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# Preparation and Evaluation of Herbal Soap Films for Hygiene Applications

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**Abstract:**The growing demand for eco-friendly, portable, and effective hygiene products has led to the development of innovative alternatives to conventional soaps. The present study focuses on the formulation and evaluation of herbal soap paper strips incorporating Tulsi (Ocimum sanctum), Neem (Azadirachta indica), and Turmeric (Curcuma longa). These herbs are well known for their antimicrobial, anti-inflammatory, and skin-protective properties. The soap strips were prepared using a melt-and-cast method combined with herbal extract incorporation and casting onto water-soluble paper. The formulated strips were evaluated for physicochemical parameters such as pH, foam height, foam retention, and skin irritation. The results showed satisfactory cleansing action, antimicrobial potential, and no skin irritation. The developed formulation offers a portable, biodegradable, and effective hygiene solution suitable for modern lifestyles.

Keyword: eco- friendly, paper soap, herbal

Introduction:

Hand hygiene plays a crucial role in preventing the spread of infectious diseases(1,2). The COVID-19 pandemic emphasized that nearly 98% of infections are transmitted via contaminated hands, highlighting the need for effective hygiene solutions(3-5). Traditional soaps, although effective, suffer from limitations such as bulkiness, risk of contamination, and environmental concerns.(6-9)

Soap is defined as a sodium or potassium salt of long-chain fatty acids with cleansing properties. To overcome the drawbacks of conventional soap forms, herbal soap paper strips have emerged as a novel and convenient drug delivery system(10-12).

These strips are:

- Lightweight and portable
- Eco-friendly and biodegradable
- Cost-effective and user-friendly

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## Materials and methods :

### Materials:

| Sr. No. | Material | Scientific Name | Category | Function |
|---|---|---|---|---|
| 1 | Tulsi Powder | Ocimum sanctum | Herbal drug | Antimicrobial, antiseptic agent |
| 2 | Neem Powder | Azadirachta indica | Herbal drug | Antibacterial, antifungal agent |
| 3 | Turmeric Powder | Curcuma longa | Herbal drug | Anti-inflammatory, antioxidant |
| 4 | Soap Base | — | Base material | Provides cleansing property |
| 5 | Glycerin | — | Humectant | Moisturizing agent |
| 6 | Distilled Water | — | Solvent | Extraction medium |
| 7 | Water-Soluble Paper | — | Substrate | Carrier for soap strips |

### Methods used for preparation of herbal soap paper strips :

| Step | Procedure | Description |
|---|---|---|
| 1 | Preparation of Herbal Extract | Accurately weighed quantities of Tulsi, Neem, and Turmeric powders were subjected to maceration using distilled water for 24 hours with intermittent stirring. The mixture was then filtered using muslin cloth followed by Whatman filter paper to obtain a clear extract. |
| 2 | Preparation of Soap Base | The soap base was melted using a double boiler method at controlled temperature (60–70°C) to avoid degradation of active components. |

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| | | |
|---|---|---|
| 3 | Incorporation of Herbal Extract | The prepared herbal extract was slowly added to the molten soap base with continuous stirring to ensure uniform distribution. Glycerin was added as a moisturizing agent. |
| 4 | Casting of Formulation | The resultant homogeneous liquid formulation was poured uniformly onto pre-cut water-soluble paper sheets placed on a flat surface. |
| 5 | Drying Process | The coated sheets were air-dried at room temperature for 24 hours to allow evaporation of moisture and formation of thin soap films. |
| 6 | Cutting and Storage | The dried sheets were cut into uniform strips and stored in airtight containers to protect from moisture and contamination. |

Procedure:(13-15)

1. Selection of Herbal MaterialsDried herbal powders of Ocimum sanctum (Tulsi), Azadirachta indica (Neem), and Curcuma longa (Turmeric) were selected based on their well-documented antimicrobial, anti-inflammatory, and skin-protective properties. All materials were inspected for purity and absence of contaminants prior to use.
2. Weighing of IngredientsAccurately weighed quantities of each herbal powder were measured using a digital analytical balance to ensure precision and reproducibility of the formulation.
3. Preparation of Extraction SolventDistilled water was used as the extraction medium due to its safety, non-toxicity, and compatibility with herbal constituents.
4. Maceration ProcessThe weighed herbal powders were soaked in distilled water and subjected to maceration for 24 hours with occasional stirring to facilitate the extraction of active phytoconstituents.
5. Filtration of ExtractThe macerated mixture was filtered first through muslin cloth to remove coarse particles, followed by filtration using Whatman filter paper to obtain a clear and particle-free herbal extract.
6. Preparation of Soap BaseA suitable soap base was taken and melted using a double boiler method at a controlled temperature range of 60–70°C to prevent degradation of thermolabile components.
7. Incorporation of Herbal ExtractThe prepared herbal extract was gradually added to the molten soap base under continuous stirring to ensure uniform dispersion of active ingredients throughout the formulation.
8. Addition of GlycerinGlycerin was incorporated into the mixture as a humectant to enhance the moisturizing properties of the final product and to prevent dryness of the skin.
9. Homogenization of MixtureThe entire formulation was stirred continuously to obtain a homogeneous and lump-free liquid mixture, ensuring uniform consistency.
10.Casting onto Water-Soluble PaperThe prepared liquid formulation was carefully poured onto pre-cut water-soluble paper sheets placed on a leveled surface to achieve uniform thickness.
11.Drying of Soap FilmThe coated sheets were allowed to dry at room temperature for 24 hours. This step ensured complete evaporation of water and formation of thin, flexible soap films adhered to the paper.
12.Cutting and Storage of StripsThe dried soap sheets were cut into uniform strips of desired dimensions and stored in airtight containers to protect them from moisture, contamination, and environmental degradation.

Usage and Applications of Herbal Soap Paper Strips

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Usage: Herbal soap paper strips are designed for convenient, single-use hygiene. One strip is sufficient for effective hand cleansing. The user should take a single strip with dry hands, place it on the palm, and add a small amount of water. Upon gentle rubbing, the strip dissolves instantly to form a mild lather. The hands should be rubbed thoroughly for 20–30 seconds, ensuring coverage of all areas including between fingers and under nails, followed by rinsing with clean water. The product is intended for external use only and should be stored in a dry place to prevent premature dissolution.

Applications: Here is a manuscript-ready section on “Usage and Applications” of the herbal soap paper strips:

Usage and Applications of Herbal Soap Paper Strips

Usage Instructions

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Applications

1. Personal Hand Hygiene

These strips provide an effective alternative to conventional soaps for routine handwashing. The presence of herbal ingredients such as Ocimum sanctum, Azadirachta indica, and Curcuma longa enhances antimicrobial protection while being gentle on the skin.

2. Travel and Outdoor Use

Due to their lightweight and compact nature, soap paper strips are highly suitable for travelers, hikers, and campers. They eliminate the need to carry bulky soap bars or liquid handwash containers.

3. Emergency and Public Hygiene

The strips are useful in emergency situations, public places, schools, and workplaces where access to conventional hygiene products may be limited. They help maintain hygiene standards and reduce the spread of infections.

4. Healthcare and Clinical Settings

These strips can be used in hospitals and clinics for quick hand hygiene by healthcare professionals and patients, minimizing cross-contamination risks associated with shared soap bars.

5. Eco-Friendly Alternative

The product is biodegradable and requires minimal packaging, making it an environmentally sustainable option compared to plastic-packaged liquid soaps and synthetic hygiene products.

6. Dermatological Benefits

The herbal formulation provides additional benefits such as anti-inflammatory, antibacterial, and antioxidant effects, making it suitable for individuals with sensitive skin and mild skin conditions like dryness, irritation, or dermatitis.

7. Educational and Institutional Use

Soap strips can be distributed in schools and institutions to promote hygiene awareness among students due to their ease of use and affordability.

**Evalution Parameter :**

1. Organoleptic Evaluation

Organoleptic evaluation involves the assessment of physical characteristics such as color, odor, texture, and overall appearance of the formulated soap strips. These parameters are important for determining product acceptability and

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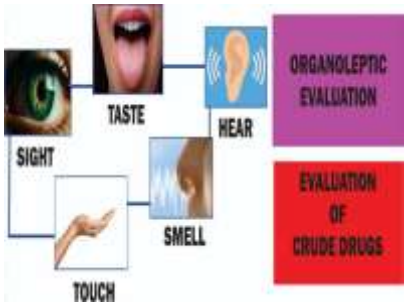
consumer appeal. The prepared herbal soap strips were visually inspected for uniformity, smoothness, and absence of cracks or imperfections. The color was observed to be light to dark brown due to the presence of herbal extracts, while the odor was pleasant and characteristic of natural ingredients. A good organoleptic profile ensures better user compliance and indicates proper formulation without degradation or incompatibility of ingredients.




2. pH Determination

The pH of the soap strips was determined to evaluate their compatibility with human skin. A small quantity of the soap strip was dissolved in distilled water, and the pH was measured using a calibrated digital pH meter. The observed pH was around 9, which is within the acceptable range for soap-based products. Maintaining an उचित pH is crucial to prevent skin irritation, dryness, or damage to the natural skin barrier. A slightly alkaline pH supports effective cleansing while ensuring that the formulation remains safe for regular topical application.


3. Foam Height Test

Foam height is an important parameter used to evaluate the foaming ability of the soap strips, which directly influences user satisfaction. The test was performed by dissolving a known amount of soap strip in water and shaking it in a graduated cylinder for a fixed number of times. The height of the foam generated was measured immediately. The formulation showed a foam height of approximately 2 cm, indicating satisfactory foaming capacity. Adequate foam formation enhances the cleansing efficiency by facilitating the removal of dirt, oil, and microorganisms from the skin surface.

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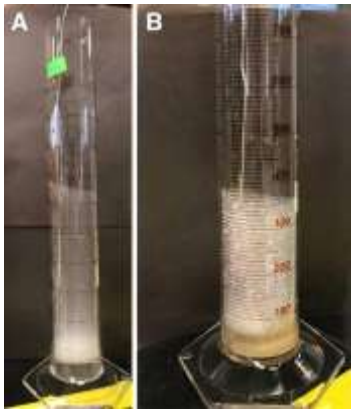
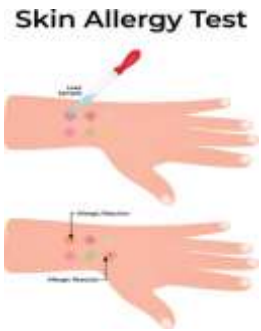
4. Foam Retention Test

Foam retention measures the stability and persistence of foam over time. After generating foam in a graduated cylinder, the volume of foam remaining after a specific time interval (1 minute) was recorded. The herbal soap strips exhibited about 60% foam retention, indicating moderate foam stability. This parameter is important because stable foam ensures prolonged contact of the cleansing agent with the skin, thereby improving washing efficiency. Good foam retention also reflects the quality of the soap base and its compatibility with herbal ingredients used in the formulation.




5. Skin Irritation Test

The skin irritation test was conducted to assess the safety and dermatological compatibility of the formulation. A small portion of the soap solution was applied to a patch of skin (usually on the forearm) of human volunteers under controlled conditions. The area was observed for redness, itching, swelling, or any allergic reaction over a specified period. The results indicated no signs of irritation, confirming that the formulation is safe for topical application. This test is essential to ensure that the product does not cause adverse effects and is suitable for regular use.




6. Thickness and Weight Uniformity

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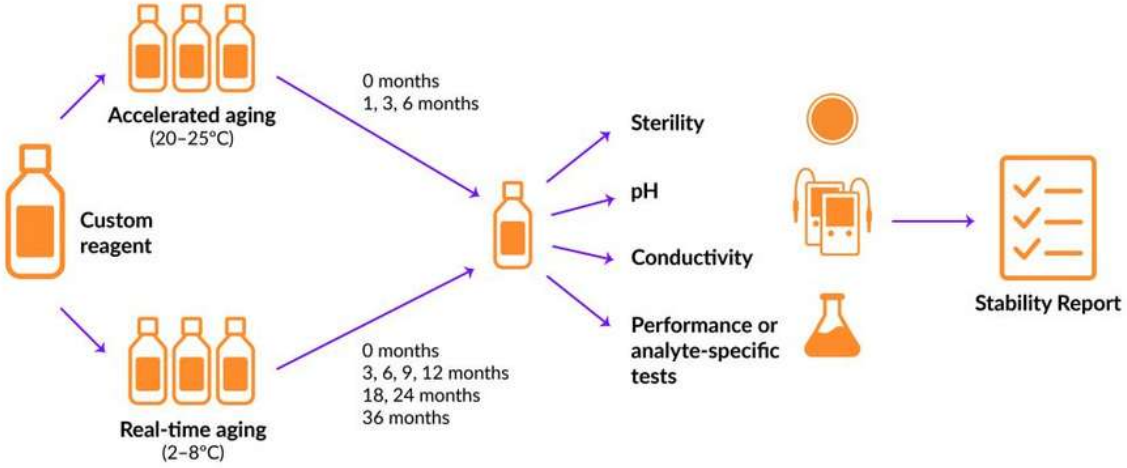
Thickness and weight uniformity were evaluated to ensure consistency in the formulation of soap strips. Randomly selected strips were measured using a micrometer screw gauge for thickness and a digital balance for weight variation. Uniform thickness and weight indicate proper casting and even distribution of the formulation over the water-soluble paper. Consistency in these parameters ensures accurate dosing, uniform performance, and reproducibility of results. It also contributes to the aesthetic quality and ease of handling of the strips during use.


7. Stability Study

Stability studies were performed to evaluate the physical and chemical stability of the formulated soap strips under different storage conditions. The strips were stored at room temperature and slightly elevated temperatures for a defined period and observed for changes in color, odor, texture, and performance. The formulation remained stable without significant changes, indicating good shelf-life characteristics. Stability testing is crucial for determining product durability, storage requirements, and overall quality during its intended shelf life.




**Evalution parameter :**

| Sr. No. | Parameter | Method | Observation/Result | Significance |
|---|---|---|---|---|
| 1 | Organoleptic Properties | Visual and sensory inspection | Brown color, pleasant odor, smooth texture | Ensures product acceptability and aesthetic quality |

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|---|---|---|---|---|
| 2 | pH Determination | Digital pH meter (1% solution) | pH ≈ 9 | Confirms skin compatibility and safe usage |
| 3 | Foam Height | Cylinder shake method | ~2 cm foam height | Indicates good foaming ability for cleansing |
| 4 | Foam Retention | Foam stability after 1 min | ~60% retained | Reflects stability and effectiveness of foam |
| 5 | Skin Irritation Test | Patch test on volunteers | No irritation observed | Ensures safety and non-toxicity |
| 6 | Thickness Uniformity | Micrometer screw gauge | Uniform thickness | Ensures consistent formulation and performance |
| 7 | Weight Variation | Digital balance | Uniform weight | Maintains dose uniformity and quality control |
| 8 | Stability Study | Storage at varied conditions | No significant change | Confirms shelf-life and formulation stability |

**Conclusion:**

The present study successfully developed and evaluated multifunctional herbal soap paper strips using natural ingredients such as Ocimum sanctum (Tulsi), Azadirachta indica (Neem), and Curcuma longa (Turmeric). The formulation demonstrated satisfactory physicochemical properties, including an acceptable pH, adequate foam formation, and good foam stability. The prepared strips showed uniformity in thickness and weight, along with desirable organoleptic characteristics.

The skin irritation study confirmed that the formulation is safe and non-irritant for topical application, making it suitable for regular use. Additionally, the presence of herbal constituents contributes to antimicrobial and skin-protective effects, enhancing the overall efficacy of the product. Stability studies indicated that the formulation remains stable under normal storage conditions without significant changes in its properties.

Overall, herbal soap paper strips offer a portable, eco-friendly, and effective alternative to conventional soap formulations. Their ease of use, minimal packaging, and reduced risk of contamination make them highly suitable for modern hygiene needs, especially in travel, outdoor, and emergency situations. This innovative dosage form holds strong potential for future development, large-scale production, and commercialization in the personal care industry.

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