and pot herbs (like onions).
Pot herbs started to be referred to be vegetables around the seventeenth century as a result of selective breeding that altered the plants' size and flavor away from those of the wild plant. At that point, they were no longer only thought to be fit for pots.
Herbal soaps are skin-purifying and skin-beautifying products. The primary benefit of utilizing herbal cosmetics is their purity, which leaves the body rich in nutrients and other beneficial minerals instead of causing any negative side effects. Individuals' skin and hair beauty is influenced by their health, lifestyle choices, regular occupation, environment, and upkeep. Summertime dehydration from prolonged heat contact to the skin results in wrinkles, freckles, blemishes, pigmentation, and sunburns .
The majority of commercial soaps on the market today have chemical ingredients that have antibacterial action and may be able to depilate skin infections. Soaps and detergents are considered disinfectants that are necessary for everyday hygiene routines. Cleaning agents, such as soaps, can be liquid, solid, semisolid, or powdered. In order to preserve health and beauty and get rid of odors from the body or inanimate objects, such as clothing, they are used to eliminate dirt, including dust, bacteria, stains, and unpleasant smells. Commercial soap is typically composed of harmful substances such plastics, aluminum, barium, mercury, and bisphenol, among others. These substances are vaporized and absorbed through the skin, both of which have detrimental side effects on the body.
The usage of herbal medicines has increased dramatically in the last several years. It is believed that around 80% of the world's population uses herbal plant extracts in their medicines, both in developed and developing nations. It is recognized as one of the main medical treatments, particularly in underdeveloped nations, for a variety of illnesses. The field of medicinal research known as "Herbal Medicinal Products" emerged as a result of the astounding increase in the use of herbal plants and their extracts.

II. COMPONENTS OF NANOEMULSION

- Oils
- Surfactant
- Co-solvents
- Aqueous phase

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2.1 OIL

Selection of an appropriate oily phase is very important as it influences the selection of other ingredients of nano emulsion, in case of o/w nano emulsions. Usually, the oil which has maximum solubilizing potential for selected drug candidate is selected as an oily phase for the formulation of nano emulsion. This helps to achieve maximum drug loading in nano emulsion. The choice of oily phase is often a compromise between its ability to solubilize the drug and its ability to facilitate formation of nano emulsion of desired characteristics. Thus, a mixture of oils can be use to meet both the requirements. Some suitable oil phases are modified vegetable oils, digestible or non-digestible oils and fats such as olive oil, palm oil, corn oil, oleic acid, sesame oil, soybean oil, hydrogenated soybean oil, peanut oil and bee's wax.

2.3 SURFACTANT

Surfactant should flavor microemulsification of the oily phase and should also posses good solubilising potential for the hydrophobic drug compounds. The choice of the surfactant is critical for the nanoemulsion formulation. Surfactant with an HLB value < 10 are hydrophobic and from w/o nanoemulsion where as high HLB (> 10) surfactant such as polysorbate 80 at hydrophilic and form o/w nanoemulsion. In many cases, mixture of lipophilic and hydrophilic surfactant may be required to obtain nanoemulsion. Surfactant in solution below their critical micellar concentration improve drug solubility by providing region for hydrophobic drug interaction in solutions. Above the CMC, surfactant self aggregate in defined orientation to form micelles with hydrophobic core and a hydrophilic surface. The hydrophobic core enhance the intrapment of drugs, thus increasing its solubility.the surfactant used in nanoemulsion formation could be ionic or non-ionic but ionicsurfactant are not preffered due to toxicological concerns . among various surfactant that a number of benefits over synthetic soaps.

• Mild on the skin:
Herbal soaps are often kinder and milder on the skin than synthetic soap, which makes them appropriate for skin types that are more sensitive.

• Natural ingredient:
They frequently include skin- nourishing and hydrating natural ingredients includingshea butter, coconut oil, olive oil, and aloe vera.

• Chemical-Free:
The absence of harsh chemicals, artificial perfumes, and synthetic colors in herbal soaps lowers the possibility of allergic responses and skin irritation.

• Environmentally Friendly:
Compared to synthetic soaps, the herbal ones are typically biodegradable and environmentally friendly as they are made with natural ingredients.

• Aromatherapy advantages:
By combining essential oilswith herbal soaps, aromatherapy advantages includingstress alleviation, mood enhancement, and relaxation can be experienced.

• Natural antibacterial qualities:
Certain herbalsubstances, like neem and tea tree oil, have antibacterial qualities that assist to cleanse and shield the skin from infections.

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Aim and Objectives

Aim : To Formulation and Evolution of Herbal Antimicrobial Soap:

Objective:

• To prepare the extract of Azadi Acta indica, Osmiumequiform, Sapindas mokoros', Aloe barbadense.

• Formulation of Herbal soap by using plant extract andlemon as flavoring agents.

• Evaluation of Herbal soap with the different organolepticand physio-chemical parameters

Materials and MethodsPlant Collection of Neem:

The leaves of Azadirachta indica (Neem) were collected fromMajhitar, East Sikkim, after that the leaves were shade dried and coarsely powdered using mortar and pestle.

Collection of Tulsi:

The leaves of Ocimum tenuiflorum (Tulsi) were collected from Majhitar, East Sikkim, after that the leaves were shade dried and coarsely powdered using mortar and pestle.

Collection of Ritha:

The seeds of Sapindus mukorossi (Ritha) were collected from Singtam, Sikkim, after that the seeds were shade dried and using mortar and pestle the seeds were grinded and coarse powder was obtained.

Collection of Aloe Vera:

The Fruit pods of Aloe barbadensis (Aloe Vera) were collected from Singtam, Sikkim, after that the fresh Fruit pods were cut into small pieces and Aloe Vera gel were collected by using spatula.

Collection of Lemon:

The Peels of Citrus limon (Lemon) were collected from Singtam, Sikkim, after that the Lemon were cut into two half and squeeze it as hard as possible by using hand.

Chemicals:

These include soft paraffin, ethanol, rose oil, glycerin.

Material and Methodology

Tomato: Botanical name: A plant belonging to the kingdom Plantae, order Solanales, family Solanaceae, genus Solanum, and species S. lycopersicum, is widely valued in herbal skincare formulations, especially for its seeds, which are rich in:

• Lycopene, a powerful antioxidant known to lighten skin tone, reduce hyperpigmentation, and diminish black spots;

• Vitamin C, which provides antioxidant protection, supports collagen synthesis, and helps combat skin damage caused by free radicals; and

• Vitamin K, which contributes antifungal activity and aids in natural blood clotting processes, making tomato extracts a multifunctional ingredient that promotes brighter, clearer, and healthier skin.

Fig 1. Tomato

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Ritha: Botanical name: A plant from the kingdom Plantae, order Sapindales, family Sapindaceae, genus Sapindus L., and species Sapindus saponaria, is widely known for the use of its seeds, which serve as a natural cleansing agent due to their high saponin content; these seeds act as a:

• Natural detergent, effectively removing dirt and oil without the use of synthetic chemicals;

• Surfactant, helping to break down oils and grease, making it ideal for cleaning skin, hair, and fabrics gently, making Ritha a sustainable and skin-friendly alternative to chemical-based cleansers, especially useful in herbal soap formulations.

Fig 2. Ritha

Lemon: Botanical name: Citrus limon, belonging to the kingdom Plantae, order Sapindales, family Rutaceae, genus Citrus, and species C. limon, is primarily valued for its peels, which are rich in:

• Vitamin C, known for its strong antioxidant and antibacterial properties that help protect the skin and promote healing;

• Volatile oils, which provide a fresh, natural scent and contribute to its antimicrobial effects;

• Additionally, lemon peel extracts are widely used in skincare for their ability to help reduce acne by cleansing pores and minimizing inflammation, making it a popular ingredient in herbal soaps and cosmetic formulations.

Fig 3. Lemon

Aloe Vera: Botanical name:(Aloe barbadensis), a species classified under the kingdom Plantae, order Asparagales, family Asphodelaceae, genus Aloe, and species A. vera, is widely used in herbal and cosmetic formulations for the therapeutic properties of its leaf latex, which is known to:

• Soothe sunburns by cooling and calming irritated skin;

• Hydrate the skin deeply due to its high water content and mucilage;

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• Clear acne by reducing inflammation and bacterial buildup;
• Speed up wound healing through stimulation of skin regeneration; and
• Fight germs with its natural antibacterial and antifungal components, making Aloe vera a versatile and essential ingredient in natural skincare products like herbal antimicrobial soaps.

Fig 4. Alo Vera

Neem: Botanical name: (Azadirachta indica), a well-known medicinal plant belonging to the kingdom Plantae and commonly used in Ayurvedic and herbal formulations, is primarily valued for its leaves, which are green in color and contain a potent combination of bioactive constituents, including:
• Flavonoids – known for their antioxidant and anti-inflammatory effects;
• Alkaloids – with therapeutic and antimicrobial properties;
• Azadirone, nimbin, and nimbidin – key neem limonoids responsible for strong antibacterial and antifungal actions;
• Terpenoids – contributing to neem's characteristic smell and healing power; and
• Steroids – which aid in reducing skin inflammation and irritation,
making neem leaves a powerful natural ingredient in the formulation of herbal antimicrobial soaps and skincare remedie.

Fig 5. Neem

Tulshi: Biological name: (Ocimum sanctum), commonly known as Holy Basil, is a revered medicinal herb from the kingdom Plantae, widely used in traditional herbal preparations for its therapeutic properties. The leaves, which are green in color, are the primary part used and are rich in potent chemical constituents, including:
• Eugenol – a natural antiseptic and pain-relieving compound;\
• Germacrene – a terpene with antimicrobial and anti-inflammatory properties; and
• Terpenes – known for their aromatic and medicinal characteristics,
making Tulsi an effective natural remedy for skin infections, acne, and inflammation, and a valuable component in herbal antimicrobial soap formulations.

Fig 6. Tulshi

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Turmeric: Botanical name: (Curcuma longa), a plant classified under the kingdom Plantae, order Zingiberales, family Zingiberaceae, genus Curcuma, and species C. longa, is primarily valued for its rhizomes, which are rich in bioactive compounds and widely used in skincare and traditional medicine. The rhizomes offer multiple benefits, including:

• Wound healing – due to its natural antiseptic and antimicrobial activity;

• Radiance and glow enhancement – as it helps improve complexion with its anti- inflammatory and antioxidant properties;

• Management of psoriasis and skin irritation – by reducing redness, scaling, and discomfort, making turmeric a key ingredient in herbal antimicrobial soap for maintaining healthy, vibrant, and clear skin.

Fig 7. Turmeric

Coconut Oil: Botanical name: (Cocos nucifera), derived from the plant classified under the kingdom Plantae, order Commelinids, family Arecaceae, genus Cocos L., and species C. nucifera, is a widely used natural oil extracted from the coconut fruit. The oil, which is the primary part used, is highly valued in skincare for its soothing, nourishing, and healing properties. It is known to:

• Reduce the appearance of stretch marks by improving skin elasticity and hydration;

• Soothe sunburns through its cooling and anti-inflammatory action;

• Treat various skin disorders, including eczema, due to its antimicrobial and deeply moisturizing effects,

making coconut oil an essential base ingredient in herbal soap formulations aimed at skin repair and protection.

Fig 8. Coconut Oil

Extractions

The Azedarach indica, Osmium tubiform, Sapindasmokoros' and Aloe barbadense, Citrus limon powder was extracted with water and chloroform at 70:30 ratio by above stated powder was taken in conical flask and extracted with water for four hours with occasional agitation then filtered.

Preparation Of Solvent Extract Extraction of Azadirachta indica

1. Fresh neem leaves are collected and shed dried for 15 days
2. The dried leaves are then powdered using motar and pestle.
3. The leaves weighed 54.3gm and macerated in a beaker using 280ml distilled water and 120ml chloroform with continuous stirring.

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4. The prepared mixture is covered with aluminum foil and allowed to macerate for three days, stirring every day. After that, filter paper is used to filter the mixture.
5. On a hot water bath, the mixture's extra solvent was dried.
6. The dried extract was collected and kept in desiccatorsfor cooling. The prepared extract is weighed.

Fig 9: Dry leaves of Neem

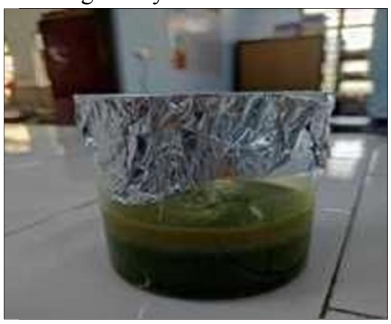

Fig 10: Extract of leaves of Neem

Extraction of Ocimum tenuiflorum

1. Fresh Tulsi leaves are collected and shed dryed for 15 days.
2. The dried leaves are then powdered using motar and pestle
3. The leaves weighed 4.90gm and macerated in a beaker using 110ml distilled water and 40ml chloroform with continuous stirring.
4. The prepared mixture is covered with aluminum foil and allowed to macerate for three days, stirring every day. After that, filter paper is used to filter the mixture.
5. The excess solvent in the mixture was dried on a hotwater bath
6. The dried extract was collected and kept in desiccator for cooling.
7. The prepared extract is weighed.

Fig 11: Dry leaves of Tulsi

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Fig 12: Extract of leaves of Tulsi

Fig 13: Filtration process of the Tulsi

Extraction of Sapindus mukorossi

1. New ritha leaves are gathered, dried for 15 days, and thenshed.
2. Next, a pestle and motar are used to ground the dried leaves.
3. The leaves weighed 154.3gm and macerated in a beaker using 840ml distilled water and 360ml chloroform with continuous stirring.
4. The prepared mixture is covered with aluminum foil and allowed to macerate for three days, stirring every day. After that, filter paper is used to filter the mixture.
5. On a hot water bath, the mixture's extra solvent wasdried.
6. After drying, the extract was gathered and stored in a desiccator to chill.
7. Weighing the produced extract is done.

Fig 14: Dry seeds of Rith

Fig 15: Extract of seeds of Ritha

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Fig 16: Evaporating of extract on water bath

Formulation Of Herbal Soap:

A mixture of powdered herbs of weight containing 1gm Ritha extract, 1gm Tulsi extract, 2gm Neem extract, Lemonoil(q.s.), 2gm Alovera gel, Vitamin E(q.s.), Rose water 2ml, Glycerine (q.s.) were taken to prepare herbal soap by following steps:

Procedure:

1. The Soap base (Glycerine) was taken in a beaker and wasmelted in a hot water bath.
2. Along with the glyceine, the extract of Ritha, Tulsi & Neem was added with Aloevera gel.
3. Then Vitamin E, Rose water and Lemon was also added and stirred continuously to mix the herbal soap ingredients as mentioned above.

It was poured in a soap base and cooled for 12 hrs

Fig 17: Herbal antimicrobial soap

Fig 18: Herbal Antimicrobial soap

Evaluation parameters:

A. Organoleptic evaluation

- Color: Brown.
- Oduor: Aromatic.
- Appearance: Smooth texture.

Benefits:

1. Natural and Skin-Friendly Ingredients

o Herbal soaps are made from plant-based ingredients like neem, tulsi, aloe vera, and turmeric, which are gentle on the skin and reduce the risk of allergic reactions or irritation.

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2. Antimicrobial Efficacy
o The herbal extracts used possess natural antibacterial, antifungal, and antiviral properties that help prevent skin infections, acne, and other microbial issues.

3. Chemical-Free Alternative
o Unlike commercial soaps, herbal soaps avoid harmful chemicals, parabens, and artificial fragrances, making them safer for long-term use.

4. Eco-Friendly and Biodegradable
o Herbal soaps decompose naturally and do not pollute water systems, contributing to environmental sustainability.

5. Promotes Traditional Knowledge
o Encourages the use and validation of Ayurvedic and traditional medicinal knowledge through scientific formulation and testing.

6. Cost-Effective and Locally Sourced
o Most ingredients can be sourced locally, reducing production cost and promoting local agriculture and herbal industries.

7. Market Potential and Entrepreneurship
o Growing awareness and demand for natural products make this a viable product for startups and small-scale industries.

8. Public Health Impact
o Regular use of antimicrobial herbal soap can help reduce the transmission of microbial diseases, especially in rural or underdeveloped regions with limited access to healthcare.

9. Educational and Research Value
o This project enhances understanding of pharmacognosy, microbiology, and cosmetic formulation, making it valuable for students and researchers.

10. Customizable Formulation
o Allows flexibility to tailor the soap's ingredients based on specific skin types or regional medicinal herbs, offering personalized healthcare solutions.

B .Physio-chemical evaluation
• pH: Sing 10 ml of distilled water and stirring, 2 g of the finished soap was dissolved, yielding a dissolved sample. A pH meter was used to measure the pH.
• Foam retention: After making 25 milliliters of the 1% soap solution and pouring it into a 100 millilitermeasuring cylinder, shake it ten times. For four to five minutes, the volume of foam was measured every minute.

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Fig 19: Foam retention

Foam height:

A sample of soap weighing 0.5 grams was obtained and dissolved in 25 milliliters of distilled water. After that, put it into a 100 ml measuring cylinder and added water to get the volume up to 50 ml. After giving 25 strokes, the aqueous volume was measured up to 50 ml, and the foam height was measured above the aqueous volume.

Fig 20: Foam height

Alcohol insoluble matter :

A 5g sample of soap was placed in a conical flask and 50mlof warm ethanol was added to dissolve it. The liquid was filtered using tarred filter paper and heated to 1050 degrees Celsius for an hour. It was no longer weighted filter paper.

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Fig 21: Alcohol insoluble matter

Total fatty matter:

By reacting soap with acid in the presence of hot water and measuring the resulting fatty acid, TFM was determined. After dissolving 10g of the designed soap in 150ml of distilled water, the mixture was heated. 20 milliliters of 15% H2SO4 were added to this and heated until a clear solution was achieved.

The resulting solution's surface fatty acid was solidified by heating it once again and adding 7g of beeswax. It was then permitted to cake. After removing the cake, it was blotted dry and weighed using formula.

%TFM= (Weight of the cake- Weight of the wax) in gm/Weight of the soap in gm x 100

Fig 22: Heating of solution to obtain TFM

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Fig 23: Total Fatty Matter

Moisture content:

A little over 5g of the sample under investigation were precisely weighed, moved to a known- weight tarred porcelain dish, and then heated to 105°C for 2 hours in a hot air oven.In order to determine the true weight of the tarred china dish, the sample and the dish were weighed together. To determine the % moisture content6, the content's weight was recorded

Moisture content= (Difference in weight/ initial weight) × 100

Result And Discussion:

Color and appearance: The formulated herbal soap was taken for evaluation in terms of its color and physical appearance.

Upon observation, it was found that the soap exhibited a rich brown color, which is typically associated with the presence of natural plant-based ingredients.

Additionally, the texture of the soap was smooth and uniform, indicating a well-blended mixture of herbal components and a successful saponification process.

The overall appearance was aesthetically pleasing, suggesting good consistency and stability in the formulation.

Sl. No.	Parameter	Standard Value	Observed Value
1.	Color, Oduor And Appearance	-	Brown, Aromatic and Smooth texture
2.	Ph	8-10	9.04
3.	Foam Height	1.3-22cm	7cm
4.	Tfm(Total Fatty Matter)	36.8%	0.03%
5.	Alcohol Soluble Matter	17.60%	25%
6.	Foam Retention	Over 5min.	Over 4minutes foam was stable
7.	Moisture Content	About 10%	1.01%

DISSCISSION

The evaluation of plant-based extracts, including Azadirachta indica (Neem), Ocimum tenuiflorum (Holy Basil), Sapindus mukorossi (Soapnut), Aloe barbadensis (Aloe Vera), and Citrus limon (Lemon), revealed significant potential for use in soap production. The process of water extraction was crucial in preserving the bioactive components of these plants, which contributed to the overall efficacy of the final product. Multiple trials of the soap formulation yielded consistent and promising results, indicating that the process used for extraction and formulation was both reliable and reproducible.

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One key aspect of the study involved user feedback from a small volunteer group. This direct consumer involvement provided practical insights into the soap's usability and skin compatibility. The volunteers reported that the soap was gentle and did not cause irritation, a critical factor for products intended for sensitive skin. This finding underscores the potential of using plant-based ingredients to create mild, hypoallergenic products.

The soap's physical and chemical properties were rigorously assessed, focusing on parameters like pH, appearance, and odor. Maintaining an optimal pH balance is essential in skincare, as it helps preserve the skin's natural barrier function. The soap's pH was found to be within a dermatologically acceptable range, ensuring it would not disrupt the skin's acid mantle. The appearance and odor of the soap also met aesthetic standards, enhancing user appeal.

Each plant extract contributed unique benefits to the soap formulation. Neem provided potent antibacterial properties, which can help reduce skin infections and acne. Aloe Vera played a crucial role in moisturizing and soothing the skin, making the soap particularly suitable for dry or sensitive skin types. Soapnut, known for its natural saponins, enhanced the soap's cleansing power and foaming characteristics, reducing the need for synthetic surfactants. Holy Basil added a calming, herbal aroma while offering antioxidant and anti-inflammatory properties. Lastly, Lemon added a refreshing citrus scent and contributed mild astringent effects, which can help in tightening pores and reducing excess oil.

From an environmental perspective, this formulation offers a sustainable alternative to conventional soaps that often contain synthetic chemicals. By utilizing renewable plant resources, the soap reduces the ecological footprint associated with synthetic ingredients and harsh chemicals.

In summary, the study demonstrates that plant-based soaps can effectively combine natural benefits with user-friendly attributes. The favorable outcomes in terms of skin compatibility, product performance.

III. CONCLUSION

The plants Azadirachta indica (Neem), Ocimum tenuiflorum (Holy Basil), Sapindus mukorossi (Soapnut), Aloe barbadensis (Aloe Vera), and Citrus limon (Lemon) were subjected to a thorough evaluation after water extraction to assess their potential for soap production. The formulation derived from these natural extracts showed promising results during multiple trials, indicating the reliability of the process.

A noteworthy aspect of this study was the involvement of a small group of volunteers who tested the soap. Their feedback confirmed that the soap was skin-friendly and did not cause irritation, further emphasizing its mildness and suitability for sensitive skin.

Additionally, the soap underwent rigorous standardization processes where physical and chemical properties were assessed, including parameters like pH, appearance, and odor.

The pH values were found to be within an acceptable range, ensuring that the soap was neither too acidic nor too alkaline, which is crucial for maintaining skin health. The product's appearance and odor were also evaluated, revealing satisfactory outcomes in terms of aesthetics and fragrance, making it appealing for users.

The inclusion of Azadirachta indica contributes antibacterial properties, while Aloe barbadensis offers soothing and moisturizing effects. Sapindus mukorossi, known for its natural cleansing abilities, enhanced.

the soap's foaming capacity, and Ocimum tenuiflorum added a refreshing, herbal element. Finally, the presence of Citrus limon imparted a pleasant citrus scent and contributed mild astringent properties.

This comprehensive evaluation highlights the soap's potential as a natural, eco-friendly alternative to conventional products

The successful combination of these plant-based ingredients not only ensures a gentle cleansing experience but also promotes skin health and well-being. In summary, the favorable test results and user feedback suggest that the soap meets quality standards, offering a safe and effective skincare option.

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