



Design and Evaluation of a Polyherbal Hair Growth Serum: Physicochemical and Biological Assessment

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Abstract

The current research was designed to develop and test a herbal hair growth serum with some natural materials (rosemary, flax seed, fenugreek and aloe vera). The ingredients were chosen because they have the potential to stimulate hair growth, enhance the health of the scalp, and strengthen hair follicles. Five solutions (F1-F5) were made using different concentration of herbal extracts. The formulations were tested on the basis of physicochemical parameters such as pH, homogeneity, spreadability, stability, and safety. All formulations had the pH that was acceptable to apply to the scalp. Formulation F5 was more homogeneous, stable, spreadable, and consistent than all other formulations. There was no skin irritation or microbial contamination signs. Studies on hair growth showed a significant improvement in growth following long-term use which implied the cumulative effect. Therefore, the optimized formula (F5) might be deemed as a safe and efficient herbal substitute to boost hair growth and scalp health.

Keywords

Herbal hair serum, Rosemary, Flaxseed, Fenugreek, Aloe vera, Hair growth

1. Introduction

Hair is crucial in improving physical looks and is usually regarded as a factor of general well-being. It is a hard body that is formed by the hair follicles in the epidermal skin. It has many sebaceous glands that produce sebum that keeps the hair shaft moist and the scalp protected, the slightly acidic to neutral pH is also beneficial in helping to keep the hair follicles and scalp microflora healthy. Over the past years, hair related issues like loss of hair, dandruff, scalp irritation, dryness and premature greying has been on the rise. These disorders are related to various causes, such as pollution of the environment, stress, hormonal disorders, deficits in nutrition, and the overuse of cosmetic products containing chemicals. Even though the traditional hair care products might have immediate cosmetic advantages, the effects of their long-term use can be detrimental to the health of the scalp because of the use of synthetic chemicals, artificial fragrances, and preservatives. This has raised a lot of concern and the interest in herbal and natural alternatives has increased. In both Ayurveda and Traditional Chinese Medicine, plant-derived ingredients have been commonly used in a variety of traditional systems of medicine to take care of the health of hair and scalp. These are natural agents that have antioxidant, antimicrobial and anti-inflammatory properties that lead to better scalp condition and growth of hair.

Hair serums are weight-less cosmetic compounds that are used to improve the appearance of hair and safeguard against environmental harm. They cover the hair shaft with a thin layer, making it less frizzy, making it shiny, and shielding against UV radiation, pollution, and heat styling. Natural oils, plant extracts, and vitamins are especially included in herbal hair serums to provide cosmetic and therapeutic value to the scalp and hair follicles. Natural oils like aloe vera, coconut oil, castor oil, fenugreek, neem, and rosemary oil have been demonstrated to have some beneficial effects in enhancing the strength of hair, increase of blood flow in the head, dandruff reduction, and breakage of hair. Although a number of commercial formulations are available, safer, effective and affordable herbal hair serums that have minimal side effects are still required. Thus, the current research project is devoted to the development and testing of herbal hair serum by means of the chosen natural products to stimulate hair growth and health of the entire scalp.

1.1. Structure and Function of Hair and Role of Herbal Serum

Hair plays significant mechanical and protective roles, such as cutting skin friction in such parts as the axillary and pubic parts and guarding against external stress. The hair shaft is the visible part of hair that comes out above the skin surface and consists mainly of Keratin which gives it strength and flexibility. It is composed of three layers: medulla (the inner-most, loosely organized cells), cortex (the major structural component, which gives strength and elasticity) and the cuticle (outer protective layer which has overlapping cells, which make it smooth and shiny). The hair follicle is a complex mini-organ which is a source of hair growth. The dermal papilla controls the hair growth cycle and affects the follicular activity and the matrix contains cells that replicate at a very high rate to form hair. The active growth region is the hair bulb and the inner and outer root sheaths nourish the growing hair shaft. The hair growth is cyclic and involves anagen (growth phase), catagen (transition phase) and telogen (resting phase). Any disturbance in this cycle may cause loss of hair and decrease in hair density. Herbal hair growth serums that have been developed using natural products like flaxseeds and rosemary promise an effective method of enhancing hair. Flaxseeds have nutrients that are vital in strengthening hair and nourishing the scalp, whereas rosemary is an antioxidant and antimicrobial agent which helps in keeping the scalp environment healthy and creating good blood circulation. Hair follicle is very crucial in balancing the growth of hair and its functionality is vital in ensuring that hair density and quality are maintained. Traditional medicine can also achieve some results, although it is usually linked to adverse effects, which makes an interest in plant-based approaches grow. Thus, herbal hair serums creation is a secure and efficient approach in order to stimulate hair growth, increase follicle activity and better overall condition of the scalp.

2. Materials and Methods

2.1 Materials: The dried leaves of rosemary, flaxseeds, fenugreek seeds and fresh aloe leaf were purchased in a local market. The excipients used were vitamin E, sodium benzoate, lavender oil and rose water. The chemicals and reagents used in the study were of analytical grade. Preparation of Herbal Extracts

2.2. Preparation of Herbal Extracts:

2.2.1 Rosemary Extract: The powdered and macerated dried leaves of rosemary (25 g) were done in 100 mL of distilled water over 24-48 h with frequent shaking. It was then filtered with muslin cloth and a low-temperature water bath was used to concentrate the filtrate to get a concentrated extract.

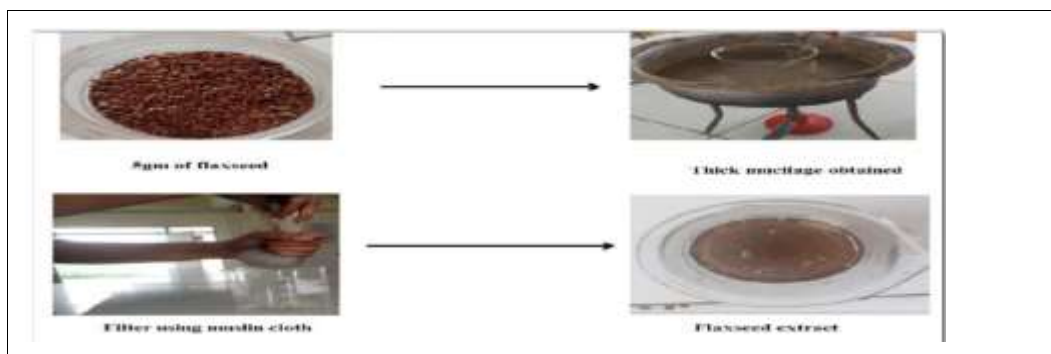
2.2.2 Flaxseed Extract: Flaxseeds (5 g) were put into 100 mL of distilled water and heated at 80-100°C with constant stirring of the water for 30 minutes. It was left to cool, and then filtered to a viscous mucilage.

2.2.3 Fenugreek Extract: Fenugreek seeds (2 g) were produced, rinsed, dried and heated using 15 mL of distilled water at 45- 80⁰ C in 45 min. The mixture was left to cool down after which it was filtered to get a clear aqueous extract.

2.2.4 Aloe Vera Extract: Washed aloe vera leaves were cut in half and the inner gel was extracted and mixed together to get a homogeneous solution. The gel was covered with distilled water and allowed to stand and then filtrated to extract the gel.

Figure 1: Extractions of herbal compounds





Formulation of Herbal Hair Serum: The preparation of the herbal hair serum was done under controlled conditions. The first step was to combine flax seed extract and rosemary extract with a clean, dry beaker. Vitamin E (1 mL) was dispersed slowly with continuous stirring with magnetic stirrer over 5-10 min. Then aloe vera extract and fenugreek extract were added and blended until a homogenous formulation was achieved. Preservative was added as sodium benzoate and then 2-3 drops of lavender oil and a small amount of rose water were added to aid in scalp-soothing. Sonication of the formulation at 45 °C to 15 min was then done to make the formulation smooth and stable. The final product was then moved into a clean, airtight sample labelled and stored at room temperature to be further assessed.

Table 1: Formulation of herbal hair growth serum

Ingredients	F ₁ (mL)	F ₂ (mL)	F ₃ (mL)	F ₄ (mL)	F ₅ (mL)	Role of Ingredients
Flaxseed extract	5	10	5	7.5	5	Gelling agent and hair growth promoter
Rosemary extract	10	5	7.5	5	5	Stimulates blood circulation in the scalp
Aloevera extract	3.5	3.5	3.5	3.5	3.5	Natural conditioner and moisturizer
Vitamin E	1	1	1	1	1	Antioxidant
Fenugreek extract	2	2	2	2	2	Potential DHT inhibitor
Sodium benzoate (0.2%)	1	1	1	1	1	Preservative
Lavender oil	1	1	1	1	1	Fragrance and scalp soothing agent
Rose water	1	1	1	1	1	Hydrating and soothing agent
Distilled water	QS	QS	QS	QS	QS	vehicle

Evaluation Parameters of Herbal Hair Serum

3.1 Physical Appearance

The prepared herbal hair serum formulations were visually evaluated for colour, odour, and texture to assess overall acceptability.

3.2 Homogeneity

A small quantity of the formulation was placed on a clean glass slide and examined for uniformity. The presence of lumps, coarse particles, or phase separation was noted. A smooth and uniform appearance indicated good homogeneity.

3.3 pH Determination

The pH of the formulation was measured using a calibrated digital pH meter by immersing the electrode into the sample. The reading was recorded after stabilization at room temperature.

3.4 Spreadability

Spreadability was determined by placing approximately 1 g of the formulation between two glass slides. A known weight (about 125 g) was placed on the upper slide to allow uniform spreading. The time taken for the slides to separate was noted, and spreadability was calculated using the formula:

$$S = \frac{M \times L}{T}$$

Where:

S=Spreadability

M=Weightapplied(g)

L=Lengthmoved(cm)

T = Time taken (sec)

3.5 Skin Irritation Test: One or two to three drops of the serum were put on a small piece of the skin and any redness, itching or irritation noted.

3.6 Stability Studies: The stability was determined by storing the formulations under cyclic conditions at 40 ± 2 °C and 4 ± 2 °C. Every cycle was 24 hours at low temperature and 24 hours of elevated temperature. Evaluations of physical appearance, pH, and phase separation changes were carried out after six cycles of the formulations.

3.7 Microbial Contamination: Microbial contamination was determined by placing the formulation on nutrient agar plates and placing them in 37 °C incubation of 48 hours. The plates were observed to find out whether there was any growth of microbes.

3.8 Hair Growth Activity: The activity of hair growth was assessed based on an experimental model. The formulation was used on the test area and an untreated area was used as control and observed throughout the study period.

3. Results and Discussion

Natural ingredients like rosemary, flaxseed, fenugreek and aloe vera have been successfully used in the formulation of the herbal hair serum. The formulations (F1-F5) were tested in a prepared form using physicochemical properties, safety, and performance and the results are discussed below.

4.1 Physical Appearance: All recipes were tested in terms of colour, smell and texture. The formulations had satisfactory physical properties such as smooth texture and pleasant smell, which depict good aesthetic properties.

Table no.2: Physical characteristics of prepared formulations

Parameter	F1	F2	F3	F4	F5
Colour	Pale yellow	Pale yellow	Pale yellow	Pale yellow	Pale yellow
Odour	Pleasant	Pleasant	Pleasant	Pleasant	Pleasant
Texture	Smooth	Smooth	Smooth	Smooth	Smooth

4.2 pH Determination: All formulations were found to have a pH of 5.8-6.2, which is considered normal in the application to the scalp (4.5-6.5). This implies that the formulations are scalp compatible and will not irritate it.



Figure 2: pH Determination of optimized formulation

4.3 Homogeneity: Formulations F1 and F2 developed some phase separation, but F3, F4 and F5 were homogenous and showed no lumps or aggregates. This shows increased homogeneity and stability in formulations F3 to F5.



Figure 3: Homogeneity Test of prepared formulation

4.4 Spreadability: F1 and F3 were highly spreadable with less consistency whereas F2 and F4 were highly consistent with relatively low Spreadability whereas spreadability has been optimum, consistency and uniformity in F5, which implies that it is more applicable.

4.5 Skin Irritation Test: They were found to be safe to use topically and no sign of redness, itching, swelling, or inflammation was observed in any formulation throughout the time period.

4.6 Microbial Contamination: The study period showed the absence of microbial growth, colour change, odour or particulate matter which indicates that the formulations were good in microbial stability.

4.7 Stability Studies: There were no significant differences in the physical appearance, pH or phase separation between stability studies at 4°C and 40°C. The optimized formulation (F5) showed excellent stability at the experimented conditions.

4.8 Hair Growth Activity Test: During the first week of application, the optimized formulation (F5) did not show significant improvement in hair growth. Nonetheless, a significant improvement in hair growth was realized after one month of continuous application among the test group than the control group.



Figure 4: Hair growth activity test for optimised formulation

Table No: 3 Evaluation Results of Prepared Herbal Hair Serum

S.No	F.C	pH	Homogeneity	Spreadability	Irritancy	Microbial contamination
1	F1	5.9	Slight separation	Satisfactory	No	No
2	F2	5.8	Slight separation	Satisfactory	No	No
3	F3	6.1	Homogeneous	Satisfactory	No	No
4	F4	6.2	Homogeneous	Satisfactory	No	No
5	F5	6.1	Homogeneous	Good	No	No

5. Summary and Conclusion

The research was able to develop and test a herbal hair growth serum with natural ingredients. Any formulae were proved to be safe and stable. F5 had a higher performance regarding physicochemical properties and growth of hair among them. The findings reveal that the formulation developed is a safe, effective and cost-effective alternative to synthetic hair care products and can be developed further.

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Conflict of Interest

The authors declare no conflict of interest.

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