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## Research Paper

# Development and Physicochemical Evaluation of a Polyherbal Shampoo Containing Ayurvedic Herbal Extracts

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## ABSTRACT

This study aimed to develop and evaluate a polyherbal shampoo using natural, plant-based ingredients that deliver effective cleansing, conditioning, and scalp compatibility without synthetic additives. In response to growing consumer demand for eco-friendly personal care products, Ayurvedic botanicals such as amla, ginger, hibiscus, aloe vera, bhringraj, senna, and shikakai were selected for their well-documented antimicrobial and nourishing properties. Herbal extracts were prepared via maceration and decoction, followed by phytochemical screening to identify bioactive constituents. Seven formulations (F1–F7) were developed using a gelatin base, incorporating herbal extracts, natural fragrance, gelling agents, and pH regulators. Each shampoo was evaluated for physicochemical and aesthetic parameters, including appearance, pH, foam generation and stability, total solids, dirt dispersion, and washability. Among all the formulations evaluated, Formulation F5 exhibited superior performance, showing a pH of 5.16, a viscosity of 946.0 mPa·s, foam stability of 90 mL after 1 minute, and a solid content of 23.88%. It effectively dispersed ink and rinsed cleanly, while also exhibiting favourable sensory attributes such as pleasant aroma, golden honey color, and commercial-grade texture. These results confirm that combining multiple herbal extracts in a single formulation can yield a safe, effective, and sensorially appealing shampoo. Formulation F5 stands out as a promising eco-conscious alternative to conventional shampoos, supporting further innovation in herbal-based personal care products.

## INTRODUCTION

Natural or herbal shampoo is more beneficial than the synthetic one because synthetic shampoo shows some side effects as compared to the herbal

one. The challenge is not only in the selection of proper natural ingredient but also in the matching the performance of formulation with synthetic formulation present in the market. [1] One of the most common hair treatments is shampooing.

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Primary function of shampoo is to clean, nourishes the hair by removing the accumulated sebum, dust and scalp debris etc. [2,3] Due to the less side effect and great effectiveness of herbal formulations like herbal shampoo, herbal cream etc, there is increase in demand for the herbal preparation. Number of types of herbal shampoo present in the market herbal powder shampoo, herbal clear liquid shampoo and herbal lotion shampoo etc. Depending upon type of herbal shampoo stability of shampoo changes because of presence of different ingredients in their formulation like vitamin, amino acids, and protein hydrolyses. [4] Selection of active natural ingredients for the formulation of the herbal hair care product depends upon the ability of the ingredient to prevent scalp damage also on the improvement in the quality of skin by cleansing and nourishing action of natural ingredient.

Herbal cosmetics, made from natural ingredients, are growing in popularity worldwide due to their safety and wellness benefits. As awareness of herbal alternatives rises, demand increases, driving innovation and sustainability in the beauty industry. While modern science has reduced the use of natural resources, herbs remain important for beauty, nutrition, and medicine. [5] Hair is an essential component of human beauty. Since ancient times, people have used herbs to manage, cleanse, and adorn their hair. As time has passed, although synthetic agents have gained a significant market share, consumers have become increasingly aware of their harmful effects on the skin, eyes, and hair. These concerns have led people to prefer herbal products because they are less expensive and are associated with fewer adverse effects. Shampoos and hair cleansers are used not only for cleaning the hair but also for providing a glossy appearance and maintaining its manageability and overall health.[6] Its primary purpose is to remove accumulated sebum, dirt, and residues of hair care products from the hair and

scalp. In addition to cleansing, shampoos may also serve as conditioners, lubricants, medicated formulations, and for other specialized purposes. Surfactants are the primary ingredients used in shampoo formulations, while other ingredients are incorporated to enhance the product's effectiveness, stability, and overall performance.[7] Herbal shampoo is a type of cosmetic preparation that utilizes natural ingredients derived from plants. The term "herbal shampoo" refers to a hair cleansing product formulated using extracts of medicinal herbs, Ayurvedic plants, and flowers. It can also be described as a viscous liquid hair care formulation that effectively cleanses the hair and removes excess oil, dirt, and other impurities from the scalp and hair.[8] Shampoo is a hair cleanser that removes oil, dirt, and dead skin cells from the hair and scalp without causing irritation [9]. Herbal shampoo is formulated with Ayurvedic herbs to cleanse the scalp naturally and help manage dandruff and other hair problems [8]. Shampoo formulations generally contain surfactants, herbal extracts, conditioners, preservatives, fragrances, and other ingredients to improve product performance [10].

The increasing popularity of herbal cosmetics has promoted the development of herbal-based hair care products. Hence, the present study aimed to formulate and evaluate a polyherbal shampoo using Ayurvedic medicinal plants and a suitable surfactant system.

## **MATERIAL AND METHODS**

### **Collection of plants:**

Fresh botanical samples — rhizomes of ginger, fruits of amla, pods of shikakai, petals of hibiscus, leaves of bhringraj, and leaves of senna — were procured from Devashree Nursery, Karad. The collected materials were washed thoroughly under



running tap water to remove surface contaminants and then shade-dried for 7–10 days.

Once dried, they were pulverized into coarse powder using a mechanical grinder and stored in labelled, airtight containers for further extraction.

**Table 1. List of Ingredients Used in the Formulation**

| S. No. | Ingredients | Scientific Name               | Form Used            | Purpose in Formulation               | Source                   |
|--------|-------------|-------------------------------|----------------------|--------------------------------------|--------------------------|
| 1      | Ginger      | <i>Zingiber officinale</i>    | Dried rhizome powder | Antimicrobial, scalp stimulant       | Devashree Nursery, karad |
| 2      | Amla        | <i>Phyllanthus emblica</i>    | Crushed fruit        | Antioxidant, strengthens hair        | Devashree Nursery, karad |
| 3      | Shikekai    | <i>Acacia concinna</i>        | Dried pod powder     | Natural cleanser, lather enhancer    | Devashree Nursery, karad |
| 4      | Hibiscus    | <i>Hibiscus rosa-sinensis</i> | Dried petal powder   | Shine promoter, hair conditioning    | Devashree Nursery, karad |
| 5      | Bhringraj   | <i>Eclipta alba</i>           | Dried leaves         | Hair growth promoter, cooling effect | Devashree Nursery, karad |
| 6      | Senna       | <i>Cassia angustifolia</i>    | Dried leaves         | Antifungal, antidandruff             | Devashree Nursery, karad |
| 7      | Aloe vera   | <i>Aloe barbadensis</i>       | Fresh gel            | Moisturizing and soothing            | Local herbal supplier    |
| 8      | Lemon juice | –                             | Fresh juice          | pH adjuster                          | Local market             |

**Table No.2 -List of Chemicals**

| Sr. No. | Chemical                     | Function                                    |
|---------|------------------------------|---------------------------------------------|
| 1       | Ethanol (95%)                | Solvent for maceration extraction           |
| 2       | Gelatin                      | Natural gelling and thickening agent        |
| 3       | Xanthan Gum                  | Thickener and viscosity stabilizer          |
| 4       | Sodium Lauryl Sulphate (SLS) | Surfactant for foam formation and cleansing |
| 5       | Geogard ECT                  | Natural preservative                        |
| 6       | Rose Oil                     | Fragrance enhancer                          |
| 7       | Distilled Water              | Solvent and vehicle                         |

## Method

### Authentication of plants:

All plant materials were authenticated by a qualified botanist from “The Department of Botany, SGM College, karad”. Herbarium specimens were prepared and deposited for reference. Botanical names were verified using The Plant List and Indian Medicinal Plants

Database, ensuring taxonomical accuracy before proceeding with formulation.

### Preparation of plant extract:

The dried and powdered herbal materials were extracted individually using suitable maceration and decoction methods. The obtained extracts were filtered, concentrated, and stored in airtight containers until further use in the formulation of the polyherbal shampoo.



**Phytochemical test of plant extracts:**

Phytochemical screening of the herbal extracts was conducted using standard qualitative tests to identify key bioactive compounds. Alkaloids were detected using Mayer's or Dragendorff's reagent, producing a creamy white or orange precipitate. Tannins and phenolic compounds were confirmed by ferric chloride, yielding greenish-black or dark blue coloration. Saponins were identified through foam formation upon shaking with water, while flavonoids showed yellow coloration with ammonia that disappeared upon acid addition. Terpenoids were indicated by a red or brown interface using chloroform and sulfuric acid. Reducing sugars were detected via Benedict's test, forming a red precipitate upon heating. Glycosides produced a brown ring at the interface of acetic acid, ferric chloride, and sulfuric acid. Quinones were confirmed by color change (red, yellow, or orange) upon reaction with sodium hydroxide. These tests validated the presence of multiple

phytoconstituents contributing to the shampoo's cleansing, conditioning, and therapeutic properties [11].

**Method of preparation:**

All herbal extracts (ginger, amla, shikakai, hibiscus, senna, and bhringraj) were prepared using appropriate extraction methods and measured as per the formulation design. In a beaker, gelatin was dissolved in warm distilled water with gentle stirring. Once fully hydrated, xanthan gum was slowly sprinkled in and stirred continuously until a uniform gel base was formed. After cooling slightly, surfactant (SLS), lemon juice, aloe vera gel, and rose oil were added gradually under moderate stirring. The prepared herbal extracts were incorporated one by one to ensure even distribution. Finally, the preservative was added, and the mixture was stirred until a smooth, homogenous shampoo was obtained. [12,13]

**Table No.3- Formulation Table of Herbal Shampoo**

| Ingredients   | F1    | F2     | F3     | F4     | F5     | F6     | F7    |
|---------------|-------|--------|--------|--------|--------|--------|-------|
| Ginger        | 8 g   | 3 g    | 5 g    | 4 g    | 6 g    | 5 g    | 6 g   |
| Amla          | 4 g   | 8 g    | 5 g    | 4 g    | 6 g    | 5 g    | 5 g   |
| Shikakai      | 1 g   | 1 g    | 1 g    | 0.5 g  | 0.5 g  | 0.5 g  | 1 g   |
| Hibiscus      | 0.5 g | 0.5 g  | 1 g    | 1 g    | 0.5 g  | 0.5 g  | 1 g   |
| Bhringraj     | 0.5 g | 0.5 g  | 1 g    | 1 g    | 0.5 g  | 2 g    | 0.5 g |
| Senna         | 0.5 g | 0.5 g  | 1 g    | 0.5 g  | 0.5 g  | 0.5 g  | 0.5 g |
| Aloe vera gel | 8 g   | 10 g   | 6 g    | 12 g   | 10 g   | 8 g    | 10 g  |
| Gelatin       | 1.5 g | 1.5 g  | 1.2 g  | 1.5 g  | 1.3 g  | 1.5 g  | 2 g   |
| Lemon juice   | 4 ml  | 5 ml   | 4 ml   | 3 ml   | 3 ml   | 4 ml   | 3 ml  |
| Rose oil      | 0.5ml | 0.5 ml | 0.5 ml | 0.7 ml | 0.3 ml | 0.5 ml | 1 ml  |
| SLS Needle    | 2.0 g | 2.5 g  | 3.0 g  | 3.5 g  | 3.5 g  | 2.5 g  | 2.5 g |

**Evaluation****1. Visual assessment:**

The visual assessment test performs for the color, odor and foam producing ability etc.

**2. pH determination:**

The pH of 10% shampoo solution in distilled water was determined at room temperature 25°C. The pH was measured by using digital pH meter.

**3. Viscosity:**

Viscosity of each shampoo formulation was evaluated using a Labman LMDV60 digital rotational viscometer equipped with spindle L2. Approximately 100 mL of the shampoo sample was transferred into a 250 mL clean beaker and maintained at  $26 \pm 1^\circ\text{C}$  using a temperature-controlled water bath. The spindle was immersed into the sample to the designated groove marking



and rotated at 120 rpm. Viscosity readings were recorded in mPa·s (centipoise) after stabilization (30–60 seconds).[14]

#### 4. Foaming stability test:

The foam stability was assessed using the cylinder shake method. For this, 50 mL of a 1% shampoo solution was poured into a 250 mL graduated cylinder and shaken vigorously ten times. The stability of the foam was then evaluated by measuring the foam volume after 1 minute and again after 4 minutes. The total foam volume was initially recorded at the 1-minute mark following shaking.[15]

#### 5. Dirt dispersion test:

To perform the test, two drops of shampoo were mixed with 10 mL of distilled water in a large test tube. One drop of India ink was then added to the mixture. The test tube was sealed and shaken ten times. The presence of ink within the foam was then evaluated and categorized as None, Light, Moderate, or Heavy based on its intensity.[16]

#### 6. Solid% test:

A Clean dry china dish was weighed and 4 grams of shampoo was added to it. The weight of dish

and shampoo was noted. The exact weight of shampoo was calculated. Place the china dish with herbal shampoo on hot plate until the liquid portion was evaporated. The weight of shampoo (solids) after drying was calculated.[17]

#### 7. Washability test:

The washability test of a polyherbal shampoo on the hand involves applying a small amount (about 1 mL) of the shampoo directly onto the palm or back of the hand. The shampoo is gently rubbed with a little water to produce lather, simulating actual use. After lathering for about 1–2 minutes, the hand is rinsed thoroughly under running tap water without vigorous scrubbing. The ease with which the shampoo is removed, absence of slipperiness or stickiness, and the feel of the skin after rinsing (smooth, non-greasy, and residue-free) are noted. A shampoo with good washability will rinse off completely, leaving the skin clean and free from any film or oily residue.[18]

## RESULTS:

**Table No.4- Result of Results of Phytochemical Screening of Herbal Ingredients**

| Tests         | Ginger | Amla | Shikekai | Hibiscus | Bhringraj | Senna |
|---------------|--------|------|----------|----------|-----------|-------|
| Alkaloids     | +      | +    | +        | -        | -         | +     |
| tannins       | -      | +    | -        | +        | +         | +     |
| Saponin       | +      | +    | +        | +        | +         | +     |
| Phenol        | -      | +    | -        | +        | +         | +     |
| Terpenoids    | +      | +    | +        | +        | +         | -     |
| Glycosides    | +      | -    | +        | +        | -         | +     |
| Carbohydrates | +      | +    | +        | -        | +         | +     |
| Flavonoids    | +      | +    | +        | +        | -         | -     |
| Quinone       | -      | -    | -        | -        | -         | -     |

Key: (+) Present, (-) Absent

**Table No.5- Physicochemical Characteristics of Polyherbal Shampoo Formulations**

| Batches | pH   | Viscosity (mPa.s) | Solid Content (%) | Washability |
|---------|------|-------------------|-------------------|-------------|
| F1      | 4.28 | 483.5             | 20.04             | Good        |
| F2      | 5.39 | 835               | 15.73             | Good        |
| F3      | 5.52 | 875               | 18.25             | Moderate    |
| F4      | 5.50 | 928.7             | 26.21             | Moderate    |
| F5      | 5.16 | 946               | 23.88             | Good        |
| F6      | 5.48 | 350.6             | 16.49             | Moderate    |



|           |      |       |       |      |
|-----------|------|-------|-------|------|
| <b>F7</b> | 4.81 | 383.8 | 19.07 | Good |
|-----------|------|-------|-------|------|

**Table No. 6- Organoleptic Properties of Herbal Shampoo Formulations**

| Batches   | Colour               | Odour                       | Appearance                         |
|-----------|----------------------|-----------------------------|------------------------------------|
| <b>F1</b> | Reddish brown        | Mild herbal                 | Translucent white slight turbidity |
| <b>F2</b> | Amber orange         | Mild citrus                 | Clear and bright                   |
| <b>F3</b> | Dark brown           | Slightly pungent            | Slightly opaque                    |
| <b>F4</b> | Light orange brown   | Mild fruity                 | Clear and glossy                   |
| <b>F5</b> | Golden honey         | Pleasant herbal             | translucent                        |
| <b>F6</b> | Pale brownish yellow | Neutral                     | Mild turbidity with bubbles        |
| <b>F7</b> | Deep reddish brown   | Mild turbidity with bubbles | Viscous, slightly hazy             |

**Table No.7- Dirt Dispersion**

| Formulation                   | F1       | F2   | F3       | F4   | F5   | F6       | F7       |
|-------------------------------|----------|------|----------|------|------|----------|----------|
| <b>Ink dispersed in water</b> | Partial  | Full | Moderate | Poor | Full | slightly | Moderate |
| <b>Ink retained in water</b>  | Yes      | No   | Slightly | Yes  | No   | Yes      | slightly |
| <b>Dirt dispersion</b>        | Moderate | Good | Good     | Poor | Good | poor     | Moderate |

**Table No. 8 - Foam Volume and Stability (Foaming Test)**

| Formulation                            | F1       | F2       | F3       | F4   | F5    | F6        | F7    |
|----------------------------------------|----------|----------|----------|------|-------|-----------|-------|
| <b>Initial Foam Height (ml)</b>        | 100 ml   | 80 ml    | 90 ml    | 95ml | 100ml | 90 ml     | 95 ml |
| <b>Foam Height After 1 Minute (ml)</b> | 60 ml    | 55 ml    | 60 ml    | 65ml | 90 ml | 95 ml     | 76 ml |
| <b>Foam Stability</b>                  | Moderate | Moderate | Moderate | Good | Good  | Excellent | Good  |

## DISCUSSION

The present study successfully formulated and evaluated seven polyherbal shampoo formulations using ginger, amla, shikakai, hibiscus, bhringraj, senna, and aloe vera. All formulations showed acceptable physicochemical properties, with pH values ranging from 4.28 to 5.52, indicating good scalp compatibility. Among the formulations, F5 demonstrated the best overall performance with an ideal pH (5.16), high viscosity (946 mPa·s), good solid content (23.88%), excellent foam stability, effective dirt dispersion, and good washability.

Phytochemical screening confirmed the presence of bioactive constituents such as saponins, flavonoids, alkaloids, glycosides, and phenolic compounds, which may contribute to the cleansing and conditioning effects of the shampoo. Based on the overall evaluation, F5 was identified as the optimized formulation and can be considered a promising herbal shampoo for effective hair cleansing and scalp care.



## CONCLUSION

The present study successfully formulated and evaluated a polyherbal shampoo using extracts of ginger, amla, shikakai, hibiscus, bhringraj, senna, and aloe vera. Seven formulations were prepared and assessed for physicochemical properties, organoleptic characteristics, foam stability, dirt dispersion, and washability. Among all the formulations, F5 exhibited the most satisfactory performance with a pH of 5.16, viscosity of 946.0 mPa·s, solid content of 23.88%, good foam stability, effective dirt dispersion, and good washability. Phytochemical screening confirmed the presence of important bioactive constituents such as saponins, flavonoids, alkaloids, glycosides, and phenolic compounds, which may contribute to the cleansing and conditioning properties of the formulation. Based on the overall evaluation, formulation F5 was identified as the optimized formulation and can be considered a promising herbal-based shampoo for effective hair cleansing and scalp care. Further studies on stability, antimicrobial activity, and consumer acceptability are recommended to establish its potential for large-scale application.

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