Design and Assessment of a Polyherbal Medicated Soap for Skin Care

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Abstract: Polyherbal soaps are formulated using skin-beneficial herbs, offering a safer alternative to conventional non-herbal soaps. This study aimed to develop a polyherbal soap incorporating varying proportions of *Beta vulgaris* Linn., *Hibiscus rosa-sinensis* Linn., *Vigna mungo* Linn., *Trigonella foenum* Linn., *Aloe barbadensis* Mill., *Curcuma longa* Linn., and *Azadirachta indica* A. Juss. The soap was prepared using the melt-and-pour method and subjected to quality control tests. The results demonstrated that the soap formulation met acceptable quality standards, confirming its safety and efficacy as an alternative to non-herbal soaps.

Keywords:

Polyherbal soap; Melt and pour method; Skin care

1. Introduction

The history of soap-making dates back to ancient times, with the earliest records found in Sumerian clay tablets from 2000 B.C. The Ebers Papyrus, dating to 1550 B.C., indicates that the Egyptians combined animal fat with ashes for bathing purposes. The commercial soap industry began in 1789 with the launch of Pears, the first registered soap brand by Andrew Pears. A significant advancement occurred in 1791 when French chemist Nicolas Leblanc discovered an alkali soda ash, revolutionizing soap manufacturing. The introduction of synthetic detergents by German scientists during World War II in 1948 marked another pivotal moment in the evolution of cleansing agents [1].

Despite the long history of soap, the importance of personal hygiene was only recognized in earnest after the first century. Since then, advancements in science have rapidly transformed the personal care industry, solidifying soap as an essential item in daily life. Soaps can be categorized into various forms, including liquid, solid, semisolid, and powdered [3].

According to the Drugs and Cosmetics Act, 1940, soap is defined as articles intended to be rubbed, poured, sprinkled or sprayed on, introduced into or otherwise applied to the human body or any part of the body for cleansing, beautifying, promoting attractiveness or altering the appearance [2]. The production of soap involves a chemical process known as saponification, wherein acids from animal or vegetable fats combine with an alkali (sodium hydroxide and water) to yield soap and glycerin [4]. Soaps and detergents function by dissolving in water and effectively removing dirt from surfaces such as skin and textiles [5].

There are several types of soaps, including medicated, transparent, laundry, and toilet soaps [2]. The methods of soap preparation include melt-and-pour, cold process, hot process, and rebatching [6]. The pH of healthy skin ranges from 5.4 to 5.9 [7], and highly alkaline soaps can disrupt this balance, prompting dermatologists to recommend specific soaps tailored to various skin types, such as normal, oily, dry, combination, or sensitive skin [8].

Herbal pharmaceuticals are in more demand than their synthetic counterparts for a variety of reasons like minimal adverse effects, enhanced safety and effectiveness, easily accessible, improved compatibility with other ingredients, significant curative effect, and increased tolerability for all skin tones [9].

Herbal pharmaceuticals have gained popularity over synthetic alternatives due to their minimal side effects, enhanced safety, and compatibility with various skin tones. Traditional medical systems, including Ayurveda, Siddha, and Unani, have long utilized plant-based components—such as leaves, roots, flowers, and seeds—with medicinal properties in their formulations. Herbal soaps, which do not contain artificial colours or flavours, represent a natural alternative to commercial soaps. Polyherbal soaps, specifically, combine multiple herbal extracts, such as neem, turmeric, aloe vera, and calendula [10, 11].

The advantages of herbal soaps include their use of natural ingredients, hypoallergenic properties, moisturising effects, and anti-ageing benefits. However, they may also have drawbacks, including variable quality, shorter shelf life, and limited lather. [12]. The disadvantages are variable in quality, shorter shelf life, higher cost, limited lather, and limited availability [11].

Recent studies highlight various methods for preparing herbal soaps, with the melt-and-pour method [4, 6, 13, 14, 16], being favored for its efficiency and ease of production than cold process method [8]. Ingredients such as goat milk [13], and glycerin soap bases [4, 6, 14, 16], are commonly used, alongside saponification with sodium hydroxide [8, 15]. While aloe vera and turmeric are prevalent in many formulations, some studies have explored a broader range of ingredients, including extracts from papaya leaves and beetroot [6]. Evaluations of the physicochemical properties and quality control tests have been conducted systematically, contributing to the understanding of herbal soap formulations and their potential benefits for skin health.

2. MATERIALS AND METHODS

2.1. Materials

The apparatus used are weighing machine, spatula, stirrer and pH meter. Glassware used were of borosil belongs to type I. All chemicals including sodium hydroxide (NaOH) are of AR grade. Herbals like beetroot, urad dal, neem leaves, lavender oil, hibiscus, fenugreek powder, coconut oil, vitamin E are purchased from the local market. The biological, chemical and uses of herbs used in the soap is given in the Table 1.

Table 1: Biological, chemical and uses of herbs used in the soap

Ingredients	Biological source	Chemical constituents	Uses
Beetroot	Beetroot, biologically known as *Beta vulgaris Linn.* [17] and belonging to the family Amaranthaceae , is primarily used for its fleshy taproot [16].	Betalin, antioxidants [18], betacyanin pigment, flavonoids and vitamin C [16].	To treat skin blemishes and acne [18], decrease the wrinkle and fine lines on face [16].
Hibiscus	Hibiscus, with several species (*Hibiscus rosa-sinensis Linn*.) belonging to the family Malvaceae [17], has various parts used depending on the species and application, including the flowers, leaves, and roots.	Anthocyanins, polyphenols [14], flavonoids, saponins, alkaloids [19].	Used as a toner for skin, for skin brightening and hydrating the skin, anti-aging [20].
Neem	Neem, scientifically known as *Azadirachta indica A. Juss*. [17] and belonging to the family Meliaceae [22], has various parts used medicinally, including its leaves, seeds, bark, and oil.	Nimbin, nimbinene, nimbidol, quercetin [19].	Antimicrobial, antifungal [19], used to treat many skin aliments including psoriasis, athlete's foot and acne [21].
Turmeric	Turmeric, biologically sourced from *Curcuma longa Linn.* and belonging to the ginger family Zingiberaceae [17], is primarily used for its rhizome.	Curcumin, curcuminoids, turmerone,zingoberene, flavonoids [19].	Natural glow to skin, used for skin lightening, helps to reduce dark spots and hyperpigmentation, helps to treat facial psoriasis, antimicrobial [21].
Aloe vera	Aloe vera, biologically classified as *Aloe barbadensis Mill*. and belonging to the family Asphodelaceae (or sometimes listed as Liliaceae) [17], is primarily used for the gel found within its thick, fleshy leaves.	Anthraquinones [19], vitamins B1, B2, B6, B12, C, β-carotene [22], aloin [23].	Anti-aging, antioxidants, used for skin lightening [21].
Fenugreek	Fenugreek, biologically known as *Trigonella foenum Linn*. and belonging to the family Fabaceae [17] (also known as Leguminosae), is primarily used for its seeds and leaves.	Trigonelline, gentianine [17], carpaine, trigogenin, flavonoids, saponins [23].	Antioxidant, antimicrobial, used for glowing skin, as a cleanser, as an anti-aging, for moisturizing skin, reducing blemishes, dark circles and acne [23].
Urad dal	Urad dal, derived from the plant *Vigna mungo Linn*. belonging to the family Fabaceae [17], primarily uses its seeds, which are commonly split and dehusked for culinary purposes.	Flavonoids, saponins, tannins, alkaloids, vitamin C [24].	It makes the skin soft and smooth [25].

2.2. METHODS

2.2.1. Pre-formulation studies

Before the formulation, the pre-formulation studies were carried out to ensure the compatibility of all components used in the soap which were evaluated by raw material evaluation, physicochemical properties, compatibility studies and stability studies.

2.2.1.1. Raw material evaluation:

2.2.1.1.1. Surfactant:

Foaming height test: 1% of sample solution were prepared by dissolving 1g of sample/soap in 100ml of distilled water and taken in a 100ml measuring cylinder. The measuring cylinder was shaken for 10 times and allowed to stand till aqueous volume measured up to 50ml and foam height which is above the aqueous volume was measured [26].

Foam retention: In a 100 ml graduated measuring cylinder, 25 ml of the 1% soap solution were added. Cylinder were shaken for 10 times while holding the cylinder with one hand. For 4 minutes, the volume of foam was measured every minute [14].

2.2.2. Physicochemical Properties:

2.2.2.1. pH test:

1% of the sample solution was prepared by dissolving 1g sample/soap in 100 ml of distilled water for the determination of pH, and a buffer solution of pH-7. The electrode was immersed in the buffer solution, and the pH meter was calibrated. After calibrating, the pH of the sample solution was measured and pH of the sample solution were recorded [26].

2.2.2.2. Solubility:

A small amount of the exact was added to a solvent (like water, methanol, etc.,) and observed whether it dissolves, forming a clear solution, or remained as a solid, indicating insolubility.

2.3. FORMULATION:

2.3.1. Soap preparation:

2.3.1.1. Preparation of soap base:

The soap base is prepared according to the following Steps: -

- Coconut oil (75 ml) was taken in a 500 ml beaker and placed on a water bath for 10-15 minutes at C temperature (oil phase).
- In another 100 ml beaker, Sodium hydroxide (13.20 g) was taken and dissolved in distilled water (24 ml) and mixed properly and kept aside for 5 minutes (aqueous phase).
- After heating the oil phase, it was slowly added to the aqueous phase with continuous stirring on the water bath and the temperature was maintained.
- After mixing both phases, the mixture was allowed to cool, and a thick texture was formed; soap base was prepared [26].

2.3.2. Procedure for soap preparation:

Aqueous extract of beetroot, hibiscus, neem and urad dal is prepared by grinding individual components in the mixer or grinder with minimal water volume. Further, the slurry was squeezed and filtered using a muslin cloth. The filtrate was used for further soap preparation.

- Melting the soap base:

  The soap base is sliced into small pieces and melted using double boiling. The soap base is stirred until it melts to a smooth consistency.

- Addition of herbs:

  The herbal extract and other ingredients is added slowly to the melted soap base. The mixture is stirred continuously to ensure that evenly distributed throughout the Soap. Lavender oil is added and stirred well until it becomes a thick trace.

- Pouring into moulds:

  Once the herbs are added, the soap is poured into moulds. The soap is allowed to cool for hours or overnight to get harder.

- Cutting and storing the soap:

  When the soap is fully cooled and hardened, it is removed from the mould and sliced into desired shapes and sizes. It is stored in a cool, dry place until ready to use [27]. The formulation of poly herbal soap is given in Table 2.

Table 2: Formulation of poly herbal soap

S. No.	Ingredients	F1	F2	F3	F4	F5
1	Soap base	50g	50g	50g	50g	50g
2	Beetroot	10ml	5ml	2ml	2ml	2ml
3	Hibiscus	-	1ml	1ml	-	1ml
4	Urad dal	-	1ml	1ml	-	1ml
5	Neem	2ml	1ml	-	1ml	0.5ml
6	Aloe vera	2ml	1ml	1ml	1ml	1ml
7	Fenugreek	0.5g	0.5g	0.5g	0.5g	0.5ml
8	Turmeric	0.2g	0.2g	0.2g	0.2g	1ml

9	Coconut oil	1ml	1ml	1ml	1ml	0.5g
10	Vitamin E	0.5ml	0.5ml	0.5ml	0.5ml	0.2g
11	Lavender oil	2 drops	2 drops	2 drops	2 drops	2 drops

The formulation procedure (2.3.2) was followed to formulate different proportions of poly herbal soap, with different compositions from F1 to F5 are given in Table 3.

2.4. EVALUATION:

2.4.1. Colour and Shape:

The colour and shape were checked by the naked eye.

2.4.2. Odour:

The odour of formulation was checked by applying formulated soap on the hand and smelling the fragrance of perfume.

2.4.3. pH:

The pH of the prepared soap was assessed by touching a pH strip to the freshly formulated soap or by dissolving 1 gram in 100 ml of water, and pH of the soap was determined with the help of a digital pH meter [10].

2.4.4. Foam retention test:

1 g of soap was dissolved in 100 ml of distilled water. From that, 25 ml of the soap solution was taken into a 100 ml measuring cylinder and covered with a hand and shaken 10 times. The volume of foam at 1 minute intervals for 4 minutes was recorded [10]

2.4.5. Dissolving time test:

In a 100 ml beaker, 1g of sample/soap was added, swirling in 50 ml of distilled water. The sample was mixed with continuous swirling, and the sample, completely dissolved in water, was observed [30]. 6.6. Foam height: 1% of the sample solution was prepared by dissolving 1g sample of soap in 100 ml of distilled water, and 50 ml of the soap solution was taken in a 100 ml measuring cylinder. The measuring cylinder was shaken 10 times and allowed to stand still, till the aqueous volume measured up to 50ml and the foam height, which is above the aqueous volume, was measured [26]

2.4.6. Skin Irritation Test:

Skin irritation test was evaluated by applying poly herbal soap on the skin and leaving it undisturbed for 30 minutes, and then washed after 30 minutes. Any itching, rashes or redness on the skin by sensory and visual inspection was observed [28].

2.4.7. Dirt dispersion test:

1% of the sample solution was prepared by dissolving 1g sample/soap in 100 ml of distilled water was taken in a measuring cylinder, and 2 drops of ink were added to the sample solution. Then the measuring cylinder was covered with a hand and shaken 10 times. The amount of ink in the foam was observed [26].

2.4.8. Wetting time test:

A cotton cloth of 1 inch in diameter in round shape was used for the determination of the wetting time of the sample. 1% of soap solution was prepared by dissolving 1g of sample in 100 ml of distilled water, and the round shape cotton cloth was placed in the sample solution, and a stopwatch was used to determine the wetting time. Initially, the cloth was floated on the surface of the sample solution. After some time, the sample cloth was observed by the time and the cloth sank in the sample solution. The sink time was recorded [26].

2.4.9. Stability test:

The stability of colour, odour, texture and pH of the soap is monitored at intervals of 15 days up to 45 days.

3. RESULTS

3.1. PRE-FORMULATION STUDIES:

The pre-formulation studies before preparing the soap were carried out as described in 2.2.1.

3.1.1. Raw materials:

3.1.1.1. Surfactant:

Table 3: Test for foaming of fenugreek

S. No.	Parameters	Observation
1	Foaming height	10 cm

2	Foam retention	2 min

In the prepared poly herbal soap, fenugreek acts as a natural surfactant (foaming agent). Thus, the foam height and foam retention of the fenugreek mixture is evaluated, and the results are given in Table 3, which are within the acceptable limits.

3.1.2. Physicochemical properties:

3.1.2.1. pH:

Table 4: pH of the extract of raw materials

S. No.	Ingredients	pH
1	Aqueous extract of Beetroot	5.75
2	Aqueous extract of Hibiscus	7.61
3	Aqueous extract of Urad Dal	6.22
4	Aqueous extract of Neem	6.75
5	Aloe vera gel	4.39

Typically, the pH of individual ingredients (herbal extract) does not have a significant impact on the pH of the soap (Table 4). The soap's pH mainly depends on the lye (sodium hydroxide) and oil combination, which dominates the pH of the soap.

3.1.2.2. Solubility:

Table 5: Solubility of raw materials

S. No.	Ingredients	Solubility in soap base
1	Aqueous extract of Beetroot	Soluble
2	Aqueous extract of Hibiscus	Soluble
3	Aqueous extract of Urad dal	Soluble
4	Aqueous extract of Neem	Soluble
5	Aloe vera gel	Soluble
6	Fenugreek powder	Soluble
7	Turmeric powder	Soluble

All the raw materials are soluble in soap base given in Table 5, which contains sodium hydroxide and is free from sedimented particles. Thus, all the ingredients like herbal extracts and powders were successfully incorporated and evenly distributed in the soap formulation, that ensures a smooth and consistent texture.

3.2. EVALUATION OF POLY HERBAL SOAP:

The formulated soaps F1 to F5 were evaluated for its pH, appearance, colour, odour, shape, foam height, foam retention, dissolving time, dirt dispersion, wetting time, skin irritation, and stability were carried out and the data were given in Table 6.

Table 6: Evaluation of poly herbal soap

S. No.	Evaluation parameters	F1	F2	F3	F4	F5
1	pH	8.02	8.35	8.50	8.86	8.03
2	Appearance	Slightly sticky	Compact	Compact	Compact	Compact
3	Colour	Blackish brown	Dark brown	Dark brown	Light amber	Light yellowish
4	Odour	Pleasant	Pleasant	Pleasant	Pleasant	Pleasant
5	Shape	Rectangle	Rectangle	Rectangle	Rectangle	Rectangle
6	Foam height	16 cm	16 cm	15 cm	14 cm	15 cm
7	Foam retention	8 min	10 min	12 min	10 min	15 min
8	Dissolving time	10 min	12 min	12 min	12 min	15 min
9	Dirt dispersion	Good	Good	Good	Good	Good10 min
10	Wetting time	3 sec	4 sec	5 sec	5 sec	3.5 sec
11	Skin irritation	No	No	No	No	No
12	Stability	Stable	Stable	Stable	Stable	Stable

The study systematically evaluated the impact of varying concentrations of herbal extracts (beetroot, neem, aloe vera, hibiscus, and urad dal) on the physicochemical properties of polyherbal soap formulations (F1–F5). Formulation F1, containing the highest concentrations of beetroot (10 ml) and aloe vera (2 ml), exhibited a blackish-brown colour and a slightly sticky texture, likely due to the high sugar and mucilage content in beetroot and aloe vera, respectively. This formulation demonstrated the highest initial foam height (16 cm) and the fastest wetting time (3 sec), suggesting that the hydrophilic components in beetroot and aloe vera enhance initial lathering and water absorption. However, F1 also displayed the poorest foam retention (8 min) and the fastest dissolving time (10 min), indicating that excessive amounts of these extracts may compromise soap hardness and lather stability.

In contrast, F5, which contained reduced amounts of neem and aloe vera along with urad dal, exhibited a compact texture, light yellowish colour, and optimal foam retention (longest duration) with a moderate initial foam height. The addition of urad dal,

known for its saponin content, likely contributed to improved structural integrity and prolonged lather stability. This suggests that a balanced combination of herbal extracts is crucial for achieving desirable soap characteristics.

pH and Skin Compatibility: All formulations exhibited slightly alkaline pH (8.02–8.86), which falls within the acceptable range for skin-friendly soaps. No skin irritation was observed, confirming their safety for topical use. The pH values were comparable to commercial products, reinforcing their potential as viable alternatives to synthetic soaps.

Dirt Dispersion and Cleansing Efficacy: All formulations demonstrated effective dirt dispersion, preventing particle redeposition on the skin. This property is essential for maintaining cleansing efficiency, particularly in hard water conditions.

Optimised Formulation (F5): Among the tested formulations, F5 emerged as the most optimised due to its: Balanced foam characteristics (good initial lather with prolonged retention), Longer dissolving time, indicating better durability, Low wetting time, ensuring quick water absorption, Pleasant odour and light colour, enhancing consumer appeal, and Effective dirt dispersion, confirming its suitability for daily skin cleansing.

The findings suggest that herbal composition significantly influences soap properties, and F5 presents a promising natural alternative to conventional soaps, combining efficacy, stability, and skin compatibility. Future studies could explore long-term stability, antimicrobial efficacy, and consumer preference trials to further validate its commercial potential.

4. CONCLUSION

The present study successfully formulated and evaluated a polyherbal soap using the melt-and-pour method, incorporating a synergistic blend of medicinal plant extracts. The optimized formulation (F5) demonstrated desirable physicochemical properties, including appropriate pH, stable foam characteristics, favorable wetting and dissolving times, and good dirt dispersion, making it suitable for dermatological use. Comparative analysis confirmed that the polyherbal soap offers significant advantages over conventional synthetic soaps, particularly in enhancing skin texture by imparting softness, smoothness, and suppleness. Furthermore, the herbal constituents contribute additional therapeutic benefits without causing irritation, underscoring their potential as a safer and more effective alternative to commercial non-herbal soaps. Future studies may explore long-term clinical efficacy and consumer acceptability to validate its broader applicability in skincare.

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