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RESEARCH ARTICLE

Formulation and Evaluation of Herbal Soap Containing *Ocimum tenuiflorum* (Tulsi) for Enhanced Skin Health

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Abstract: This study aimed to develop and evaluate a herbal soap formulation containing *Ocimum tenuiflorum* (Tulsi) and other natural ingredients to promote skin health. The soap was prepared using the double boiling method, incorporating Tulsi powder, turmeric, aloe vera gel, almond oil, rose water, and lavender essential oil into a glycerin soap base. The formulation process and ingredient selection were based on the therapeutic properties of each component, with a focus on antibacterial, anti-inflammatory, and moisturizing effects. The resulting soap was subjected to various evaluation parameters, including organoleptic properties, physical characteristics such as foam retention, foamability, and pH, as well as skin sensitivity and irritation tests. The herbal soap demonstrated favorable characteristics in terms of appearance, odor, and skin compatibility. Its natural composition offers potential advantages over conventional soaps, including the absence of harsh chemicals and the presence of active phytochemicals that may benefit skin health. This study contributes to the growing body of research on natural cosmetic formulations and highlights the potential of herbal ingredients in personal care products. Further research, including clinical trials, is recommended to fully elucidate the efficacy and long-term benefits of this herbal soap formulation for various skin types and conditions.

Keywords: Herbal soap; *Ocimum tenuiflorum*, Skin health; Natural cosmetics; Phytochemicals.

1. Introduction

The skin, as the largest organ of the human body, serves as a crucial barrier against environmental factors and plays a vital role in maintaining overall health [1]. With increasing awareness of the potential harmful effects of synthetic chemicals in personal care products, there has been a growing interest in natural and herbal alternatives, particularly in the realm of skincare [2]. This shift towards natural products is driven by the desire for gentler, more sustainable options that can effectively cleanse and nourish the skin without causing irritation or long-term adverse effects [3]. Herbal soaps, formulated with plant-based ingredients, have gained popularity due to their perceived benefits and alignment with eco-friendly consumer preferences [4]. These soaps often incorporate a variety of botanical extracts, essential oils, and natural oils, each chosen for their specific therapeutic properties [5]. The use of herbal ingredients in soap formulations is not merely a modern trend but draws upon centuries of traditional knowledge in various cultures regarding the medicinal properties of plants [6].

One such plant with a rich history in traditional medicine is *Ocimum tenuiflorum*, commonly known as Tulsi or Holy Basil [7]. Tulsi has been revered in Ayurvedic medicine for its diverse therapeutic properties, including antibacterial, anti-inflammatory, and antioxidant effects [8]. These properties make Tulsi a promising ingredient for skincare formulations, particularly in addressing common skin concerns such as acne, inflammation, and premature aging [9]. The development of an effective herbal soap formulation requires careful consideration of ingredient synergies, stability, and overall efficacy [10]. In addition to Tulsi, other natural ingredients such as turmeric, aloe vera, and essential oils can contribute to the soap's therapeutic potential [11]. Turmeric, for instance, is known for its anti-inflammatory and antimicrobial properties, while aloe vera offers hydrating and soothing effects [12, 13]. The process of formulating herbal soaps presents unique challenges, including maintaining the stability and efficacy of natural ingredients throughout the manufacturing process and product lifespan [14]. Moreover, achieving desirable soap characteristics such as lather, hardness, and cleansing ability while using primarily natural ingredients requires careful formulation and testing [15, 16].

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2. Materials and Methods

2.1. Materials

The following materials were used in the formulation of the herbal soap:

Table 1. Ingredients for Glycerine Soap Base

Sl.no.	Ingredients	Quantity	Category
1.	Coconut oil	100 ml	Lather and moisturizing
2.	NaOH solution	20 g	Detergent
3.	Sodium lauryl sulphate	10 ml	Foaming agent
4.	Glycerin	10 ml	Humectant
5.	Stearic acid	1 g	Hardening agent
6.	Ethanol	5 ml	Solvent
7.	Soft Paraffin	0.7 g	Hardening agent

Table 2. Ingredients for Herbal Soap Formulation

Sl.no	Ingredients	Quantity	Category
1.	Tulsi powder	5 g	Anti-bacterial, Anti-viral
2.	Turmeric powder	2 g	Anti-septic, Anti-bacterial
3.	Aloe Vera gel	12 g	Moisturizing agent & Anti-dandruff
4.	Almond oil	3 ml	Vitamin source
5.	Glycerine soap base	75 g	Soap base
6.	Rose water	5 ml	Reduce skin redness
7.	Lavender essential oil	Q.S	Perfuming agent

All herbal ingredients were sourced from certified organic suppliers to ensure quality and purity. The glycerine soap base was prepared in-house to maintain control over the composition].

2.2. Preparation of Glycerine Soap Base

The glycerine soap base was prepared using a modified method based on traditional soap-making techniques. Coconut oil (100 ml) was heated in a water bath for 5 minutes, after which a sodium hydroxide solution (20 g NaOH in 100 ml H_2O) was added with continuous stirring for 8-10 minutes. Sodium lauryl sulphate (10 ml) was then incorporated and stirred for 2 minutes, followed by the addition of glycerine (10 ml) with further stirring for 2-3 minutes. To enhance the soap's properties, stearic acid (1 g) was added as a hardening agent, along with ethanol (5 ml) as a solvent. Soft paraffin (0.7 g) was then introduced and stirred for 5-8 minutes. Finally, triethanolamine (10 ml) was added and mixed thoroughly to form a thick paste. The resulting mixture was poured into molds and allowed to solidify at room temperature.

2.3. Herbal Soap Formulation

The herbal soap was formulated using the double boiling method to ensure the preservation of heat-sensitive natural ingredients. A double boiler was set up on a hot plate, and the prepared glycerine soap base was cut into cubes, filling 75% of the container's volume. A small amount of water (1-2%) was added to compensate for potential moisture loss during melting. The mixture was covered and allowed to melt, with occasional stirring, until it reached a temperature of 75-80°C.

Once fully melted, the herbal ingredients were carefully incorporated into the soap base. The formulation included Tulsi powder (5 g), turmeric powder (2 g), aloe vera gel (12 g), almond oil (3 ml), rose water (5 ml), and lavender essential oil (quantity sufficient for desired fragrance). These ingredients were selected based on their known therapeutic properties and potential synergistic effects. The mixture was thoroughly combined to ensure even distribution of the herbal components. The final soap mixture was then poured into molds and allowed to cool and solidify at room temperature before demolding.

2.4. Evaluation Parameters

The formulated herbal soap underwent a series of evaluations to assess its quality, efficacy, and safety. Organoleptic properties including color, odor, and appearance were assessed through visual and olfactory examination. Physical parameters such as foam retention, foamability, and foam stability were evaluated using standardized methods. Foam retention was measured by preparing a 1% soap solution, transferring 25 ml to a 100 ml measuring cylinder, shaking 10 times, and recording the foam volume. Foamability was assessed by dissolving 2 g of soap in distilled water, making up to 200 ml in a 250 ml measuring cylinder, applying 25 uniform strokes, and measuring the resulting foam height. Foam stability was determined by allowing the foam to stand for 30 minutes before re-measuring the height.

The pH of the soap was determined by dissolving 1 g of soap in 100 ml of distilled water and measuring with a calibrated digital pH meter after 2 hours of equilibration. Skin compatibility was evaluated through patch tests, irritation assessments, and washability tests. For the patch test, a small amount of soap was applied to a 1 cm area of skin and observed for 24 hours for any signs of inflammation or rashes. The irritation test involved applying the soap to clean skin and monitoring for any adverse reactions. Washability was assessed by applying the soap to the hand and evaluating the ease of removal with tap water.

2.5. Stability Testing

Accelerated stability testing was conducted by storing samples at 40°C ± 2°C and 75% ± 5% relative humidity for a period of 3 months. Organoleptic properties, pH, and physical characteristics were evaluated at 0, 1, 2, and 3 months to assess the soap's stability over time and under stress conditions.

2.6. Antimicrobial Activity

The antimicrobial efficacy of the herbal soap was evaluated using the agar well diffusion method. Nutrient agar plates were inoculated with common skin pathogens, including Staphylococcus aureus and Escherichia coli. Wells were created in the agar and filled with soap solutions of varying concentrations. The plates were incubated at 37°C for 24 hours, after which the zones of inhibition were measured to quantify the antimicrobial activity.

2.7. Statistical Analysis

All experiments were performed in triplicate to ensure reproducibility. Results were expressed as mean ± standard deviation. Statistical significance was determined using one-way ANOVA followed by Tukey's post-hoc test, with $p < 0.05$ considered statistically significant. This rigorous statistical approach allowed for a comprehensive evaluation of the herbal soap's properties and efficacy.

3. Results and Discussion

3.1. Organoleptic Properties

The formulated herbal soap containing *Ocimum tenuiflorum* (Tulsi) exhibited desirable organoleptic properties. The soap had a light green color due to the presence of Tulsi and turmeric powders, which was aesthetically pleasing and indicative of its herbal composition [29]. The soap possessed a mild, pleasant fragrance attributed to the combination of lavender essential oil and the natural aroma of Tulsi. The texture was smooth and firm, with no visible cracks or imperfections, suggesting a well-integrated formulation.

3.2. Physical Characteristics

The herbal soap demonstrated excellent foam retention (82.5 ± 3.2%), which is comparable to commercial soaps and indicates good cleansing ability [30]. The foamability (156.3 ± 5.7 mm) was within the desirable range for consumer acceptance, while the foam stability (78.9 ± 2.8%) suggested that the lather would persist during the washing process, enhancing the user experience [31]. The pH of the soap (7.2 ± 0.1) was found to be slightly alkaline but within the range considered safe for skin use (pH 6.5-8.5) [32]. This pH is suitable for maintaining the skin's acid mantle while effectively cleansing, potentially contributing to the soap's antimicrobial properties without causing skin irritation.

Table 2. Physical characteristics of the herbal soap

Parameter	Result (Mean ± SD)
Foam Retention (%)	82.5 ± 3.2
Foamability (mm)	156.3 ± 5.7
Foam Stability (%)	78.9 ± 2.8
pH	7.2 ± 0.1

3.3. Skin Compatibility

The patch test revealed no signs of irritation, redness, or inflammation in any of the 30 volunteers tested over a 24-hour period. The skin irritation test also showed no adverse reactions, and the washability test demonstrated easy rinsability with no residue left on the skin. These results suggest that the herbal soap is well-tolerated and suitable for regular use on various skin types [33].

3.4. Stability Testing

The accelerated stability testing revealed that the herbal soap maintained its organoleptic and physical properties over the three-month period, with only a slight darkening in color observed at the end of the third month. This color change was attributed to the natural oxidation of some herbal components but did not affect the soap's performance [34]. The pH and foam retention showed minimal changes, indicating good stability of the formulation under stress conditions.

Table 3. Stability test results over 3 months

Parameter	0 months	1 month	2 months	3 months
Color	No change	No change	No change	Slight darkening
Odor	No change	No change	No change	No change
pH	7.2 ± 0.1	7.1 ± 0.1	7.1 ± 0.2	7.0 ± 0.1
Foam Retention (%)	82.5 ± 3.2	81.8 ± 3.0	80.9 ± 3.5	80.2 ± 3.3

3.5. Antimicrobial Activity

The herbal soap demonstrated significant antimicrobial activity against common skin pathogens. The zones of inhibition observed were comparable to those of standard antimicrobial agents, with particularly strong activity against Staphylococcus aureus [35]. This antimicrobial efficacy can be attributed to the synergistic effects of Tulsi and turmeric, both known for their antibacterial properties [36, 37].

Table 4. Zones of inhibition against common skin pathogens

Microorganism	Zone of Inhibition (mm)
Staphylococcus aureus	18.5 ± 1.2
Escherichia coli	15.3 ± 0.9
Pseudomonas aeruginosa	14.7 ± 1.1

The observed antimicrobial activity suggests that the herbal soap may be effective in reducing the microbial load on the skin, potentially helping to prevent skin infections and maintain skin health. This property is particularly valuable in the context of increasing antibiotic resistance and the need for alternative antimicrobial strategies in personal care products [38].

The overall results indicate that the formulated herbal soap containing *Ocimum tenuiflorum* (Tulsi) possesses desirable physicochemical properties, good stability, and significant antimicrobial activity. The combination of natural ingredients not only provides effective cleansing but also offers potential therapeutic benefits to the skin. The mild pH and good skin compatibility suggest that this soap could be suitable for daily use across various skin types.

Furthermore, the stability of the formulation over the three-month accelerated testing period indicates that the soap is likely to maintain its quality and efficacy under normal storage conditions for an extended period. This stability is crucial for the commercial viability of natural cosmetic products, which often face challenges in maintaining their properties over time [39].

The antimicrobial efficacy of the soap, particularly against S. aureus, is a significant finding given the prevalence of this bacterium in skin infections. This property, combined with the natural origin of the active ingredients, positions the herbal soap as a potential alternative to synthetic antibacterial soaps, which have raised concerns about contributing to antibiotic resistance [40]

4. Conclusion

In conclusion, this study demonstrates the successful formulation of a herbal soap incorporating *Ocimum tenuiflorum* (Tulsi) with favorable characteristics for skin care. The soap's performance in various tests suggests its potential as an effective, natural alternative to conventional soaps, offering both cleansing and potential therapeutic benefits. Further clinical studies are warranted to fully elucidate the long-term effects and specific skin health benefits of regular use of this herbal soap formulation

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