PREPARATION AND EVALUATION OF HERBAL SCALP SERUM

Submitted to

ATMIYA UNIVERSITY

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DECLARATION

We, all hereby declare the Work is presented in the project report entitled Preparation and Evaluation of Herbal Scalp Serum.

It is an authentic record of work carried out by us during the studying period of semester 8 at and under the guidance of Atmiya University, Rajkot, and is being submitted for partial fulfillment of the requirement for the award of a bachelor's degree in B.pharm. This is not submitted anywhere else for the award of any other degree/diploma.

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ABSTRACT

Nowadays, a lot of individuals use cosmetics regularly and they are highly in demand in daily life. The reason that herbal cosmetics are so popular is that they offer greater safety and protection with fewer side effects. Individuals who are going through hair loss are looking for strategies to both stop and boost hair growth. Scalp serums are a common therapy hair for dry scalps because they hydrate the skin beneath the hair. Amla, bhringraj, and coffee are among the concentrated elements that make up the mixture. Coffee extract (Coffea Arabica) may encourage the growth of new hair and protect our scalp from harm. Eclipta alba (Bhringraj) treats balding, premature greying, split ends, dandruff, and hair loss. Phyllanthus Emblica Linn (Amla), is one of the essential minerals. Moreover, it encourages pigmentation, hair development, and the avoidance of greying. The aqueous extract of coffee, bhringraj, and amla was combined with vitamin E, aloe vera, biotin, tween 20, D-panthenol, and essential oils of cinnamon oil, castor oil, lavender oil, and to enhance the effects on the scalp. Upon evaluation, the manufactured medicated scalp serum had a brown color. The pH of the formulation was shown to have strong antibacterial activity and to be stable in the stability chamber.

Keywords: *Hair Growth, Scalp Serum, Biotin, Urtica diocia, Eclipta Alba, Phyllanthus Emblica.*

1. INTRODUCTION

- A healthy head of hair is defined as having shine, being silky, long, and satiny, having lots of volume, and showing no signs of thinning at the roots or dandruff. (1)
- To that end, the hair care business has provided us with an abundance of tools to enhance, upgrade, strengthen, and maintain our hair. (2)
- Hair care products are intended to provide added benefits, such as strengthening hair, making it easier to manage, or mending damage. Additionally, there are remarkable products for treating particular hair problems, including dandruff. (3)
- Hair has an aesthetic purpose in humans, influencing our look.
- The structure of hair is intricate, consisting of numerous parts that work together to protect the scalp and improve physical appearance.
- Herbal hair serum is a type of styling product that is applied to the hair's surface.
- It is a liquid hair care solution with a thicker viscosity than water.
- Hair serum with herbal ingredients is not limited to hair styling. They can also be used to address a variety of hair issues, such as dull hair, dry scalp, and scalp moisturizer.
- For varying hair goals, there are several kinds of hair serum. Hair serums can straighten hair, add gloss, or lessen frizz depending on the formula.
- This style product with an herbal base is meant to be applied to the hair's surface to help enhance shine, smoothness, hydration, humidity, and protection from pollutants.
- One problem and many hair problems can be resolved with a herbal hair serum. It's referred to as a one-stop shop for all hair problems for a purpose.

1.1. COSMETICS

As per the D & C Act 1940 and Rule 1945, Cosmetics means any particle intended to be rubbed, poured, sprinkled or sprayed on, or introduced into, or otherwise applied to the human body or any part thereof for cleansing, beautifying, promoting attractiveness, or altering the appearance and including any article intended for use as a component of cosmetics. (3,6)
Examples: Hair Care, Skincare, Oral care, Etc.

1.2. HERBAL COSMETICS

"Natural Cosmetics or Herbal Cosmetics" refers to goods that are developed with several approved cosmetic elements to form the basis in which one or more herbal substances are employed to provide specific cosmetic benefits entirely (7). Herbal cosmetic products are mixtures made with phytochemicals from various botanical sources that affect how the skin functions and provide the nutrients required for healthy skin and hair (8). In addition, there is a widespread misconception that beauty care products with synthetic ingredients are bad for the skin. This misconception was sparked by consumers' growing understanding of the benefits of herbal goods, which in turn drove demand for natural products and natural extracts in cosmetic formulations (9).

1.3. SCALP (10)

Anatomically, the scalp is bounded at the front by the human face and at the sides and back by the neck.

Layers of soft tissue cover the skull in the scalp.

- The layer of skin on the head that the head hair grows from. It has many hair follicles and sebaceous glands.
- Connective tissue. a substantial layer of stringy tissue and fat beneath the epidermis that houses the scalp's many nerves and blood arteries.
- The upcoming layer is known as the aponeurosis or Galea aponeurotica. It is the thick, stringy, tough layer of tissue that extends from the frontalis muscle in the front to the occipitalis in the back.
- Between the top three layers and the pericranium, the loose layer of areolar connective tissue offers an easy plane of separation. This layer is also known as the "danger zone" due to the ease with which infectious organisms can pass through it and into the emissary veins that drain into the skull. The free Collagen packets at random make up the areolar tissue in this layer.
- The membrane that covers the outer layer of the skull bones and gives them nourishment and the ability to heal itself is called the pericranium. It is made up of amorphous connective tissue.

1.4. HAIR AND SCALP CARE

Despite their apparent separation, hair and scalp care are related since hair grows from the skin. To ensure optimum hair product, scalp skin needs to be maintained in good health, just like any other part of the body. Taking good care of our hair and scalp is essential for our general hygiene as well as attractiveness. Exfoliation will be used as part of a scalp treatment to remove dead skin cells and restore a healthy layer of skin.

Although hair grows from beneath the skin, hair care and scalp care are related despite their apparent differences. Maintaining healthy scalp skin is essential for using quality hair products, much like any other part of the body. Taking care of our hair and scalp is essential for both our general hygiene and aesthetic appeal. To remove all the dead skin and restore a layer of healthy skin to the scalp, an exfoliation procedure will be used.

The majority of them are gels, moisturizers, serums, conditioners, and cleaners.

1.5. SCALP SERUM

Targeting particular skin and hair care industries, serum is a concentrated form of significant, small-molecule active ingredients. You may alternatively think of serums as topical medications with a thin consistency and high concentrations of active ingredients. While several serum formulas may be used on both hair and scalp, hair and scalp serums differ in that one concentrates on the former while the other does not (11).

1.5.1 BENEFITS OF SCALP SERUM (42)

- Scalp serum minimizes hair loss and encourages hair growth.
- It protects and stimulates hair roots.
- It hydrates the scalp and stops hair breakage and split ends.
- Prevents fungal growth and reduces dandruff.
- It Protects from sunlight
- Increase blood circulation.

1.5.2 TYPES OF SERUM AVAILABLE FOR HAIR AND SCALP: (12)

i. Oil based Serum
ii. Spray serum
iii. Water-based Serum
iv. Silicone-based serums
v. Serums for other issues

i. **Oil-based serum:**

An oil-based serum is a concentrated treatment formulated with various oils such as argan, coconut, jojoba, or avocado oil, often combined with vitamins, antioxidants, and other beneficial ingredients.

ii. **Spray serum:**

Moroccanoil Glimmer Shine Spray: this spray contains argan oil to enhance shine and control frizz. It can be added to both wet and dry hair to add a luminous finish.

- OGX Renewing + Argan Oil of Morocco Weightless Healing Dry Oil: this lightweight spray serum is infused with argan oil to help hydrate and soften hair, leaving it smooth and shiny without weighing it down.
- Biosilk Silk Therapy Shine-on Spray: this spray serum is enriched with silk proteins to add shine and protect hair from UV damage.

iii. **Water based serum:**

A water-based serum for hair typically contains water as the main ingredient, along with various active ingredients to address specific hair concerns. Here are some examples of a water-based serum used for hair: glycerine, panthenol, aloe barbadensis leaf juice, hydroxyethylcellulose, phenoxyethanol, ethylhexyglycerin, etc.

iv. **Silicone-based serum:**

Here are some examples of silicone-based serums for hair:

- Moroccanoil Treatment
- John Frieda Frizz Ease Extra Strength Serum
- OGX Renewing Moroccan Argan Oil

- Pantene Pro-V Smooth Serum with Argan Oil
- TRESemme Keratin Smooth Shine Serum

v. **Serum for other issues:**

Hair serums are lightweight, often silicone-based products designed to coat the hair's surface, providing various benefits like smoothing frizz, adding shine, and protecting against heat damage. Here are some common types of serums used for hair:

- Smoothing serums
- Shine serum
- Heat protectant serum
- Repairing serum
- Colour protectant serum
- Moisturizing serum
- Volumizing serum
- Styling serum

- Scalp serums are becoming more and more popular as a treatment for dry scalps because they are designed to nourish the skin behind your hair. Usually, they are leave-in conditioners designed to instantly nourish, moisturize, and tame hair. Medicated scalp serums are made with active ingredients chosen to treat certain medical disorders such as alopecia, dandruff, and seborrheic dermatitis. The benefits of cosmetics products and the effectiveness of medical agents are combined with the components of cosmetics technology and medical medicines (4, 9).

1.5.3 IDEAL CHARACTERIZATION OF SCALP SERUM (3, 13)

- They must be gentle to the hair and scalp; they cannot dry out or harm it.
- Long lasting effect.
- Makes hair easier to comb and glossier and silkier.
- Not allergenic and easily absorbed.
- Should be easy to use.
- Need to make an impact on a region.
- It should be simple to apply and remove.

1.5.4 ADVANTAGES OF SCALP SERUM (5, 9)

- Nourishes and hydrates the scalp and hair.
- They help create strong, glossy, and shiny hair. conditions hair and softens the scalp.
- They prevent hair damage caused by free radicals.

- Medicated serums, which are used to treat split ends, dandruff, hair loss, scalp infections, and other conditions, have antibacterial properties.
- They can be used to stop hair loss and stimulate hair growth.
- Herbal ingredients are becoming more and more popular in serums and other cosmetic products due to their positive effects, which include reduced side effects and improved compliance. Numerous hair preparations contain a variety of plants, including amla, Brahmi, henna, aloe vera, bhringraj, neem, and Tulsi.

1.6 HUMAN HAIR: ANATOMY AND PHYSIOLOGY

1.6.1 ANATOMY OF HAIR

The epidermis gives rise to hair. Hair is made up of thin, flexible tubes of fully keratinized, dead epithelial cells on the outside, yet it is a component of individual living cells inside the skin.

Hair follicles, subcutaneous fat, and cylindrical epithelial down growth into the dermis that swell at the base into the hair bulb around the dermal papilla generated from mesenchymal tissue. (17)

Hair is made up of two distinct structures: the hair shaft, which is visible on the surface of the body, and the follicle in the skin (Fig.1).

The hair shaft consists of two parts: cortex and cuticle cells, while in some cases it also consists of a medulla in the central region. The majority of hair fibre composition is represented by the cortex, whereas the medulla is the core portion of the hair. The cortex plays a significant role in the mechanical and physical aspects of the hair and is the peripheral component of hair, comprising roughly 50–60% microfibrils, which consist of rods of microfibrils embedded into a matrix (19). The cuticle cell comprises multiple sub-lamellar structures, including the epicuticle, A-layer, exocuticle, endocuticle, and inner layer, in addition to the cell membrane complex. Typically, each cuticle cell has a thickness of 0.3 to 0.5 µm and a visible length of approximately 50 µm (19). The part of the follicle that actively generates hair is called the hair bulb. The follicular dermal papilla, dermal papilla cells, nerve fibers, mucopolysaccharide-rich stroma, and a solitary capillary loop are all enclosed by it. Two sections may be seen in the hair bulb: an upper region containing differentiated cells and a lower region containing undifferentiated cells.

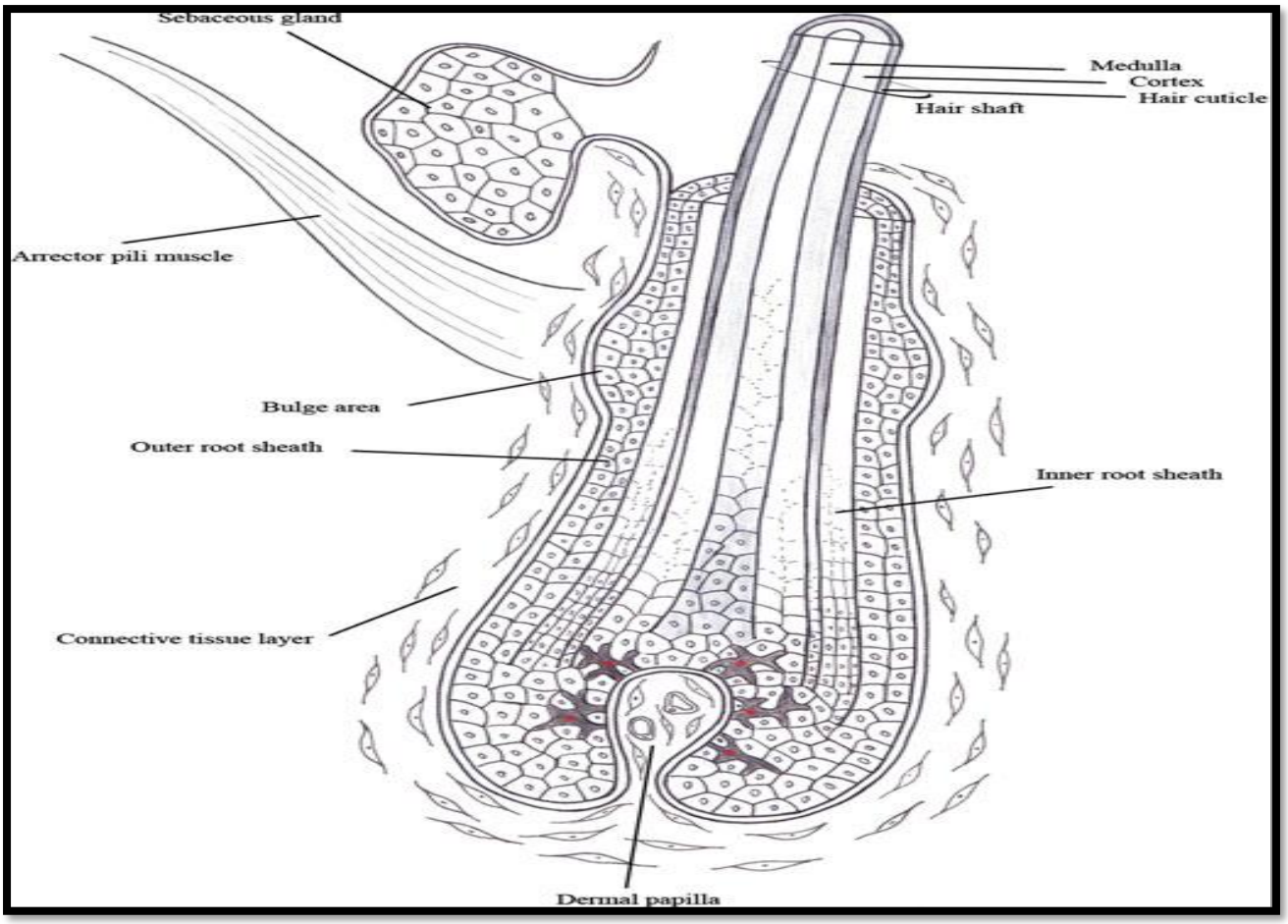


Figure 01: Hair and its follicle

1.6.2 PHYSIOLOGY OF HAIR: HAIR GROWTH CYCLE

Hair is the result of multiple keratinocyte layers in the hair follicle working together. The process of developing hair is dynamic and cyclical, with multiple hormones and cytokines coordinating the length of growth cycles (51, 52). Other factors that affect this process include the individual's age and developmental stage, dietary habits, and environmental changes like day length. Hair follicles grow in cyclical patterns where phases of fast growth and hair shaft creation alternate with phases of relative hair follicle quiescence and regression caused by apoptosis (22, 23). Specifically, there are four separate phases to the hair development cycle: [1] the anagen, or growth phase; [2] the catagen, or transitional phase; [3] the telogen, or resting period and,[4] the exogen phase, or shedding phase.

i. Anagen (phase of growth):

- The longest period lasts between three and five years, but frequently seven years or longer.
- Pubic and eyebrow hairs grow at a shorter phase than scalp hairs.
- Hairs that will develop further are being pushed out by hair follicles.

- At any given time, 90% of all hairs are in this phase.
- As the anagen phase lengthens over time, hair is thinner and weaker with each cycle.

ii. Cetagen Phase (Regression Phase):

- The hair follicle shrinks and separates from the dermal papilla during ten days.
- Following this stage, hair growth slows down.
- At any given time, 5% of all hairs are in this phase.

iii. Telogen Phase (Resting Phase):

- Duration: 3 months.
- 10%–15% of all hairs are in this phase at any given time; hair doesn't grow during this phase, which is why it's referred to as the resting phase.

iv. Exogen Phase (Shedding Phase):

- Time frame: two to five months.
- The last stage of the hair growth cycle.
- The hair shaft stops growing and the hair follicle stays dormant.
- At any given time, 15% of all hairs are in this phase.
- Hair shedding promotes the growth of new hair.
- Hair fallout through brushing and washing.
- 50 to 100 hairs fall out per day, which is normal.
- Because 75–100 hairs are lost per day, the exogen phase is sometimes referred to as the shedding phase.

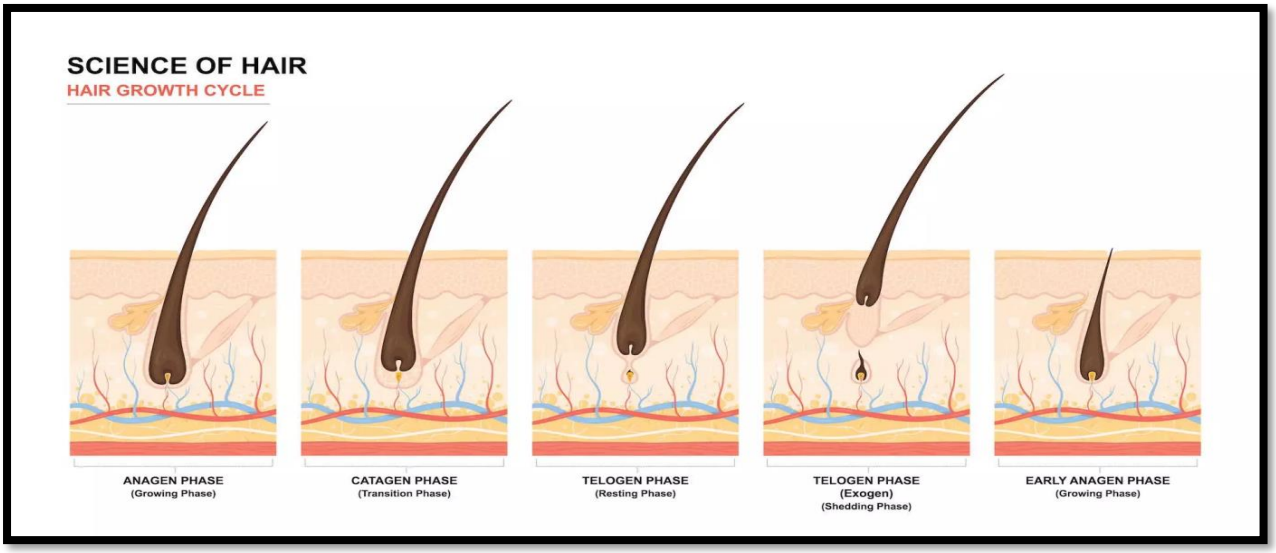


Figure 02: Hair Growth Cycle

1.6.3 PROBLEMS RELATED HAIR

The human body's hair is an essential component. The issues that come with it include dullness, dandruff, hair thinning, hair loss, conditioning, lack of volume, and juvenile greying. Hairs vary in diameter, shape, color, and length.

Every mammal has hair. Its primary function is to control body temperature. To protect itself from sunlight, it also wants to reduce friction. Hairs on the scalp used to be believed to serve as a protective covering (42).

a) Dandruff

Dandruff is the term for tiny, white bits of dead skin that fall out of a person's hair. It appears to be brought on by the fungus Malassezia restricta, while Globose—formerly known as Pittosporum—may be a yeast that infects the skin and scalp. Lack of hair brushing, allergies, insufficient washing, etc. are the causes.

b) Hair Loss

Hair loss is also frequent in women, even though it has historically been more common in men. Common causes of female hair loss include menopause, stress, medication, and hormone changes. Many hair styling products may exacerbate hair loss.

c) Split end

Split ends are caused by over-brushing, excessive perming, overheating, and using poor-quality conditioner. Split ends can result from hair care practices like blow drying, straightening, and curling as well as exposure to harsh weather.

d) Gray hair

Gray hair is seen by many as a sign of distinction. However, some people would rather get rid of it because grey hair can be more fragile and troublesome than other hair types.

e) Dry Hair

Over-shampooing leads to dry hair. While having spotless hair may seem ideal, many people go overboard and wash their hair once, twice, or even more often than necessary, which removes all of the natural oils from their hair.

f) Dull hair

Dull-looking hair can have a variety of causes, including environmental pollutants and chemical or heat styling damage.

g) Oily Hair

Sebum, a natural oil produced in excess by the scalp, is the cause of oily hair. Sebaceous glands create sebum, which results in excessive oil production.

2. LITERATURE REVIEW

TABLE 1

Name of Author	Remarks
Shaun C. Desai, MD; Jordan P. Sand, MD; Jeffrey D. Sharon et. al. [2015]	Layers of soft tissue cover the skull in the scalp. Layer of scalp: layer of skin, connective tissue layer, galea aponeurotic, loose areolar connective tissue, and pericranium.
Barbara Buffoli, Fabio Rinaldi, MD, Mauro Labanca, et. al.	Anatomy and physiology of human hair
Ralf Paus, vol. 25 [1998]	Hair growth cycle, various phase of hair growth cycle: anagen, cetagen, telogen, exogen
Alicia, M. G. [2021, June 1]	Various hair growth shampoos are available in the market for the treatment of hair growth. But the problem comes over it is that after applying the shampoo the scalp can be rinsed off within 2-3 minutes. So, the serum is used, which is a product that hydrates the scalp and promotes hair growth without leaving an oily feeling or there is no need to rinse it off
Amey Lanjewar, Soni Maurya, Devendra Sharma, Anchal Gaur [March 2020]	Scalp serum: Benefits of scalp serum like prevents hair loss, encourage hair growth, hydrates the scalp, increases hair length,etc
Janos Zempleni [2005]	Mechanism of Biotin: it also functions as a coenzyme for a variety of carboxylases, converting acetyl-CoA's irreversible carboxylation to malonyl-CoA.
Said HM, Ortiz A, McCloud E, et. al. [Nov. 1998]	Overconsumption of biotin may result in stomach distress, even though it is a vitamin with little adverse effects. Human colonic epithelial cells absorb biotin by a carrier-mediated mechanism.
Punyani S., Tosti A., Hordinsky M., et. al., [January 1, 2021]	The disadvantage of applying the shampoo is that: Under cleaning could result in the accumulation of toxic stimuli, while overcleaning could cause surface degradation.
Wattanutchariya W., Seesuriyachan P., Arree B., et. al.	Decreasing hair loss and encouraging new hair development. Coffee is commonly used as a flavoring agent. Aid in accelerating hair development by stimulating your hair follicles.
Ruchi Tiwari, et al., Vol. 15, [2021]	Development and Evaluation of Herbal Hair Serum Method of preparation of herbal scalp serum.
Sumangala BK, Kalpana P, Aishwariya T, et al., Acta Scientific Agriculture 2019.	Evaluation test of herbal formulation

3. DRUG PROFILE, EXCIPIENT PROFILE, AND EQUIPMENT PROFILE:

3.1 DRUG PROFILE AND EXCIPIENT PROFILE:

Table 1

Sr no.	Ingredients	Uses	Manufactured by
1.	Coffee	To stimulant hair	Carmine Country Pvt. Ltd.
2.	Bhringraj	Promote hair growth	Vedaoil Pvt. Ltd.
3.	Amla	Antioxidant, strengthen hair and scalp	Vedaoil Pvt. Ltd.
4.	Aloe- vera	Moisturizing agent	Veda Oil Pvt. Ltd.
5.	D-panthenol	Thickening and hair shiner	Central Drug House (P) Ltd.
6.	Biotin	Hair strengthens and thickens	Phyto Herbal
7.	Vitamin-E	Antioxidant	Titanium Technologies (India) Pvt. Ltd.
8.	Guar gum	Thickening agent	HiMedia Laboratories Pvt. Ltd.
9.	Xanthan gum	Stabilizer and thickener	Qualikems Fine Chem Pvt. Ltd
10.	Lecithin	It helps to moisturize and refortify cell membranes around dry, damaged, or brittle hair	Bakersville India pvt. Ltd.
11.	HPMC K4M	Thickening agent, stabilizer, film former, moisture retention	Methocel^tm K4M
12.	Tween 80	Emulsifier	Sdfine-chem limited
13.	Cinnamon oil	Increase blood flow to the scalp	ACS Chemicals
14.	Castor oil	Help for hydrating an itchy, dry scalp	Qualikems Fine Chem. Pvt. Ltd
15.	Lavender oil	Fragrance	INR CHEM
16.	Sodium Benzoate	Preservative	Qualigens Fine Chemicals

3.2 EQUIPMENT PROFILE:

Table 2

Sr. No.	Equipment Used	Manufactured by
1.	Digital Weighing Balance	Shimadzu AUG220
2.	Hot Plate	Universal
3.	Magnetic Stirrer	Ramj
4.	Sonicator	Samarth Electronics
5.	pH Meter	MK-VI
6.	Viscometer	Ostwald Viscometer

4. RATIONALE AND OBJECTIVE

4.1 RATIONALE

- Various hair growth shampoos are available in the market for the treatment of hair growth. But the problem comes over it is that after applying the shampoo the scalp can be rinsed off within 2-3 minutes. So, the serum is used, which is a product that hydrates the scalp and promotes hair growth without leaving an oily feeling or there is no need to rinse it off (43).

- The shampoo is a product that works mainly for the cleansing of the scalp, while on the other hand serum is a product that hydrates the scalp and promotes hair growth without leaving it feeling greasy.
- The disadvantage of applying the shampoo is that: Under cleaning could result in the accumulation of toxic stimuli, while overcleaning could cause surface degradation. (44).
- In the formulation of the serum the stinging nettle is used but has some side effects like fluid retention, sweating, diarrhea, and hives or rash (mainly from topical use). It is important to be careful when handling the nettle plant because touching it can cause allergic rash. Stinging nettle might increase the risk of blood pressure dropping too low in people prone to low blood pressure. So, due to the side effects of the stinging nettle we used coffee in our formulation.

4.2 OBJECTIVE

- The objective of the current study is to prepare hair serum having herbs in it for the treatment of hair growth.
- The primary objective of herbal hair serum is to nourish and hydrate the hair strands.
- Serum is a type of cosmetic product that has a very high concentration of active ingredients in its composition to provide the deeper layers of skin with intensive nutrition and a non-greasy finish that is good for the skin.
- Herbal hair serum is used to stimulate and strengthen hair roots, which reduces hair fall. It prevents hair breakage and split ends and moisturizes the scalp.
- Applying serum to the scalp it reaches the deeper layer of hair. Due to the increased contact time of serum on the scalp, it increases hair growth.
- It causes minimum side effects due to the use of herbal ingredients.

5. MATERIAL AND METHODOLOGY

5.1 MATERIAL PROFILE

1. COFFEE

Coffee Extract

- **Synonyms:** Coffea beans,
- Coffee seed, Arabica coffee**.**
- **Scientific name:** Coffee Arabica.
- **Family:** Rubiaceae.
- **Biological source:** It is the dried ripe seeds of Coffea arabica Linn.
- **Geographical source:** India, Mexico, Indonesia, Sri Lanka, Brazil.
- **Chemical constituent:** The main constituents of coffee are caffeine, tannin, fixed oil, and proteins. It contains 2-3% caffeine,3-5%tannins,13%proteins,10-15%fixed oils. In the seeds, caffeine is present as a salt of chlogenicacid. Also, it contains oil and wax.
- **Uses:** Decreasing hair loss and encouraging new hair development. Coffee is commonly used as a flavoring agent. Aid in accelerating hair development by stimulating your hair follicles (45).

- **Chemical structure:**

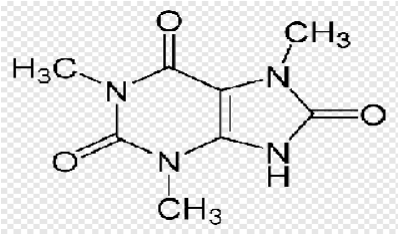


Figure 03: Structure of Caffeine

2. BHRINGHRAJ

Bhringraj Extract

- **Synonyms**: false daisy, bhangra
- **Scientific name**: Eclipta alba
- **Family:** Asteraceae
- **Biological source**: obtained from the flower of the plant species.
- **Geographical source**: obtained from word wide. This species grows commonly in moist places in warm temperatures to tropical areas worldwide. It is widely distributed throughout India, Nepal, China, Thailand, Bangladesh, and Brazil. (25)
- **Chemical constitutes** its alkaloid content including Ecliptine and nicotine. It also contains flavonoids and isoflavonoids. The herb is also a good source of calcium, magnesium, iron, vitamin D and E. The β- sitosterol and wedelolactone are the phytochemicals responsible for hair growth activity. (26)
- **Uses**: Used to treat hair loss, split ends, dandruff, baldness, and premature graying. Bhringraj promotes healthy development by nourishing the scalp and hair. It's also well-recognized for enhancing blood flow to the scalp, which can provide a greater supply of nutrients and oxygen to the hair follicles, resulting in healthier, stronger hair.
- **Chemical structure**:

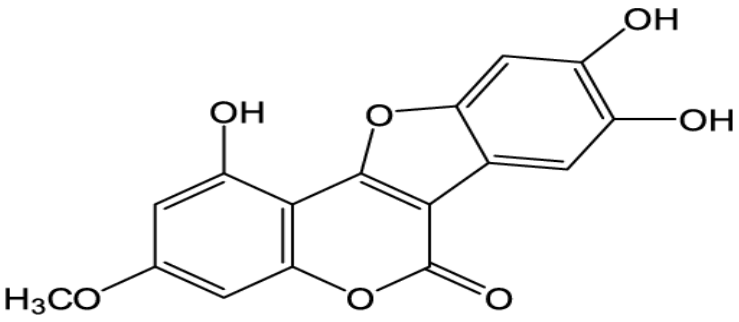


Figure 04: Structure of Wedelolactone

3. AMLA

Amla Extract

- **Synonym**: Emblica, Indian gooseberry, Amla.
- **Scientific name**: Emblica Officinalis
- **Family**: Euphorbiaceae.
- **Biological source**: Dried as well as fresh fruits of the plants.
- **Geographical source**: India, Africa, Australia, Europe, Asia, America.
- **Chemical constituents**: It is rich in nutrients and a significant nutritional source of minerals, amino acids, and vitamin C. After being dried and separated from the nuts, the main part of pulpy fruit has the following contents: 1.32% gallic acid, tannin, 36.10% sugar, 13.75% gum, 13.08% albumin, 17.08% crude cellulose, 4.12% mineral matter, and 3.83% moisture. Gallic acid, ellagic acid, and phyllembin combine to form tannins. Phyllantidine and phyllantine, two alkaloidal components, have also been found in fruits.
- **Uses:** It can improve blood flow, particularly to the scalp, which feeds the roots of your hair with nutrition. It has a potent antibacterial character that lessens the effects of infections and when used in a specific way, contains conditioning and moisturizing qualities. It can hydrate your hair cells, preventing hair loss and strengthening (50).
- **Chemical structure:**

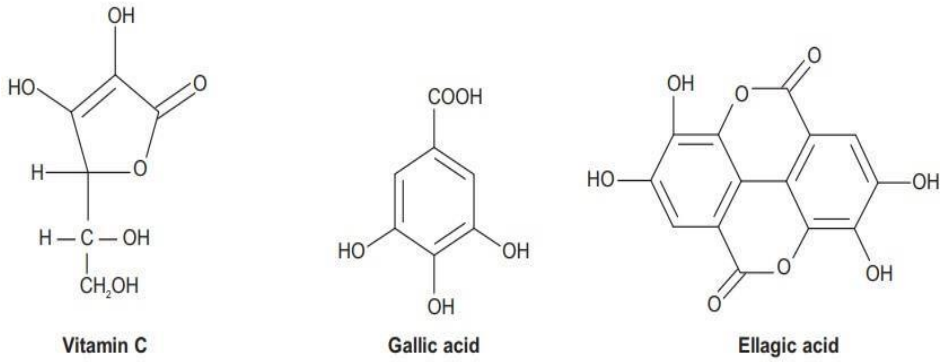
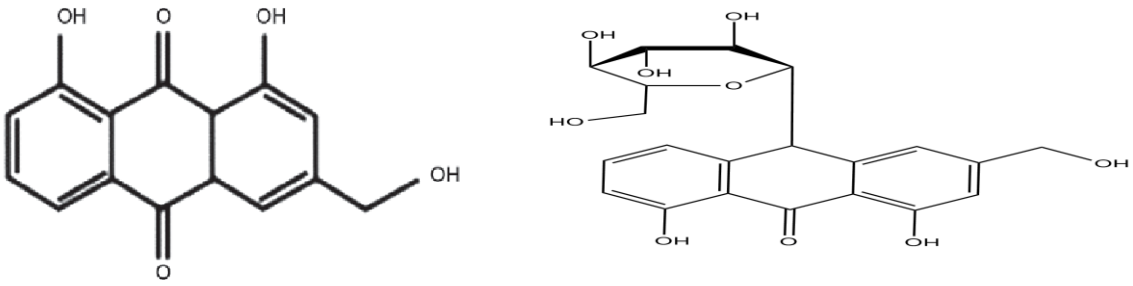


Figure 05: Structure of Vitamin C, Gallic Acid, Ellagic Acid

4. ALOE VERA

Aloe vera Extract

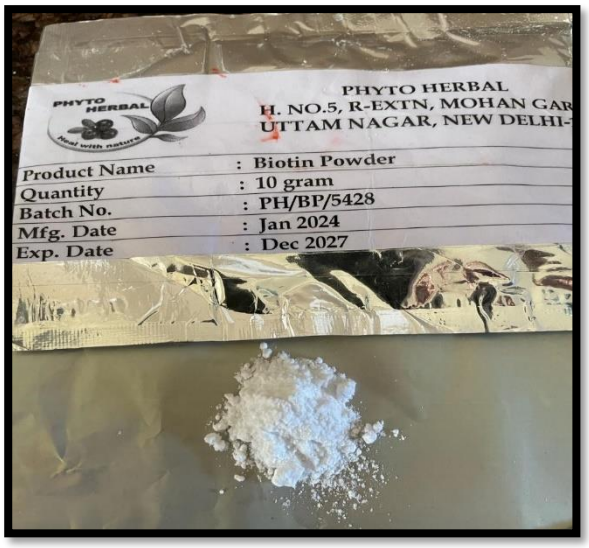
- **Synonyms**: Aloe, musabbar
- **Scientific name**: Aloe barbadense Miller.
- **Family**: Liliaceae
- **Biological source**: Dried juice collected by incision from the bases of the leaves of various species of aloe.
- **Geographical source**: Africa, Asia, Europe, India.
- **Chemical constituents**: The most important constituents of aloes are the three isomers of Aloins, Barbaloin, β- barbaloin and iso barbaloin, which constitute the so-called 'crystalline' Aloin, present in the drug at from 10 to 30%. Other constituents are amorphous Aloin, resin, emodin, and Aloe emodin.
- **Uses**: Aloe Vera contains a substance called aloenin, which dissolves dead skin cells. Additionally, it has proteolytic enzymes, which encourage quick hair development and help stop hair breaking. Check out this blog post on how to grow hair faster if you are having problems with both hair growth and hair loss. (27)
- **Chemical structure:**



(A) (B)

Structure of 06: (A) Aloin (B) Aloe-emodin

5. BIOTIN:



Biotin Powder

- **Introduction of biotin**
  One of the B vitamins is biotin, sometimes referred to as vitamin H or B7. It is engaged in many different metabolic processes, mostly connected to the use of lipids, crabs, and amino acids, in both humans and other species. The term biotin originates from the Ancient Greek word βίοτος (bíotos; 'life') and the suffix "-in" (a suffix typically used in chemistry to signify 'forming'). It was derived from the German Biotin. Biotin has a needle-like appearance and is a white, crystalline substance. (28)

- **Boosts strength and thickness of hair**
  Biotin benefits for hair include boosting the strength and thickness of hair.

- **Prevents hair breakage**
  Strong hair is less likely to break from the ends, thus preserving the length of your hair.

- **Improves texture of the hair**
  As per experts, there is evidence that a higher intake of biotin could improve the texture of your hair while adding to its shine and thickness.

- **Promotes healthy scalp and hair**
  Biotin is known to improve your scalp and hair health by boosting keratin a protein that is the basis of hair, skin, and nails. Biotin supplements improve hair health, by increasing the volume and providing scalp coverage.
- **Chemical structure**

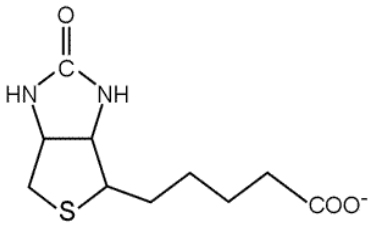
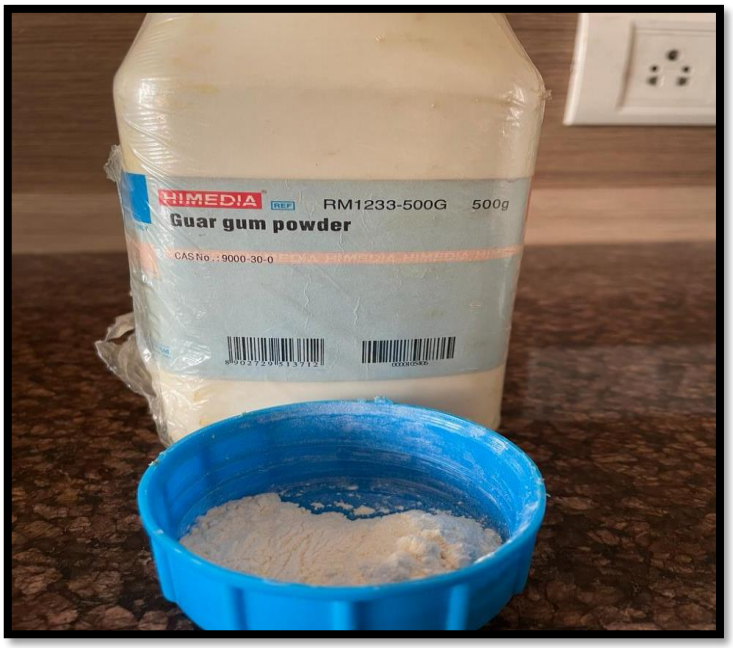


Figure 07: Structure of Biotin

- **Mechanism of Biotin Drug:**

In humans, biotin also functions as a coenzyme for a variety of carboxylases, converting acetyl-CoA's irreversible carboxylation to malonyl-CoA. In many different metabolic processes, these enzymes are essential. Biotin has been recognized recently for its novel functions, particularly in cell signaling and epigenetic regulation (37). The way that biotin works is by binding to particular lysine residues (38). Overconsumption of biotin may result in stomach distress, even though it is a vitamin with little adverse effects. Human colonic epithelial cells absorb biotin by a carrier-mediated mechanism (39). Three important carboxylation processes involving pyruvate to oxalacetate, acetyl-CoA to malonyl-CoA, and propionyl-CoA to methylmalonyl-CoA all require vitamin B7 as a cofactor. Carbon is transferred during a carboxylase reaction with the help of biotin. In essence, food is broken down into glucose by these transformations, which are aided by biotin. Glucose is the main supply of carbohydrates for the body and brain.

6. GUAR GUM

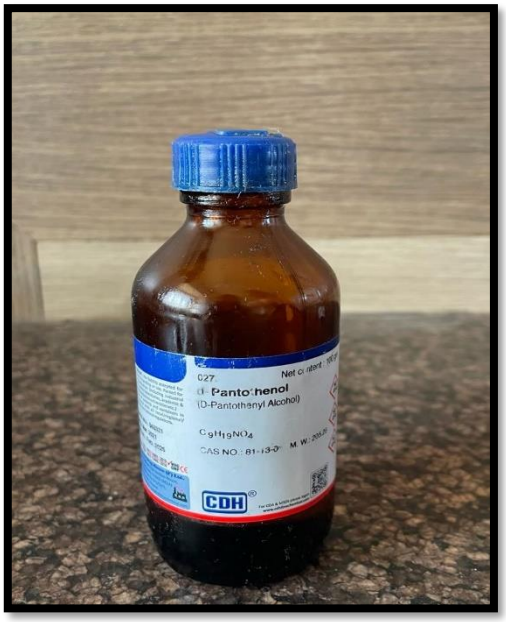


Guar Gum Powder

- **Synonyms:** Guaran, Goma guar
- **Scientific name:** Cyamopsis tetragonolobus.
- **Family:** Fabaceae
- **Biological source:** Extracted from guar beans.

- **Geographical source:** Rajasthan, Gujarat, Haryana.
- **Chemical constituents:** The majority of the high molecular weight hydrocolloidal polysaccharide found in the water-soluble portion of guar gum is galactomannan, also referred to as guaran. Guaran is made up of linear chains of (1→4)—β—D mannopyranosyl units joined by (1→6) connections to α—D glucopyranosyl units. Nonetheless, the ratio of D-mannose to D-galactose is 1:2. Approximately 5–7% of the gum is made up of proteins.
- **Uses:** Guar gum is used as a protective colloid, a binding and disintegrating agent, an emulsifying agent, a bulk laxative, an appetite depressant, and in peptic ulcer therapy. Industrially, it is used in paper manufacturing printing, polishing, textiles, and also in food and cosmetic industries. Guar gum remains an important ingredient in over-the-counter weight loss preparation.

7. D-PANTHENOL



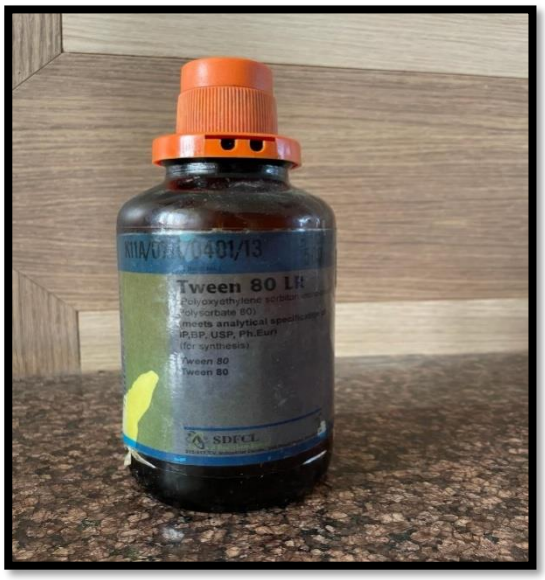
D- Panthenol

Panthenol or Pantothenol is known to be the alcohol analog of Pantothenic Acid (vitamin B5). This chemical compound is a transparent viscous liquid at room temperature. It is packed with nourishing and moisturizing properties due to which it is readily used in major hair care products such as shampoos, conditioners, and leave-in serum. Let's look at some of the benefits of D-Panthenol for hair:

- D-Panthenol's hydrating ability increases the suppleness of your hair strands, minimizing breaking and giving it a vibrant, healthy appearance.
- It forms a thin protective layer on the surface of your strands, thereby making it look shiny and radiant.
- Because of its exceptional humectant properties, D-Panthenol is renowned for leaving your hair feeling silky and smooth.
- It adds strength to your strands by boosting the elasticity of your hair and preventing the breakage, and hair fall.
- It also protects your strands from pollution and other environmental aggressors.

Due to these beneficial properties, you can frequently find this name popping up in the ingredient list of your haircare product-panthenol in your hair care product is known to improve the overall health of your scalp and hair, making it look healthy and bouncy.

8. TWEEN 80



Tween 80

- **Introduction:**

  A common nonionic surfactant and emulsifier in food, medicine, and cosmetics is tween 80. This artificial substance is a yellow liquid that is viscous and soluble in water.
  A solubilizer and surfactant, tween 80 is included in many medicinal oral and topical preparations. Tween-80 is light yellow to amber oily viscose liquid, non-toxic. It is easily soluble in water, soluble in ethanol, vegetable oil, ethyl acetate, and insoluble in mineral oil. HLB value is 15.0 and molecular weight is 428.6
  Polyether, often referred to as polyoxyethylene groups, are hydrophilic groups in Tween-80, a chemical formed from polyethoxylated sorbitan and oleic acid. Polyethers are polymers of ethylene oxide. When polysorbates are named, the lipophilic group—in this example, oleic acid—is indicated by the number that comes after polysorbate (31).

- **Use of tween 80:**
  Tween 80 is a versatile ingredient used in hair care products to promote hair growth, address hair loss concerns, and improve scalp condition. It acts as an emulsifier, facilitating the delivery of active ingredients to the hair follicles.
  The emulsifying nature of polysorbate 80 helps hair to have a layer of oil and water mixture. Mixture protects the hair from dust and other pollutants longer than conditioners. It also strengthens hair, helping it to retain length.

9. VITAMINE E

Figure 11 Vitamin E Capsule

- **Benefits of vitamin E for hair growth:**
  Vitamin E promotes healthy hair growth and also repairs damaged hair. Take a vitamin E capsule4 and break it. Mix it with warm coconut or olive oil and massage this mixture on the scalp and hair for a few minutes. Leave it on for 30 minutes and then rinse hair with warm water. Antioxidants present in vitamin E oil improve the blood circulation to each part of the body and strengthen hair with healthy hair growth.

- **Adds Shine to Hair:**
  Using vitamin E regularly reduces hair damage and provides shine to the hair. Massage your hair with vitamin E oil regularly to make it lustrous. Vitamin E brings back the protective layer of the cuticle that gets removed and makes your hair shinier than before. It also manages dull and frizzy hair and makes them convenient and beautiful.

- **Helps In Repairing Split Ends:**
  Split ends and other hair damage are caused due to drying, coloring, and curling of hair. Here is how to use vitamin E for treating split ends. Add 3- 3-ounce (1 ounce is about 30 ml) olive oil, 3- 3-ounce hemp oil, 3- 3-ounce jojoba oil, 3- 3-ounce coconut oil, 2- ounce vitamin E oil in a bowl and mix them well. Use this mixture as a sealant or hot oil to treat split ends. Vitamin E oil heals the cuticles of the hair and reduces hair breakage.

- **Regulates oil production:**
  Vitamin E creates a layer outside the skin's surface to capture moisture in it. Vitamin E deficiency can lead to dry and itchy skin. Vitamin E oil and other oils containing vitamin E maintain the oil balance and keep the scalp moisturized, preventing excess oil production.

- **Maintains A Healthy Scalp:**
  Because of its inherent antioxidant properties, vitamin E may help sustain healthy hair and scalp while also promoting hair growth. The antioxidant qualities of the vitamin may assist lessen the quantity of oxidative stress and free radicals that lead to the deterioration of a person's scalp's hair follicle cells (29).

10. CASTOR OIL

Castor Oil

- **Synonyms:** Ricinus oil, OleumRicini, GoldBond, Tangantangan oil.
- **Scientific name:** Ricinus communis.
- **Family:** Euphorbiaceae.
- **Biological source:** Castor oil is a vegetable oil obtained by pressing the seeds of the castor oil plant.
- **Geographical source:** India, South America, Africa, China.
- **Chemical constituent:** Ricinoleic acid, linoleic acid, glycerol, oleic acid, stearic acid (34).
- **Uses:** Applying castor oil once a month is enough to increase hair growth five times faster than usual. It can help hydrate an itchy, dry scalp. Dandruff can be lessened by the antibacterial and antifungal qualities of castor oil. It can aid in the growth of hair on other body areas, such as the eyelashes and eyebrows.

11. CINNAMON OIL

Cinnamon Oil

- **Synonyms:** Ceylon cinnamon, cinnamum verum.
- **Family:** Luraceae.
- **Scientific name:** Cinnamomum zeylanicum.
- **Biological source:** The native tree of Sri Lanka, Cinnamomum zeylanicum, yields cinnamon bark and leaf oils; however, the majority of the oil currently produced comes from cultivated regions. C. zeylanicum is a significant spice and aromatic crop with a variety of uses in medicine, drinks, perfumes, and flavoring.
- **Geographical source:** Sri Lanka.
- **Chemical constituent:** Cinnamaldehyde, Eugenol, Cinnamyl acetate.
- **Uses:** Cinnamon may be beneficial for hair growth. Cinnamon is suggested by the dermatologist to be added to hair oil. It has cinnamon aldehyde, which makes your hair shiny and dilates blood vessels to increase blood flow to the scalp. Additionally, it has antifungal qualities that help shield the hair and scalp from irritation, free radical damage, and dandruff.

12. LAVENDER OIL

Lavender Oil

- **Scientific name:** Lavandula angustifolia.
- **Family:** Lamiaceae.
- **Biological source:** It is obtained from the flowers of Lavandula angustifolia by steam distillation.
- **Chemical constituent:** linalool, camphor, Eucalyptol, vinyl acetate.
- **Uses:** Its topical application also strengthens hair follicles and promotes hair growth. Psychological and physiological parameters and its use as an antimicrobial agent (35). Applying castor oil once a month is enough to increase hair growth five times faster than usual. It can help hydrate an itchy, dry scalp. Dandruff can be lessened by the antibacterial and antifungal qualities of castor oil.

12. XANTHAN GUM

Xanthan gum

- **Synonyms:** Bacterial Polysaccharide, Corn Sugar Gum, Goma Xantana.
- **Scientific name:** Xanthomonas campastris.
- **Biological source:** Bacterium Xanthomonas campestris.
- **Geographical source:** United States, France.
- **Chemical constituents**: The bacteria Xanthomonas campestris secretes xanthan gum, which is a polysaccharide (48). It is made up of repetitive units of pentasaccharides, which are glucose, mannose, and glucuronic acid in the molar ratio of 2:2:1 (49). Xanthan gum is very stable at a wide range of temperatures and pH (3 to 12). It is also used as a suspending agent.
- **Uses:** cosmetic formulators have numerous thickeners at their disposal to stabilize and increase the viscosity of their formulation, good formulation stability, hair fixatives, and provide rheology modifying and other properties including excellent stiffness, gloss, dry comb, wet comb, non-flake, anti-static, feel and high humidity curl retention (33).

- **Chemical structure:**

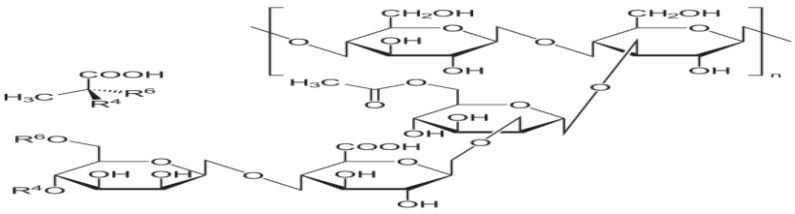


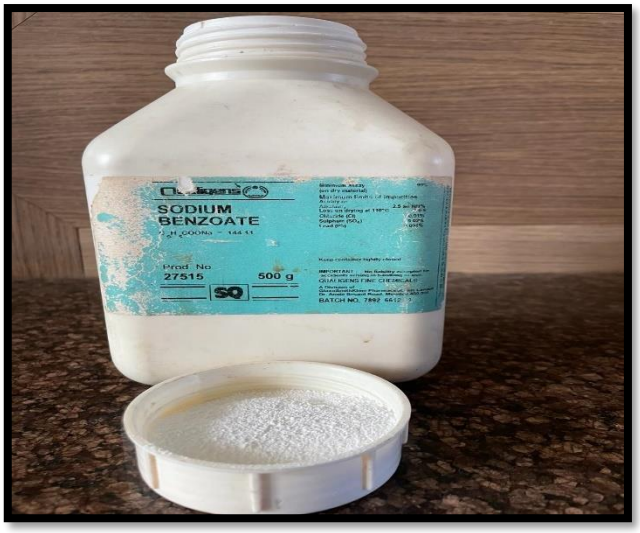
Figure 08: Structure of Xanthan gum

13. HPMC K4M

H.P.M.C. K4M Powder

- **HPMC K4M**: Hydroxypropyl methylcellulose
- **K4M**: K4M is a cellulose ether polymer that dissolves in water.
- **USES**: It is used as a thickening agent, Stabilizer, Film-former, and Moisture retention (40).

14. SODIUM BENZOATE



Sodium Benzoate Powder

- **Chemical constituents:** sodium salt and benzoic acid
- **Chemical formula**: C6H5COONa
- **Uses:** Sodium benzoate helps keep hair healthy, eliminate scalp inflammation, and lessen dandruff. Apply a conditioner that has sodium benzoate in it: Sodium benzoate-containing conditioners can help untangle hair, stop breakage, and maintain its lustrous, healthy appearance

- It is a hair care product that is used to clean hair, It usually takes the shape of a viscous liquid (41).
- **Chemical structure:**

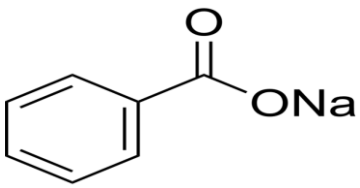


Figure 09: Structure of Sodium Benzoate

15. LECITHIN

- **Synonyms:** Phosphatidylcholine
- **Chemical constituents:** Phosphatidylserine, Choline, Phosphocholine
- **Chemical formula:** C42H80NO8P
- **Uses:**
  - **i.** Lecithin is a great source of the B complex vitamins inositol and choline, which are necessary for normal hair development.
  - **ii.** It is rich in fatty acids, which give your hair a softer and smoother texture by sealing in moisture and maintaining a protective barrier.
  - **iii.** Because lecithin moisturizes and restores the natural protective layer of your hair, which is frequently harmed by heat, style, or chemical treatments, it's an excellent remedy for dry, brittle hair.
  - **iv.** It also gives your hair strength and shine while promoting the synthesis of proteins needed for hair development.
  - **v.** Lecithin also makes your hair silkier, shinier, and healthier by reversing the damaging effects of aging. (53)

5.2 METHODOLOGY

- The herbal medicated scalp serum is prepared by the General Method of serum formulation.
- Take aqueous extracts of Urtica Dioica, Eclipta alba, Phyllanthus emblica, and Aloe vera were measured and taken in the beaker.
- Required amount of D-panthenol, Tween 80, castor oil, Cinnamon oil, Lavender oil, and Vitamin E were mixed in a glass mortar pastel.
- The mixture of mortar pastels added to extract with constant stirring.
- The serum is made up of 50ml distilled water.
- Add the required amount of Sodium Benzoate to the mixture.
- Keep this prepared serum in amber color dropper bottle (15).

6. PROCEDURE:

It includes 2 main parts:

I. Preparation of Formulation
II. Evaluation of Formulation
    i. Physical Appearance
    ii. pH Measurement
    iii. Homogeneity
    iv. Skin Irritation Test
    v. Skin Sensitivity
    vi. Viscosity
    vii. Spreadability Test
    viii. Stability Test

6.1 PREPARATION OF SERUM

6.1.1 Preparation of Solution:

- **Preparation of Biotin Water Solution**: Weigh 1mg of biotin powder. Add the power in a 250ml conical flask. Then add 100 distilled waters in a flask with stirring. Sonicate the solution in an Ultra sonicator for 20 minutes. After sonication, a cleared solution is obtained which is used as a vehicle in preparation of formulation.
- **Preparation of HPMC K4M solution**: Weigh 0.40 gm of HPMC K4M powder. Take 15ml of biotin water in the beaker. Warm the water on a hot plate for 2 to 4 minutes. Sprinkle the HPMC K4M powder in the beaker with constant stirring.
- **Preparation of Xanthan gum solution:** Weigh 50mg of Xanthan gum powder. Add this powder to the already prepared HPMC K4M solution with continuous stirring.

6.1.2 Preparation of Formulation:

- For the formulation of 25ml batch, 2ml coffee extract, 5ml Bhringraj extract, 2 ml Amla extract and 2.5ml aloe vera extract in a beaker.
- Take 0.15 ml of D-panthenol and 0.15ml Tween 80 in a mortar pastel and triturate it and then add 0.15ml Castor oil, 0.15ml Cinnamon oil, 0.15ml Lavender oil and 0.15 ml of vitamin E in Mortar pastel. Mix them well.
- The mixture of mortar pastels added into the extract with constant stirring.
- Add the solution of the above-prepared K4M water and xanthan gum solution (prepared in biotin water) with constant stirring.
- Make the volume 25ml with a biotin water solution.
- Add 0.042gm of Sodium benzoate to the formulation and stir it well.
- Keep this prepared serum in amber color dropper bottle (15).

(A)

(B)

(C)

Various equipments used to preparaed herbal sclap serum:
(A) Sonicator (B) Magnetic stirrer (C) Hot Plate

6.2 EVALUATION OF FORMULATION

i. Physical Appearance:

To determine the physical appearance, we have to observe the following characteristics: Color, texture, and consistency observe the color of our hair serum with our naked eyes. Note down the odor of the serum.

ii. pH Test:

This test is performed by dipping the pH paper in the solution. Then compare the pH paper color obtained by dipping the paper in the solution with the standard. The value of pH for hair serum should be 4.5 to 6.5.

iii. Homogeneity:

Take a clean and dry glass container. Add the prepared solution to the container and then it was sealed. Then it was observed under the light whether the particles/ homogeneity was present or not. The homogeneity of the herbal hair serum was checked visually, and any lumps flocculates, or aggregates were looked for.

iv. Skin Irritation Test:

Apply the prepared serum on the skin, and observe any redness or itching observed after 2 hours.

v. Skin Sensitivity Test:

The procedure involves applying the serum to the skin, exposing it to the sun, and checking after 10 minutes to see whether there are any rashes or irritation.

vi. Viscosity

The viscosity of the formulation was evaluated by Ostwald viscometer. Time taken by the serum (solution) to travel from one mark to another mark was noted down and viscosity was calculated.

vii. Spreadability Test (54)

Measure the Spreadability of scalp serum by using the parallel plate method gm of the sample which was prepared before 48 hours was taken on one parallel plate 20*20cm. Another plate is sandwich on this. A weight of 20gm is placed on the top for 1 minute. Allow to spread the serum for 1 minute.

Measure the diameter of the circle. Calculate the Spreadability using this formula;

$S_i = d^2 \times \pi/4$

Where, S_i =Spreadability

d = Diameter of spreading area (mm)

π = constant (3.14)

viii. Stability study

The formulation was kept at room temperature for 1 week. Then after 1 week check the pH, Homogeneity, and clarity of the solution. Then the result with the above obtained result (46).

7. RESULT AND DISCUSSION

7.1 DISCUSSION

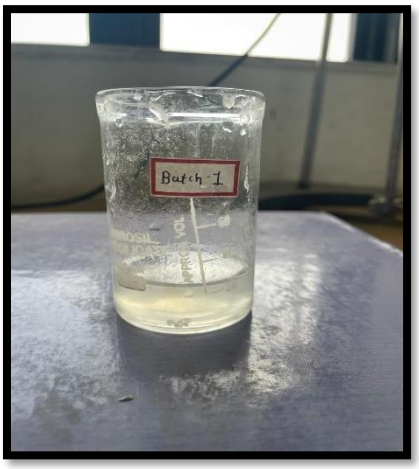
Ingredients used: Aqueous extracts [Bhringraj, Amla, Coffee, Aloe vera], Oils [Cinnamon oil, Castor oil, Vitamin E, Lavender oil], D-panthenol, Guar gum, Lecithin, Tween 80, HPMC K4M, Biotin, Sodium benzoate.

- **7.1.1 GENERAL PROCEDURE**

  Take the required quantity of aqueous extracts in a beaker. [B-1]
  Take the required amount of Biotin and Aloe vera extract in another beaker. [B-2]
  Add B-2 into B-1, with stirring. [Aqueous phase]
  Now, in a china dish add D-panthenol and Guar gum and mix it well.
  In that add lecithin, Tween 80, oils, and mix it well. [Oil phase]
  Add the oil phase into the aqueous phase with constant stirring.
  Add sodium benzoate and make it up to the required quantity with Distilled water.

- **BATCH 1**

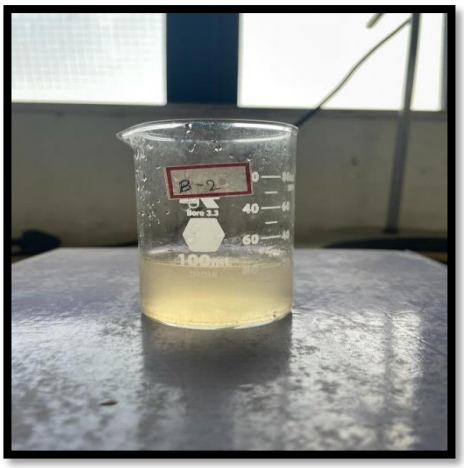
  Take the aqueous extract in one beaker.
  Now in the china dish take the required quantity of D-Panthenol add guar gum and mix it well and then add all the oils and mix with constant stirring.
  Now mix the oil phase in the aqueous phase with constant stirring make it up to the required quantity with distilled water and add a preservative.
  Observation: stability issues, phase separation, and particles(fibers) are observed.
  Solution: increase the quantity of guar gum.



Batch 1

- **BATCH 2**

  The above procedure is the same but the quantity of guar gum is increased and then the rest of the process is.
  Observation: The fibers of guar gum are observed and particles are also observed.
  Solution: Now with guar gum, lecithin is also added.



Batch 2

- **BATCH 3**
  The above procedure of batch 1 is the same but now we add guar gum+lecithin in the required quantity, and the rest of the procedure is the same as above.
  Observation: Phase separation is observed, also less amount of fibers is observed.
  Solution: guar gum is replaced by lecithin.

Batch 3

- **BATCH 4**
  The above procedure of batch 1 is the same but now we replace the guar gum with lecithin in the required quantity, and the rest of the procedure is the same as above.
  Observation: Particles and phase separation are still observed but fibers are not observed.
  Solution: Lecithin is replaced by Tween 80.

Batch 4

- **BATCH 5**
  The above procedure of batch 1 is the same but now we replace the lecithin by tween 80 in the required quantity, and the rest of the procedure is the same as above.
  Observation: Consistency of hair serum is not achieved and also particles and phase separation are observed.
  Solution: To improve the consistency we add HPMC K4M.

Batch 5

- **Batch 6**
  The above procedure of batch 1 is the same but now we prepared the HPMC K4M solution and used this solution as the vehicle.
  Observation: Particles and phase separation are still observed.
  Solution: We prepare the biotin solution by dissolving it in water.

Batch 6

- **BATCH 7**
  The above procedure of batch 1 is the same but now in place of biotin powder, we use a biotin solution as a vehicle.
  Observation: Particles are not observed but the phase separation is still observed.
  Solution: Now we added xanthan gum to stabilize the hair serum.

Batch 7

- **BATCH 8**
  The above procedure of batch 1 is the same but now we prepare a solution that contains xanthan gum, HPMC K4M, and Biotin in distilled water.
  Observation: Phase separation was not observed.
  So, we consider Batch 8 as our final batch.

Batch 8

Table 4

Trial No. or Batch No.	**Observation**	**Solution**
Batch No. 01	Stability issues, phase separation, and particles observed	Increase the quantity of guar gum
Batch No. 02	Fiber are observed	Now, with guar gum, lecithin is als
Batch No. 03	Phase separation is observed and less amt. of fibers is observed	Guar gum is now removed
Batch No. 04	Phase separation and particles are still observed but fibers are not observed	Lecithin is replaced by tween 80
Batch No. 05	Consistency of solution is not achieved but particles and phase separation are observed	To improve consistency, we add HPMC K4M
Batch No. 06	Particles and phase separation are still observed	Prepare the biotin solution by dissolving it in water
Batch No. 07	Particles are not observed but phase separation is still observed	Add xanthan gum to stabilize hair serum
Batch No. 08	Phase separation was not observed	Consider this batch as the final batch

7.2 RESULTS

- **Physical Appearance:**
  To determine the physical appearance, we have to observe the following characteristics: Color, Texture, and consistency were observed in our hair serum by our naked eyes.
  Color: Milky off white
  Texture: Mild oily
  Consistency: Thicken

Physical Appearance of Serum

- **pH Test:**
  This test is performed by dipping the pH paper in the solution. Then compare the pH paper color obtained by dipping the paper in the solution with the standard. The value of pH for hair serum should be 4.5 to 6.5.
  pH value= 6

- **Homogeneity:**
  Take a clean and dry glass container. Add the prepared solution to the container and then it was sealed. Then it was observed under the light whether the particles/ homogeneity was present or not. The homogeneity of the herbal hair serum was checked visually, and any lumps flocculates, or aggregates were not observed.

- **Skin Irritation Test:**
  Apply the prepared serum on the skin, and observe any redness or itching after 2 hours. No, irritation or redness was observed on the skin. So, our hair serum is non-irritant.

- **Skin Sensitivity Test:**
  The procedure involves applying the serum to the skin, exposing it to the sun, and checking after 10 minutes we observed that no rashes appeared on the skin.

- **Viscosity**

The viscosity of the formulation was evaluated by Ostwald viscometer. The time taken by the serum (solution) to travel from one mark to another mark was noted down and viscosity was calculated. Calculate the viscosity using this formula:

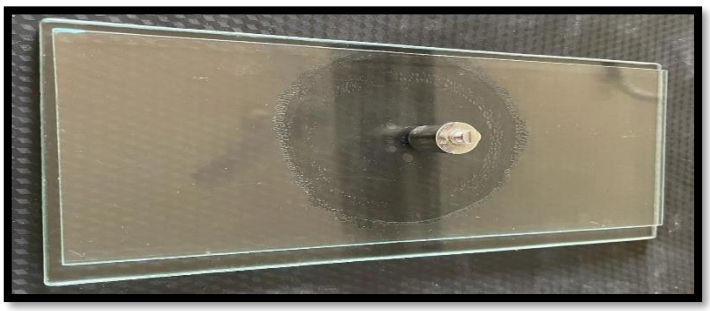
$$\eta s = (\rho s \times ts/\rho w \times tw) \times \eta w$$

Where, ηs = viscosity of serum
ηw = viscosity of water (cps)
ρs = density of serum (gm/ml)
ρw = density of water (gm/ml)
ts = time required to travel from mark A to B for serum (sec)
tw = time required to travel from mark A to B for water (sec)

$$\eta s = (\rho s \times ts/\rho w \times tw) \times \eta w$$
= 1.002(0.03*5400/1.008*75)
= **2.1475 cps**

- **Spreadability Test (54)**

Measure the Spreadability of scalp serum by using the parallel plate method.
1 gm of sample which was prepared before 48 hours was taken on one parallel plate 20*20cm.
Another plate is sandwich on this.
A weight of 20gm is placed on the top for 1 minute.
Allow to spread the serum for 1 minute.
Measure the diameter of the circle.
Calculate the Spreadability using this formula;
$S_i = d^2 \times \pi/4$
Where, S_i =Spreadability
d = Diameter of spreading area (mm)
π = constant (3.14)
Value of d= 10.5cm
$S_i = d^2 \times \pi/4$
$= (10.5)^2 \times 3.14/4$
= **$86.54 cm^2$**



Measurement of Spreadability

- **Stability study (46)**
  The formulation was kept at room temperature for 1 week. Then after 1 week check the pH, Homogeneity, and clarity of the solution. Then the result with the above obtained result. After comparing we observe that both the results are matched. So, over solution is stable.

Table 4

Test	Result
Physical appearance	i. Color: Milky off white ii. Texture: Mild oily iii. Consistency: Thicken
pH measurement	6
Homogeneity	Good
Skin Irritation Test	Nonirritant
Skin Sensitivity Test	No rashes or irritation observed
Viscosity	2.1475 cps
Spreadability Test	86.54cm²
Stability study	Stable solution

8. CONCLUSION

In the personal hygiene and health care system, using natural cosmetics has modified via way of means of numerous folds. Therefore, the natural cosmeceutical individual care or personal health care industry, that is surely concentrating and praying greater care at the manufacturing of herbal based cosmetics.

It may be inferred that organized natural scalp serum has a useful impact at the mechanism of hair growth. For the treatment of hair growth shampoos are used but after applying the shampoo the scalp can be rinsed off within 2-3 minutes. So, the serum is used, as it stays for the longer time in the scalp that hydrates the scalp and promotes hair growth without leaving an oily feeling or there is no need to rinse it off.

Study concluded that herbal scalp serum can be efficiently formulated by the usage of distinct herbal components which includes Coffee extract, Bhringraj extract, Amla extract, Aloe vera extract, extract, Vitamin E capsule, Biotin, D- panthenol, Tween 80, and essential oils of cinnamon, lavender, castor.

From the Evaluation parameters like physical appearance, consistency, pH, irritation, Spreadability, viscosity of our formulation was satisfactory. The formulations do not produce any redness or itching during the testing period. Hence, from the present study we concluded that the formulated medicated scalp serum shows minimum side effects and also prevent hair loss.

9. LIST OF ABBREVIATION

Table 5

H.P.M.C.	Hydroxy propyl methyl celluose
D&C Act 1940	Drug and Cosmetic Act 1940
UV	Ultraviolet
gm	Gram
mg	Milligram
cm	centimeter
µm	micrometer
ml	mililiter
CoA	Co enzyme A
HLB	Hydrophilic Lipophilic Balance
B7 / H	Biotin

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