

Formulation & Evaluation of Herbal Hair Serum

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❖ 1. Abstract :

In the mammalian system the hair follicle is known to be the most significant organ that determines appearance, gender distinction, provides intense temperature protection and plays a role in self-defence. The younger generations have begun to suffer extreme hair loss problem due to many reasons. The hair loss is not temporary in most cases. but it results in alopecia. Many people suffering from hair loss is in search of multiple treatments due to extreme anxiety and tension. To improve hair growth and to prevent hair loss, hair root activation is required. Flax seed is full of fatty acids and antioxidants that tend to remove pollutants and dead cells from the scalp. Rosemary improves scalp blood circulation, which helps stimulate hair growth and strengthen. It also reduces hair fall and dandruff, keeping the scalp healthy for better hair growth. Bhringraj Promotes hair growth and helps reduce hair fall by strengthening roots(1). Aloe vera Soothes the scalp, reduces dandruff, and supports healthy hair growth. Hibiscus Nourishes hair, encourages growth, and helps prevent premature greying. Neem help to fight dandruff and infections, keeping the scalp clean for better hair growth. This review article focuses on the materials required for the formulation of hair serum and various Evaluation tests to evaluate hair serum.

❖ 2. Keywords :

Hair, Hair growth, Alopecia, Cosmetics, Herbs

❖ 3. Introduction :

In the human body, hair is an essential part. It's critical to take Proper care of one's hair because it's thought to be one of the Key features that enhance one's beauty. The definition of hair Is "improved epithelial structure formed and so forth, hair can Be found. Sebaceous glands and a large number of on the scalp Are hair follicles. The pH of the hair shaft is 3.671 and the pH Of the scalp is due to the cyclical changes in the environment And the presence of sebaceous glands. It is more prone to Mycotic infections such as tinea capitis, excessive dandruff, Scalp psoriasis, scalp folliculitis, head lice, and even alopecia. A vital component is the scalp. Component about human Hair and hair development is one of the symbols of beauty in Humans. The skin that covers the cranium. Furthermore, there Are layers of soft tissue on the areas of the head that produce Hair. Hair has a distinct chemical and physical behavior and is An integrated framework. It is an extremely strong and elastic, thin, flexible keratin thread. Two hair care products are used to enhance this cyclical medium, which includes hair shaft conflation, extension, and shedding. Anagen, catagen, and telogen phases combine to form hair, which has a root, shaft, and tip(2). Cosmetic science is a multidisciplinary field and a valid branch of science. For those looking for a natural and efficient hair care product, the herbal hair serum presents a promising option. It tries to address

common hair issues like dryness, frizz, and lack of shine with its blend of nourishing oils and botanical extracts. This review explores the main characteristics, advantages, and possible disadvantages of this herbal hair serum, providing information on its efficacy and suitability for different types of hair. For those looking for sustainable, safe, and effective hair care solutions, herbal hair serums have become a popular option(3). These potent serums are made with ingredients found in nature and are designed to give the hair and scalp intense care and rejuvenation. Essential Oils, vitamins, minerals, and botanical extracts that have been Specifically chosen for their restorative and nourishing qualities Are blended to create herbal hair serums. In addition, herbal Hair serums frequently have calming and anti-inflammatory Qualities, which makes them especially helpful for people with Scalp problems like irritation, dandruff, or itching. Regularly Using these serums may support proper hair development and Help keep a healthy environment on the scalp and lowering Hair fall (4). Herbal hair serums' deep penetration of the hair Shaft, which allows them to provide vital nutrients to the roots, Is one of their primary advantages. The hair becomes more Resilient to breakage and damage as a result of this internal Strengthening. Herbal serums also create a shield around the Hair strands to protect them from pollution, UV rays, and Heat styling, among other environmental stresses(5). Herbal hair Serums are safe for all hair types, including sensitive scalps, Because they don't contain any harmful chemicals, unlike Conventional hair care products that might include artificial Fragrances and preservatives. They are perfect for daily use Because of their mild yet potent formula, which hydrates and Nourishes hair continuously without adding weight or leaving A greasy aftereffect(6). Hair is derived from the epidermis and Is an essential component that enhances the body's overall Elegance. A few issues people have with their hair are dandruff, Hair fall, and gray hair. Hair turns white as a result of melanin, The pigment responsible for giving hair its color, ceasing to Function in an aging person(7) . People are paying greater attention To body shape and beauty in today's highly visual consumer Culture because these attributes now play a significant role in A person's sense of identity. The most outward manifestation Of a person's identity is their body. Conventional hair care Products frequently contain harsh chemicals that, while they Might provide short-term fixes, can harm hair health over the Long term. Naturally nourishing and protecting hair without The possibility of negative side effects has caused the demand To rise for herbal and natural alternatives.(8)

- **Background of Hair Serum**

Ancient cultures utilized plant extracts and natural oils to Nourish and enhance hair, which is where hair serum got Its start (9). But in the late 20th century, new developments in Cosmetic science and consumer demand for more specialized Hair care products gave rise to the modern notion of hair serum As a separate hair care product. 8 Conventional Methods Many civilizations have used natural ingredients to protect and Moisturize their hair throughout history, including olive oil, Coconut oil, and herbal extracts. Frequently transmitted across Successive generations, these customs laid the groundwork for Ensuing advancements in hair styling(10).

- **Development of Modern Hair Care**

The beauty business saw tremendous breakthroughs in Cosmetic technology in the middle of the 20th century, which Prompted the creation of shampoos, conditioners, and styling Products catered to particular hair types and issues(11) . But a Lot of these products had harsh chemicals in them that could Eventually damage the hair by removing its natural oils.

- **Introduction of Hair Serums**

Hair serums emerged as a new class of hair care products and Started to become popular in the 1980s and 1990s(12). Lightweight Oils, silicones, and other conditioning ingredients were used In the formulation of these serums to reduce frizz, boost Shine, and shield the hair from the elements. Hair serums Were initially mostly used in professional salon settings, but They were later made available to consumers for use at home(13).

- **Improvements in Formulation**

Hair care companies started creating serums enhanced with Antioxidants, vitamins, and botanical extracts as consumer Demand for more sustainable and natural beauty products Increased. These mixtures sought help strengthen and protect The scalp and hair, addition to offering cosmetic advantages.(14).

- **Increasing Product Variety**

Hair serums have evolved into more complex products with Cutting-edge ingredients and delivery methods to maximize Their effectiveness, thanks to developments in cosmetic Science and technology(15). These days, some serums use heat-Activated formulas for improved penetration into the hair shaft, While others contain encapsulated nutrients that are released Gradually for extended benefits(16).

- **Traditional Medicine System**

Herbal hair care remedies have long been used in conventional Medical practices, including, traditional Chinese medicine (TCM) and Indian traditional medicine (ITM) Ayurveda (17).In Conventional medical systems, plant-based ingredients are Frequently used in herbal serums to treat particular health Or aesthetic issues, such as hair care. This is a summary of Traditional herbal serums from various cultural contexts(18).

- **Historic Civilizations**

The ancient civilizations of Egypt, Mesopotamia, China, And India are among those who first used herbs and natural Ingredients for hair care. To strengthen hair strands, encourage Hair growth, and preserve scalp health, these cultures used A variety of botanicals and herbs as hair treatments. They Frequently combine these herbs and botanicals with oils or Other natural substances(19).

- **Development of Herbal Hair Serums**

Because more and more people are turning to natural hair care Products instead of chemical ones, the phrase “herbal hair Serum” may have become more well-known more recently—Probably in the late 20th or early 21st century (20).An assortment Of botanical extracts, vitamins, essential oils, and other natural Ingredients are often found in herbal hair serums, which are Designed to nourish hair, enhance its appearance, and treat Particular issues like frizz, dryness, or damage (21).

- **Types of Hair Serum**

There are many different kinds of herbal hair serums, and Each is a supply of blood to the scalp and is designed to target Particular hair issues and tastes. Typical herbal hair serum Varieties include the following(22).

- **Moisturizing serum**

These serums are designed to hydrate dry, brittle hair. Herbal Components usually contain nutrients like argan oil, shea Butter, coconut oil, and aloe vera, which work to moisturize And nourish the hair strands, leaving them feeling silky and Smooth and easier to manage(23).

- **Growth-promoting serum**

Hair density and growth stimulation are the two main goals of These serums’ formulations. Ingredients like biotin, promote Hair growth ginseng extract, and fenugreek extract may be Present in them; these are thought to stimulate follicles(24).

- **Strengthening serum**

To prevent breakage and encourage healthier-looking hair, Strengthening serums are made to strengthen weak, damaged Hair. The presence of vitamins, minerals, and antioxidant-Rich herbs that promote hair resilience and strength, such As horsetail extract, nettle leaf extract, and rosemary oil, is Common in them.(25).

- **Anti-dandruff serum**

Anti-dandruff serums are designed to address problems with The scalp, including flakiness, itching, and dandruff. They Frequently contain herbal ingredients like tea tree oil, neem Oil, and peppermint oil that have antimicrobial

and anti-inflammatory qualities. These ingredients help to calm the Scalp and lessen the bacteria that cause dandruff(26).

➤ Color-protecting serum

The purpose of color-protecting serums is to maintain the Brightness and durability of hair that has had color treatment. Herbal components like green tea extract, grapeseed oil, And sunflower seed oil are frequently found in them; these Ingredients help prevent UV rays and environmental damage From fading hair color(27).

➤ Repairing serum

Damage from chemical treatments, heat styling, and Environmental stressors can all be repaired with the help of Repairing serums. Herbal extracts that help to seal the hair Cuticle, tame frizz, and bring back shine include keratin, Avocado oil, and bamboo extract(28).

➤ Soothing serum

The purpose of soothing serums is to soothe and calm the Scalp, thereby lowering inflammation and irritation. Herbal Ingredients with anti-inflammatory and calming qualities, such As calendula extract, lavender oil, and chamomile extract, may Be present in them to help soothe and reduce scalp discomfort(29).

➤ Smoothing serums

These serums are intended to make hair look sleek and smooth, Manage to fly away, and reduce frizz. They frequently include Ingredients like silicone or argan oil for a smooth texture and To coat the hair shaft(30).

➤ Shine serums

Shine serums are designed to give dull hair luster and Brightness. To increase shine without weighing the hair down, They typically include light-reflecting particles or oils like Coconut or jojoba oil.

➤ Repairing serums

By supporting and fortifying the hair shaft, reparative serums Help repair damaged hair. Along with vitamins and minerals To support healthy hair and repair damage, they may contain Proteins like keratin or amino acids(31).

➤ Heat protectant serums

These serums act as a barrier to keep heat-producing Manufacturing hair are blow dryers, flat irons, and curling Irons among the styling instruments that are safe(32).

To reduce the Harm caused by heat styling, they frequently include silicones Or other heat-protective substances.

• Structure and Composition of Human Hair:

1. Hair Shaft:

→ The visible part of the hair that protrudes above the skin.

2. Hair Root:

→ The part of the hair embedded in the skin, surrounded by the hair follicle(33).

3. Hair follicle:

→ A tubelike pocket of the epidermis that encloses a small section of the dermis at its base, where new hair cells are constantly being made.

4. Hair Layers:

→ Human hair consists of three main layers:

- The Cuticle - The outermost layer made up of tightly packed scales that protect the inner layers from damage and moisture loss.

- The Cortex - The middle layer responsible for hair strength, elasticity, and pigment. It contains melanin, which determines hair colour.
- The Medulla - The innermost layer, which is sometimes absent in fine or light-colored hair. It provides structural support to the hair shaft

5. Keratin:

→ Hair is mainly made of keratin, a strong fibrous protein that also forms skin and nails(34).

6. Sebaceous Glands:

→ Follicles are also connected to sebaceous glands, which produce oil(35).

7. Arrector Pili Muscles:

→ Each hair follicle is attached to a tiny muscle (arrector pili) that can make the hair stand up (like goosebumps).

• PHASES OF HAIR GROWTH:

1) Anagen Phase:

First stage of hair growth cycle & roughly 1,000 days. It begins in the papilla and can last from. Two-six times. Eighty to ninety percent of all mortals in anagen stage(36).Period of growth when cell around the Follicle is fleetly dividing of depositing materials within the hair. The hair being suitable to grow 1 measure. The hair growth is determined by genetics. The cells in the papilla divide to produce new hair threads & Follicle buries itself into dermal layer of Skin to nourish the strand(37).

2) Catagens phase:

At the end of the anagen phase, hair enters Catalan phase. Short transitional phase, lasts roughly 10 days. First sign of Catalan is conclusion of melanin product in hair bulb & apoptosis of follicular melanocytes. Also known as the transitional phase follicle renews itself. Two weeks hair follicle shrinks(38).Due to breakdown & papilla detaches & rest Cutting hair strand out of its nutritional blood supply. Hair not growing during this phase. The length of terminal fiber increases. The follicle pushes them upward.

3] Telogen phase: -

The final stage of hair growth. During phase, the hair follicle is dormant/resting, and hair fluently lost 10–18 hair in telogen phase. Follicle also remains inactive for 3 months. The epidermal Cells lining the follicle Channel Continue to grow & concentrate around the base of hair(39).The follicle will begin to grow phase within two weeks; the new hair shaft will begin to crop 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 slipping actually occurs as distinct phase nominated as oxygen phase(40) The shedding of hair fiber largely controlled the active process. The process different from quiescence typically found during hair follicle cycling.

The process of has two steps: After telogen, the follicle base cells admit signal initiate oxygen. Turn on the effects of slipping.

5] Kenogen phase:

The empty hair follicle noticed after shedding of hair fiber. Kenogen means the hair follicle remains empty after telogen & before new anagen hair reappears. (41).Hair loss, hair thinning & problems with hair growth occur when the growth cycle is disintegrated.

Suitable types of hairs for using hair serum:

1. Straight
2. Wavy
3. Curly
4. Coily

• Benefits of Hair Serum:

- 1) Protect hair: it acts against the heat, sun damage, dirt, dust, pollution When hair serum applied on hair it forms the thin layer on hair It protects the hair from the hair damage(42).
- 2) Gives shine to the hair: Hair serum forms the thin layer which reflects the light. The serum provides the shiny appearance to the hair. Hair serum contained the amino acids which protect colored and chemically treated hair.
- 3) Multipurpose: Hair serum is used to treat the various hair related problems. Few drops of hair serum make your hair shiny and silky it turns your bad day into the good day. It is one remedy to multiple hair issue.
- 4) Nourished hairs: Hair serum fills the follicular cracks and act on damaged hairs. Hair serum makes hair manageable which make them lustrous and easy to carry (43).
- 5) Best for hair dry: Most commonly hair serums are used for the damaged, dry, and frizz hairs. Hair serum locks and provide the moisture to the hair and make them smooth and shiny
- 6) Prevent hair fall from breakage: When our hair becomes frizz, damaged, messy, tangled in further conditions we loss lot of hair follicles. Hair serums act as the lubricant in such cases and make them detangled easily It may cause the stop the hair fall problems(44).

- OBJECTIVE:

1. Herbal hair serum can effectively smoothen, soften, and make hair silky.
2. Serums protect hair excellently, guarding against heat damage, sun damage, dirt, dust, and pollution.
3. They give shine to the hair, prevent hair fall from breakage, are best for dry hair, nourish hair, and make them manageable(45).
4. To provide alternative to synthetic hair serum
5. To carried out preparation oh herbal hair serum
6. To improve hair condition and texture
7. To carry out evaluation oh herbal hair serum

- Advantages Of Hair Serum –

1. Hair serum can effectively smoothen, soften and make your hair silky.
2. It protects the hair from environmental aggressors.
3. Both pre styling treatment and finishing product.
4. It can be used before or after using heat styling.
5. Controls frizz.
6. If your hair is weak and damaged, it may look frizzy or dry.
7. Boosts smoothness(46).
8. The anti-frizz effect of hair serum also helps improve the smoothness of hair serum.
9. Hair serum is also reduces the tangles and promote the shine.
10. To enhances the straightness and curls.
11. It protects against the damage.

- Disadvantages Of Hair Serum -

1. After several days of continued use, this build-up weights down your hair, making it appear flat and dull(47).
2. Accumulation on your scalp can cause dryness, flaking, and skin irritation.

- Side Effects of Using Hair Serum: -

1. Regular use and over application can make the hair unhealthy and ultimately dry.
2. Applying the serum on the scalp can lead to inflammation.
3. Silicones present in the hair serum can be harmful for the hair in the long hair(48).
4. Scalp application should be avoided as it might make it oily or can lead to inflammation.

❖ 4. MATERIALS AND METHODS



Rosemary oil is widely studied as a key ingredient in hair growth serums due to its ability to improve scalp circulation, stimulate hair follicles, and reduce inflammation. Rich in antioxidants such as carnosic acid, it helps protect hair follicles from oxidative stress while supporting cellular regeneration. Research suggests that rosemary oil may be comparable to Minoxidil in promoting hair growth, particularly in conditions like Androgenetic Alopecia, with fewer side effects such as scalp irritation(49). Additionally, its antimicrobial properties contribute to a healthier scalp environment, reducing dandruff and itchiness, which are factors that can hinder hair growth. Therefore, rosemary oil is considered an effective, natural, and well-tolerated component in modern hair growth serum formulations.

Bhringraj is a prominent botanical ingredient in hair growth serum formulations, valued for its traditional use in promoting hair health and follicular regeneration. It contains bioactive compounds such as wedelolactone and ecliptine, which are known to support the anagen (growth) phase of the hair cycle and improve blood circulation to the scalp. Its anti-inflammatory and antioxidant properties help reduce scalp irritation and oxidative stress, both of which are associated with hair thinning and loss. Additionally, bhringraj exhibits potential inhibitory effects on factors linked to Androgenetic Alopecia, thereby aiding in the prevention of premature hair fall. Regular incorporation of bhringraj in serum formulations contributes to enhanced hair density, reduced shedding, and overall improvement in scalp health, making it a valuable component in evidence-based herbal hair care products(50).



Aloe vera is widely incorporated into hair growth serum formulations due to its hydrating, soothing, and bioactive properties that support scalp and follicle health. It contains vitamins (A, C, and E), enzymes, amino acids, and polysaccharides that help nourish hair follicles, maintain moisture balance, and promote a healthy scalp environment conducive to hair growth. Aloe vera also exhibits anti-inflammatory and antimicrobial effects, which can reduce dandruff, scalp irritation, and microbial imbalance—factors often associated with impaired hair growth.

Additionally, its proteolytic enzymes assist in removing dead skin cells that may block hair follicles, thereby enhancing follicular function(51). These combined actions make aloe vera a valuable natural ingredient in hair growth serums aimed at improving hair strength, reducing breakage, and supporting overall hair regeneration.



Hibiscus *rosa-sinensis* is a widely utilized botanical ingredient in hair growth serum formulations due to its rich content of bioactive compounds, including flavonoids, amino acids, mucilage, and vitamins. These constituents help nourish hair follicles, enhance keratin production, and support the anagen phase of the hair growth cycle. Hibiscus also exhibits strong antioxidant and anti-inflammatory properties, which protect the scalp from oxidative stress and reduce follicular damage associated with hair loss. Its natural conditioning and emollient effects improve hair texture, reduce breakage, and maintain scalp hydration. Additionally, hibiscus has been reported to help prevent premature graying and may contribute to reduced hair fall, making it a valuable component in herbal-based hair growth serums designed to improve hair density and overall scalp health(52).



Flaxseed is increasingly incorporated into hair growth serum formulations due to its high content of omega-3 fatty acids, lignans, and mucilage, which collectively support scalp health and follicular function. The essential fatty acids help nourish hair follicles, reduce inflammation, and improve blood circulation to the scalp, thereby promoting the anagen phase of hair growth. Flaxseed also exhibits antioxidant properties that protect follicles from oxidative stress, a key factor in hair thinning and loss. Its mucilage content provides natural conditioning and hydration, forming a protective film over hair strands that reduces breakage and enhances smoothness. Additionally, flaxseed may help regulate scalp oil balance and improve overall hair strength and elasticity, making it a valuable ingredient in natural, multifunctional hair growth serum formulations(53).

Neem is a well-recognized botanical ingredient in hair growth serum formulations due to its potent antimicrobial, anti-inflammatory, and antioxidant properties. Rich in bioactive compounds such as nimbidin and azadirachtin, neem helps maintain scalp hygiene by controlling microbial overgrowth, dandruff, and fungal infections that can impair hair follicle function. Its anti-inflammatory action soothes scalp irritation and supports a balanced environment conducive to healthy hair growth. Additionally, neem aids in improving blood circulation to the scalp and may help strengthen hair roots, thereby reducing hair fall. The presence of antioxidants further protects hair follicles from oxidative stress, contributing to improved hair density and overall scalp health. Consequently, neem is considered an effective natural component in hair growth serums aimed at enhancing follicular health and preventing hair-related disorders(54).



Fenugreek seed extract contains a dietary supplement that Also contains micronutrients such as B-vitamins, antioxidants, And trace elements that are also present in the hair. Fenugreek (*Trigonella foenum-graceum* L.) is a leguminous herb.Fenugreek is native to Southern Europe, Western Asia, and the Mediterranean region. Fenugreek seeds contain a wide range of Active ingredients such as saponins, especially diosgenin, Yamogenin, and gitogenin derivatives, trigonelline alkaloids, Flavonoids, galactomannan vitamins, and fiber, etc .

The Seeds have a good fragrance and a sour flavor. As both a Culinary and medicinal plant of the ancient world, it has a long Tradition. Because of their therapeutic ability, including their Usage as hypoglycemic, antiulcerogenic, hypo-cholesterolemic, And antihypertensive agents, the beneficial properties of Fenugreek seeds have drawn

significant interest in the recent Past . There are known beneficial effects of fenugreek on Hair growth, but the mechanism is not characterized(55). It is Addressed that fenugreek interacts in a physiological manner With the synthesis of DHT (dihydrotestosterone) by enhancing The blood supply of hair follicles and steroid saponins. The impact of DHT on genetically predisposed hair follicles is Suspected to be one cause for male and female variant hair loss. Binding DHT to the hair follicle results in the hair’s progressive Miniaturization and subsequent hair loss .



Castor oil, also known as *Ricinus communis*, is a vegetable Oil that is rich in nutrients and comes from castor beans. While It originates from tropical East Africa, it is commonly used in India and the West Indies for cosmetic and medicinal purposes.

Castor oil, which is known as black castor oil, is typically Transparent or pale yellow unless it is derived from roasting or Boiling. Castor oil is a long-chained fatty acid at the molecular Level. “Fatty acids give hair follicles essential proteins and Nutrients and prevent inflammation of hair follicles,” as According to Bridgette Hill. Castor oil has a few other Noteworthy effects in addition to being anti-inflammatory(56).

“Increased gloss or shine of the

hair, increased hair shaft Flexibility by coating the hair shaft, and antimicrobial Properties are some of the benefits of using castor oil.” A total Of 90% of castor oil is made up of ricinoleic acid fatty acid.

It Is believed to activate the Prostaglandin E2 receptor, which can Contribute to the dilation of the blood vessels. Increased blood Vessel dilation increases the supply of oxygen-rich and Nutrient-rich blood to the follicle’s powerhouse, dermal papilla,Or hair root.



Vitamin E plays a significant role in promoting hair growth due to its potent antioxidant properties, which help reduce oxidative stress in the scalp—one of the key factors linked to hair follicle damage and hair loss. By neutralizing free radicals, Vitamin E supports a healthy scalp environment and improves blood circulation, thereby enhancing nutrient delivery to hair follicles. It also contributes to maintaining the lipid barrier of the scalp, preventing dryness and supporting hair shaft integrity. Additionally, its moisturizing effects can reduce hair breakage and improve overall hair texture. These combined actions make Vitamin E a

valuable component in hair growth formulations and therapeutic hair care products.

Glycerin is widely utilized in hair growth formulations due to its strong humectant properties, which enable it to attract and retain moisture in the scalp and hair shaft. By maintaining adequate hydration, glycerin helps prevent dryness and brittleness, thereby reducing hair breakage and creating a favorable environment for healthy hair growth.

It also improves scalp condition by minimizing flakiness and irritation, which can otherwise hinder follicular function. Furthermore, glycerin enhances hair elasticity and softness, contributing to improved manageability and reduced mechanical damage. Through its moisturizing and protective effects, glycerin indirectly supports optimal conditions for sustained hair growth and overall hair health(57).

Glycerin is an important functional ingredient in hair growth formulations owing to its hygroscopic nature, which allows it to draw moisture from the surrounding environment into the scalp and hair fibers. This hydration is essential for maintaining the structural integrity of the hair shaft and preventing transepidermal water loss from the scalp.

By improving moisture retention, glycerin supports the optimal functioning of hair follicles and helps maintain a balanced scalp microbiome, reducing conditions such as dryness, itching, and dandruff that may contribute to hair fall.

Additionally, glycerin forms a protective film over the hair cuticle, enhancing smoothness, shine, and elasticity while minimizing friction-induced damage. Its compatibility with other active ingredients also makes it an effective carrier in polyherbal or cosmetic formulations, enhancing the penetration and efficacy of bioactive compounds.

Collectively, these properties make glycerin a valuable adjunct in promoting conditions favorable for healthy hair growth and improved hair quality.

• METHOD OF PREPARATION:-

Procedure of Herbal Hair Serum Formulation

1. Clean all the glassware and dry them properly as per bribe.
2. Measure the accurate quantity of aloe vera, and transfer it in a beaker.
3. Mix required quantity of vitamin E in aloe vera(58).
4. Now mix rose water to the below mixture of aloe vera and vitamin E.
5. After stirring for many minutes, heat the set result for many minutes.
6. Add many drops of almond oil.
7. After that stir the preparation with the help of a glamorous stirrer.



8. Transfer the preparation to the measuring cylinder and adjust the final volume to 30 ml.
9. Transfer final result into container.

● Evaluation of The Hair Serum: (59)

➤ Physical Appearance :

The physical appearance, color, and feel of the prepared Herbal hair serum are visually tested. Table 2 reflects the Outcomes.

➤ Homogeneity Test:

A clean and dry object glass was smeared with the hair Serum, and a cover glass was sealed. The appearance under the Light of some coarse particle/homogeneity was investigated. Herbal hair serum was tested by visual examination for Homogeneity and tested for some lumps, flocculates, or Aggregates .

➤ pH Test:

The pH meter was calibrated using pH 4 and pH 7 buffer Solutions. Then, the electrode was soaked in the hair serum and Left until the pH normalized after a few minutes .

➤ Viscosity:

The viscosity measurement was performed with spindle Number 6 on a Brookfield viscometer (RVDV-II+PRO). In the Beaker, 50 ml of hair serum was placed, and the viscosity was Measured at various rpm, i.e., 10, 20, 50, 100 .

➤ Spreadability :

Spreadability was measured by a parallel plate process Typically used to assess and measure the spreadability of semi- Solid preparations. One gram hair serum was pressed between Two horizontal plates of dimension 20× 20 cm, the upper of Which weighed 125 g. The spread diameter was measured after 1 min. Spreadability was calculated using the following Formula: (60) .

$$S = M \times L / T$$

Where, S= Spreadability, M= Weight in the pan (tied to the Upper slide), L= Length moved by the glass slide, and T =Time (in sec) taken to separate the slides completely .

Table 1. Ingredients used in the preparation of herbal hair Serum.

Ingredient	Quantity
1. Bhringraj	5 ml
2. Amla	5 ml
3. Hibiscus	5 ml
4. Aloe vera	5 ml
5. Fenugreek	5 ml
6. Flaxseed	5 ml
7. Castor oil	5 ml
8. Neem leaf extract	5 ml
9. Rosemary essential oil	1 ml
10. Vitamin e	1 ml
11. Glycerine	3 ml

12.	Distilled water	q.s. up to 100 ml
13.	Natural preservative	0.2-0.5 %

Table2. Stability study on herbal hair Serum

pH*		Viscosity at 100 rpm (centipoise) *	
Initial	Final	Initial	Final
6.7±0.022	6.6±0.012	1110±0.002	1124±0.117

*the value is expressed as mean ±SD, n=3.

- Test the Sensitivity of the Eye (Draize Eye Test) :

Eye sensitivity was tested on three rabbits for getting the Average result of sensitivity. One drop of hair serum was Injected into the left eyes of the rabbits in physiological NaCl (as the control is the right eye) and then observed for 30 Minutes, 60 minutes, 120 minutes, 240 minutes, 1 day, 2 days, 3 days, and 4 days. The scores of the cornea, iris, and Conjunctiva were determined .

- Hair Growth Activity Test:

This test was conducted on 3 areas of a single rabbit on Either foot, right and left of the shaved backs of the rabbits, Each 4x4 cm in size. Then, after 3-5 minutes, depilatory cream (Veet ® cream) was applied, and the area was rinsed with Water until the area was clean with hair. As an antiseptic, 70 Percent ethanol was then added. Before any action evaluation, The rabbit was left behind for 24 hours. As no intervention was Performed, treatment 1 was the standard control, and treatment 2 was the positive control where the hair serum with the test Material was added. Again, as no intervention was undertaken, Treatment 1 was the standard control, and treatment 2 was the Positive control where hair serum with the test material was Added. For 3 weeks, 0.1 ml of each drug was then administered Twice a day to the rabbit. The first day of use of the hair serum Was called day 0 . (61) .

- Qualitative Assessment of Hair Growth:

Qualitative measurement of hair growth analysis was Carried out by visual inspection of 2 criteria, initial hair growth Time (minimum time needed for hair growth on the shaved Area, measured from the darkening of the skin color showing Initial hair growth) and completion time for hair growth (minimum time required for the entire shaved area to be Covered with new hair) on three groups (Group I: Normal control; Group II: Negative control; Group III: Positive control (Herbal hair serum)). Each group consists of three rabbits.

- Observations of the Growth of Hair:

It was done by taking 10 random hair strands on each box On days 7, 14, and 21. The hair had been drawn out, Straightened, and stuck with the tape, and measured using Mitutoyo Digimatic wireless calipers. The average length Collected was analyzed to see if the difference between the Research region and the control was statistically significant .

- **Hair Weight Measurements:**

To evaluate the weight of each box, the hair was removed And weighed on day 21 and then statistically measured(62).

- **Microbial Contamination:**

Microbial contamination of hair serum was determined via Spreading a thin loopful of the serum on a nutrient and Sabouraud agars and incubating for 48 hours at 37°C. In order To examine the degree of contamination, one gram of material Was used to be dispersed in 4 ml of sterile Ringer solution, Containing 0.25% Tween 80. In the same dispersion vehicle, Sufficient dilutions were made, and 0.5 ml was mounted on the Appropriate solid medium using the viable surface procedure. Following required incubation, emergent colonies were Counted (63).

- **Stability:**

The herbal hair serum was kept for three months at two Separate temperatures of $4\pm 2^{\circ}\text{C}$ and $30\pm 2^{\circ}\text{C}$, with 65% RH. Compared with the original pH and viscosity, the pH and Viscosity of the herbal hair serum were determined after three Months .

- **Sterility test:**

The sterile discs were loaded with 1% hair serum and Incubated for 24 hours at 32°C as part of the sterility tests On nutrient agar

- **Skin sensitivity test (Draize skin test):**

The skin sensitivity examination was an initial Examination to detect any allergic reaction that may be Caused by the hair serum. Hair on the right and left back Were shaved and divided into 6 regions each with a size Of 4into4 cm in a rectangular shape with a distance of 1.5 Cm between the square(64).Each square was number 1-6. Before using a hair tonic and after shaving. No 1-5 Represents.

No. 1: No tonic was applied/ normal control, no. 2: Have Control was applied/ placebo, no. 3: Hair serum 2.5% was Applied, no. 4: 5% of hair serum was applied and no. 5: 10% of hair serum was applied.

Any sensitivity of the skin such as erythema, edema and Peeling were observed at 24 hours and 48 hours after the Application.

- **Observations of the growth of hair length:**

It was done by taking 10 random hair strands on each box On days 7, 14 and 21. The hair has to measured using Mitutoyo digimatic wireless callipers by straighten hair, And stuck with the tape. The average length collected was Analysed to check if the variation between the research Region and the control were statistically significant(65).

- **Quality assessment of hair growth:**

Any visible method of qualitative hair growth analysis was Used inspection of 2 criteria, initial hair growth on the time (minimum time needed for hair growth on the shaved area, Measured from the darkening of the skin colour showing Initial hair growth) and the least amount of time necessary For the complete shaved region to

regenerate hair covered With new hair on three groups. (Group 1: Normal control; Group 2: Negative control: group 3: Positive control herbal Hair serum). Each group consists of three rabbits(66).

❖ Conclusion:

In conclusion, the formulation of a plant-based hair serum incorporating multiple bioactive ingredients such as bhringraj, amla, hibiscus, flaxseed, aloe, fenugreek, castor oil, neem, rosemary, vitamin E, and glycerine demonstrates a promising multi-target approach to hair care. Each component contributes distinct yet complementary biological activities, including stimulation of hair follicle growth, improvement of scalp health, antioxidant protection, moisturization, and reduction of hair fall. The synergistic interaction of these phytoconstituents enhances overall efficacy by targeting various underlying causes of hair damage and loss, such as oxidative stress, microbial imbalance, and nutrient deficiency. Furthermore, evaluation parameters indicate that such formulations can achieve desirable physicochemical stability, safety, and user acceptability. Thus, this multi-herbal serum represents a viable, natural, and effective alternative to synthetic hair care products, supporting the growing demand for holistic and sustainable cosmetic solutions(67).

In the present era, where conventional hair care products are often dominated by synthetic chemicals such as sulfates, parabens, and silicones, the use of herbal hair serums offers a safer and more sustainable alternative. Herbal formulations, enriched with naturally derived ingredients, are generally associated with fewer side effects, making them suitable for long-term use and for individuals with sensitive scalp conditions. These plant-based serums not only nourish the hair with essential vitamins, antioxidants, and fatty acids but also support scalp health without disrupting its natural balance. Additionally, herbal products are often biodegradable and eco-friendly, aligning with the increasing consumer preference for green and clean beauty solutions. The holistic action of herbal serums—addressing hair growth, hydration, dandruff control, and damage repair—makes them a valuable choice in modern hair care, bridging traditional knowledge with contemporary needs(68).

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