



Formulation and Evaluation of Herbal Hair Serum: -A Review

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Abstract: Hair loss, often progressing to conditions like alopecia, has become a significant concern for younger generations, causing considerable anxiety. The hair follicle, a crucial organ in mammals, is vital for appearance, gender distinction, temperature regulation, and even self-defense. Given its importance, finding effective solutions for hair loss is a high priority for many.

One promising approach to combating hair loss and promoting hair growth is hair root activation. This review explores the formulation of hair serums using natural ingredients known for their beneficial properties:

- Citrus sinensis: Valued for its antidandruff, antibacterial, and anti-inflammatory properties, it supports overall scalp health.
- Nigella sativa: Known to enhance hair's shine, strength, volume, and texture.
- Flaxseed: Rich in fatty acids and antioxidants, it helps cleanse the scalp by removing pollutants and dead cells.
- Coconut oil: A potent moisturizer that helps seal hair, preventing dryness, flaky scalp, and dandruff.

This Review article will detail the materials necessary for developing a hair serum formulation and the various evaluation tests required to assess its efficacy.

Keywords: Hair, Hair growth, Alopecia, Cosmetic, Herbs

INTRODUCTION

Hair is an intricate and remarkable structure, acting as a flexible keratin thread known for its exceptional strength and elasticity.¹ Its appearance is often enhanced through various hair care products. Hair growth follows a fascinating cycle of shaft formation, extension, and shedding, originating from follicles that cycle through anagen, catagen, and telogen phases.² Each strand comprises a root, shaft, and tip. As we age, hair can turn white, and the cosmetic industry offers products aimed at promoting growth and preventing hair loss.⁵

Cosmetic science is a genuinely multidisciplinary field, drawing on extensive knowledge from numerous scientific disciplines.⁶ It encompasses the entire process of developing, formulating, and producing cosmetics and personal care items. Within this realm, cosmeceuticals represent a unique and rapidly expanding area within dermatology and the healthy skin industry.⁷

Products referred to as "natural" or "herbal cosmetics" are formulated with a base of approved cosmetic ingredients along with one or more herbal ingredients specifically chosen for their cosmetic benefits.⁸ These herbal cosmetic products derive their efficacy from phytochemicals sourced from various botanicals.⁹ A recent study aimed to identify the risk factors associated with using synthetic products, particularly those containing local herbs, before and after a trial period. It also sought to assess user satisfaction with hair serum products incorporating local herbal ingredients.¹⁰

Advantages of Hair Serums¹¹⁻¹²

Hair serums offer several benefits for hair health and appearance:

- Enhanced Shine and Protection: Serums provide a natural shine and protect hair from environmental stressors or heat damage due to their rich moisturizing properties.

- Improved Health and Reduced Brittleness: By moisturizing and sealing in moisture, serums help hair become healthier and less brittle, contributing to a smoother feel and healthier look.
- Anti-Frizz Properties: The anti-frizz capabilities of hair serums further contribute to increased hair smoothness.

Disadvantages of Hair Serums^{11,13}

- Prolonged and excessive use of the product may lead to hair damage.
- Consistent application can result in product buildup, causing hair to appear heavy, flat, and lacking vitality.
- Furthermore, direct application to the scalp may trigger inflammation.

MATERIAL & METHOD:

Ginger (*Zingiber officinale*): A Root of Wellness

Ginger, scientifically known as *Zingiber officinale* (L.) Rosc., is a globally beloved spice revered for more than just its culinary uses. This remarkable root has long been a staple in traditional folk medicine, and modern research continues to uncover its impressive therapeutic potential.

What makes ginger so powerful? It's packed with a wealth of active compounds, including gingerol, shogaol, zingerone, and bisabolene.¹⁴ These constituents are the driving force behind ginger's wide array of health benefits.

Historically, ginger has been a go-to remedy for various ailments, from rheumatoid arthritis and neurodegenerative diseases to inflammation and asthma.¹⁵ More recently, studies have highlighted its significant anti-diabetic, anti-cancer, and anti-inflammatory properties, along with its potent antioxidant activity. It's also been shown to reduce numerous pro-inflammatory biomarkers, making it a valuable tool in combating inflammation throughout the body.^{16,17}

Furthermore, ginger's active components are not only effective but also safe and convenient. These characteristics are crucial, as they can significantly enhance patient compliance, particularly for those undergoing treatment for conditions like alopecia areata (AA), where consistent use is key.¹⁸

Flaxseeds (*Linum usitatissimum*): A Versatile Nutritional Powerhouse

Flaxseeds, or linseeds as they're also known, are rapidly gaining recognition as an essential functional food. This is largely due to their exceptional nutritional profile, boasting high concentrations of alpha-linolenic acid (ALA) – a vital omega-3 fatty acid – along with lignans and fiber.¹⁹

The potential health benefits of flaxseed, whether in the form of oil, fiber, or lignans, are extensive. They are being explored for their role in reducing the risk of conditions like cardiovascular disease, atherosclerosis, diabetes, and certain types of cancer. Additionally, flaxseeds show promise in mitigating symptoms associated with arthritis, osteoporosis, autoimmune disorders, and neurological conditions.

Beyond internal health, flaxseeds also offer remarkable benefits for external well-being. They are a rich source of antioxidants and fatty acids that can help cleanse the scalp, removing toxins and dead skin cells. Applying flaxseed gel directly to the scalp and hair can act as a natural moisturizer, promoting hair growth and strengthening existing strands.²⁰

Flaxseed extract is particularly beneficial for skin health, providing deep hydration and maintaining suppleness across all skin types – normal, dry, and oily. For hair, flaxseed oil is a savior for damaged locks, effectively moisturizing them, soothing sensitive scalps, and adding much-needed volume to limp, lifeless hair.²¹⁻²²

Orange (scientific name: *Citrus sinensis*)

peel is a rich source of various nutrients, including Vitamin C, carotenes, and proteins. These components are beneficial for hair health, as they can supply essential nutrients, aid in repairing damaged hair, and improve hair strength. Additionally, orange peel can stimulate blood circulation in the scalp, boost metabolism, nourish the scalp, and create a conducive environment for hair growth.

The medicinal properties attributed to *Citrus sinensis* are largely due to the abundance of secondary metabolites found within the plant. The antimicrobial efficacy of plants, including oranges, is often linked to the presence of compounds such as tannins, saponins, phenolic compounds, essential oils, and flavonoids.²²⁻

Black seed (*Nigella sativa* L.)

A member of the buttercup family, has been prized for centuries for its medicinal properties. In India, it's a cornerstone of traditional Unani and Ayurvedic medicine.²⁵

The Powerhouse of Bioactive Compounds

Nigella sativa is rich in potent bioactive compounds, including:

- Thymoquinone
- Thymohydroquinone
- Dithymoquinone
- Thymol
- Carvacrol
- Nigellimine
- Nigellisin
- Alpha-hederin

Pharmacological and Cosmetic Wonders²⁶

These compounds give black seed a wide array of health and beauty benefits. Its notable properties include:

- Antioxidant: Fights oxidative stress.
- Antimicrobial: Combats various microbes.
- Anti-inflammatory: Reduces inflammation.
- Astringent: Tightens and tones tissues.
- Stimulant: Boosts bodily functions.
- Diuretic: Promotes urine production.

Applications in Personal Care²⁷

The oil extracted from *Nigella sativa* seeds is a true natural marvel for personal care products. It's an excellent ingredient for oral hygiene products like mouthwash and toothpaste. Moreover, its ability to fight fungal and bacterial infections makes it ideal for:

- Anti-dandruff shampoos
- Anti-acne creams
- Hand washes
- Skin clarifying creams

Beyond these applications, *Nigella sativa* also shows significant promise as a natural hair growth promoter.

Trigonella foenum-graceum (Fenugreek)

Fenugreek seed extract is a nutritional supplement that also contains micronutrients like B-vitamins, antioxidants, and trace elements found in hair. *Trigonella foenum-graceum* L. (fenugreek) is a leguminous herb.²⁸ Fenugreek is indigenous to Southern Europe, Western Asia, and the Mediterranean. Saponins, including diosgenin, yamogenin, and gitogenin in derivatives, trigonelline alkaloids, flavonoids, galactomannan vitamins, and fiber among other active components, are found in fenugreekseeds.²⁹⁻³⁰ The seeds have a pleasant aroma and a tart taste. Fenugreek is recognized to promote healthy hair development, although the exact mechanism has not been identified. It is suggested that fenugreek increases the blood flow to hair follicles and steroid saponins, which interact physiologically with the formation of DHT (dihydrotestosterone). One possible cause of both male and female variant hair loss is the effect of DHT on genetically predisposed hair follicles. The increasing miniaturisation of the hair and eventual hair loss are caused by binding DHT to the hair follicle.³¹

Prunus dulcis (Almond Oil):³⁴

Therapeutic Applications for Hair and Skin

Prunus dulcis (almond) oil, a well-regarded botanical extract, offers a range of dermatological and trichological benefits attributed to its rich biochemical composition.

Benefits for Hair and Scalp Health:

- Hydration and Follicle Fortification: Almond oil is a highly emollient substance that deeply penetrates the scalp, providing intense hydration. This action, coupled with its nutrient profile, is believed to fortify hair follicles, contributing to improved hair density and luster.
- Antimicrobial and Exfoliating Properties: The oil exhibits mild antimicrobial characteristics that may assist in managing scalp conditions such as dandruff. Its emollient nature also aids in the gentle

exfoliation of dry, desquamated skin cells from the scalp, promoting a healthier microenvironment for hair growth.

- **Biotin Content and Hair Growth:** Almond oil is a natural source of biotin (Vitamin B7), a B-complex vitamin crucial for keratin infrastructure. Topical application, particularly through scalp massage, delivers biotin directly to the hair follicles, potentially stimulating hair growth and mitigating hair thinning, especially in individuals with compromised hair cycles.

Benefits for Skin Health and Photoprotection:

- **Photo-protective and Anti-aging Effects:** Emerging research suggests that topical application of almond oil may offer protective benefits against ultraviolet (UV) radiation-induced skin damage. Its antioxidant constituents are thought to mitigate cellular damage and reduce oxidative stress, thereby contributing to a reduction in the visible signs of photoaging.
- **Cellular and DNA Protection:** Studies indicate that almond oil can assist in cellular protection by reducing DNA damage induced by UV rays. It may also help prevent the deleterious chemical and structural alterations that UV radiation can inflict upon dermal components.

Tocopherol (Vitamin E)

- Tocopherol, commonly known as Vitamin E, is an essential nutrient that offers significant benefits for hair health. As a potent antioxidant, Vitamin E plays a crucial role in mitigating oxidative stress and neutralizing free radicals, which are known culprits in the deterioration of hair follicle cells.³⁵
- Incorporating Vitamin E-rich oils into hair care routines can contribute to restoring hair's natural luster. These oils work by forming a protective layer around the hair shaft, which helps to seal in moisture, thereby minimizing breakage and shielding the hair from environmental damage. Furthermore, by fostering a healthier environment for hair follicles, Vitamin E can support the growth of a robust and vibrant crown.

FORMULATION

Formulation I

To prepare the fresh sauces, we carefully measured and combined sweet orange peel, ginger root, flax seeds, black cumin seeds, and fenugreek seeds. These ingredients were added to 50 ml of water, and the mixture was brought to a boil and simmered for 15 minutes. After cooling, the liquid was filtered, and the resulting extract was enriched with coconut oil, almond oil, and vitamin E. The finished serum was then ready for storage in a nebulizer.³⁶

Formulation II

Medicinal plant hair serum is meticulously crafted following standard serum preparation guidelines. The heart of its composition lies in a precise blend of aqueous extracts. We begin by carefully weighing and combining the aqueous extracts of *Nigella sativa* seeds, *Zingiber officinale* roots, *Linum usitatissimum* seeds, and *Trigonella foenum-graecum* seeds in a glass vessel.

Into this botanical blend, we thoroughly incorporate *Citrus sinensis* peel extract. Concurrently, a measured amount of coconut oil is taken in a porcelain dish and expertly mixed with a portion of the for mentioned botanical extraction until a smooth, consistent paste is achieved.

To this rich paste, a trio of nourishing oils is introduced: approximately three drops each of coconut oil, almond oil, and the contents of a Vitamin E capsule, all meticulously blended. The porcelain mixture is then gradually integrated into the remaining aqueous extract with continuous stirring to ensure complete homogenization.³⁷

Finally, the serum's volume is brought up to 50 ml with distilled water. To maintain its efficacy and shelf life, rosemary extract is added as a natural preservative. The finished serum is then carefully decanted into an amber dropper bottle, safeguarding its potency from light degradation.

Formulation III

Combine coconut oil, almond oil, and vitamin E in a heat-safe bowl. Infuse with *Nigella sativa* seeds, *Zingiber officinale* root, Flax seeds, *Trigonella foenum-graecum*, and *Citrus sinensis* peel extract. Gently heat the mixture, then cool in a water bath. Strain, transfer to a spray bottle, and refrigerate for 24 hours before use.³⁸

Formulation IV

Ensure all glassware is clean and dry according to standard operating procedures (SOP).

Precisely measure and combine the extracts of *Nigella sativa* seeds, *Zingiber officinale* roots, Flax seeds, and *Trigonella foenum-graecum* seeds into a glass.

In a separate container, mix the required amount of Vitamin E with *Citrus sinensis* peel. Then, blend this mixture with coconut oil and almond oil.

Combine the oil and vitamin E mixture with the herbal extracts. Stir the solution thoroughly for a few minutes before gently heating it for a short duration.

Following heating, use a magnetic stirrer to ensure complete mixing.

Finally, transfer the prepared serum to a measuring cylinder and adjust the volume to 50 ml. Transfer the finished serum into a suitable container.³⁹

Table I: Formulation Table

Ingredients	Quantity (%)	Role
Linum usitatissimum	10	Emollient
Ginger	20	Antioxidant
Nigella Sativa	10	Natural DHT blocker
Feugreek	10	Emulsifying Agent
Orange Peel	08	Antidandruff
Coconut Peel	30	Detangles hair
Almond oil	10	Hair growth
Tocopherol	02	Healthy Scalp

EVALUATION OF HERBAL HAIR SERUM

Physical Appearance:

Visually inspection of the herbal hair serum to assess its physical characteristics, including its color and texture. This initial check helps us determine if the product meets our expected standards for appearance.⁴⁰

Homogeneity Test

To evaluate the serum's homogeneity, a small amount was applied to a clean, dry glass slide and then covered with a coverslip. We then carefully examined the sample for any signs of coarse particles, lumps, flocculates, or aggregates. A truly homogeneous serum should appear smooth and uniform, free from any visible inconsistencies.⁴¹

pH Test

The pH of the herbal hair serum was determined using a calibrated pH meter. Calibration was performed with buffer solutions at pH 4 and pH 7. The electrode was immersed in the hair serum and allowed to stabilize for several minutes until a consistent pH reading was obtained. This ensures the serum's pH is within the desired range for product stability and scalp compatibility.⁴²

Viscosity:

Measured using a Brookfield viscometer (RVDV-II+PRO) with spindle number 6. A 50 mL sample was tested at 10, 20, 50, and 100 rpm.⁴³

Spreadability:

Determined by pressing 1 gram of serum between two 20x20cm vertical plates, with a 125 gm weight applied. The spread periphery was measured after 1 minute, and spreadability (S) was calculated using the formula: $S = (M \times L) / T$, where M is weight, L is length moved, and T is time to separate slides.

Stability (Freeze-Thaw): The product underwent three cycles of refrigeration (4°C) followed by return to room temperature (28°C).

- **Drug-Excipient Interactions:** Assessed using Fourier Transform Infrared Spectroscopy (FTIR) with potassium bromide pellets.

Safety and Efficacy Testing (Animal Models)

- **Sterility Test:** Sterile discs loaded with 1% hair serum were incubated on nutrient agar for 24 hours at 32°C

Hair Growth Activity: Conducted on a single rabbit in Three Location, 4 in. x 4 cm areas on either the right or left foot were depilated. After 24 hours (and antiseptic application), Treatment 1 (standard control, no intervention) and Treatment 2 (positive control, hair serum with test substance) were applied (0.1 mL twice daily for 3 weeks). Day 0 marked the start of hair serum application.⁴⁴

- **Eye Sensitivity (Draize Test):** Three rabbits were used. One drop of hair serum in physiological naphthalene was applied to the left eye (right eye as control). Observations were made at 30, 60, 120, 240 minutes, and on days 1, 2, 3, and 4, with scores for conjunctiva, iris, and cornea.
- **Skin Sensitivity (Draize Skin Test):** Shaved areas on the right and left backs of rabbits were divided into six 4 x 4 cm rectangular regions. Applications included: No. 1 (normal control), No. 2 (placebo), No. 3 (2.5% hair serum), No. 4 (5% hair serum), and No. 5 (10% hair serum). Erythema, edema, and peeling were observed at 24- and 48-hours post-application.
- **Hair Length Observations:** Ten random hair strands from each treated area were measured on days 7, 14, and 21 using Mitutoyo digimatic wireless calipers. Average lengths were analyzed for statistical significance against controls.
- **Qualitative Hair Growth Assessment:** Visual inspection assessed two criteria on three groups of rabbits (Normal Control, Negative Control, Positive Control herbal hair serum): initial hair growth time (skin darkening) and time for complete hair regeneration in the shaved area.⁴³⁻⁴⁵

CONCLUSION:

Embrace a holistic approach to hair care with our new serum. Every ingredient has been carefully chosen for its inherent benefits, and all parameters are precisely balanced to promote natural hair growth and maintain scalp vitality. By supplying your sebaceous glands with essential nutrients, this serum ensures they continue to function as nature intended. This commitment to natural solutions mirrors the significant advancements in personal hygiene and healthcare, where herbal cosmeceuticals are increasingly recognized for their efficacy and gentle approach. We're proud to report that our formulations were thoroughly tested, causing no redness or itching, and exhibited potent antibacterial properties.

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