

# Development of a Phyto-Cosmetic Hair Serum and Its Evaluation

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**Abstract**—Hair plays a vital role in defining an individual's identity, confidence, and overall appearance. In recent years, the demand for herbal-based cosmetic formulations has increased significantly due to their safety, efficacy, and minimal side effects compared to synthetic products. The present study focuses on the formulation and evaluation of a herbal hair serum using natural ingredients such as Aloe vera, ginger, vitamin E, flaxseed, rosemary, neem, and almond oil. These ingredients are widely known for their nourishing, conditioning, and therapeutic properties that support hair health and growth.

The formulated serum aims to improve hair texture, smoothness, and shine, while effectively managing frizz, tangles, and damage. Each ingredient contributes specific benefits—Aloe vera acts as a natural conditioner, ginger and rosemary stimulate hair follicles to promote growth, neem provides antimicrobial protection, vitamin E and almond oil offer nourishment and protection against oxidative stress, and flaxseed enhances smoothness and strength. The formulation was evaluated for key parameters such as pH, viscosity, appearance, and stability, which are critical to ensuring product safety and effectiveness.[1] [2]

The findings suggest that the prepared herbal serum is stable, pH-balanced, and non-irritating, making it suitable for regular cosmetic use. Furthermore, its natural composition minimizes the risk of adverse reactions while promoting healthy hair growth and preventing premature greying. The study concludes that the herbal hair serum represents a promising, cost-effective, and eco-friendly alternative to synthetic hair care products [3].

**Index Terms**—Hair, Hair serum, Hair follicles, Alopecia, herbal formulations, PH balance.

## I. INTRODUCTION

Cosmetics are the substance that are applied to the body in order to enhance its appearance or order. Cosmetics include articles intended to be rubbed,

poured, sprinkled or otherwise applied to the human body or any part for cleansing, beautifying, promoting attractiveness or altering the appearance. Serum is the one of the cosmetic product with very high concentrations of active ingredients in their formula for providing intensive nutrition to the deeper skin layer and non-greasy finish product which is suitable for skin. Hair serum is the styling product that coats the surface of hair; serum is intended to be used on wet or dry hair, serum can act as both a pre-styling treatment and finishing product stylist-free days.[4] [5]

**HAIR:** - all mammals have hairs, its main purpose is to regulate body temperature. Hair is an important part of the human body. Hairs can vary in shape, length, diameter, texture, and colour. It also wants to decrease friction to guard against sunlight for the scalp.

**LAYERS OF HAIRS:**

- **MEDULLA** – Deepest layer of hair shaft seen in large and thick hair, honey comb like keratin structure.
- **CORTEX** – The middle layer responsible for hair strength, elasticity and pigment. It contains melanin which determines
- **CUTICALS** – Outer layer of hair shaft thin and colourless protect the cortex made up of hair shaft and follicle. [6][7]

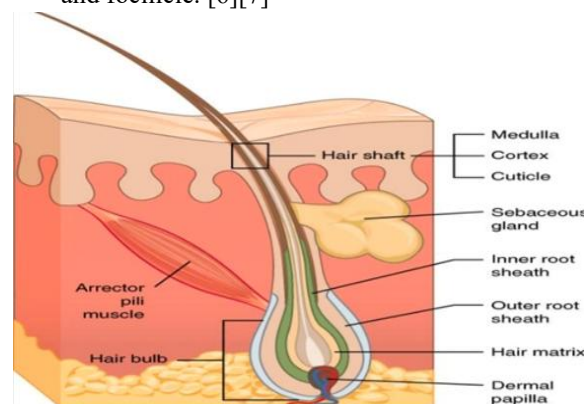


Fig. Structure of Hair

## II. STRUCTURE AND COMPOSITION OF HUMAN HAIR

### 1. Hair shafts:

The visible part of the hairs that produce above the skin.

### 2. Hair roots:

The part of the hair embedded in the skin, surrounded by the hair follicle.

### 3. Hair follicles

A tube-like pocket of epidermis that enclose a small section of the dermis at its base, where new hair cells are constantly being made.

4. Keratin: Hair is mainly made of keratin a strong fibrous protein that also forms skin.

5. Sebaceous Glands: Follicles are also connected to sebaceous glands, which produce oil

6. Arrector Pili Muscles: Each hair follicle is attached to a tiny muscle (arrector pili) that can make the hair stand up (like goosebumps).[8]

## HAIR GROWTH CYCLE

Hair grows in a cyclic process involving five distinct phases:

### 1) Anagen Phase:

First stage of hair growth cycle & approximately 1,000 days. It begins in papilla & can last from. Two – six years. Eighty to ninety percent of all human in anagen stage. Period of growth When cell around the Follicle rapidly dividing of depositing materials within the hair. The hair Being able to grow 1 meter. The hair growth determined by genetics. The cells in papilla divide To produce new hair Fibers & Follicle buries itself into dermal layer of Skin to nourish the Strand.

### 2) Catagen phase:

At the end of anagen phase, hair enters catagen phase. Short transitional phase, lasts approximately 10 days. First sign of Catagen is cessation of melanin production in hair bulb & Apoptosis of follicular melanocytes. Also known as transitional phase follicle renew itself Two Weeks hair follicle shrinks. Due to disintegration & papilla detaches & rest Cutting hair strand Off from its nourishing blood Supply. Hair not grows during this phase length of terminal fibre Increases follicle pushes them upward.

### 3] Telogen phase:

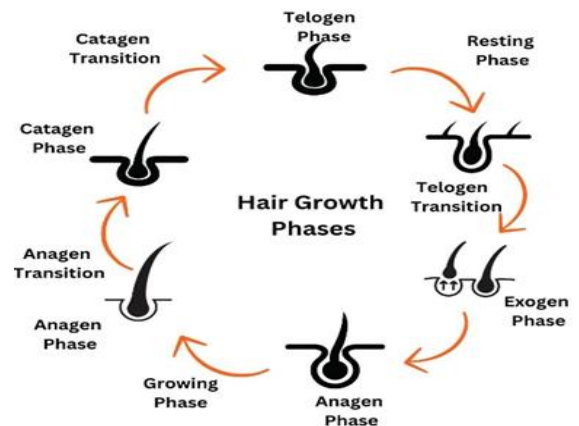
The final stage of hair growth. During phase hair follicle is dormant/ resting & hair easily lost 10-18% hair in telogen phase. Follicle then remain inactive for

3 months. The epidermal Cells Lining follicle Channel Continue to grow & accumulate around base of hair. The follicle will Begin to grow phase within two weeks the new hair shaft will begin to emerge once the telogen Phase is complete. The process results in normal hair loss known as shedding.

### 4] Exogen phase:

For long hair shedding function has been assumed to be part of telogen phase, but now it has been shedding actually occurs as distinct phase termed as exogen phase. The shedding of hair Fiber highly controlled active process. The process different from quiescence normally found during hair follicle cycling. The process of has two steps: After telogen the follicle base cells Receive signal initiate exogen. Turn on effectors of shedding.

5] Kenogen phase: The empty hair follicle noticed after shedding of hair fiber. Kenogen means hair follicle remains empty after telogen & before new anagen hair reappears. Hair loss, hair thinning & Problems with hair growth occur when growth cycle is disrupted. [8]



## Types of Hair Serum:

### ❖ Based on Therapeutic Action:

#### 1. Frizz-Control Hair Serum:

Purpose: To tame dry, rough, and frizzy hair.

How It Works: Coats the hair strands to reduce friction and lock in moisture, giving Smooth and manageable hair.

Best For: People with curly, dry, or unmanageable hair; especially in humid climates.

#### 2. Hair Growth Stimulating Serum:

Purpose: To stimulate hair follicles and promote new hair growth.

How It Works: Improves blood circulation in the scalp, nourishes follicles, and

Activates the anagen (growth) phase of hair.

Best For: People with hair thinning, slow hair growth, or early-stage baldness.

### 3. Anti-Hair Fall Serum:

Purpose: To reduce hair breakage and prevent hair loss.

How It Works: Strengthens the hair shaft, prevents hair damage due to styling or

Pollution, and reinforces root health.

Best For: People facing seasonal hair fall, stress-related shedding, or post-partum hair Loss.

### 4. Split-End Repair Serum:

Purpose: To seal and repair damaged hair ends.

How It Works: Binds broken cuticles temporarily, smooths out rough ends, and

Prevents further splitting.

Best For: Chemically-treated or long hair prone to split ends.

### 5. Heat Protection Serum:

Purpose: To protect hair from damage caused by heat-styling tools (straighteners, Curlers, blow dryers).

How It Works: Forms a protective barrier on the hair shaft to minimize direct heat

Damage and moisture loss.

Best For: Regular users of heat styling tools.

### 6. Scalp Nourishing Serum (Leave-in Treatment):

Purpose: To treat scalp issues like dandruff, itching, or bacterial infections.

How It Works: Penetrates the scalp, unclogs follicles, reduces inflammation, and kills Microbes.

Best For: Dandruff-prone or oily scalp; people with seborrheic dermatitis or itchiness.

### 7. Colour Protection Serum:

Purpose: To maintain colour vibrancy in dyed or chemically-treated hair.

How It Works: Shields hair from UV damage, reduces oxidation of hair colour, and

Nourishes chemically stressed strands.

Best For: People who frequently colour or bleach their hair.

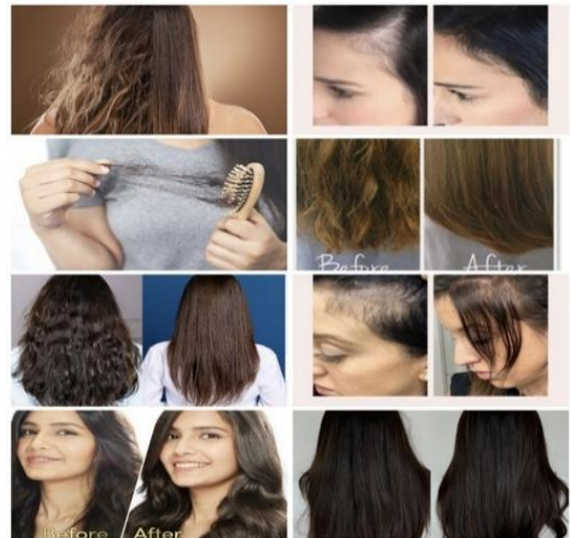
### 8. Overnight Repair Serum:

Purpose: Deep nourishment and repair while sleeping.

How It Works: Penetrates deeper layers of hair overnight, repairing damage and

Hydrating intensely.

Best For: Damaged, dry, or lifeless hair needing deep conditioning.



❖ □ Based on Formulation Base:

#### 1. Water-Based Hair Serum:

Description: These serums have a water or hydrosol base and are usually light-weight,

Non-greasy, and fast-absorbing.

Texture: Thin, liquid, and often transparent.

Best For: Oily scalp, fine or thin hair, people who don't want a sticky feel.

Benefits:

1. Hydrates hair without heaviness

2. Can be used as leave-in

3. Great for daily use

4. Doesn't weigh down the hair

#### 2. Oil-Based Hair Serum:

Description: These serums are oil-rich and provide deep nourishment and shine.

They're slightly heavier and stay longer on hair strands.

Texture: Thick or semi-thick, glossy, and smooth.

Best For: Dry, frizzy, damaged, or chemically-treated hair.

Benefits: 1. Deeply nourishes and strengthens hair

2. Adds shine and smoothness

3. Prevents breakage and split ends

#### 3. Emulsion-Based (Water + Oil Mix) Hair Serum:

Description: These are a blend of water and oil phases, stabilized by emulsifiers. They give Balanced hydration and nourishment.

Texture: Milky or creamy texture, medium weight.



Best For: Normal to combination hair, scalp and strand care.

Benefits:

1. Hydration + oil nourishment
2. Lightweight conditioning
3. Easy absorption without greasiness [9]

### III. MATERIALS

Alovera (Aloe barbadensis miller) When it comes to hair care and skin care, aloe vera gel is a boon. A healthy and balanced pH is essential for Healthy hair growth. Aloe vera gel comes into play here. It also acts as a natural conditioner and prevents hair Loss. Simply apply it to your scalp and hair, and let the gel work its magic on your scalp and hair for complete Nourishment [10]



Hibiscus (Hibiscus rosa-sinensis)



It also known as hibiscus rosa sinensis and is edible in appearance. Chinese hibiscus teas actually very good for hair and is also effective at stimulating hair follicles for better growth. It even increases the follicular size.[11]

Flax (Linum usitatissimum)



Linum usitatissimum seed oil is an amber-coloured oil extracted from the seeds of the linseed/flax plant (linum Usitatissimum). In some of our hair care products, we use this ingredient as an emollient, resulting in smooth and healthy hair. Linum usitatissimum seed oil, also known as flaxseed oil, is a seed oil that is extracted from linum usitatissimum seed oil. This well-known super ingredient contains essential fatty acids as well as unsaturated fatty acids, which will help soften your hair and give it a beautiful shine. Flaxseed oil's omega-3 fatty acids can also help to strengthen your hair.[12]

Nigella saliva [ black cumin]



These black cumin seed are scientifically called nigella sativa and are known to contain nutrients that stimulate hair follicles. Stress, pollution, and age can contribute to hair loss, so its good idea to be proactive if you want to protect hair loss. Black seeds oil mixed with coconut oil enhanced hair growth, according to one study, and a second white paper found that hair fallout was reduced by 76% when subject used a hair oil containing nigella sativa.[13]

Fenugreek [*Trigonella Foeniculum*]

Fenugreek seed are a rich source of iron and protein, two essential nutrients for hair growth. They also contain a unique group of plant compounds, including flavonoid and saponins. Due to their anti-fungal and anti-inflammatory properties, these compounds are thought to stimulate hair growth. Fenugreek can slow down DHT ability to attach to your hair follicles. A human oil supplemented with fenugreek seed extract has also shown that it can improve hair thickness and growth. It helps to repair hair damages.[14]

## Almond oil

The nourishing oil can soften and strengthen your hair. It's rich in vitamin B-7, or biotin, so almond oil helps to keep hair and nails healthy and strong. It can also help protect your hair from sun damage, with a natural SPF. [15]



## Orange peels

Orange peels (*Citrus sinensis*) are an excellent natural ingredient commonly used in herbal hair care formulations due to their rich content of vitamins, antioxidants, and essential oils. They offer multiple benefits for hair and scalp health, particularly in improving shine, reducing dandruff, and stimulating hair growth.[16]



## FORMULATION TABLE:

Sr. No	Quantity given	Property
Alovera gel	2gm	Cleansing agent , smoothening
Orange peel	4.5gm	Antioxidant
Black cumin seeds	3gm	Hair growth stimulant
Flaxseed	5gm	Gelling agent
Almond oil	1ml	Emollient ,Shinning
Vitamin E	1ml	Preservatives
Hibiscus	2gm	Hydration of hairs

## Procedure for Formulation of herbal hair serum

Solution	Step	Procedure
Solution 1	1	In a beaker, add 5 gm of flaxseed in 50 ml distilled water and apply heat.
	2	Continue heating until clear, viscous gel is formed.
	3	Filter the gel using muslin cloth.
Solution 2	1	In a beaker, add 1 gm of dried cumin seeds in 20 ml distilled water and boil for 5 minutes.

	2	Filter the solution and add about 5 gm of orange peel powder. Keep the mixture at room temperature.
	3	Add distilled water to the solution to make it free from lumps.
Solution 3	1	In a beaker, add 2 gm hibiscus powder in 40 ml water.
	2	Heat the solution until requisite colour is obtained.
	3	Filter the solution and store.
Solution 4	1	In a beaker, mix Solution 1 and Solution 2 with continuous stirring for 20 minutes.
	2	Add hibiscus solution dropwise into the mixture until suitable colour is obtained, stir continuously with glass rod.
	3	Add 1 ml of almond oil to the solution.
Solution 5	1	Filter the solution. Add Aloe Vera gel into the beaker.
	2	Add 0.5 gm Vitamin E (as preservative). Mix the solution using stirrer for 15 minutes.
	3	Store in spray bottle.

#### IV. BENEFITS OF HERBAL HAIR SERUM

##### 1. Multi-purpose

A hair serum can solve a variety of hair problems, not just one. It is also known as a one-stop solution to all your hair problems. A bad hair day is turned into a good hair day with hair serum. Your hair will feel and look different after just a few drops.[17]

##### 2. Protect hair

Hair serum adheres to hair strands. It also acts as an excellent shield against heat, sun damage, dirt, pollen, and pollution. It helps keep your hair from getting ruined. For this reason, it is recommended that you use a heatprotecting cream before using hot styling creams. [18]

##### 3. Shine to the hair

The hair serum's layer acts as a light reflector, making it easier to see your hair. Hair serums contain amino acids that protect colored and chemically treated hair. [19]

##### 4. Prevents hair loss from breakage

When our hair becomes a tangled mess, we lose a lot of hair strands as a result of the wear and tear that goes into detangling. Hair serum acts as a lubricant for such hair and makes detangling simple. And the result is less hair fall. [20]

##### 5. Good for dry hair

Hair serum are beneficial for dry and frizzy hair. Hair serums keep moisture and make hair smooth and shiny. [21]

##### 6. Nourishment of hair

Hair serums fill the follicular gaps and revitalize brittle and damaged hair. Hair serum makes hair more manageable, making it easier to style them. Time, effort, and patience are all needed. Everything has been saved. [22]

##### POSITIVE EFFECTS:

1. Hair serums can effectively soften, smoothen, and make your hair silky.
2. It shields the hair from environmental aggressors.
3. Act as both a pre styling treatment and a finishing product.
4. It can be used after and before heat styling. Reduces frizz.
5. Prevent frizz. If your hair is weak and damaged & Improves smoothness.
6. Hair serum's anti-frizz properties also improve the appearance of hair serum.
7. Hair serum also reduces tangles and improves shine & to improve the straightness and curls.
8. It protects against damaged.

##### NEGATIVE CONSEQUENCES:

1. Regular use and over application can cause the hair to become dry and brittle.

2. The serum on the scalp can cause inflammation, irritation and allergy.
3. Silicones in the hair serum can be harmful to the long hair. It can breakage of hair.
4. Scalp application should be avoided as it could make it oily or result in inflammation.[23]

## V. HOW TO APPLY SERUM

### Step 1: Clean Your Scalp and Hair:

- Wash your hair with a mild herbal or sulphate-free shampoo to remove dirt, oil, and buildup.
- Gently towel-dry your hair.
- Hair should be slightly damp for better absorption.



### Step 2: Part Your Hair into Sections:

- Use a comb or your fingers to divide your hair into small section.
- Allows better access to the scalp, where the serum needs to be applied.



### Step 3: Take a Small Amount of Serum:

- Shake the bottle well if needed.
- Take 1–2 ml of serum using a dropper or your fingertips
- If using spray bottle, 5-6 sprays are usually enough to cover the scalp.



- Step 4: Directly apply on the Scalp:
- Apply the serum directly onto the scalp, especially in thinning or balding areas.
- Gently press or tap it into the skin.
- Do not on hair strands, as this type of serum targets the roots.



### Step 5: Massage the Scalp Gently:

- Use your fingertips to massage in circular motions for 3–5 minutes.
- This improves blood circulation and helps serum penetrate into the hair follicles.



### Step 6: Leave it on:

- Do Not Rinse
- Let it fully into the scalp.
- Step 7: Apply Consistently:





- Use the serum once or twice daily for best results—morning and night.
- Hair growth results usually appear after 4–8 weeks of regular use.[9]



## VI. EVALUATION PARAMETERS

1. Physical appearance: - Colour, Texture, Smell
2. pH:-The pH will be determined by using digital pH meter. Dipper of digital pH will be deep into the sample of serum formulation and the pH will be recorded. The pH of the formulation should have acidic pH as the skin has an acidic pH of around 4-6.
3. Homogeneity test: - A clean and dry glass object was smeared with the hair serum and covered. Glass was sealed. The appearance under the light of some coarse practical was investigated.
4. Viscosity: -Viscosity of formulation is determined by Brookfield Viscometer at 100rpm using Spindle type model S6 4.5 ml of serum. The serum will be placed in a big mouth container with the Spindle dipped in it for 5 minutes before measurement.

5. Spreadability test: - Spreadability is measured by parallel plate process typically used to assess and measure the spreadability of semisolid preparation. One gram hair serum was pressed between two horizontal plates of dimension 20\*20 cm, the upper of which weighed 125g. The spread Diameter was measured after 1 min. Spreadability is measured using the formula  $S=M*L/T$

6. Stability test: - The hair serum is kept for three months at two separate temperatures and 65 Rh. Compare the original pH and viscosity. The pH and viscosity of herbal hair serum is determined after 3 months.

## VII. RESULT

The formulated herbal hair serum exhibited desirable physicochemical characteristics and stability throughout the evaluation period. The product showed a smooth, non-sticky texture with a pleasant herbal fragrance, and was easy to apply and spread evenly on the hair surface. The pH of the formulation was found to be  $5.5 \pm 0.2$ , which lies within the ideal range for scalp and hair care products, indicating its compatibility with the skin. The viscosity results demonstrated that the serum maintained a uniform consistency suitable for topical application, ensuring ease of use and good absorption.

The stability studies conducted at room temperature and accelerated conditions confirmed that there were no significant changes in color, odor, or consistency over 30 days, suggesting good product stability. No phase separation or precipitation was observed during storage. The spreadability and smoothness tests indicated that the formulation spreads easily without leaving a greasy residue.

On application, the serum provided noticeable improvements in hair texture, smoothness, and shine. Regular use reduced frizz, tangles, and hair breakage, while imparting a healthy appearance and softness to the hair. The combination of Aloe vera, ginger, rosemary, neem, flaxseed, vitamin E, and almond oil contributed synergistically to hair nourishment and scalp protection.

Overall, the results indicate that the prepared herbal hair serum is stable, safe, and effective, making it suitable for routine cosmetic use and a promising alternative to synthetic hair care products.



## VIII. CONCLUSION

An herbal hair serum offers a natural, safe, and highly effective way to promote hair health and vitality. Unlike chemical-based products, which may provide temporary results but often lead to long-term damage, an herbal serum harnesses the healing and nourishing properties of nature. By combining carrier oils, such as coconut, jojoba, or argan oil, with essential oils like rosemary, lavender, or tea tree oil, and enriching them further with herbal extracts, you can create a powerful blend tailored to specific hair needs. This customization allows the serum to directly target concerns such as dryness, frizz, hair fall, or scalp irritation, making it a versatile solution suitable for different hair types. One of the most valuable aspects of preparing a DIY herbal hair serum is the control over ingredients. You are free to select only natural and chemical-free components, avoiding harmful additives like parabens or silicones. This not only ensures healthier results but also contributes to sustainability, as homemade products reduce reliance on mass-produced items with heavy packaging and preservatives. With careful preparation and proper storage in dark glass bottles, the serum retains its potency for weeks. Regular application can improve scalp circulation, strengthen hair follicles, and restore shine, providing both immediate nourishment and long-term protection. Incorporating a herbal hair serum into your hair care routine can therefore become more than just a beauty step—it can be a holistic practice that supports overall wellness while giving you stronger, healthier, and more vibrant hair naturally.

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