

Standardized of Biosaponins Formulation and Evaluation of Herbal Shampoo

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Abstract -Saponins are naturally occurring high-molecular-weight glycosides with distinct foaming characteristics. They are found in many plants, but get their name from the soapwort plant (*Saponaria*), of which the root was historically used as soap. The name saponin is derived from the Latin word *Sapo*, which means soap. Saponins are high-foaming agents and therefore excellent to use when natural surface active compounds are required. Saponins are excellent when used in soaps, shampoos, creams, lotions, shaving products, body washes, etc. Biosaponins were extracted from individual plant and formulation was prepared with aqueous juice of hibiscus petals as base. The proportion of individual saponin extract is selected upon its foaming index. Finally olive oil and citrodora oil was added as conditioner and antidandruff respectively, formulated shampoo were also subjected for same test performed for individual plants as mentioned in formulation, it possess all evaluatory parameter which should satisfy by ideal shampoo. In future research newer herbs should carr outnewew herbal base

Keywords: Bio saponins Herbal Plants, Shampoo, Foaming Index; Herbal shampoo; *Ficus Religiosa*; *Hibiscus*; *Reetha*; *Shikakai*; *Aloe vera*; natural and healthy

I. INTRODUCTION

Hair is one of the external barometers of internal body conditions. It is an important part of human body [1] Due to the growing desire for natural, chemical-free, and environmentally friendly personal care products, herbal shampoos have attracted a lot of attention recently. Conventional shampoos frequently include artificial perfumes, preservatives, and surfactants that can irritate the scalp, dry out the hair, and harm it over time. Herbal shampoos, on the other hand, use natural elements like plant extracts, essential oils, and herbal powders that provide therapeutic advantages including conditioning, cleaning, preventing dandruff, and encouraging hair development 2-3.

Herbal shampoo is always better than synthetic shampoo because it doesn't cause irritation to eye, drying of hair, loss of hair hence we have to use herbal shampoo. Shampoos are simply detergents. They are a different type of cleaning media than ordinary laundry or hand detergents because of their application to different types of hair. Shampoos are used to remove excess oil, dirt and skin debris from the hair known as sebum. A good shampoo will perform this function while leaving the hair manageable.

These products should possess rich foaming action and rinse out easily. Various forms of shampoos are available, from clear liquids to opaque pastes.

To select detergent for using in shampoos, the following factors should be considered-

1. Safety or non-toxicity
2. Ease of distribution and lathering power
3. Luster imparted to hair
4. Ease of combing wet hair
5. Speed of drying
6. Ease of setting dry hair

Herbal shampoos and conditioners provide an all-natural organic experience. They are gentle and made with organic and herbal extracts. Herbal shampoos and conditioners tend to be pH balanced and are great for all hair types. They are especially beneficial for restoring dry, damaged or chemically treated hair. Using herbal cleansers, nourish the scalp shafts helping prevent dandruff. Using natural or herbal shampoos and conditioners cleanse and moisturize hair without harsh chemicals that strip your hair of its natural oils. Your hair receives nourishment from the herbal botanicals and is left clean, shiny and healthy. 4,5,6,7.

The objective of the present research work is to formulate and evaluate an herbal shampoo with

various herbs for multipurpose use by eliminating all traditionally incorporated synthetic ingredients. This shampoo clears sebum, dirt, dandruff, promotes hair growth, strengthens, and darkens hair. Moreover, it also acts as a conditioning agent. This herbal shampoo powder performs all these actions without affecting or damaging hair [1].

The main constituent of hair is keratin. Keratin is a remarkable protein which is resistant to wear and tear. As years passed by, synthetic agents have taken a dominating role in the formulation industries, but now a day, due to the less expensive and reduced side effects of the natural products people are getting attracted towards natural products because of the harmful effect on the skin, hair and eyes caused by synthetic products [8].

Market-available shampoo contains artificial ingredients that are bad for the skin. The common surfactant sodium lauryl sulphate damages hair follicles and irritates the scalp when used in shampoo. Preservatives like formaldehyde are also added to shampoo formulas, which increases the sensitivity of the skin. Because consumers are now aware of the negative effects that synthetic products can have on their skin, hair, and eyes, they choose herbal products over synthetic ones. The adverse effects of herbal products are minimal. There are many different types of shampoos, including medicated shampoos, liquid herbal shampoos, lotions, powders, clear liquids, and solid gels [24]

Herbal shampoo

Herbal formulations are considered as alternative to synthetic shampoo but formulating cosmetics using completely natural raw material is a difficult task. There are large numbers of medicinal plants which are reported to have beneficial effects on hair and are commonly used in formulation of shampoo. These plant products may be used in their powdered form, crude form, purified extracts or derivative form.

Herbal shampoos are prepared from natural ingredients and are meant for cleansing hair and scalp just like regular shampoo. These shampoos are free from side effects since no surfactants are involved it has good stability and are less harmful compared to synthetic shampoo. Synthetic shampoo contains surfactants and long-term use of these surfactants can

lead to serious effects like scalp irritation, loss of hair, drying of hair, greying of hair, split ends and skin irritation.

Due to these reasons public is getting attracted towards herbal cosmetics due to its insignificant side effects and inexpensive nature.

II. OBJECTIVES

1. Select one or two high-saponin plant sources (e.g., *Sapindus mukorossi* — soapnut, and *Quillaja saponaria* or *Acanthophyllum*).
2. Optimize extraction to maximize yield and preserve activity.
3. Standardize extracts by total saponin assay and HPLC fingerprinting.
4. Formulate 2–3 shampoo prototypes (clear, conditioning, mild) replacing part or all surfactant with biosaponin extract.
5. Evaluate physicochemical, performance, stability and safety parameters.
6. Provide scale-up and regulatory recommendations

Advantages, benefits & applications

• Functional benefits

Mild cleansing: biosaponins are often milder on skin/scalp than some synthetic anionic surfactants.

Good foaming: many saponins produce stable foam desirable to consumers.

Conditioning & shine: combined with polymers/proteins, shampoos can improve combability and smoothness.

Biodegradability: plant origin → better environmental profile.

Multi-functional: some saponin extracts show antimicrobial, anti-inflammatory or antioxidant properties (depends on plant source and extract).

• Market & application benefits

Positioning as 'natural' / 'sulfate-free' shampoos.

Good for mild formulations marketed for sensitive scalps, baby lines, or environment-conscious consumers.

Can be used in personal care formulations beyond shampoo: body wash, facial cleansers, foam cleansers, household cleaners.

- Limitations & how to mitigate

Variability: stabilize by strict raw-material specification and analytical standard.

Irritation potential (at high concentration): limit saponin active concentration; conduct patch tests; add co-surfactants for mildness.

Preservation challenges: natural formulations may need robust preservative systems; perform challenge tests.

Analytical & standardization details (protocols)

Vanillin-sulfuric acid assay — improved protocol (practical)

1. Prepare aescin standard solutions (e.g., 0–200 µg/mL).
2. Evaporate solvent from measured aliquots of extract; dissolve residue in methanol (1 mL).
3. Add 0.2 mL of 8% vanillin in ethanol, then add 2.0 mL of concentrated sulfuric acid, vortex; incubate at 60 °C for 10 min; cool in ice bath.
4. Read absorbance at 544 nm. Build standard curve and compute total saponin equivalents.

(Follow optimized steps from Le et al. and Le Bot et al. to avoid solvent interference)

Data handling & statistics

Run tests in triplicate ($n \geq 3$) for physicochemical parameters. Report mean $\pm$ SD.

Use ANOVA to compare multiple formulations (post-hoc Tukey) for foam height, detergency, viscosity. Significance level $p < 0.05$.

For stability data, perform regression analysis to estimate degradation rate (saponin content) and shelf life extrapolation if zero/first-order kinetics fit.

Antamony of hair

The hair is made up of 95% keratin a fibrous, helicoidal protein (shaped like a helix) that forms part of the skin and all its attachments (body hair, nails etc.). The hair structure consists of 3 different parts:

Medulla: It is the innermost layer of the hair shaft, made up of an amorphous, soft, oily substances.

Cuticle: Thin protective outer layer that contains nutrients beneficial for hair growth. It is highly keratinized with cells

shaped like scales that are layered one over the other, measuring about 60 micro-meters long and about 6 micro-meters wide.

Cortex: It is the main constituent of the hair, containing long keratin chains which gives elasticity, suppleness and

resistance to the hair. The cells of the cortex are joined together by an intercellular cement rich in lipids and proteins.

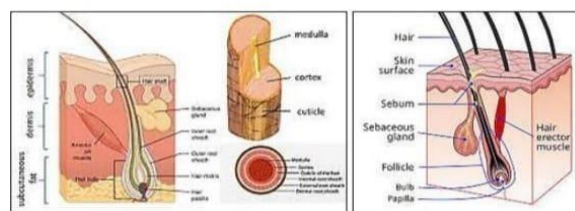


Figure.1. Anatomy of hair

- 1 Hair problem

Split ends:- When the oil from the scalp doesn't reach the ends of the hair, it tends to dry and split over time and another reason is heat worse the ends. Applying a dash of oil on the ends can avoid split ends.

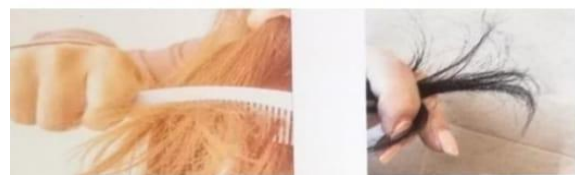


Figure.2. Splits ends of hair.

- 2 Hair loss

Hair loss occurs due to several factors such as stress, hormonal imbalance, and using the wrong products. Prevention is possible by using protein-rich food, switching to mild shampoos, massage with hot oil, staying hydrated, and exercise regularly.



Figure.3. Hair loss problem.

• 3 Dandruff

The scaly particles that cling to the root of the hair is dandruff which is caused by poor diet, dry scalp, infection, excess sebum, and sensitivity to certain products. It is a harmless, non-inflammatory skin condition that affects the scalp and can lead to hair loss.



Figure.4. Dandruff problem in hair.

• 4 Hair colour damage

Regular colouring sessions can damage the hair in the long run. The chemicals in the dye can also cause dryness, dandruff, breakage, and split ends. Medicated shampoos extra care, conditioning, and nourishing can treat the damaged hair.



Figure.5. Hair colour damage

• 5 Oily scalp

Many reasons like poor diet, genetics, or hormonal changes, the biggest culprit of an oily scalp is excessive washing. Ingredients like lactic acid help to regulate the production of oil.



Figure.6. Oily Scalp

III. MATERIAL AND METHODS

Extraction of biosaponines and determination of foaming index of plants Extraction of biosaponines All the plant material were produced from local market, authenticated, washed, cleaned and powdered and subjected for extraction. Individual plant materials were extracted with distilled water, as saponines are soluble in water. The aqueous extracts were evaporated under reduced pressure. It was used for further study 5 Determination of foaming index: (1% solution) The foaming index of individual plant was determined for 5, 15, 30 and 45 min. All the plant produced stable foam up to 45 min.

The observation was shown in Table No. 1.

Table No 1: Foaming index of 1% extract of individual plants.

Plant name	Ritha	Shikakai	Amla
Foaming index	250	166.66	142.85

Decoction Method –

- Determined the weight of each ingredient using the formula. Dissolution A mixture of one part water and soap nut, shikakai, henna, neem, amla, and alovera gel was made.
- Using muslin cloth, filter it. Gather the filtrate. In another portion of water, a decoction of soap nuts and shikakai was made.
- Using muslin cloth, filter it. Gather the filtrate.
- Constantly stirred the above filtrate mixtures together.
- Combined Acacia as a thickening ingredient to preserve the semisolid consistency of herbal shampoo.
- Lastly, perfume and preservatives were applied.

The different batches F1, F2, F3 were prepared by changing the concentration of soap nut powder to enhance the cleansing property.

Table No: 2: Constituents

CONSTITUENTS	F1 Batch	F2 Batch	F3 Batch
Shikakai powder	10g	10g	10g
Amla powder	10g	10g	10g
Neem powder	10g	10g	10g
Soap nut powder	10g	20g	30g
Acacia gum	3g	3g	3g
Aloe vera gel	1g	1g	1g
Methyl paraben	1ml	1ml	1ml

IV. COLLECTION OF MATERIALS

Different parts of plant were selected to study hair care property. All the required plant parts were purchased from the local Jadav Nursery of Udalpur. These are powdered for further use and passed through sieve No. 100. Details of the plant materials study is given in Table 1

Table 3: Details of the plant materials study

S. No.	Plant Name	Medicinal use	Figure
1	Neem leaves: <i>Azadirachta indica</i>	Antibacterial, anti-fungal, anti-septic	
2	Hibiscus <i>Rosa-sinensis</i>	Hair conditioner, Hair growth promoter	
3	Shikakai: <i>Acacia concinna</i>	Foaming agent, Anti-dandruff agent	
4	Liquorice: <i>Glycyrrhiza glabra</i>	Nourishes the scalp, Heal damage	
5	Amla: <i>Phyllanthus emblica</i>	For hair loss treatment, To prevent premature graying of hair.	
6	Aloe vera powder: <i>Aloe vera</i>	Moisturising agent, delivers something property to the skin	
7	Soap Nut: <i>Sapindus mukorosi</i>	Provides shining and silky hair	
8	Bringraj: <i>Eclipta prostata</i>	It is believed to maintain and rejuvenate hair (9) and also used in hair darkening and as hair growth promoter	

Classification of Shampoo [10-15]

Based on Appearance.

- Powder shampoo
 - Liquid shampoo or lotion shampoo
 - Gel shampoo or Solid shampoo
 - Cream shampoo
 - Oil shampoo
 - Miscellaneous anti dandruff shampoo or medicated shampoo
- Based on Use or Function.
- Conditioning shampoo

Antidandruff shampoo

- Therapeutic shampoo
 - Baby shampoo
 - Balancing shampoo
 - Clarifying shampoo
- Based on origin:
- Herbal shampoo
 - Egg shampoo

Problems Related To Hair:

- Dandruff
- Dry hair
- Split ends
- Oily hair
- Hair loss
- Heat damage
- Colour damage

Application of herbal shampoos

1. Creating a Safer, Natural Shampoo

Application: Replacing harsh chemicals with gentle plant-based ingredients.

Simple Explanation: Biosaponins are the natural, soap-like compounds found in plants (like Soapnuts or Shikakai). Your project aims to prove that a shampoo using these natural ingredients can clean your hair and create good foam without the strong, irritating chemicals (like SLS) found in many commercial shampoos. This is great for people with sensitive skin or those who prefer "clean label" and eco-friendly products.

2. Setting a Quality Standard for Herbs:

Application: Standardizing the biosaponin formulation.

Simple Explanation: Not all plant extracts are the same. A batch of Ritha (soapnut) grown this year might be stronger or weaker than a batch grown last year. Your project's core job is to figure out the exact amount and quality of the biosaponins needed to make a shampoo that works perfectly every single time. This

standardization allows companies to make a reliable product that gives the same results every time you buy it.

3. Developing a Multi-Benefit Shampoo:

Application: Using the herbal benefits of saponin-rich plants.

Simple Explanation: Biosaponins do more than just clean. The plants they come from often have extra benefits like:

Anti-dandruff properties (antifungal effects).

Conditioning properties that make hair soft and shiny without stripping natural oils.

Gentle cleansing that removes dirt and oil while helping hair stay moisturized.

Your project shows that your formulated shampoo delivers all these benefits naturally.

4. Supporting the Herbal Cosmetics Industry:

Application: Providing a tested and evaluated formula for commercial use.

Simple Explanation: You are creating a ready-to-use recipe that has been scientifically tested (evaluated). This proven formula can be given to a natural cosmetic company. They can then use your work to confidently launch a new, high-quality, herbal shampoo that they know will be effective and safe, helping them meet the growing demand for natural products.

Formulation of herbal shampoo

The plant extracts were mixed in different proportions to obtain a shampoo whose formula is shown in Table-4 Herbal extracts were added to 10% flaxseed and were mixed by shaking for 20 min. Lemon juice (1 ml) and Methyl paraben were also added with stirring. Finally, the pH of the solution was adjusted by adding sufficient quantity of 1% citric acid solution. Few drops of rosemary oil were also added to impart aroma to the prepared shampoo and the final volume was made to 100 ml with flaxseed solution.

Table:4. Formulation of herbal shampoo

S.No	Ingredients	Formulations (100 gms)	Uses
1	<i>Sapindus indica</i>	5 gm	Cleanser, removing head lice
2	Bhringraj	0.5 gm	Promotes hair growth
3	Amla extract	25 gm	Strengthening of hair
4	Shikakai	25 gm	To treat scalp disorder
5	Lemon juice	1 ml	Refreshes the hair
6	Methyl paraben	1 ml of 0.05% solution	preservative
7	Citric acid	Q.5	Balance the pH level
8	Essential oil (rosemary)	0.1 ml	Prevent dandruff
9	Fenugreek seeds	1 gm	Nutrient for hair growth
10	Tulasi	10 gm	Treat skin disorders
11	Flaxseed solution	Q.5 to 100 ml	Provides nourishment

Evaluation of Herbal Shampoo:

To evaluate the prepared formulations, quality control tests including organoleptic and physicochemical characteristics such as pH, solid contents, and viscosity were performed. As well to ensure the quality of the products, specific tests for shampoo formulations including surface tension, foam volume, foam stability, detergency, eye irritation, skin sensitization tests, and preliminary stability study were also carried out. The results were compared with frequently used marketed herbal shampoo considered as reference [14]

Physical appearance/visual inspection:

All samples were observed for their physical appearance/visual inspection. The prepared Formulations were evaluated in terms of their clarity, foam-producing ability, and fluidity. [15]

1) Determination of pH:

The pH of the shampoo solution (10% w/v) in distilled water was determined at room Temperature. [16]

2) Testing of wetting

Wetting time was calculate paper by noting the time required by the canvas paper to sink completely [15].

3) A canvas:

paper weighing 0.44 g was cut into a disc of diameter measuring 1 inch. Over the shampoo (1% v/v) surface, the canvas paper disc was kept and the time taken for the paper to sink was measured using the stopwatch.

4) Determination of solid content percentage:

The percentage of solid substance was determined by weighing about 4 g of shampoo in a dry, clean, and evaporating dish. To confirm the result, the procedure was repeated. The liquid portion of the shampoo was evaporated in a dish by placing it on a hot plate. The percentage and the weight of the solid contents present in the shampoo were calculated after drying completely [17].

5) Detergency and cleaning action:

A 5gm sample of solid human hair is placed at 35°C in 200cc of water containing 1gm of shampoo. The flask is shaken 50 times a minute for 4 minutes. Then washed once again with sufficient amount of water, then after the filter the hair was dried and weighed.

The amount of soil removed under this condition is calculated.[18]

6) Surface tension measurement:

The prepared shampoo in distilled water (10% w/v) was evaluated for surface tension using a stalagmometer at room temperature [19].

7) Conditioning action:

Conditioning action the degree of conditioning given to hair is ultimately judged by the shampoo the user who is evaluated based on experience.[20]

8) Foam stability:

200 ml of surfactant solution is dropped into a glass column containing 50 ml of the same solution. the height of foam generated is measured immediately and again after a specified time interval and is considered proportional to the volume[21]

9) Viscosity:

The viscosity of liquid shampoo is determined using "Ostwald Viscometer" Product viscosity plays an important role in defining and controlling many attributes such as shelf life stability and product aesthetics such as clarity ease of flow on removal from packing and spreading on application to hair and product consistency in the package. The flow characteristics of nonNewtonian materials are usually not measured with a single data point, because their viscosity is dependent on the shear rate. The best approach is to take multipoint measurements approximate to those of the process being modeled. Indicates that shampoos are low- viscosity products, whose viscosity remains almost unchanged over the range of r.p.m used.

Shampoo shows pseudo plastic behavior the same as the commercial one (reference), which is a desirable attribute in a shampoo formulation. At a low r.p.m., these shampoos show high viscosity. On increasing the shear, the viscosity is. [22]

10) Dirt dispersion

Two drops of shampoo were added to a large test tube containing 10 ml of distilled water. 1 drop of Indian ink was added; the test tube was stopped and shaken ten times. The amount of ink in the foam was estimated as None, Light, Moderate, or Heavy. Ossify

drops, which would allow ease of spreading on the hair.[23]

V. CONCLUSION AND SUMMARY

All the plant material shown good detergent property. This was revealed by the different evaluatory test. As foaming index 1% Aqueous extract of individual plant material found to be good, and stable up to 45 min. the maximum foaming index was shown by Ritha i.e. 250 while minimum was 142.5 by Amla. Both the formulated shampoo and individual plant (1%) extract shown spreading ability on natural hair within 2 min. Effect of combing on wet hair, effect of combing and setting of dry hairs and dirt dispersion ability was found to be good. All the plant material shown good lustering effect and leathering power. The lustering effect of formulated shampoo was found to be excellent. The foam stability and foam retention was comparable within the individual plant material and shampoo. While amla shows the least foaming index and foam stability and foam retention ability as more or less because of conditioner effect of amla.

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