

Eco-Friendly Herbal Paper Soap: Amla, Reetha and Shikakai Based Formulation and Evaluation

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Abstract:

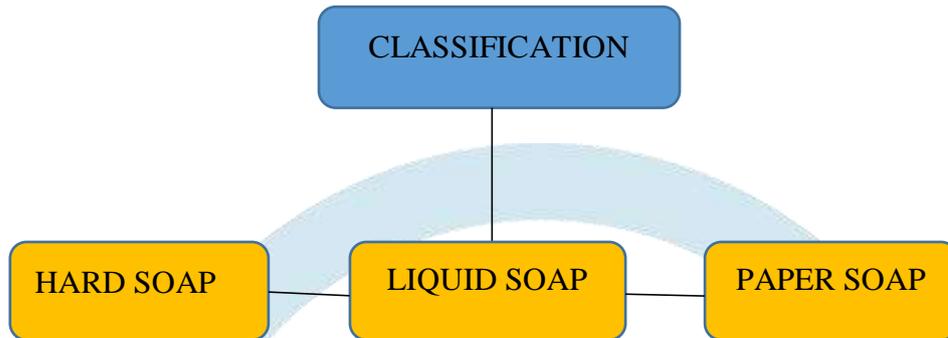
The demand for herbal-based personal care products is increasing due to their natural origin, safety, and environmental sustainability. This study focuses on the formulation and evaluation of herbal paper soap incorporating natural cleansing and conditioning agents like Reetha (*Sapindus mukorossi*), Shikakai (*Acacia concinna*), and Amla (*Emblica officinalis*). These herbs are well known for their foaming, antimicrobial, and nourishing properties, making them ideal for use in herbal soap formulations. The paper soap is most used handwash preparation in this article formulate poly herbal paper soap and evaluate their parameter. Paper soaps are biodegradable sheets prepared and evaluated for dermal infections. Which act as a anionic surfactant on application with water helps to maintain the hygiene. These strips are easy to carry, use and portable. The parameters used such as moisture content, stability of foam, Ph. value, free alkali content, skin irritation test, visual analysis, organoleptic test. The result of physiological characters was revealed. These steps were carried out for the best result of our paper soap formulation.

Keywords: Herbal paper soap, Reetha, Shikakai, Amla, Biodegradable, Personal care.

Introduction

Human skin is the outer covering of the body constituents the first line of defenses against various pathogens. As the skin interfaces the environment, it is constantly exposed to different environmental stimulus a reaction, which makes skin damage. Similarly the damage skin will usually form scar tissue mostly hand is a part of body which connects to pathogens even through working in day-to-day life so therefore soap has been made as formulation which is mostly used in our day-to-day life to fight against various pathogens. Soap is nothing but, substances that, when dissolved in water, possess the ability to remove dirt from surfaces such as the human skin, textiles, and other solids. Soap cannot produce bubbles in hard water and thus condition results in the wastage of soap. Scum is not easily cleaned. It will leave a clear sediment that can be seen on clothes, and causes them to feel hard.

Classification of Soap:



Paper Soap:

Paper soap is a convenient and innovative form of soap designed for portability and ease of use. It consists of thin, biodegradable sheets that dissolve upon contact with water, producing lather similar to traditional soap. These sheets are typically packaged in compact, lightweight containers, making them ideal for travel, outdoor activities, and personal hygiene on the go. Paper soap is often infused with antibacterial and moisturizing agents, ensuring effective handwashing while being gentle on the skin. Its eco-friendly nature, minimal plastic waste, and single-use format contribute to its growing popularity as a sustainable alternative to liquid or bar soaps. The main focus of our research is manufacture of the paper soap sheet. Paper soap is a thin soap sheet. It is an anionic surfactant that is used in conjunction with water for washing and cleaning. The soap includes a substrate, a cleaning composition, and a holder. Paper soap is a dry, lightweight sheet of soap that dissolves within seconds when exposed to a small amount of water. It is a convenient, pocket-sized product that can be used for cleaning both hands and face. Nowadays, people prefer hand-washing soap that is easy to carry, and paper soap represents an innovative solution, as it is as thin as paper and turns into foam when it comes into contact with water. Due to its compact size, paper soap is typically used as a disposable hand-washing option, making it ideal for outdoor activities. Soap is traditionally made from fats and alkali, with the cold process method being the most popular soap-making technique today, though some manufacturers still use the traditional hot process method.



Fig. 1: Paper Soap

Nowadays, many people prefer herbal products due to their lack of side effects, which has led to the development of herbal paper cleaners. This study aims to develop and evaluate a multipurpose paper soap incorporating Tea tree oil, Lavender oil, and complementary ingredients renowned for their antibacterial and skin-nourishing properties. Sodium lauryl sulfate, a common surfactant in personal care products, facilitates lather formation and effective dirt removal. Glycerin, a humectant, enhances moisturizing properties by attracting and retaining skin moisture. HPMC is a semi-synthetic polymer commonly used as a film-foaming agent in paper soap formulation. It provides stability, flexibility and smooth texture to the soap film.

MATERIAL AND METHOD:

Formulation involved incorporating powdered extracts of amla, shikakai, and reetha into a glycerin-based soap matrix, which was then cast onto absorbent paper and dried to produce herbal paper soap.

1. Reetha:



Fig. 2: Sapindus Trifoliatus

- **Synonym:** Soapberry, Soapnut, Aritha.
- **Biological Source:** It consists of dried fruits of sapindus trifoliatus.
- **Family:** Sapindaceae
- **Category:** Cleanser and natural surfactant.

Chemical Constituents:

Saponins are found throughout the plant, but are particularly concentrated in the fruit. Saponins are secondary plant metabolites with diverse biological activities. Sapindus saponins are a mixture of six sapindosides (sapindosides A, B, C, D and mukoroji saponins (E1 and Y1)), with sapindoside B as one of the main component. Seeds contain fatty acid, trifolioside, kaempferol, proteins, carbohydrates and starch.

Pharmacological activity:

These saponins act as natural surfactants, forming micelles that encapsulate grease, dirt, and microbes, facilitating their removal upon rinsing. Unlike synthetic surfactants (like SLS), it does not cause dryness or irritation, enhancing the cosmetic acceptability of paper soaps.

2. Shikakai:



Fig. 3: Acacia Arabica.

- **Synonym:** Soap-pod, *Acacia concinna* .
- **Biological Source:** It is the dried gummy exudation of stem and branches of *Acacia Arabica*.
- **Family:** Leguminosae.
- **Category:** Antibacterial and Antifungal

Chemical constituents :

It principally consists of arabin, which is a complex mixture of calcium, magnesium and potassium salts of Arabic acid. Arabic acid upon hydrolysis give L-arabinose, L-rhamnose, D-galactose and D-glucuronic acid. It also contains oxidase and peroxidase enzyme.

Pharmacological activity:

The saponins and tannins present in Shikakai disrupt bacterial cell membranes, leading to cell lysis. Phenolic acids in Shikakai possess oxidative stress-inducing capabilities that can kill or inhibit bacterial growth. Antifungal action is mainly attributed to tannins and flavonoids, which disrupt the fungal cell membrane and inhibit spore germination.

3. Amla :



Fig. 4: Embellica officinalis

- **Synonym :** Indian gooseberry , Awla .
- **Biological Source:** It consists of the dried or fresh fruit of the plant phyllanthus emblica linn.
- **Family :** Phyllanthaceae.
- **Category :** Antioxident

Chemical Constituents:

Amla is highly nutritious and is one of the richest sources of vitamin-C, amino acids and minerals. It contains several chemical constituents like tannins, alkaloids and phenols. Among all hydrolysable tannins, Emblicanin A and B; gallic acid, ellagic acid are reported to possess biological activity.

Pharmacological activity:

Amla is one of the richest natural sources of Vitamin C, a powerful water-soluble antioxidant that neutralizes free radicals, protects skin cells from oxidative stress, and supports collagen production.

4. Lavender Oil:



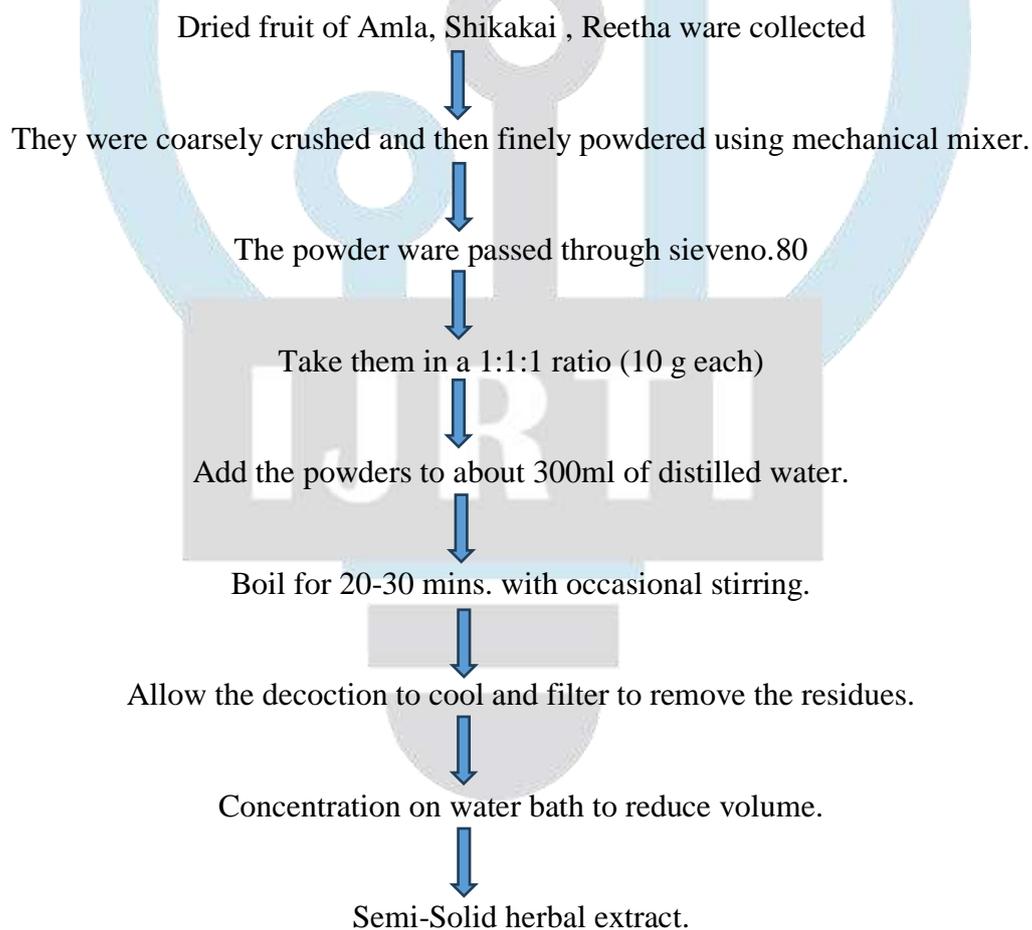
Fig. 5: Lavender oil

- **Synonym:** Lavandula angustifolia Oil.
- **Biological Source:** Lavender oil is derived from the flowers and sometimes the stems of various lavender species, particularly *L. angustifolia*.
- **Family:** Lamiaceae
- **Category:** Fragrance Agent.

Pharmacological Activity:

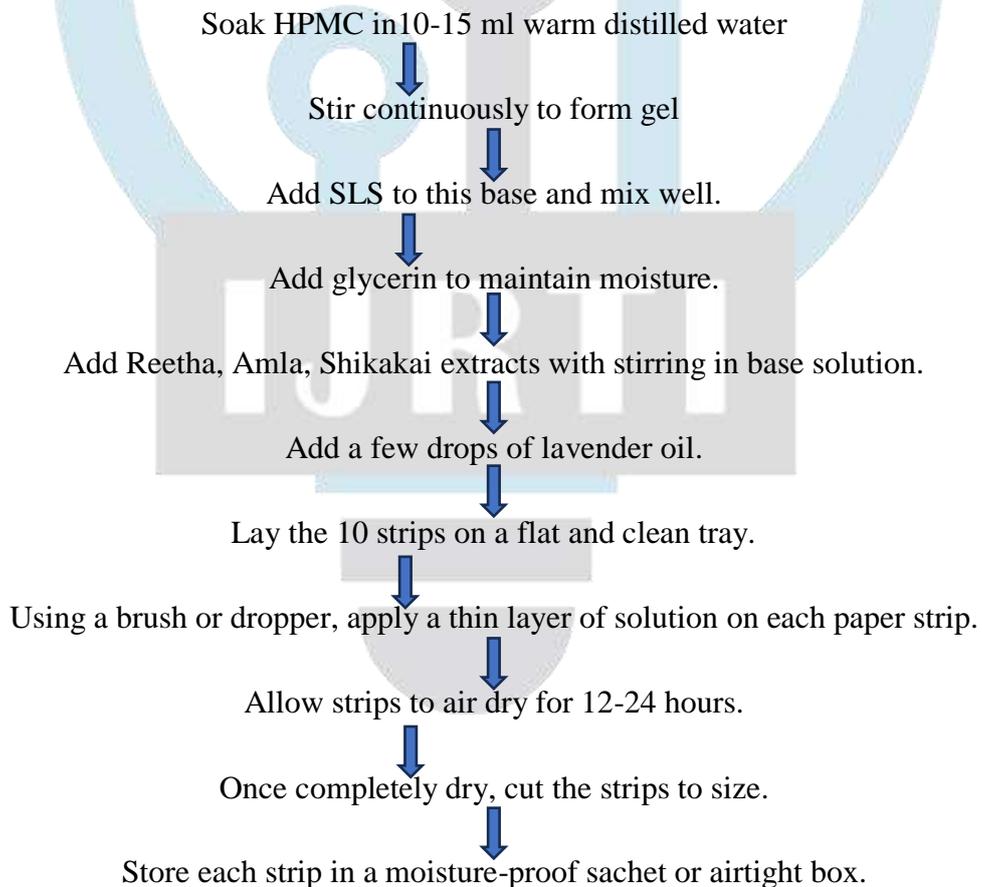
Naturally masks unpleasant odors with a fresh, floral fragrance. Acts as a natural deodorant component in the soap.

Method of Extraction:



Formulation Table:**Formulation Table: 1**

Sr No.	Ingredient	Quantity	Category
1.	Shikakai Extract	0.35 g	Cleaning, Conditioning
2.	Reetha Extract	0.35 g	Foaming
3.	Amla Extract	0.21 g	Antioxidant
4.	Sodium Lauryl Sulphate	0.14 g	Enhance foam and cleaning
5.	HPMC	0.14 g	Help form a film on paper
6.	Glycerin	0.35 g	Skin moisturizer
7.	Lavender Oil	0.035 g	Fragrance
8.	Distilled Water	5.075 g	Solvent
9.	Paper Strips (5 7cm)	10 strips	Carrier for soap formulation

Procedure :-

Evaluation test of herbal paper soap:

1. Organoleptic evaluation:

The formulated herbal paper soap was evaluated for colour, odour, texture, solubility and size.

2. Physical evaluation:

1. pH:

The pH test is done to determine whether the soap is safe and gentle for skin use. Skin has a natural pH of around 5.5, so the soap should ideally be between 5.5 to 7 (slightly acidic to neutral) to avoid irritation or dryness.

Procedure:

1. Take one strip of the herbal paper soap.
2. Dissolve it in 10 mL of distilled water in a clean beaker.
3. Stir gently until fully dissolved.
4. Measure the pH using: pH paper/strip (dip and compare with color scale), or Digital pH meter (more accurate; calibrate before use).

2. Foam Test:

The foam test is performed to check the foaming ability of the soap, which reflects its cleansing power and user acceptability. Good foam formation is often associated with effective cleaning, though it doesn't directly determine soap quality.

Procedure:

1. Take one dried herbal paper soap strip.
2. Dissolve it in 50 mL of distilled water in a clean conical flask or beaker.
3. Shake the solution vigorously for about 1–2 minutes.
4. Observe the amount and stability of foam formed.

3. Cleansing Test:

The cleansing test checks the cleaning efficiency of the herbal paper soap. It helps determine how well the soap removes dirt, oil, or grease from a surface (like skin or glass).

Procedure:

1. Take a clean glass slide or oily hand as the test surface.
2. Apply a small amount of grease, lipstick, or cooking oil to the surface to simulate dirt.
3. Wet the herbal paper soap strip and rub it on the surface.
4. Rinse gently with water.
5. Observe the surface for clean.

4. Drying Test:

The drying test is used to determine how long the paper soap takes to dry after being soaked in the formulation. This test helps ensure the product can be prepared quickly and remains stable during storage.

Procedure:

1. Soak 5×7 cm paper strips in the herbal soap formulation.
2. Remove excess liquid and place the strip on a clean surface.
3. Dry the strips under two conditions: Hot air oven at 40–5 ,Room temperature air drying.
4. Record the time taken for complete drying in each case. “Complete drying” means the strip is no longer sticky or wet to touch.

5.Skin irritation test:

The skin irritation test is conducted to ensure the safety of the product on the skin, especially when used frequently. It helps determine if the herbal paper soap causes any allergic reactions, redness, or irritation.

Procedure:**Patch Test:**

Apply a small amount of the soap solution (from a dissolved strip) on a small patch of skin, such as on the inner part of the forearm. Cover the area with a bandage. Leave it for 24 hours without washing.

6. Moisture absorption test:

Initial Weighing (W_0):

Weigh a dry paper soap sheet using the analytical balance. Record the initial weight (W_0).

Exposure:

Place the sample in a humidity chamber or closed box with a saturated salt solution to maintain 75% relative humidity (e.g., NaCl solution) at room temperature. Keep it for a set period (commonly 24 hours).

Final Weighing (W_1):

Remove the soap and immediately weigh it again. Record the final weight (W_1).

Calculation:

$$\text{Moisture Absorbed (\%)} = (W_1 - W_0) / W_0 \times 100$$

Result

1. Organoleptic Evaluation:

The formulated herbal paper soap was light brown in colour, pleasant in odour, smooth in texture, soluble in water and consistent in size.

Table 2: Organoleptic Evaluation

Sr.No.	Parameter	Observation
1.	Colour	Light Brown
2.	Odour	Pleasant
3.	Texture	Smooth
4.	Solubility	Soluble in Water
5.	Size	Consistent

2. Physical Evaluation:

The pH of formulated herbal paper soap was found to be 6.58, which indicates that the formulation is slightly acidic and suitable for application. The foam is stable for 3 to 5 min. (3cm in height) which indicates effective surfactants are present. They have good cleansing property with 10 min. drying time. They show no irritation to skin. The % moisture absorbed was found to be 9.09% which indicates good thermal stability.

Table 3: Physical Evaluation

Sr.No.	Parameter	Observation
1.	pH	6.58
2.	Foam Test	Stable(3cm in Height)
3.	Cleansing Test	Good
4.	Drying Test	10 min.
5.	Skin irritation Test	No irritation
6.	Moisture absorption Test	9.09 %

Conclusion:

The present study focused on the formulation and evaluation of an innovative herbal paper soap using aqueous extracts of amla (*Emblica officinalis*), reetha (*Sapindus mukorossi*), and shikakai (*Acacia concinna*), all of which are traditionally recognized for their cleansing, conditioning, and antimicrobial properties. The formulation process successfully yielded thin, uniform, and fast-dissolving paper soap strips with a pleasant natural aroma and acceptable mechanical strength. The evaluation of physical and chemical parameters revealed that the soap strips had a suitable pH (close to skin-friendly range of 5.5–6.5), excellent foam-forming capacity, rapid disintegration in water (within 15–30 seconds), and good cleansing efficiency. The incorporation of natural herbal extracts helped minimize the need for synthetic surfactants and preservatives, making the product safer for sensitive skin and more environmentally friendly. In conclusion, the herbal paper soap formulated with amla, reetha, and shikakai extracts provides a natural, portable, and sustainable alternative to conventional hand cleansers. It offers both hygiene and herbal skin care benefits, making it particularly suitable for travelers, students, and individuals in remote or outdoor environments. Further studies may focus on enhancing shelf-life, optimizing aroma, and exploring additional herbal actives for specific skin benefits.

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