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Development of a Polyherbal Shampoo Based on Traditional Medicinal Plants

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Abstract:

Artificial compounds used in commercially available synthetic shampoos have the potential to injure hair follicles, the epidermis, and the scalp, among other adverse effects. Customers now favor herbal products over synthetic ones since they have less side effects and are therefore safer. This is because consumers are more conscious of the negative effects that synthetic products can have on their skin, hair, and eyes.

Herbal shampoo is a type of cosmetic preparation that uses herbs to remove excess oil and dandruff from the hair and scalp. The current study's primary goal is to create and assess a polyherb shampoo using natural ingredients. Aloe vera (Aloe barbadensis), Shikakai fruit (Acacia concinna), Hibiscus flower (Hibirosea), Neem leaf (Azadirachta indica), and soap are among the botanicals used in the preparation. Hibiscus flower (Hibirosea), Neem leaf (Azadirachta indica), Shikakai fruit (Acacia concinna), Aloe vera (Aloe barbadensis), Soap n (soap berries), Amla (Emblca officinalis), Black sesame seeds (Sesamum indicum L.), Reetha (Sapind mukorossi), and Fenugreek powder (Trigonella foenum-graecum) are among the herbs used in the preparation. Physical appearance, pH, wetting time, viscosity, surface tension, foam stability, soil dispersion, percent solid content, antibacterial activity, skin irritation, and general stability were all assessed for the formulations. Only little variations in the prepared shampoo's assessment characteristics were found during a stability study that lasted one to two months.

Keywords: Herbal shampoo, natural ingredients, green chemistry, organic synthesis, sustainability,



Graphical Abstract: Polyherbal Shampoos (Onion, Aloe Vera, and Hibiscus) Using Natural Plant Extracts

Introduction:

Hair is an important component of the human body, derived from the ectoderm of the skin. It functions as a protective appendage and is considered an accessory structure of the integumentary system, along with sebaceous glands, sweat glands, and nails [1]. Beyond its biological role, hair also contributes significantly to an individual's appearance and psychological well-being. Hair care products are specifically designed formulations used to remove excess oil, dirt, and dandruff from the scalp and hair. In addition to cleansing, these products help nourish the hair, improve texture, and enhance overall appearance [2]. The development of modern hair cleansing products began with the invention of soap cakes and progressed significantly with the introduction of shampoos in the last century. The term "shampoo" originates from the Hindi word "chāmpo", which means to massage the head, particularly with oils. This practice dates back to 1762 in the Indian subcontinent, which is considered the birthplace of shampoo [3]. A shampoo is essentially a cosmetic preparation intended for cleansing the scalp and hair. Its primary function is to remove accumulated sebum, dirt, environmental pollutants, and residues of hair care products. Additionally, shampoos may provide conditioning, lubrication, and therapeutic benefits depending on their formulation [4]. Surfactants are the principal components of shampoo formulations, responsible for cleansing action by reducing surface tension and facilitating the removal of impurities. Other ingredients such as conditioners, preservatives, fragrances, and thickeners are added to enhance product performance and consumer acceptability [5]. However, commercially available shampoos often contain synthetic ingredients that may have adverse effects on the scalp and hair. Common surfactants like sodium lauryl sulfate can cause irritation, dryness, and potential damage to hair follicles upon prolonged use. Similarly, preservatives such as formaldehyde-releasing agents may increase the risk of skin sensitivity and allergic reactions [6]. With growing awareness of these harmful effects, there has been a significant shift toward herbal and natural products. Herbal shampoos, formulated using plant-based ingredients, are gaining popularity due to their safety, biocompatibility, and minimal side effects [7]. Various forms of shampoos are available, including medicated shampoos, liquid herbal formulations, powders, lotions, and gel-based systems. Proper nutrition also plays a crucial role in maintaining healthy hair. Adequate intake of essential vitamins and nutrients supports vital physiological functions. Since hair growth is a non-essential biological process, nutrient deficiencies can negatively impact hair health, leading to reduced growth rate, weakened strands, decreased sebum production, and even hair loss. Therefore, a balanced diet supplemented with essential vitamins is important for maintaining strong and healthy hair [8].

Methods:

All chemicals and reagents used were of analytical grade. Distilled water was used throughout the experiment.



Figure 2.1: Laboratory Synthesis of Polyherbal Shampoos (Onion, Aloe Vera, and Hibiscus) Using Natural Plant Extracts

1 Preparation of Onion Herbal Shampoo

Figure 2.2: Laboratory Synthesis of Polyherbal Onion Shampoos Using Natural Plant Extracts

Materials:

Fresh onion bulbs (*Allium cepa*), reetha powder (*Sapindus mukorossi*), shikakai powder (*Acacia concinna*), aloe vera gel (*Aloe barbadensis*), distilled water, muslin cloth, beaker, magnetic stirrer. All chemicals and reagents used were of analytical grade. Distilled water was used throughout the experiment.

Procedure:

Fresh onion bulbs were peeled, washed, and chopped into small pieces. The chopped onions were ground into a fine paste using a mixer and filtered through muslin cloth to obtain onion extract. Separately, reetha and shikakai powders were dispersed in distilled water and heated mildly to extract natural saponins. The mixture was cooled and filtered to remove insoluble particles. The obtained filtrate served as the cleansing base. The onion extract was gradually added to the cleansing base under continuous stirring. Aloe vera gel was incorporated as a conditioning agent to improve hair texture and moisture retention. The mixture was stirred using a magnetic stirrer until a homogeneous consistency was achieved. The final formulation was filtered and stored in a clean, airtight container. **Yield:** ~90–95% gel

2 Preparation of Aloe Vera Herbal Shampoo

Figure 2.3: Laboratory Synthesis of Polyherbal Aloe Vera Shampoos Using Natural Plant Extracts

Materials:

Fresh aloe vera leaves (*Aloe barbadensis*), reetha powder (*Sapindus mukorossi*), shikakai powder (*Acacia concinna*), neem extract (*Azadirachta indica*), distilled water, blender, muslin cloth, beaker

Procedure:

Fresh aloe vera leaves were washed thoroughly, and the outer rind was removed. The inner gel was scraped out and blended to obtain a uniform gel. The gel was filtered through muslin cloth to remove fibrous material. Reetha and shikakai powders were separately boiled in distilled water to extract saponins and then filtered to obtain a clear solution. This

solution acted as the primary cleansing agent. The aloe vera gel was added slowly to the saponin extract with continuous stirring to form a uniform mixture. Neem extract was incorporated to provide antimicrobial properties. The mixture was stirred until a smooth and consistent formulation was obtained. The prepared shampoo was filtered and stored in an airtight container for further evaluation. **Yield:** ~80–85% gel

3 Preparation of Hibiscus Herbal Shampoo



Figure 2.4: Laboratory Synthesis of Polyherbal Hibiscus Shampoos Using Natural Plant Extracts

Materials:

Hibiscus flower powder (*Hibiscus rosa-sinensis*), amla powder (*Emblca officinalis*), reetha powder (*Sapindus mukorossi*), fenugreek powder (*Trigonella foenum-graecum*), distilled water, grinder, sieve, beaker

Procedure:

Fresh hibiscus flowers were collected, washed, and dried under controlled conditions. The dried petals were ground into fine powder and sieved using a 120-mesh sieve. Reetha powder was boiled in distilled water to extract natural surfactants and filtered to obtain a clear solution. Hibiscus powder, amla powder, and fenugreek powder were added to the filtrate and mixed thoroughly. The mixture was stirred continuously to ensure uniform dispersion of all herbal ingredients. The formulation was allowed to stand for a specific period to enhance extraction of active constituents and then filtered to remove any remaining particulate matter. The final shampoo was collected and stored in a suitable container. **Yield:** ~85–90% gel

Literature Review:

Explanation of Table: Role of Vitamins and Herbs in Hair Care

The **Table 3.1** presents a comprehensive overview of essential vitamins and medicinal herbs commonly used in polyherbal shampoo formulations, along with their respective roles in maintaining hair health. Both internal (nutritional) and external (topical herbal) factors play a crucial role in promoting healthy hair growth, preventing hair damage, and maintaining scalp condition [9,10].

No.	Category	Name (Scientific Name)	Role / Description & Uses	Deficiency / Key Benefit
1	Vitamin	Vitamin A	Supports sebum production and maintains scalp hydration	Dry scalp, hair thinning
2	Vitamin	Vitamin B7 (Biotin)	Promotes keratin synthesis and hair growth	Hair loss, brittle hair
3	Vitamin	Vitamin B12	Improves oxygen supply to hair follicles	Hair thinning, premature greying
4	Vitamin	Vitamin C	Antioxidant; helps collagen synthesis and iron absorption	Weak hair, increased hair fall
5	Vitamin	Vitamin D	Stimulates hair follicle growth cycle	Hair loss (alopecia)
6	Vitamin	Vitamin E	Enhances blood circulation; reduces oxidative stress	Dry, damaged hair
7	Herb	Shikakai (<i>Acacia concinna</i>)	Natural foaming agent; promotes growth, conditions hair, reduces dandruff	Gentle cleansing and conditioning
8	Herb	Aloe vera (<i>Aloe barbadensis</i>)	Moisturizes scalp, soothes irritation, promotes hair growth and shine	Hydration and scalp soothing
9	Herb	Reetha (<i>Sapindus mukorossi</i>)	Natural cleanser; produces rich foam, removes dirt and oil	Effective cleansing
10	Herb	Neem (<i>Azadirachta indica</i>)	Antifungal, antibacterial; reduces dandruff and infections	Scalp protection
11	Herb	Hibiscus (<i>Hibiscus sabdariffa</i>)	Promotes hair growth, reduces greying, nourishes follicles	Hair strengthening
12	Herb	Amla (<i>Emblca officinalis</i>)	Strengthens hair, prevents breakage, antioxidant	Hair nourishment
13	Herb	Fenugreek (<i>Trigonella foenum-graecum</i>)	Rich in protein; prevents dandruff, strengthens roots	Root strengthening
14	Herb	Black Sesame (<i>Sesamum indicum</i>)	Nourishes scalp, strengthens hair, prevents premature greying	Hair nourishment

Table 3.1: Role of Vitamins and Herbs in Hair Care

Role of Vitamins in Hair Health

Vitamins are essential micronutrients required for various physiological functions, including hair growth and maintenance. Their deficiency can directly impact hair quality, leading to issues such as hair fall, dryness, and premature greying [10].

Vitamin A plays a vital role in maintaining scalp health by regulating sebum production, which keeps the scalp moisturized. However, its deficiency can lead to dry and brittle hair [11]. Vitamin B7 (Biotin) is one of the most important vitamins for hair growth as it supports keratin production, the primary structural protein of hair. A deficiency of biotin often results in hair thinning and increased hair fall [10].

Vitamin B12 is responsible for red blood cell formation, which ensures adequate oxygen supply to hair follicles. Insufficient levels may lead to hair thinning and early greying [12]. Vitamin C acts as a powerful antioxidant that helps in collagen synthesis and enhances iron absorption, both of which are necessary for strong and healthy hair. A lack of vitamin C can cause weak hair structure and increased breakage [11].

Vitamin D is associated with the stimulation of hair follicles and plays a role in the hair growth cycle. Its deficiency has been linked to conditions such as alopecia [13]. Vitamin E improves blood circulation in the scalp and protects hair from oxidative stress, thereby preventing dryness and damage [10].

Role of Herbs in Polyherbal Shampoo

Herbal ingredients are widely used in shampoo formulations due to their natural origin, safety, and therapeutic properties. These herbs not only cleanse the scalp but also provide nourishment and protection against common hair problems [11,14].

Shikakai (*Acacia concinna*) is a natural cleansing agent rich in saponins, which produce mild foam and effectively remove dirt without stripping natural oils. It also conditions the hair and helps in reducing dandruff [14]. Aloe vera (*Aloe barbadensis*) is known for its excellent moisturizing and soothing properties. It hydrates the scalp, reduces irritation, and promotes hair growth [15].

Reetha (*Sapindus mukorossi*), commonly known as soapnut, acts as a natural surfactant and produces rich foam, making it an effective cleansing agent [16]. Neem (*Azadirachta indica*) possesses strong antifungal and antibacterial properties, which help in controlling dandruff and preventing scalp infections [17].

Hibiscus (*Hibiscus sabdariffa*) is widely used for its ability to promote hair growth, reduce premature greying, and nourish hair follicles [18]. Amla (*Emblica officinalis*) is a rich source of vitamin C and antioxidants, which strengthen hair, prevent breakage, and improve overall hair texture [19].

Fenugreek (*Trigonella foenum-graecum*) seeds are rich in proteins and nicotinic acid, which help in strengthening hair roots, reducing dandruff, and preventing hair loss [20]. Black sesame (*Sesamum indicum*) seeds are known for their nourishing properties, providing essential nutrients that strengthen hair and prevent premature greying [21].

Overall Significance

The combined use of essential vitamins and herbal ingredients provides a synergistic effect in maintaining healthy hair. While vitamins support internal nourishment and metabolic processes, herbs provide external care by cleansing, conditioning, and protecting the scalp and hair. This holistic approach makes polyherbal shampoo formulations highly effective, safe, and suitable for regular use compared to synthetic products [9,10,15].

Result and Discussion:

The formulated polyherbal shampoo was evaluated for various physicochemical and performance parameters to determine its effectiveness, safety, and suitability for regular use.

1 Physical Appearance

The prepared shampoo exhibited a pleasant herbal odor, smooth texture, and acceptable consistency with a natural brownish color. The formulation was free from particulate matter and showed good homogeneity, indicating proper mixing of ingredients.

2 pH Determination

The pH of the formulation was found to be in the range of 5.5–6.5, which is close to the natural pH of the scalp. This slightly acidic nature helps in maintaining scalp health, preventing irritation, and preserving the integrity of hair proteins [1].

3 Viscosity

The viscosity of the shampoo was found to be moderate, ensuring easy application and spreadability on the hair. Proper viscosity is important for consumer acceptability and also influences the stability of the formulation [2].

4 Foam Stability and Foaming Ability

The shampoo demonstrated good foaming ability and foam stability due to the presence of natural saponins in ingredients such as shikakai and reetha. Although herbal shampoos typically produce less foam compared to synthetic shampoos, the foam generated was sufficient for effective cleansing [3].

5 Dirt Dispersion Test

The dirt dispersion test showed that the ink particles were effectively dispersed in the water rather than being retained in the foam, indicating good cleansing efficiency of the shampoo formulation [4].

6 Conditioning Performance

The formulation provided good conditioning effects, making hair soft, smooth, and manageable. This can be attributed to the presence of aloe vera, hibiscus, and amla, which are known for their moisturizing and nourishing properties [5].

7 Overall Performance Evaluation

The polyherbal shampoo showed satisfactory results in all evaluation parameters and was comparable to commercially available shampoos. Additionally, the absence of synthetic surfactants and harmful preservatives makes it safer for long-term use. Herbal ingredients also provide added therapeutic benefits such as antimicrobial activity, dandruff control, and hair strengthening [6].

Conclusion:

The present study successfully formulated and evaluated a polyherbal shampoo using traditional medicinal plants. The formulation demonstrated satisfactory physicochemical properties, including appropriate pH, viscosity, foam stability, and cleansing ability. The presence of natural ingredients such as shikakai, reetha, neem, aloe vera, and amla contributed to its effectiveness in maintaining scalp health and improving hair quality.

The results confirm that polyherbal shampoos are a safe, effective, and eco-friendly alternative to synthetic shampoos. They offer multiple benefits, including cleansing, conditioning, and protection against common hair problems, with minimal side effects.

Thus, the developed polyherbal shampoo has significant potential for commercial application and can be further optimized through stability studies and clinical evaluation.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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