ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 11| Issue: 6| June 2025|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2025: 8.691 || ISI Value: 1.188

THE FORMULATION AND EVALUATION OF HAIR SERUM FOR SHINY HAIR

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ABSTRACT

The hair follicle holds a pivotal role within the mammalian system, influencing appearance, gender distinctions, and serving as a crucial element for temperature regulation and self-defence. Unfortunately, contemporary lifestyle choices, including factors like stress, fatigue, unhealthy dietary habits, and the frequent use of hairstyling/colouring techniques, have contributed to a growing concern of hair loss among younger generations. This hair thinning issue is often not temporary and can result in alopecia. In response to these concerns, individuals experiencing hair loss often seek a range of solutions, from traditional remedies rooted in mythology to more conventional and therapeutic approaches, including the utilization of substances like minoxidil and finasteride[1]. It becomes evident that stimulating hair root activation is essential for enhancing hair growth and combatting hair loss.

KEYWORDS: *Hair Serum, Hair Defence, Hair Loss*

INTRODUCTIONS

Hair serum is a liquid hair care product with a thicker consistency than water. It serves both styling and treatment purposes for various hair concerns like dryness, dullness, and manageability. Typically, it is applied to wet hair. It's worth noting that hair loss can be a challenging issue to address. One of the factors contributing to hair loss is the alpha reductase enzyme, which converts testosterone into Dihydrotestosterone (DHT). Hair follicles have receptors for DHT, which can lead to the shrinkage of dermal papillae cells, resulting in atrophy of the stem cells.Therefore, finding a definitive solution for hair loss remains a complex and elusive challenge. Consulting a healthcare professional or dermatologist for personalized advice is often recommended for those experiencing significant hair loss concerns.Human hair is widely regarded as a symbol of beauty in humans. The scalp,covering the cranium and the area where hair grows, is a critical element for hair growth. Composed of soft tissue layers, the scalp hosts numerous hair follicles and sebaceous glands. The pH level of the scalp is approximately 5.5, while that of the hair shaft is around 3.671. This slight acidity of the scalp helps maintain hair and skin health. However, the scalp is susceptible to various mycotic infections due to the presence of sebaceous glands and cyclic environmental changes.[2]

Hair can be defined as- "improved epithelial structure formed as a result of keratinization of germinative cells" Hair loss has the potential to impact either the scalp or the entire body, and it can be either temporary or permanent. This condition can arise due to various factors such as genetics, medical conditions, hormonal fluctuations, or simply as a natural consequence of aging. It is more commonly observed in men that they experience hair loss on their head. The term "baldness" is often used to describe excessive hair loss specifically from the scalp. The primary cause of baldness is typically attributed to hereditary factors as individuals grow older. Some individuals choose to allow their hair loss to progress naturally without any intervention or concealment. [5]On the other hand, some may opt to camouflage it

- Hair loss can impact either the scalp or the entire body, and it can be temporary or permanent. The causes may include heredity, medical conditions, hormonal changes, or simply aging. Typically, hair loss on the head is more common in men, often referred to as baldness. The primary reason for baldness is usually hereditary as individuals grow older. Some individuals choose to embrace their hair loss without intervention, while others may opt to conceal it with various methods such as hairstyles, makeup, hats, or scarves[6]. Alternatively, some may decide to pursue treatments to prevent further hair loss or promote hair growth.. As more individuals aspire to maintain a youthful and attractive appearance, the significance of cosmetics has grown. Cosmeceuticals, which combine the cosmetics and pharmaceutical industries, have emerged as a result. While cosmetics companies specialize in producing cosmetics, pharmaceutical companies focus on manufacturing pharmaceuticals.

- **Anatomy of Hair**

  Hair follicles, situated in the adipose layer of the scalp, produce hair in clusters of 1-4 strands known as "follicular units". The growth process of hair takes place at the hair bulb, located at the bottom of each follicle. The follicles receive nourishment from blood vessels in the dermis, and the cells divide and mature to form the hair shaft. While developing beneath the epidermis, the hair remains soft, but once it emerges, the outer layer hardens into keratin.

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Terminal hairs are primarily found on the scalp, eyebrows, and eyelashes. Vellus hairs are distributed throughout the body. At birth, vellus hairs are present on the scalp and eyebrows, while terminal hair is present on other body parts[8]. During puberty, specific terminal hairs (such as beard hair, chest hair, armpit hair, and pubic hair) are distinguished by the presence of androgens.

Terminal hair is long (> 2 cm), thick (~60 µm), and pigmented. Terminal hairs are also medullated and have a bulb at the base of the hair. Vellus hair is thin



Fig. Hair Anatomy

- **Physiology of Hair**

Hair growth undergoes three distinct phases: Anagen, Catagen, and Telogen. Anagen is the primary growth phase, lasting several years for each hair. Catagen is a brief stabilization phase, lasting a few weeks, during which the hair follicle shrinks and the cuticle slows down. Telogen is the resting phase when old hair is shed and new hair begins to grow. Telogen consists of dead hardened cells, providing protection to the old hair as it is pushed out from the follicle over the course of months.

The Anagen phase, which is the growth phase of hair, is comprised of three components: the Henley layer, Huxley layer, and a distinct phase. At any given time, the majority of hair is in the Anagen phase. The Henley and Huxley layers are capsular layers that intertwine to ensure the hair's stability. This particular phase continues for a duration of several years.[9]

During the catagen phase, which lasts for a few weeks, there is a slowdown in hair growth and the hair follicle, particularly the cuticle that is closest to the hair shaft, undergoes a shrinking process.

Telogen, the phase of rest, can span over multiple months. Throughout this period, hair growth stops and the old hair separates from the hair follicle. Subsequently, a new hair initiates the growth phase, displacing the old hair. The cuticle, consisting of deceased hardened cells, offers extra safeguarding to the hair shaft. Alongside the capsular layers of the Henley's and Huxley's layers, it guarantees the hair's protection and facilitates its growth.



Fig. Different phases of Hair Cycle

Telogen, the resting phase, can last for several months. Throughout this phase, hair growth stops and the old hair separates from the hair follicle. A new hair then starts the growth phase, displacing the old hair. The cuticle, made up of dead hardened cells, provides additional protection to the hair shaft. Together with the capsular layers of the Henley's and Huxley's layers, it ensures the hair's security and enables its growth.

[8] Hair growth is a complex process that involves the coordinated activities of multiple keratinocyte layers within the hair follicle. This dynamic and cyclic development is regulated by various hormones and cytokines, with the duration of growth cycles influenced by factors such as location, age, nutritional habits, and environmental changes like day-length. Cytokines play a crucial role in instructing the follicle to undergo necessary changes, ensuring that each hair is at a different stage of the growth cycle compared to its neighboring hairs. Hair follicles undergo a continuous cycle of growth and regression, characterized by alternating periods of rapid growth and hair shaft formation, as well as stages of hair follicle regression and relative quiescence driven by apoptosis. The hair growth cycle can be categorized into three distinct phases: the anagen phase, which represents the active growth phase; the catagen phase, which signifies the transitional phase; and the telogen phase, which denotes the resting phase of the hair follicle. The anagen phase represents a period of active growth in which the hair

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follicle undergoes enlargement to achieve its characteristic onion shape and produces a hair fiber. This phase is further categorized into six stages (I–VI). Throughout anagen I–V (proanagen), hair progenitor cells undergo proliferation, encase the growing dermal papilla, extend downwards into the skin, and initiate differentiation into the hair shaft and IRS. Subsequently, the nascent hair shaft commences development, while melanocytes within the hair matrix exhibit pigment-producing activity. In anagen VI (metanagen), complete restoration of the hair fiber-producing unit occurs, marked by the formation of the epithelial hair bulb encircling the dermal papilla situated deep within the subcutaneous tissue, and the emergence of a new hair shaft from the skin surface. This phase may persist for numerous years within hair follicles. The catagen phase commences once the anagen growth phase concludes. At the onset of the catagen phase, there is a notable decline in the differentiation and proliferation of hair matrix keratinocytes. Additionally, the melanocytes cease their pigment-producing activity, and the production of hair shafts reaches completion. This particular stage persists for a limited duration of a few weeks. The telogen phase commences subsequent to the catagen phase; the hair enters a period of rest, which can range from a few weeks (eyelashes) to eight months (scalp hair). Even though there is no growth of hair during this phase, the dermal papilla remains in a state of rest. Telogen hair follicles are identified by the absence of pigment- producing melanocytes and the IRS. Their dermal papilla is closely linked to a small cap of secondary hair germ keratinocytes that contain hair follicle stem cells.

- **HIGHLIGHT OF HAIR SERUM**

Hair serum is the styling product that coats the surface of the hair knownas hair serum.

It is basically a hair care product in liquid form, its consistency thickerthan water.

Hair serum is not just meant for hair styling. They are also for treating multiple hair concerns like dry hair, dull hair, and unmanageable hair.

Hair Serum are the benefits are following :-

- **Benefits of Hair Serum**

1. **Smoothens Hair**: Reduces frizz and flyaways by sealing the hair cuticle.
2. **Adds Shine**: Gives hair a glossy, healthy-looking finish.
3. **Protects from Damage:** Shields hair from heat (like blow dryers or straighteners), humidity, and pollution.
4. **Detangles Hair:** Makes hair easier to comb and manage, especially for those with curly or coarse textures.
5. **Reduces Hair Breakage**: Minimizes friction and breakage during styling or brushing.
6. **Improves Hair Texture:** Softens rough or dry hair, making it feel silkier.

- **Suitable types of hairs for using hair serum**

_ Stick straight .
_ Straight.
_ Wavy big curls.
_ Small curls[12]

- **ADVANTAGES OF HAIR SERUM**

1. Hair serum serves as a multi-purpose product, effectively smoothening, softening, and imparting silkiness to your hair
2. Additionally, it acts as a protective shield for your hair against environmental aggressors, making it suitable for both pre-styling preparation and as a finishing touch.
3. Whether you're styling with heat tools or looking to safeguard your hair afterward, hair serum is versatile and can be used before or after heat styling.
4. One of its notable benefits is its ability to control frizz, especially useful for those with weak or damaged hair, as it helps reduce the appearance of fizziness and dryness.
5. Hair serum enhances the overall smoothness of your hair, making it look sleek and well-maintained.
6. Its anti-frizz properties contribute significantly to improving the overall smoothness and appearance of your hair.
7. Hair serum is also effective at reducing tangles, making your hair more manageable, while simultaneously promoting a healthy shine

- **SIDE EFFECTS OF USING HAIR SERUM**

1. Consistent and excessive use of hair serum can result in dry and unhealthy hair.
2. Applying serum directly to the scalp may cause inflammation.
3. Some hair serums contain silicones, which may have long-term negative effect on hair health.
4. It's advisable to avoid applying serum to the scalp to prevent excessive Oiliness and potential inflammation

Methods of Preparation of Hair Serum

1.Oil-Based Serum Preparation

This is suitable for frizz control, shine, and nourishment.
Ingredients: Carrier oils (e.g., argan, jojoba), essential oils (e.g., lavender, tea tree), silicones (optional), vitamin E, and fragrance.

An oil-based formulation, also known as an oil dispersion (OD) or oil- in-water emulsion, is a type of formulation where an active ingredient (like a pesticide or drug) is dispersed or dissolved in an oil-based carrier. This formulation is often used for water-sensitive active ingredients and can offer advantages like better spray retention, spreading, and foliar uptake.

2.Water-Based or Emulsion-Based Serum

For lighter formulations (non-greasy), often leave-in types.
Ingredients: Water phase (distilled water, hydrosols), oil phase (light oils or esters), emulsifier (e.g., polysorbate 20, lecithin), humectants (e.g., glycerin, panthenol), preservatives, and actives.

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A water-based formulation is one where water is used as the main solvent or dispersing agent instead of organic solvents. This approach offers several advantages, including reduced environmental impact, improved indoor air quality, and ease of cleanup. Water-based formulations are widely used in various applications, including adhesives, paints, coatings.

Chemicals

1. Argan oil

BIOLOGICAL SOURCE*: Argania spinosa L.*

COMPOSITION: about 80% of unsaturated fatty acids and only approximately around 19 g/100 g saturated fatty acid.

Argan Oil Benefits

The fats and in argan oil can help your body stay healthier.

Its high concentration of vitamin E means it's effective in boosting the immune system. It also helps your body maintain and repair your eyes and skin.

Other health benefits of argan oil include:

Cholesterol control

The fatty acids in argan oil can help boost your levels of "good" cholesterol and lower potentially reducing your chances of heart disease.

Cancer-Fighting Properties

Some early studies show that argan oil compounds may slow cancer growth and kill more cancer cells.

Anti-Aging

Applying argan oil to your skin can help support skin health and elasticity. This results in skin that is slower to sag or wrinkle, warding off common signs of aging.

Wound Healing

The same properties that make argan oil helpful for keeping skin looking young may also help wounds heal. The antioxidants found in argan oil can help reduce inflammation. One early study showed that burns heal faster when you apply argan oil regularly, but scientists still need to do human trials**.**

STRETCH MARKS

Some research shows argan oil could improve your skin's elasticity, whether you apply it to your skin or consume it.

Is Argan Oil Good for Your Hair?

The evidence for this is unclear. While one review found no meaningful evidence that argan oil improves hair growth or quality, other studies suggest potential benefits, including hair protection. Another study found that argan extract, which has argan oil, may enhance cell growth in hair follicles while preventing inflammation and other harmful reactions in your body.



FIG.Argan Oil

2. Sorbitol

What is Sorbitol?

Sorbitol is a polyalcohol containing more than one hydroxyl group. But what do we make out of this? The multiple hydroxyl groups closely packed together make it one of the most versatile naturally-occurring compounds.

Sorbitol Uses

It's the chemical structure of sorbitol that helps the body in several ways. Despite being sweet it is poorly absorbed by the body. As it does not hike the glucose levels in the body, it is touted as a 'healthy sugar'. It is used in chewing gums, toothpaste, bakery and confectionery items, diet drinks, and ice creams as a sugar-free sweetener.

Its polyalcohol structure also adds to its ability to attract and retain moisture, making it a perfect humectant. No wonder it is an important addition to cosmetic formulations such as creams, lotions, and serums.

Its mild laxative properties make it an effective remedy against constipation. It is also used in cough syrups for its sugar-free sweet taste and as a slip agent.

Sorbitol for Hair

Of the many diverse sorbitol uses, the beauty benefits of sorbitol are profound. Its innate properties as a humectant with a thick and slippery texture make it a vital ingredient in skin and hair care products

Role of Sorbitol in Hair Care Products

The hair care products are either water-based or oil-based. We pick products based on our hair texture. In both products properties of humectant and surfactant become important. Sorbitol compounds bind oil and water molecules together making hair nourished and healthy. As a surfactant, the compounds bind with dirt and grime, making cleaning easier and more effective.

Benefits of Sorbitol for Hair

Now that we know what is sorbitol used for, let's understand more about its benefits for hair health.

Well, hair hydration is the primary advantage of sorbitol. Its use traps the moisture within the hair strands. This reduces dryness and makes the hair soft and more manageable.

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Remedy for Hair Fall
Once the scalp is nourished and the hair strands are well hydrated, don't you think the problem of hair fall gets sorted automatically? Hydrated hair is less prone to breakage and hair fall.

Helps in Hair Cleansing
Do you know that Sorbitol compounds have a surfactant action? As the dirt, oils, and impurities from the hair and scalp bind with the sorbitol compounds they turn water-soluble. This makes rinsing and cleansing easier.

Improves Hair Texture
Sorbitol has a slippery texture and lubricating feel. It is hygroscopic which helps it attract and absorb water molecules from its surrounding environment. This makes the hair soft, shiny, smooth and tangle-free.

Adds to Hair Elasticity
Do you know about the plasticizer abilities of sorbitol? The innate property of sorbitol adds to hair elasticity, increasing its tensile strength.

Increases Hair Volume
A healthy scalp and happy hair prolongs the anagen phase or the active growth phase of the hair. This gradually leads to increased hair

Fig. Sorbitol



3. Peppermint Oil
Peppermint oil can be a great addition to a hair serum formulation due to its potential benefits for hair and scalp health. Here's a possible formulation:

Benefits of Peppermint Oil for Hair
1. Cooling sensation: Peppermint oil can provide a refreshing and cooling sensation on the scalp.
2. Stimulating hair growth: Peppermint oil may help stimulate hair growth by increasing blood flow to the scalp.
3. Reducing dandruff: Peppermint oil's antifungal and antibacterial properties may help reduce dandruff and other scalp irritations.[20]

Hair Serum Formulation Ingredients
1. Peppermint oil: 5-10% (depending on individual tolerance)
2. Carrier oils: Jojoba oil, argan oil, or coconut oil (70-80%)
3. Essential oils: Optional (e.g., lavender oil, rosemary oil)
4. Vitamin E oil: Optional (antioxidant properties)

Formulation
1. Mix peppermint oil with carrier oils: Combine peppermint oil with jojoba oil, argan oil, or coconut oil in a small bowl.
2. Add essential oils (optional): Add a few drops of lavender oil or rosemary oil for their potential benefits.
3. Add vitamin E oil (optional): Add a few drops of vitamin E oil for its antioxidant properties.
4. Blend well: Mix the ingredients thoroughly.

Usage
1. Apply to hair ends: Apply a small amount of the serum to the ends of your hair, working your way up to the mid-lengths.
2. Massage into scalp: Gently massage a small amount of the serum into your scalp to stimulate hair growth and reduce dandruff.

Precautions
1. Skin sensitivity: Perform a patch test before using peppermint oil, especially if you have sensitive skin.
2. Allergic reactions: Discontinue use if you experience any allergic reactions or irritation.

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Fig. Peppermint Oil

4. Almond Oil

The almond fruit is categorized as a drupe, consisting of an outer hull and a hard shell enclosing the seed, which is distinct from a true nut.

The process of shelling almonds involves removing the outer shell to access the seed. Almonds are available for purchase both in their shelled and unshelled forms. Blanched almonds refer to shelled almonds that have undergone a treatment involving hot water to soften the seedcoat, which is subsequently removed to reveal the white embryo. Once cleaned and processed, almonds have a good shelf life. Almonds are a staple in various cuisines and are frequently featured in desserts like marzipan.[22]

These trees thrive in a Mediterranean climate characterized by moderate temperatures and cool winters. While they are native to regions such as Iran and the Levant, it's rare to find wild almond trees in their original habitats today. Almonds have a rich history of domestication, dating back to the Early Bronze Age, as evidenced by archaeological findings in the Middle East.

They have since spread across the Mediterranean region and similar arid climates with cool winters. One notable aspect of almonds is their ability to produce quality offspring entirely from seed, without the need for suckers or cuttings.

Benefits of Almond Oil for Hair

1. Moisturizing: Almond oil helps hydrate and moisturize hair, reducing dryness and frizz.
2. Nourishing: Rich in vitamins and minerals, almond oil helps nourish and strengthen hair follicles.
3. Protective: Almond oil's antioxidant properties help protect hair from damage caused by free radicals.
4. Shine and softness: Almond oil can add shine and softness to hair, making it look healthy and vibrant.

Using Almond Oil in Hair Serum

1. Mix with other oils: Blend almond oil with other oils, such as argan oil or coconut oil, to create a nourishing hair serum.
2. Use as a leave-in treatment: Apply a small amount of almond oil to the ends of your hair, working your way up to the mid-lengths, to help lock in moisture and reduce frizz.
3. Add to hair masks: Mix almond oil with other ingredients, such as honey or avocado, to create a nourishing hair mask.

Tips for Using Almond Oil

1. Choose sweet almond oil: Sweet almond oil is generally considered safer for hair and skin than bitter almond oil.
2. Use a small amount: Start with a small amount of almond oil and adjust as needed to avoid greasiness.
3. Be patient: Almond oil can take time to absorb into hair, so be patient and give it a few hours or overnight to work its magic.



Fig. Almond Oil

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1. **Glycerin**

Glycerin is a popular ingredient in hair serums due to its ability to:

Benefits of Glycerin in Hair Serum

1. Lock in moisture: Glycerin helps retain moisture in hair, reducing dryness and frizz.
2. Hydrate hair: Glycerin attracts and retains moisture from the air, helping to keep hair hydrated.
3. Smooth hair cuticle: Glycerin can help smooth the hair cuticle, reducing frizz and adding shine.

How Glycerin Works

1. Humectant properties: Glycerin's humectant properties allow it to attract and retain moisture.
2. Moisture balance: Glycerin helps maintain a healthy moisture balance in hair.



Fig. Glycerin

METHODOLOGY

Silicone-Based Serum

Popular for smoothening and shine with a non-oily feel. Ingredients: Argan oil , Almond oil, Sorbitol, Glycerin. amount

1. **Preparation**
   Ensure all equipment (beaker, stirrer, etc.) is clean and dry. Use glass or stainless steel beakers.
2. **Mixing Phase A**
   Add sorbitol, glycerin ,into a clean beaker no. 1 Add argan oil, almond oil into a beaker no.2
   Begin mixing slowly using a mechanical stirrer or overhead stirrer.
3. **Incorporate Additives**
   Add fragrance and preservative under continuous stirring. Add colorant if desired (ensure it's silicone oil-soluble).
4. **Homogenization**
   Mix gently but thoroughly for at least 10–15 minutes. Avoid high-speed mixing to prevent air entrapment and foaming.
5. **Filling**
   Fill into serum pump bottles or glass dropper bottles while still fluid Allow to stand to remove air bubbles, or degas if necessary.
   6.**Stability Testing**: Conduct pH, viscosity, and stability tests under different conditions (RT, 4°C, 40°C).

FORMULTION TABLE

Sr no.	Ingredient	Function	F1	F2
1.	Argan oil	Nourishing oil	10ml	10ml
2.	Almond oil	Softening oil	8ml	5ml
3.	Glycerin	Humectant	2.5ml	3ml
4.	Sorbitol	Shine enhancer	5ml	5ml
5.	Emulsifying agent (optional)	Oil -water phase mixing	6 ml	3ml
6.	Preservative	Prevent microbial contamination	1g	1g
7.	Distilled water	Base	17ml	17

Preformulation Studies

1. **Identification and Characterization of Active Ingredients**
   - Solubility (in water, alcohols, oils)
   - Partition coefficient (hydrophilic vs lipophilic nature)
   - pKa and pH stability range
   - Thermal stability
   - UV absorption (if photostability is a concern)
   - Viscosity behavior in different solvents[17]
2. **Excipient Compatibility**
   Check interactions between actives and excipients (e.g., emulsifiers, preservatives, humectants, oils).
   Use techniques like DSC (Differential Scanning Calorimetry), FTIR, and HPLC for compatibility analysis.
3. **Vehicle and Base Selection**
   Oil-based, water-based, or silicone-based depending on hair type and ingredient solubility.
   Evaluate spreadability, greasiness, absorption rate, and sensory feel.
4. **pH Optimization**
   Determine the ideal pH for scalp and hair compatibility (typically pH 4.5–6.5).
   Ensure pH stability over time.

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EVALUATION OF THE HAIR SERUM

1. **Visual Examination for Physical Appearance:** The prepared herbal hair serum was visually examined to assess its physical appearance, colour, and texture. The outcomes of this examination are summarized.
2. **Homogeneity Test:** To test the homogeneity of the herbal hair serum, a clean and dry glass object was coated with the serum, and a cover glass was then sealed over it. The sample was inspected under light to identify any coarse particles or signs of non-uniformity. This test aimed to detect lumps, flocculates, or aggregates within the serum.
3. **pH Test:** The pH meter was calibrated using pH 4 and pH 7 buffer solutions. Subsequently, the pH electrode was immersed in the hair serum and allowed to stabilize for a few minutes until the pH reading normalized. This test measured the acidity or alkalinity of the serum.
4. **Viscosity Measurement** Viscosity measurement was carried out using a Brookfield viscometer (RVDV-II+PRO) with spindle number 6. In a beaker, 50 ml of the hair serum was placed, and the viscosity was measured at various rotational speeds, including 10, 20, 50, and 100 rpm. This test provided information about the thickness and flow properties of the serum.
5. **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 20x 20 cm.

RESULT

Sr no.	PARAMETER	RESULT -1	RESULT -2
1.	Physical Appearance		
	○ Colour	Whitish Yellowish	Light Yellowish
	○ Odour	Characteristics	Characteristics
	○ Texture	Soft	Soft
2	pH	6.5	4.5
3.	Homogeneity test	Better	Good
4.	Viscosity	Medium	Medium
5.	Spreadability test	Easily spreadable	Easily spreadable

FUTURE SCOPE

1. **Natural and Sustainable Ingredients**
Plant-based actives (e.g., peptides, oils, plant stem cells)
Biodegradable polymers as conditioning agents , Eco-friendly preservatives.Growing demand for vegan and cruelty-free formulations.
2. **Targeted Treatments**
Serums for specific hair concerns like hair fall, frizz, greying, dandruff, or scalp sensitivity , Age-specific formulations (e.g., for hormonal changes or aging scalp
3. **Advanced Delivery Systems**
Nanotechnology for better penetration and sustained release of actives
Encapsulation techniques to protect and deliver sensitive ingredients (e.g., vitamins, antioxidants)
4. **Customization and Personalization**
AI-driven tools for recommending serums based on scalp microbiome, hair type, or genetic data
DIY kits or customizable serum bases with add-ins
5. **Multifunctional Products**
Hybrid products combining styling, protection, and treatment UV protection, heat protection, pollution shield in one formula
6. **Clinical and Scientific Backing**
Formulas backed by clinical trials and dermatological testing, Use of biomimetic ingredients to mimic natural hair and scalp repair processes

CONCLUSION

Hair follicles have receptors for DHT, which can lead to the shrinkage of dermal papillae cells, resulting in atrophy of the stem cells.Therefore, finding a definitive solution for hair loss remains a complex and elusive challenge. Consulting a healthcare professional or dermatologist for personalized advice is often recommended for those experiencing significant hair loss concerns.Human hair is widely regarded as a symbol of beauty in humans. The scalp,covering the cranium and the area where hair grows, is a critical element for hair growth. Composed of soft tissue layers, the scalp hosts numerous hair follicles and sebaceous glands. The pH level of the scalp is approximately 5.5, while that of the hair shaft is around 3.671. This slight acidity of the scalp helps maintain hair and skin health. However, the scalp is susceptible to various mycotic infections due to the presence of sebaceous glands and cyclic environmental changes

SUMMARY

The hair follicle holds a pivotal role within the mammalian system,influencing appearance,gender distinctions, and serving as a crucial element fortemperature regulation and self-defence. One of the factors contributing to hair loss is the alpha reductase enzyme, which converts testosterone into Dihydrotestosterone (DHT). . Hair serum serves as a multi-purpose product, effectively smoothening,softening, and imparting silkiness to your hair Additionally, it acts as a protective shield for your hair against environmental aggressors, making it suitable for both pre-styling preparation and as a finishing touch. Wound healing The same properties that make argan oil helpful for keeping skin looking young may also help wounds heal. The antioxidants found in argan oil can help reduce inflammation. One early study showed that burns heal faster when you apply argan oil regularly, but scientists

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still need to do human trials.

DISCUSSION

- The Present work of herbal hair Serum was evaluated for its organoleptic properties, physical properties and its Evaluation.
- The prepared formulation of herbal hair serum showed non- irritant effect on hairIt also has nourishment and smoothness effects.
- The formulation was found in yellowish colour with oily consistency and smooth texture.The formulation was found in yellowish colour with oily consistency and smooth texture

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