

FORMULATION, QUALITATIVE & QUANTITATIVE EVALUATION OF HAIR SERUM USING HERBAL INGREDIENTS

Submitted in partial fulfillment of the requirements for the award of

BACHELOR OF PHARMACY BY

ALLAN ANTHONY. J	40050003
KAVIARASAN S	40050024
MERLIN MADHUMITHA J	40050029
NUSRATHUNISHA S.F	40050033
PARREDDY ABHI SARAYU REDDY	40050034



**SCHOOL OF PHARMACY
SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
CATEGORY – 1 UNIVERSITY BY UGC
CHENNAI – 600119**



SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
CATEGORY - 1 UNIVERSITY BY UGC



SCHOOL OF PHARMACY

Guide Name: Mrs. K Nithya Kalyani

Designation: Assistant Professor

BONAFIDE CERTIFICATE

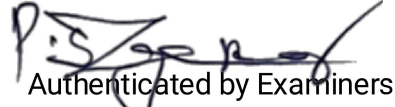
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Place: Chennai

Date: 02.04.2024


Approved by Dean


Research Guide: Mrs. K Nithya Kalyani


17/04/2024

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DECLARATION

We hereby declare that the work presented in the thesis entitled **"FORMULATION, QUALITATIVE & QUANTITATIVE EVALUATION OF HAIR SERUM USING HERBAL INGREDIENTS"** submitted by us to the **Sathyabama Institute of Science and Technology (Deemed to be University), Chennai - 600119**, for the award of **Bachelor of Pharmacy (2020-2024)** by research is an original record of research work carried out by us under the supervision of **"Mrs. KNithya Kalyani, Assistant Professor, School of Pharmacy"**. The contents of this dissertation, in full or in parts, have not been submitted to any other institute or university for the award of any degree, diploma, membership, fellowship, associate ship, etc, In keeping with the general practice reporting scientific observation, due acknowledgment has been made whenever the work described is based on the findings of other investigators.

Place: Chennai

Signature of the Students

Date: 02.04.2024

ALLAN ANTHONY. J

40050003

KAVIARASAN S

40050024

MERLIN MADHUMITHA J

40050029

NUSRATHUNISHA S.F

40050033

PARREDDY ABHI SARAYU REDDY

40050034

✓

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ABSTRACT

Combining herbs into a single composition enhances their curative and therapeutic effects compared to individual use. Even non-medicinal plants, when processed into appropriate formulations or dried powders using advanced techniques, can offer superior therapeutic benefits. Hair cosmetic formulations, particularly serums, with their high concentration of active ingredients, provide deep skin nutrition and a non-greasy finish. Integrating plants into hair serum formulations maximizes therapeutic benefits and enhances skin absorption. Herbal cosmetics, derived from botanical phytochemicals, are increasingly popular for their aromatic value and skin benefits such as suppleness, collagen protection, UV protection, and wrinkle smoothing. India's cosmetic industry is rapidly growing, with herbal cosmetics contributing significantly to revenues. Hair, being a crucial aspect of one's appearance, faces issues like dandruff, hair loss, and greying. Hair serums, with their intensive nutrition and tailored formulas, cater to diverse skin types. Overall, hair serum stands as an elegant and effective styling product, offering multiple benefits for hair and skin health.

INTRODUCTION:

The global cost of raising living standards has increased consumer demand for cosmetics, which combines the pharmaceutical and cosmetics industries. Cosmetics and pharmaceuticals are combined in skincare products known as cosmeceuticals, with serum being a high-concentration product with a non-greasy finish and intensive nutrition for the deeper layers of the skin. Bhringraj, also known as false daisy in English and Bhringraj in India, is a wild plant with significant ethno-medicinal value. It is used in traditional medical systems like Ayurveda, Siddha, and Unani. The leaves' fresh juice was used as a hair serum.

Natural medicinal substances, such as alkaloids, flavonoids, tannins, and phenolic compounds, have replaced many manufactured medications that could have negative effects. Neem, a natural raw material for mass production of cosmetics, can be used to make herbal cosmetics like hair serum.

The root, gum, leaves, flowers, and fruits of this tree, biologically similar to mahogany, can be used to create herbal cosmetics like hair serum. As well Hibiscus rosa sinensis Linn (HRS) which is used as a raw material for hair serum for smoothening nourishes and stimulates the hair follicles. The goal of this study was to create a hair serum for improving hair quality using extracts of several herbs.

HIGHLIGHTS:

Hair serums are fantastic products to have on your cosmetics shelf because of their many benefits. It is simple to use and is normally applied after washing and before styling the hair. Hair serum is a liquidized product that provides a protective layer over the hair Fiber, assisting in smoothing frizz. This smooth layer reflects the light, which is how serum gives hair a shiny, not greasy finish.

However, hair serum isn't just for frizz control. The proper serum for the right kind of hair can take care of several issues, including detangling, smoothing, and adding shine, as well as healing damage and shielding against pollution.

ADVANTAGES:

Relieves itchy scalp Intensify hair growth Averts premature greying of hair
Nourishment Dandruff control Improves Hair Texture Healthy Scalp Prevent
split ends Makes our hair look shiny, smooth, silky and lustrous Condition
against frizz, dryness, breakage, etc.

DISADVANTAGES:

Sometimes it gives a damp and oily look Sometimes it causes skin irritation.

SIDE EFFECTS:

Excessive serum use might result in might result in serious hair loss and breakage. Some of them may cause irritation, inflammation, redness, or itchiness in your mane.

BENEFITS OF USING HAIR SERUM:

Hair serum makes your hair brighter and healthier, and it also helps to prevent tangles. Hair serum makes your hair brighter and healthier, and it also helps to prevent tangles. Highlights Hair serums are fantastic products to have on your cosmetics shelf because of their many benefits. It is simple to use and is normally applied after washing and before styling the hair. Hair serum is a liquidized product that provides a protective layer over the hair Fiber, in assisting smoothing frizz. This smooth layer reflects the light, which is how serum gives hair a shiny, not greasy finish [4]. However, hair serum isn't just for frizz control. The proper serum for the right kind of hair can take care of several issues, including detangling, smoothing, and adding shine, as well as healing damage and shielding against pollution [5]. Advantages Relieve itchy scalp Intensify hair growth Avert premature greying of hair Hair Nourishment Dandruff control Improves Hair Texture Healthy Scalp Prevent split ends Makes our hair look shiny, smooth, silky, and lustrous Condition against frizz, dryness, breakage, etc [6]. Disadvantages Sometimes it gives a damp and oily look Sometimes it causes skin irritation. Side Effects Excessive serum use might result in might result in serious hair loss and breakage. Its low pH level reduces swelling and keeps hair strands together, minimizing damage. Hair serum also shields your hair from the sun, pollutants, other dangerous chemicals, and heat styling tools. It hydrates dry hair and hair that has been color-treated.

METHODOLOGY:

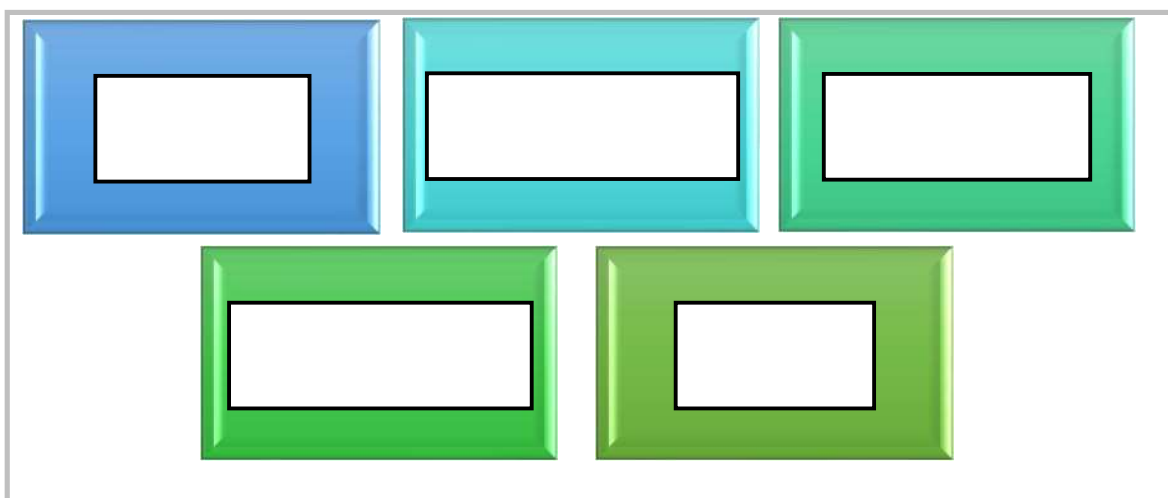


Figure 0. 1 – Methodology

RESULT AND DISCUSSION:

Prepared semi-synthetic hair serum was found to be in transparent color. Which is suitable for hair of all types, the observation reveals that there is a substantial hair length difference between control and normal hair. This results in the growth behavior displayed by normal, negative, and positive control, and having a mild irritation in the left eye of the animal. Furthermore, it also results in antibacterial activity. As a result, showing the bacillus in the zone of inhibition. This serum shows no physical instability and there was no notable difference was seen in the before and after study.

CONCLUSION:

This hair serum is a natural, nutrient-rich product that promotes healthy hair growth and prevents dandruff. It supports sebaceous gland function and is popular in personal hygiene and healthcare due to its lack of parabens and sulfates.

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CHAPTER – I

1.1 INTRODUCTION:

The global cost of raising living standards has increased consumer demand for cosmetics, which combines the pharmaceutical and cosmetics industries. Cosmetics and pharmaceuticals are combined in skincare products known as cosmeceuticals, with serum being a high-concentration product with a non-greasy finish and intensive nutrition for the deeper layers of the skin. Bhringraj, also known as false daisy in English and *Bhringraj* in India, is a wild plant with significant ethno-medicinal value. It is used in traditional medical systems like Ayurveda, Siddha, and Unani. The leaves' fresh juice is used as a hair serum. Natural medicinal substances, such as alkaloids, flavonoids, tannins, and phenolic compounds, have replaced many manufactured medications that could have negative effects. *Neem*, a natural raw material for mass production of cosmetics, can be used to make herbal cosmetics like hair serum. The root, gum, leaves, flowers, and fruits of this tree, biologically similar to mahogany, can be used to create herbal cosmetics like hair serum. As well *Hibiscus rosa-sinensis* Linn (HRS) which used as a raw material for hair serum for smoothening nourishing and stimulating the hair follicles. The goal of this study was to create a hair serum for improving hair quality using extracts of several herbs.

1.1.1 COSMETICS:

Cosmetics are a class of health and beauty goods that are used to enhance or change a person's look, as well as to care for the face and body. Cosmetics have a history that dates back at least 7,000 years and are a part of practically every civilization in the world. The beauty industry has done an incredibly magnificent job of brainwashing our thoughts. With each passing year, India has emerged as one of the developing nations with one of the fastest-growing cosmetic businesses. The Indian cosmetics industry registered revenues of more than 350 billion rupees in 2009, despite the global economic downturn.

Soaps, creams, and sunscreens are a few of the common cosmetics. Although a vast majority of people view cosmetics as beneficial. The word "cosmetic" comes from the Greek adjective "cosmetics" which means "having the power, arrange, or decorating skill".

1. As cosmetics evolved throughout the history of man, a consistent narrative about their beginnings emerged. In prehistoric times, around 3000 BC, man utilized color as an adornment to entice the animals he wanted to hunt. He also used color to shield himself from enemy assault by coloring his skin and decorating his body to make an adversary (whether a man or an animal) fear him.

2. Initially connected to superstition, religion, fighting, and hunting, cosmetics were eventually linked to medicine.

3. Herbal cosmetics, sometimes known as "products", are created using a variety of legal cosmetic components as the foundation.

1.1.2 HERBAL COSMETICS:

Herbal Cosmetics " refers to products that contain one or more herbal substances but are only utilized to provide certain cosmetic benefits. Beginning in the 1990s, cosmetic manufacturers coined the word "cosmeceuticals" to refer to over-the-counter skin care products that include active ingredients derived from plants, such as alpha-hydroxy acids, retinoic acids, ascorbic acids, and coenzyme Q10. These active compounds have multiple functions, including improving skin suppleness, preventing collagen degradation, protecting against UV radiation, and delaying the aging process of the skin by smoothing out wrinkles. Individuals' skin and hair beauty are influenced by their health, habits, daily activities, environment, and upkeep. During the summer, the skin will get dehydrated as a result of prolonged exposure to heat. The harsh winter harms the skin by causing infections, maceration, fissures, and wounds. Skin conditions affect people of all ages often and can be brought on by exposure to germs, chemicals, biological toxins found in the environment, and to some extent by starvation. The Ayurvedic knowledge of nature was the only thing on

which they could rely. Ayurvedic medicine uses a variety of plants and herbs to create cosmetics for protection against the elements and attractiveness. The natural components in botanicals do not have any negative impact on the human body instead they nourish it with vitamins, minerals, and other beneficial substances. According to Drugs and Cosmetics, the cosmetics Articles intended to be rubbed, poured, sprinkled, sprayed, introduced into, or otherwise applied to the human body or any part thereof for cleansing, beautifying, enhancing attractiveness, or altering the look are considered cosmetics under the Drugs and Cosmetics Act. The cosmetic is not covered by a drug license preemption. Herbal cosmetics are products made with phytochemicals derived from a variety of botanical sources that influence skin functions and supply nutrients for healthy skin or hair. Natural herbs and their products are referred to as herbal cosmetics when they are employed in cosmetic preparations for their aromatic value. There is a common belief that chemical-based cosmetics are harmful to the skin and an increased awareness among consumers of herbal products triggered the demand for natural products and natural extracts in cosmetics preparations. The increased demand for natural products has created new avenues in the cosmeceutical market. The Drug and Cosmetics Act specifies that herbs and essential oils used in cosmetics must not claim to penetrate beyond the surface layers of the skin nor should have any therapeutic effect. The legal requirements and the regulatory procedures for herbal cosmetics are the same as those for other chemical ingredients used in cosmetic formulations. There is a widespread assumption that cosmetics with chemical bases are bad for the skin, and as consumers became more aware of herbal remedies, there was an increase in demand for natural ingredients and extracts in cosmetics. The cosmeceutical business has been opened up by the rising demand for natural products. The Drug and Cosmetics Act states that herbs and essential oils used in cosmetics cannot make claims that they can penetrate deeper than the skin's outer layers or have any therapeutic properties. Herbal cosmetics are subject to the same legal requirements and regulatory processes as other chemical substances used in cosmetic composition.

1.1.3 STRUCTURE OF HAIR:

An epidermal product, hair is one of the most important components that contributes to the body's overall elegance. Dandruff, hair loss, and grey hair are a few issues people have with their hair.

1. Melanin, the pigment responsible for the color of the hair, quits functioning as a person ages.
2. This disorder may negatively impact patients' quality of life in a way similar to that reported for other skin conditions such as psoriasis and dermatitis.
3. Numerous cosmetics are offered the ability to solve these issues now, and hair serum is one of them.
4. Individuals are born with on the scalp, there are about 100,000 terminal hair follicles that are predisposed to generate long and thick hair.

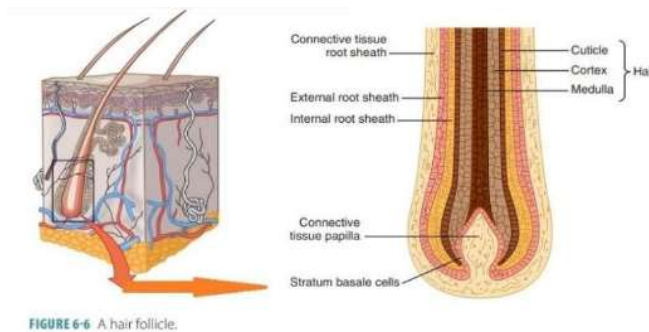


Figure 1.1.3 – Structure Of Hair

The hair follicle is considered the most significant organ in the mammalian system because it influences self-defense, gender differences, attractiveness, and extreme temperature protection. Numerous lifestyle modifications, including exhaustion, worry, and junk food consumption

and the use of different hair-coloring/styling techniques have resulted in significant hair loss.

Challenges facing younger generations. the thinned hair of a person Most of the time, it is not

Temporary, but it results in alopecia. Many folks are suffering from excessive anxiety and tension.

Various treatments for hair loss, spanning from mythology to conventional and therapeutic methods.

To promote hair growth and stop hair loss.



Figure 1.1.3(a) – Structure Of Hair

HAIR CYCLE

There are three stages that each hair follicle goes through:

- ☒ Anagen (growth)
- ☒ catagen (regression)
- ☒ Telogen (rest)

1.1.4 SYNTHETIC HAIR SERUM:

MERITS	DEMERITS
Provides a Shiny look Reduces extreme Frizzy hair Conditions Feels light in weight, and non-greasy Promotes results in a short period	Does not fit for regular usage Very less amount to be used Cannot be directly applied on hair, must be mandatory to be used only on damp hair. Not Paraben-free

No bad odor (Good Fragrance) Heat Protective – from direct exposure to sunlight Protects hair from environmental chemicals and dust Helps in good Moisturizing	Less safety for exposure to Hair problems Not cost-effective Silicone is not good for usage in the long run Hair care routines should be followed in regular terms All types of serums can be applied for both scalp and hair
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Table 1.1.4 – Merits And Demerits of Synthetic Hair Serum

1.1.5 HERBAL HAIR SERUM:

One of the most popular cosmetic items is serum. Which have a very high concentration of the active substance and multiple formulas for specific ingredients can be chosen, offering intensive nutrition to the deeper dermal layer of the skin. which is appropriate for skin type. The elegant and styling product is a hair serum. which protects the hair's surface, feeds the hair, and enhances the beauty of the hair. The nature of the product's consequence will be seen if the serum is applied to wet or dry hair. Without the assistance of a stylist, serums can serve as both a pre-styling treatment and a finishing product. Those are regarded as days without stylists. Hair serum is the name of the styling product that coats the hair's surface. It is essentially a liquid hair care solution with a viscosity thicker than water. Hair serum has uses other than merely styling hair. They are also used to cure a variety of hair problems like dry, dull, and unruly hair. For various hair objectives, various types of hair serums are available. A hair serum may straighten hair, add gloss, or lessen frizz depending on the product's recipe. This silicone-based styling solution coats the hair's surface to help give shine, smoothness, hydration, humidity, and pollution protection. designed to be applied to wet hair.

MERITS	DEMERITS
They were completely safe because they were natural Paraben-free Delivers nutrients necessary for healthy hair Protects against damage They do not provoke allergic conditions No negative effects caused Easily Incorporated They were free from Toxins Easily available Good for Long run usage Cost-effective	Herbal serums show slower results Requires long-term therapy Difficult to mask color and odor Time consuming process Complicated manufacturing

Table 1.1.5 – Merits And Demerits of Herbal Hair Serum

1.2 COMPARISON BETWEEN HERBAL SERUM & SYNTHETIC SERUM:

Overall, As I see it both the serums are useful in their ways, but rather than using different serums for different problems, I prefer to use one serum as beneficial for all the natural causing issues. Whereas, in general, I preferably say using herbal hair serum is more effective because with the small quantity they are very effective, they can be applied on the scalp as well as hair, are chemical and paraben-free, have no allergic reactions provoked, prevent moisture loss, protects the hair cuticle, Smooth the abraded cuticle scales, prevents intense drying, can be applied on dry hair, acts a natural dye, sensitive to all skin types, provides additional benefits as well, can be used for the long run, used by all age and skin types, and Completely toxic-free, as the benefits were more in natural herbal hair serums when compared to synthetic serums. I

chose to go further with the formulation of Herbal hair serums using natural ingredients.

1.2.1 SEMI-SYNTHETIC HAIR SERUM:

A semi-synthetic hair serum typically contains a combination of synthetic and natural ingredients. Here's a breakdown of what you might find in such a product:

1. Synthetic preservatives: These may include compounds like methylparaben, propylparaben, or butylparaben, which help to extend the shelf life of the product by preventing microbial growth.

2. Natural oils: Ingredients like argan oil, coconut oil, or jojoba oil are commonly included for their nourishing and moisturizing properties. They can help to soften hair, reduce frizz, and add shine.

3. Botanical extracts: Plant extracts such as aloe vera, green tea, or chamomile may be added for their soothing and antioxidant benefits. These ingredients can help to protect the hair from environmental damage and promote overall hair health.

4. Essential oils: Essential oils like lavender, rosemary, or peppermint may be used for their aromatic properties as well as their potential benefits for hair and scalp health. They can provide a pleasant scent to the serum and may also have calming or stimulating effects.

5. Silicone compounds: Some semi-synthetic serums may contain silicone-based ingredients like dimethicone or cyclomethicone, which can help to smooth and condition the hair, making it appear sleeker and more manageable.

Overall, a semi-synthetic hair serum combines the best of both synthetic and natural ingredients to provide a balance of efficacy and gentleness for various hair types and concerns.

MERITS	DEMERITS
1. *Effective Preservation*: Synthetic preservatives like methylparaben help extend the shelf life of the serum, ensuring it remains stable and safe for use over an extended period. 2. *Consistency*: Synthetic ingredients can provide a consistent formulation, ensuring that the serum performs predictably from one batch to another. 3. *Affordability*: Synthetic ingredients are often more cost-effective to produce and incorporate into formulations, making semi-synthetic serums more affordable compared to fully natural alternatives. 4. *Performance*: Combining synthetic and natural ingredients allows for a balance of performance benefits, such as nourishment, hydration, and frizz control, resulting in a versatile product suitable for various hair types.	1. *Synthetic Chemical Concerns*: Some consumers may have concerns about the safety or potential side effects of synthetic ingredients like parabens, particularly regarding their impact on health or the environment. 2. *Sensitivity Reactions*: Synthetic ingredients, especially preservatives, can cause adverse reactions in individuals with sensitive skin or allergies, leading to irritation or discomfort. 3. *Environmental Impact*: The production and disposal of synthetic ingredients may have a greater environmental impact compared to natural alternatives, contributing to pollution or resource depletion. 4. *Limited Natural Benefits*: While semi-synthetic serums may contain natural ingredients, their overall benefits may be overshadowed by the presence of synthetic chemicals, limiting their potential for holistic hair care.

Table 1.2.1 Merits and Demerits of Semi-Synthetic Hair Serum

Ultimately, the choice between semi-synthetic and fully natural hair serums depends on individual preferences, priorities, and sensitivities, with each option offering its own set of merits and demerits.

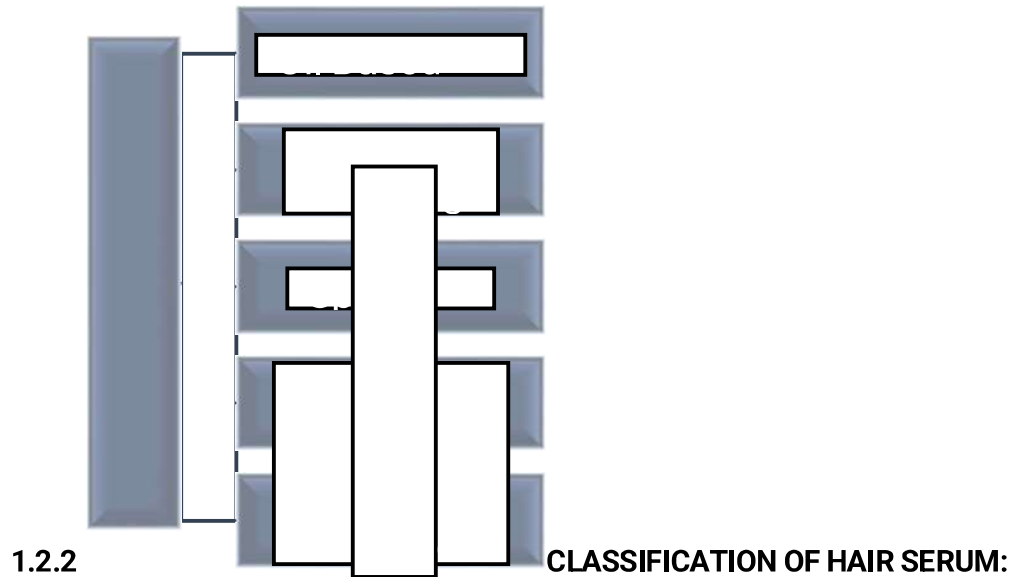


Figure 1.2.2 – Classification of Hair Serum

OIL-BASED SERUM-

Oil-based face serums are anhydrous, meaning they predominantly include oils and lipids and don't contain any water-based components. Many rare and precious oils, which are truly gifts from nature when used on the skin, can be

used to make a serum.

CURL-DEFINING SERUM-

This multipurpose hair serum makes it easier to moisturize and feed curly hair without weighing it down, leaving curls bright, silky, and amazing! The vegan recipe doesn't contain any components or byproducts that come from animals.

SPRAY SERUM –

Serum Spray is a revolutionary, one-of-a-kind hair serum that serves as both a nourishing, bio-active scalp concentration and a smoothing, shaping style treatment.

WATER-BASED SERUM-

In a nutshell, the main component of water-based skin care solutions is water. Products that prominently use water tend to be lighter and easier to absorb into your skin. A water-based face serum absorbs quickly, allowing you to follow up with moisturizer, sunscreen, and makeup right away.

SILICONE-BASED SERUM-

A silicone-based styling solution that coats the surface of the hair to give shine, smoothness, moisture, and protection from humidity and pollutants.

1.2.3 STANDARDIZATION OF HERBAL INGREDIENTS:

The "standardization" of herbal medications is a difficult endeavor because many variables affect their bio-efficacy and repeatable therapeutic impact. Care should be given to the accurate identification of plants, seasons, and locations of cultivation through the procurement of quality-oriented herbal goods. collection, their extraction, the purification procedure, and, in the case of a combination, polyherbal medicines. Standardization entails modifying the formulation of natural medications to a defined content of one or more constituents or a combination of chemicals with established medicinal effects by mixing herbal medications herbal drug preparations, or both, with excipients. A drug's "evaluation" entails verifying its authenticity and determining its quality, purity, and the ability to identify adulteration of any kind.

IMPORTANCE OF STANDARDIZATION:

The establishment of quality control standards is essential for ensuring consistency in the composition of batches of herbal formulations. • Verification

of the proper dose amount in grams or extraction per milli liter • Positive control to flag potential degradation or loss throughout production.

TYPES OF STANDARDIZATION:

A specific phytochemical or combination of elements is known to have activity in the first category of standardization, known as "true" standardization.

The second kind of standardization is based on producers promising the presence of a specific proportion of marker chemicals; these are not measures of the herb's therapeutic potency or purity.

1.2.4 QUALITY CONTROL OF HAIR SERUM:

A drug's status as determined by its identity, purity, content, and other chemical, physical, and biological features, as well as by the manufacturing methods, is referred to as its quality. The word "quality control" describes the procedures used to sustain the reliability of a manufactured good.

WHO GUIDELINES FOR STANDARDIZATION OF HERBAL FORMULATION:

Monitoring the quality of raw drug ingredients, plant preparations, and final goods.

- ☒ evaluation of stability and shelf life.
- ☒ Assessment of safety; record of safety based on toxicological studies or experience.
- ☒ Evaluations of biological activity and ethnomedical data are used to determine effectiveness.

CHAPTER - II

LITERATURE OF REVIEW

S.NO	ABSTRACT	JOURNAL	PUBLISHED IN
1.	Gayatri M. Penkar, Maithilee R. Salkar, Prachi S. Chavan, Maitrey S. Ambade, Sanchit A. Parab, Manasvi M. Sawant, Vijay A. Japgap*. 1. EVALUATION OF HERBAL Cosmetics, including toothpaste, hair color, hair oil, and hair serum, are in high demand due to their herbal components. They address hair-related issues like hair loss, split ends, dandruff, sebum production, thinning, and early aging. Fenugreek, a home treatment for hair growth, aids in maintaining a healthy scalp. 2. EVALUATION OF HERBAL This study focuses on the use of herbal formulations for treating common hair issues like baldness, alopecia, hair loss, grey hair, dryness, and dandruff. The study emphasizes the high safety profile and lower dose of these herbal medicines, which are widely used in cosmetics to enhance beauty and youthful appearance. 3. STABILITY OF SERUM Hair follicles are crucial for self-defense, gender differences, attractiveness, and temperature protection. Lifestyle changes like exhaustion, worry, junk food, and haircuts can cause hair loss. Activating hair roots is essential for healthy growth and hair loss prevention.	Formulation and Evaluation of Herbal Hair Serum in Treatment of Various Hair-Related Problems	Research Journal of Pharmacognosy and Phytochemistry June 2023, Vol. 15, ISSN 0975-2331

2.	Soni kk Soni S*, Plants, including <i>Eclipta alba</i>, have been used for treating human ailments since ancient times. Bhringraj, also known as the false daisy, is a popular plant in traditional medicine systems like Ayurvedic, Unani, Siddha, homeopathy, Chinese, and folk. It contains phytochemicals like coumestans, triterpenes, flavonoids, steroids, polypeptides, and saponins.	<i>Eclipta alba</i> (L.) An Ethnomedicinal Herb Plant, Traditionally Use in Ayurveda	Journal of Horticulture 2017, Volume 4 • Issue 3, ISSN:2376-0354
3.	Timalsina D, Devkota HP*, Bhringraj, a plant known for its medicinal properties, has been used in various regions for various treatments. Its extracts are anti-hepatotoxic, anti-diabetic, and anti-inflammatory, and Bhringraj, a plant known for its medicinal properties, has been used in various regions for various treatments. Its extracts have anti-hepatotoxic, anti-diabetic, anti-inflammatory, and	<i>Eclipta prostrata</i> (L.) L. (Asteraceae): Ethnomedicinal Uses, Chemical Constituents, and Biological Activities	National library of medicine Nov 2021
4.	Kumari I*, Kaurav H, Chaudhary G, Cosmetics are in high demand due to their daily use in skincare, hair care, nails, and teeth. However, synthetic products often have side effects, leading people to prefer organic, natural, and herbal formulations. Herbal preparations are known for their "no side effect" properties. People are seeking ways to increase hair development, prevention, and care. Hairserums, <i>Trigonella foenum graecum</i>, flaxseed, <i>citrussinensis</i>, ginger, castor oil, Vitamin E, and hibiscus are all effective in treating hair diseases.	Formulation and Evaluation of Herbal Hair Serum in Treatment of Various Hair-Related Problems	Research Journal of Pharmacognosy and Phytochemistry June 2023, Vol. 15, ISSN 0975-2331

5.	Gayatri M. Penkar, Maithilee R. Salkar, Prachi S. Chavan, Maitrey S. Ambade, Sanchit A. Parab, Tejas S. Padte, Pallavi L. Salgoankar, Manasvi M. Sawant, Vijay A. Jagtap*, Hair loss is a common condition influenced by genetic nutritional, medical, and environmental factors. Men often experience Androgenic alopecia, while women may experience medical conditions like hypothyroidism, oral contraceptives, and nutritional deficiency. Humans have approximately 100,000 terminal hair follicles on the scalp, which grow and shed during a specific growth cycle. A healthy scalp typically has 90% growth, with shedding of 100 hairs daily considered normal. Approximately 50% of women	Clinical Study to Evaluate the Efficacy and Safety of a Hair Serum Product in Healthy Adult Male and Female Volunteers with Hair Fall	Clin cosmeti cinvesting Dermatol, 2020, vol.13,
6.	Debashish Mukharjee, Sakshi Lokwani, Arya Dave, Cloris Gonsalves and Chiradeep Sarkar* The herb <i>Hibiscus rosa-sinensis</i> Linn. is a popular ornamental plant in the tropics, known for its hair growth-promoting and anti-greying properties. Its leaves and flowers	In vivo and in vitro evaluation of hair growth potential of <i>Hibiscus rosa-sinensis</i> Linn.	Pubmed, 2003 Oct.

7	Hiba Shams, Imam Pasha.S*, M. Mushraff Ali Khanand Anupama Koneru*, This work aims to formulate herbal oil for general purposes using various herbs, as natural products are increasingly popular due to their safety, toxicity, and side effects.	Formulation and Evaluation of Herbal Hair Oil Using Sesame Hair Oil	Research Gate, September 2022, Volume 2, Issue 1, ISSN (Online) 2581-9429
8	Khairullah Aswin Rafif 1 , Solikhah Tridiganita Intan 2* , Ansori Arif Nur Muhammad1 and Raharjo Hartanto Mulyo 3, The study evaluated the effectiveness of essential oils in reducing hair fiber protein loss during grooming treatments like cleansing, bleaching, and straightening. The study used coconut, mustard, and neem oil. Results showed a significant decrease in protein loss in cleansing, bleaching, and straightening treatments. Neem oil was found to be the most effective, with the order of efficacy being Neem >Coconut > Mustard Oil. The study concluded that essential oils can significantly reduce hair fiber proteinloss.	Chemical analysis of Hair Control Damage. Controlled by essential oils, using analytical techniques.	World Journal Pharmaceutical Research, 2014, vol 3, Issue 3, ISSN 2277 – 7105

9	VC Bhagat , MS Kondawar*, This article discusses the use of herbal remedies and products for alopecia, highlighting their advantages over synthetic products and drugs. Herbal blends have minimal side effects, and maximum efficacy, and are economically and easily prevalent. They can treat various types of hair loss due to genetics, stress, nutritional deficiencies, environmental triggers, and chemical exposure. The article describes various herbal products, remedies, and nutrient supplements available, their brand names, manufacturing details, and cost used in medicine for wound healing, treatment of arterial hypertension, and antifertility. In India, herbal products	This article discusses the use of herbal remedies and products for alopecia.	Bioscience Biotechnology Research Asia, 2023, Vol.20, Number 2.
10.	Gayatri M. Penkar, Maithilee R. Salkar, Prachi S. Chavan, Maitrey S. Ambade, Sanchit A. Parab, Manasvi M. Sawant, Dr. Vijay A. Japgap*, This study explores hair fall among Kannada-speaking Hindu women in Mysuru, Karnataka, India. Through focus group discussions, participants shared their understanding of hair loss and its causes. They connected hair fall to broader stressors, making it a symbol of distress. However, further research is needed to determine its importance and its potential value in research and intervention.	The Hair in the Garland: Hair Loss and Social Stress Among Women in South India	National Library of Medicine, 2021.

CHAPTER – III

3.1 AIM:

To formulate, prepare, and evaluate the herbal serum using Bringaraja, Redhibiscus, and Neem as the main ingredients.

3.2 OBJECTIVES OF THE STUDY:

- To collect the Herbal powders and to perform the Physico Chemical and Phyto chemical Screening
- To prepare the herbal serum.
- To perform evaluation studies of the finished product.

3.3 PLAN OF WORK:

Collection of the Herbal Powders

Phytochemical screening of the Herbal Powders

Physio-chemical constants analysis

- ☒ Moisture Content/ Loss on Drying
- ☒ Determination of ash value
- ☒ Total Ash value
- ☒ Water soluble ash
- ☒ Acid insoluble ash
- ☒ Sulphated Ash
- ☒ Thin Layer Chromatography

Qualitative Phytochemical Analysis

- ☒ Fluorescence Analysis

Formulation of Hair Serum by the use of

- ☒ BRINGARAJA: (Plant Name: *Eclipta alba* Hassk),
- ☒ RED HIBISCUS: (Plant Name: *Hibiscus rosa sinensis*),
- ☒ NEEM: (Plant Name: *Azadirachta indica* A.)

Evaluation studies for the hair Serum

- ☒ Physical Appearance
- ☒ pH

- ☒ Homogeneity Test
- ☒ Viscosity
- ☒ Spreadability Test
- ☒ Observations of the Growth of Hair
- ☒ Test the Sensitivity of the Eye (Draize Eye Test)
- ☒ Microbial properties determination
- ☒ Stability Test

3.3.1 COLLECTION OF PLANT PART:

To prepare the hair serum, various plant materials (powders) viz., *Eclipta alba* Haska, *Hibiscus rosa sinensis*, and *Azadirachta indica* were collected from the local market of Chennai, Tamil Nadu, and confirmed the purity by conducting various standardization methods.

3.2.2 PHYTOCHEMICAL SCREENING OF THE HERBAL POWDERS:

Detection Of Alkaloids-

a. Dragendroff's Test

The powder/extract was dissolved in 5ml of distilled water, to this 5ml of 2M HCl was added. Then 1ml of Dragendroff's reagent was added and examined for an immediate formation of an orange-red precipitate.

b. Mayer's Test

The powder/extract was mixed with a small amount of dilute HCl and Mayer's reagent and examined for the formation of a white precipitate.

c. Wagner's Test

The powder/extract was mixed with Wagner's reagent and examined for the formation of the reddish-brown precipitate.

Detection of Carbohydrates-

a. Molisch's Test

To the test solution, a few drops of alcoholic alpha-naphthol and a few drops of concentrated Sulphuric acid were added through the sides of the test tube. The appearance of a purple-to-violet color ring at the junction indicates the presence of carbohydrates.

b. Fehling's Test

The test solution was mixed with Fehling's I and II, heated, and examined for the presence of red coloration for the presence of sugar.

Detection of Steroids-

a. Salkowski reaction

A few mg of extract was taken in 2 ml of chloroform and 2 ml of concentrated sulphuric acid was added from the side of the test tube. The test tube was shaken for a few minutes. The development of red color indicates the presence of steroids.

Detection of phenol-

a. Ferric chloride Test

A small quantity of powdered drug/ extract was dissolved in 2ml distilled water and a few drops of 10% aqueous ferric chloride solution was added and observed for the appearance of blue or green color.

Detection of flavonoids:

- a. .To a small quantity of the solution of powder taken in a test tube, 5-10 dropsof Dilute hydrochloric acid and a small piece of magnesium were added andthe solution was boiled for a few minutes. The presence of a reddish-pink color indicates flavonoids.

Detection of saponins:

- a. A drop of sodium bicarbonate solution was added to the sample and the mixture was shaken vigorously and left for 3 minutes. The development of any honeycomb-like froth was examined.

Detection of proteins:

a. Biuret test-

A few mg of the residue was taken in water and 1 ml of 4% sodium hydroxide solution was added to it, followed by a drop of 1% solution of copper sulfate. The development of violet or pink color indicates the presence of proteins.

b. Xanthoproteic test-

A small quantity of test sample was taken with 2 ml of water and 0.5 ml of concentrated nitric acid was added to it. The development of yellow color indicates the presence of proteins.

c. Millon's test-

A small quantity of test sample was taken and 2 to 3 ml of millons reagent was added. The white precipitate slowly turns to pink, indicating the presence of proteins.

Detection of tannins:**a. Lead acetate Test-**

The test solution was mixed with a basic lead acetate solution and examined for the formation of a white precipitate.

b. Ferric chloride Test-

A few drops of 5% aqueous ferric chloride solution were added to 2 ml of aqueous extract of the drug and examined for the presence of bluish-black color.

Detection of glycosides:**a. Bontrager's Test-**

The powdered plant material/extract was boiled with 1 ml of sulphuric acid in a test tube for a few minutes. The solution was filtered while hot, cooled and shaken with an equal volume of chloroform. The lower layer of the solvent was separated and shaken with half of its volume of dilute Ammonia. The formation of a rose-pink to-red color in the ammoniacal layer indicates the presence of glycosides.

b. Modified Bontrager's Test-

The test material was boiled with 2 ml of dilute sulphuric acid. This was treated with 2ml of 5% freshly prepared aqueous ferric chloride solution for 5 min and shaken with an equal volume of chloroform. the lower layer of solvent was separated and shaken with half of its volume of dilute ammonia. The formation of a rose-pink to-red color in the ammoniacal layer

indicates the presence of glycosides.

c. Legal's Test-

The test material when treated with sodium nitroprusside in pyridine and methanolic alkali. The formation of a pink to blood-red color indicates the presence of cardiac glycosides.

3.3.3 PHYSIO-CHEMICAL CONSTANTS ANALYSIS:

Determination of moisture content-

Loss on drying-

10 g of the sample substances (without preliminary drying) was taken in a tarred evaporating dish. The use of high-speed mills in preparing the samples is avoided. The samples in the tarred evaporating dish were placed in the drying chamber (105°C) for 5 hours and weighed. Drying and weighing are continued every one-hour interval until the difference between the two successive weights is not more than 0.25 percent. Constant weight is reached when the two consecutive weighs after drying for 30 minutes and cooling for 30 minutes in a desiccator, show not more than 0.001 g difference. Percentage moisture content is compared concerning the air-dried sample.

$$\% \text{ Moisture content} = \frac{\text{Final weight of the sample} - \text{Final Weight of the}}{\text{Final Weight of the}} \times 100$$

Determination of ash values-

Ash values help determine the quality and purity of a crude drug in the powdered form. The residue remaining after the incineration is the ash content of the drug, which simply represents inorganic salts, a naturally occurring drug or adhering to it or edibility added to it, as a form of adulteration. The Ash value of a crude drug is defined as the inorganic residue remaining after incineration, which complies with inorganic salts, naturally occurring in the drug or adhering to it or deliberately added to it as a form of adulteration. Hence it is used for the determination of the quality and purity of the crude drug in the powdered form.

Total ash-

The total ash method is designed to measure the total amount of material remaining after ignition. They include both physiological ash which is derived from

plant tissue itself and non-physiological ash which is the residue of extraneous matter adhering to the plant surface.

Procedure:

The Silica crucible was heated to red hot for 30 minutes and cooled in the desiccators. Incinerate about 2 to 3 g accurately weighed, the ground drug in a tarred silica dish at a temperature not exceeding 450°C until the sample was free from carbon, cooled in desiccators and weighed. The ash obtained was weighed. The percentage of total ash was calculated.

Water soluble ash-

The difference in weight between the total ash and the residue after treatment of the total ash in water.

Procedure:

The total ash obtained was boiled for 5 minutes with 25 ml of water, and insoluble matter was collected in an ashless filter paper, washed with hot water, and ignited for 15 min at a temperature not exceeding 450°C. Subtract the weight of this residue in mg from the weight of the total ash. Calculate the content of water-soluble ash in mg per gram of air-dried material.

$$\text{Water soluble ash} = \frac{\text{Weight of residue obtained}}{\text{Weight of the sample}} \times$$

Acid insoluble ash-

The residue obtained after boiling the total ash with dilute hydrochloric acid, the remaining insoluble matters are ignited and measured. This measures the amount of silica present, especially sand and siliceous earth.

Procedure:

To the crucible containing the total ash of the sample, 25 ml of dilute hydrochloric acid is added. The insoluble matter is collected on an ashless filter paper (Whatman 41) and washed with hot water until the filtrate is neutral. Filter paper containing the insoluble matter to the original crucible, dry it on a hot plate and

$$\text{Acid soluble ash} = \frac{\text{Weight of residue obtained}}{\text{Weight of the sample}} \times$$

ignite to constant weight. Allow the residue to cool in a suitable desiccator for 30 minutes and weigh without delay. The content of acid-insoluble ash regarding the air-dried drug is calculated

Sulphated ash-

A sulphated ash test is used to measure the amount of residual substance not volatilized from a sample. These tests are usually used to determine the content of inorganic substances.

Procedure:

The Silica crucible was heated to redness for 10 minutes, allowed to cool in a desiccator, and weighed. 2 g of sample was accurately weighed, ignited gently then thoroughly charred. Cool, moisten the residue with 1 ml of sulphuric acid, heat gently until the white fumes are no longer evolved, and ignite at $800 \pm 25^\circ\text{C}$ until all black particles have disappeared. Crucible is allowed to cool, add a few drops of sulphuric acid and heat. Ignite as before, and allow to cool, and weigh. This process is repeated until two successive weights differ by more than 0.5 mg.

$$\text{Sulphated ash} = \frac{\text{Weight of residue obtained}}{\text{Weight of the sample}} \times 100$$

Thin Layer Chromatography (TLC)-

Thin-layer chromatography is a tool for the separation and identification of chemical constituents. Thin-layer chromatography is a technique in which a solute undergoes distribution between two phases, a stationary phase acting through adsorption and a mobile phase in the form of a liquid.

Step-1: Chromatography plates: T.L.C. plate coated with 0.25 mm layer of silica gel 60 F254 with fluorescent indicator was used. (Each plate dimension is 10 cm long and 2 cm wide)

Step 2: Activation of pre-coated Silica gel 60 F254: The plate was dried in a hot oven at 105°C for one and a half hours.

Step-3: Preparation of mobile solution: Toluene: Acetone: Formic acid (11: 6: 1).

Step-4: Preparation of test solution: 4 gm powdered test drug was extracted with 100 ml of ethanol (90 percent) in Soxhlet apparatus consecutively three times. The extract was filtered and concentrated to 10 ml.

Step-5: Sample application: The sample was applied with the help of a capillary (one) cm above

the base of the T.L.C. plate. Then it was dipped in a mobile solution. The T.L.C. plate was removed from the mobile solution immediately after the spot reached the 1 (one) cm below the top of the T.L.C. plate

Step-6: Visualization: p-anisaldehyde sulphuric acid spray.

Step-7: Rf Value: Measured and recorded the distance of each spot from the point of its application and calculated the Rf value by dividing the distance travelled by the spots by the distance travelled by the front of the mobile phase.

3.3.4 QUALITATIVE PHYTOCHEMICAL ANALYSIS:

Fluorescence analysis-

Fluorescence analysis was carried out in daylight and UV light. The powdered plant raw materials and their extracts were treated with various reagents and solvents to identify the presence of chromophores. The fluorescence was observed in daylight and short and long UV light 254nm and 365nm respectively.

3.3.5 FORMULATION OF SEMI-SYNTHETIC HAIR SERUM:

Step-1: Clean all the glassware and dry them properly as per SOP.

Step 2: Measure the accurate quantity of powders as per the table and transfer it to the beaker.

Step 3: Mix the required quantity of Coconut oil and Vitamin E.

Step-4: Now mix rose water with the above mixture of Coconut oil and Vitamin E

Step-5: After stirring for a few minutes, heat the prepared solution for a few minutes.

Step 6: Add a few drops of almond oil.

Step-7: After that stir the preparation with the help of a magnetic stirrer

Step 8: Add the Preservative to the above mixture

Step-9: Transfer the preparation to the measuring cylinder and adjust the final volume to 100 ml.

Step 10: Transfer the final solution into the container.

Ingredients used in the preparation of hair serum

S. No	Name of the Ingredient	Part of the plant used	Category	Quantity (%)
1	<i>Eclipta alba</i>	Leaves	Hair Growth Promoter	20 %
2	<i>Hibiscus rosa sinensis</i>	Leaves	Anti-dandruff, Conditioner Hair Growth Promoter	40 %
3	<i>Azadirachta indica</i>	Leaves	Hair Growth Promoter and Anti-Microbial Activity	15 %
4	Coconut Oil	-	Conditioner	8.5 %
5	Almond oil	-	Conditioner	8.5 %
6	Vitamin E	-	For hair growth	5 %
7	Rose water	-	Flavor	Q. S
8	Methyl Paraben	-	Preservative	3 %
9	Distilled Water	-	Vehicle	Q. S

Table 3.3.5 (a)- Ingredients used in the preparation of hair serum

3.3.6 EVALUATION OF THE HAIR SERUM:

Physical Appearance-

The physical appearance, color, and feel of the prepared hair serum are visually tested. The results are tabulated in Table.

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.

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. hair serum was tested by visual examination for homogeneity and tested for some lumps, flocculates, or aggregates.

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 semisolid preparations. One gram of 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 minute. Spreadability was calculated using the following formula:

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

Where,

S= Spreadability,

M Weight in the pan (tied to the upper slide),

L= Length moved by the glass slide, and

T = Time (in seconds) taken to separate the slides completely

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.

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

Eye sensitivity was tested on three rabbits to get 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.

Microbial Contamination-

The antimicrobial activity of semi-synthetic hair serum using different solvents. Strains of aerobic and anaerobic micro-organisms were evaluated by the standard cup plate method. For these standard cup plate methods, the nutrient agar medium is used as a culture medium. To perform an antimicrobial test the pre-sterilized petri plate was used. To sterilize, the Petri plate was incubated for 24 hours at 37°C then next to the agar culture media was poured on the Petri plate uniformly in an aseptic condition. After spreading the agar medium is covered with another petri plate and kept aside for 24hrs in the refrigerator to solidify the agar medium. After these the plate was removed and, on this plate, the cup was formed. On two particular plates, the standard solution which contains microorganism strains *Bacillus subtilis* was uniformly spread in an aseptic condition. Now in the cup which is created on two petri plates the standard which is a pure marketed product of 1 ml is poured by the pipette and in the next cup the formulated hair serum is poured in an aseptic condition. Then these two plates were kept for incubation for 24 hours at 37°C. After the incubation period, the inhibition was found on the petri plate. The Petri plate shows the zone of inhibition. on the Petri plate, the zone of inhibition of hair serum and pure form of marketed formulation and *Bacillus* the zone of inhibition appeared.

Stability-

The semi-synthetic 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 hair serum were determined after three months.

CHAPTER - IV

4.1 PLANT PROFILE:

4.1.1 AZADIRACHTA INDICA

Name: Neem

Family: Meliaceae

Part used: leaves

VERNACULAR NAME:

Tamil : vembu, veppan

English: neem, Indian lilac

Telugu: Vepa

Kannada : Garujalu, Gurugada, Soppu, Keshavardhana, Kodigaraju.



Figure 4.1.1 - Azadirachta indica

Morphological characteristics:

Neem trees can reach 15-30m in height and have attractive grounded crowns and thick furrowed bark. The compound leaves have toothed leaflets and are typically evergreen but do drop during periods of extreme drought.

The smallest fragrant white flowers are bisexual staminate males and are borne in clusters.

Phytochemical constituents:

nimbolinin, nimbin, nimbidin, nimbidol, sodium nimbinate, gedunin, salannin, and quercetin.

Therapeutic uses:

Anticancer, antidiabetic, neuroprotective activity, antifungal, antibacterial, antiviral, antimalarial, antioxidant.

4.1.2 ECLIPTA PROSTA

Name : Bhringraja

Family: Asteraceae **Part**

used : leaves

VERNACULAR NAME :

Tamil : kayanthakara

English : False daisy

Telugu : guntagalagaraku

Kannada : Garagada soppu, Garga



Figure 4.1.2 - *Eclipta prosta*

Morphological characteristics:

It is an erect or prostrate, branched (occasionally rooting at nodes) annual herb up to 30-40 cm high. The stem is cylindrical or flat, rough due to appressed white hairs, nodes distinct and greenish occasionally brownish.

Phytochemical constituents:

Ecliptal, wedelolactone, desmethyl wedelolactone, stigmasterol.

Therapeutic uses:

The entire plant is used as an emetic, antiseptic, febrifuge, tonic, and deobstruent in hepato- and splenic-enlargement, and deobstruent.

The juice is administered along with aromatics for anemia, catarrh, and cough.

The plant is additionally employed as a scalp tonic to encourage hair growth.

In viral hepatitis and other disorders requiring hepatic enlargement, bhringaraj is frequently used as a de-obstruent to encourage bile flow and protect the liver parenchymatous tissue.

4.1.3 HIBISCUS ROSA – SINENSIS

Name: Hibiscus rosa-sinensis

Family: Malvaceae

Part used: leaves

VERNACULAR NAME:

Tamil: sembaruthi

English: Hibiscus

Telugu: Mandharam

Sanskrit : japa, aruna

Kannada: dasavala



Figure 4.1.3 - Hibiscus rosa – sinensis

Morphological characteristics:

The leaves are often lobed and may be smooth or covered in trichomes (plant hairs). The flowers can be borne singly or in clusters, and the flowers of many species last only a single day.

An epicalyx (whorl of leaflike bracts that surrounds the sepals) is particularly common, and the stamens are typically fused into a tube. Members of the genus characteristically have spiny pollen, and their fruits are capsules.

Phytochemical constituents:

The phytochemical analysis showed that Hibiscus rosa-sinensis contained tannins, anthraquinones, quinines, phenols, flavonoids, alkaloids, terpenoids, saponins, cardiac glycosides, protein, free amino acids, carbohydrates, reducing sugars, mucilage, essential oils, and steroids.

Therapeutic uses:

All plant parts of Hibiscus Rosa Sinensis Linn are most widely used to treat several ailments like anti-tumor, anti-fertility, anti-ovulatory, anti-implantation, anti-inflammatory, analgesic, anti-estrogenic, antipyretic, anti-spasmodic, anti-viral, anti-fungal, anti-bacterial, hypoglycemic, spasmolytic, CNS depressant, hypertensive and juvenoid Activity.

4.2 INGREDIENT PROFILE:

Ingredients used in the preparation of semi-synthetic hair serum

S. No	Name of the Ingredient	Part of the plant used	Category	Quantity (%)
1	<i>Eclipta alba</i>	Leaves	Hair Growth Promoter	20 %
2	<i>Hibiscus rosa sinensis</i>	Leaves	Anti-dandruff, Conditioner Hair Growth Promoter	40 %
3	<i>Azadirachta indica</i>	Leaves	Hair Growth Promoter and Anti-Microbial Activity	15 %
4	Coconut Oil	-	Conditioner	8.5 %
5	Almond oil	-	Conditioner	8.5 %
6	Vitamin E	-	For hair growth	5 %
7	Rose water	-	Flavor	Q. S
8	Methyl Paraben	-	Preservative	3 %
9	Distilled Water	-	Vehicle	Q. S

Table 4.2 (a) - Ingredients used in the preparation of semi-synthetic hair serum

Coconut oil-

It is one of the household staples in Southern India. Considered to be the safest option used for any hair problems. Best home remedy for cuts, burns, wounds, etc.

Here are some of the effects of coconut oil used for hair:

- Protects from heat damage
- Prevents dandruff
- Can be used as styling gels if used to a minimum quantity.
- Reduces damage to the hair.
- Emollients the hair from root to tip.

Almond oil-

It is one of the versatile oils. It is also a household staple. Eating raw almonds can help in various bodily functions such as providing energy, building muscles, etc.

Here is the enumeration of oil benefits:

- Improves blood flow therefore contributing to hair growth
- Ensures regrowth of hair.
- Involved in reactivating dormant hair follicles.
- Contains keratin one of the essentials for hair growth, thickening, and conditioning of hair.

Vitamin E-

It is one of the fat-soluble vitamins available in markets in the form of capsules (even). It is popular for its anti-aging properties.

Hair benefits of vitamin E are:

- Provides elasticity to hair
- Mostly protected from UV radiation.

Methylparaben-

It is one of the preservatives used. It is also an FDA (Food and Drug Administration) approved preservative.

Reasons for usage in this serum:

- Preservation when used as per IP.
- Prevents microbial growth.

Rose water-

Most used in cosmetic products. Easily available in markets. Most preferred and affordable product to use. Safe to use for all age people.

Purpose of using:

- Controls oily scalp.
- Enables minimum hair growth.
- Used predominantly for odour.

4.3 DISEASE PROFILE:

4.3.1 INTRODUCTION:

Dandruff is a common scalp condition affecting nearly half of prepubescent people, regardless of gender or race. It is caused by the lipophilic yeasts of the genus *Malassezia*, which are a natural component of the skin's normal microbiome. *Malassezia* species are more prevalent on seborrheic skin regions and have varied species distributions on the skin, potentially having diverse global distributions. Different diagnostic approaches may be responsible for these disparities, as some species may overgrow others in culture. *Malassezia*-related skin conditions are often treated with antifungal medication and anti-inflammatory therapy, but their responsiveness to various treatments varies. Identifying the *Malassezia* species may be necessary to select the most sensitive antifungal medication, despite the practical challenges in settings with limited resources.

4.3.2 Dandruff Ratings:

It is common practice to score the amount of dandruff visually. Before beginning any clinical research, a two-week washout period is always required. The entire scalp

should be examined rather than just a single location. Photographic and other bio-instrumental techniques for quantifying dandruff are also used.

4.3.3 Corneocyte's Function in Dandruff:

Malassezia, a yeast, is not evenly distributed across the skin's surface and inside the stratum corneum in seborrheic dermatitis and dandruff. Corneocytes may have different Malassezia binding sites or produce natural antifungal peptides. The Malassezia-corneocyte theory remains unclear, as it doesn't explain why low-grade scaling and a low parakeratotic index persist even after dandruff has cleared. Antifungal drugs may not completely eradicate deep-seated yeasts, allowing a limited inflammatory reaction.

4.3.4 Pathology:

SD is diagnosed through a history and physical examination, with a skin biopsy sometimes needed for differential diagnosis. SD can be divided into two stages, with superficial inflammatory infiltrates, parakeratosis, and neutrophils in the acute and subacute stages. Chronic lesions may have psoriasiform hyperplasia, parakeratosis, and dilated surface plexus venules.

4.3.5 Pathophysiology:

Dandruff, a non-inflammatory condition, shares similarities with seborrheic dermatitis (SD) in terms of histology, epidermal hyperplasia, parakeratosis, and Malassezia yeasts. However, dandruff

lacks inflammatory cells, such as lymphocytes and NK cells, which are found in SD. The cause of dandruff's development remains unknown.

4.3.6 Dandruff Non-Microbial Etiopathology:

It is commonly known that dandruff has non-microbial causes. Desquamation of the scalp is a known side effect of prolonged sun exposure. Dandruff can also be partially brought on by minor scalp irritation brought on by excessive shampooing, frequent combing, the use of specific cosmetic products, dust, and grime. However, the aforementioned hypotheses are not sufficiently supported by experimental data.

4.3.7 Skin Conditions Associated with Malassezia:

Malassezia is a component of the human microbiome, but it also plays a role in the etiology of pityriasis versicolor, head and neck dermatitis, seborrheic dermatitis, and Malassezia folliculitis. Under some circumstances, it interacts with both the innate and acquired skin immune systems, leading to immunological reactions. IgG and IgM antibodies against Malassezia can be found in the majority of people.

HEAD DERMATITIS



Figure - 4.3.7 (a)

NECK DERMATITIS



Figure - 4.3.7 (b)

4.3.8 Therapeutic Presentation:

According to Maarouf et al. (2018), the eyelids, forehead, and neck are frequently affected by erythematous alterations that have wheal-like (urticarial) characteristics. The itching, scaling, and affected regions give off the look of an eczema flare.

4.3.9 Causes:

Atopic dermatitis can be caused by various factors including an overreactive immune system, genetics, environmental factors, and chemical exposure. The immune system may overreact to seemingly insignificant irritants or allergens, leading to inflammation. Genetics also play a role, with alterations in genes affecting protein maintenance. Environmental factors like air pollution, tobacco smoke, and fragrances can also contribute to dermatitis.

Sleep loss.

Depression.

Anxiety.

Asthma.

Allergies.

CHAPTER - V

RESULTS AND DISCUSSION

5.1 PHYTOCHEMICAL SCREENING OF THE HERBAL POWDERS

Phytochemical Screening of the Herbal Powders

Constituents	Bringaraja (<i>Eclipta alba</i> Hassk)	Red Hibiscus (<i>Hibiscus sinensis</i>) <i>rosa</i>	Neem (<i>Azadirachta indica</i>)
Alkaloids	Present	Present	Present
Carbohydrates	Present	Present	Present
Steroids	Absent	Absent	Present
Phenols	Absent	Present	Present
Flavonoids	Present	Present	Present
Saponins	Present	Present	Present
Proteins	Absent	Absent	Absent
Tannins	Absent	Present	Present

Table 5.1 (a) - Phytochemical Screening of the Herbal Powders



**Figure 5.1 (a) – Alkaloids
(Mayers Test)**



**Figure 5.1 (b) – Saponins
(Frothing Test)**

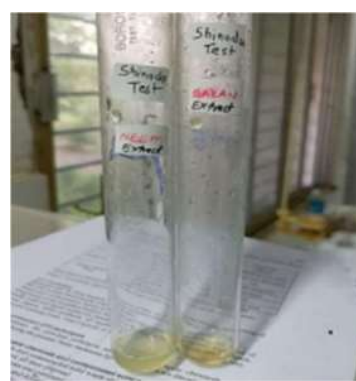


Figure 5.1 (c) -Flavonoids



**Figure 5.1 (d) – Tannins
(FeCl₃ Test)**



**Figure 5.1 (e) – Test for
terpenoids**

5.2 PHYSIO-CHEMICAL CONSTANTS ANALYSIS:

5.2.1 DETERMINATION OF MOISTURE CONTENT:

a. Loss On Drying-

S.NO	Ingredient	LOD (%w/w)
1	Bringaraja (<i>Eclipta alba</i> Hassk)	11%
2	Red Hibiscus (<i>Hibiscus rosa sinensis</i>)	13.50 %
3	Neem (<i>Azadirachta indica</i>)	1.2 %

Table 5.2.1 (a)- Loss on Drying Herbal Powders

5.3 DETERMINATION OF ASH VALUES:

Physiochemical parameters are mainly used in the assessment of purity and quality of the powdered drug. Ash values of a drug give an idea of the earthy matter or inorganic elements and other impurities present along with the drug.

Ash values are mainly used in judging the purity and quality of the drug is indicative of contamination, substitution, and adulteration. The total ash usually consists of

carbonate, phosphate, and silicates. Total ash, acid-insoluble ash, and water-soluble ash were done and reported in the table below.

a. Total Ash-

The total ash content of the raw materials was determined, by taking samples from the Collected materials.

S.NO	Ingredient	Total ash (%w/w)
1	Bringaraja (<i>Eclipta alba</i> Hassk)	11.45 %
2	Red Hibiscus (<i>Hibiscus rosa sinensis</i>)	6.7 %
3	Neem (<i>Azadirachta indica</i>)	9 %

Table 5.3 (a)- Total Ash Value of Herbal Powders

b. Water Soluble Ash:

S.NO	Ingredient	Water Soluble ash (%w/w)
1	Bringaraja (<i>Eclipta alba</i> Hassk)	11.45%
2	Red Hibiscus (<i>Hibiscus rosa sinensis</i>)	5.72 %
3	Neem (<i>Azadirachta indica</i>)	1.6 %

Table 5.3 (b)- Water Soluble Ash Value of Herbal Powders

c. Acid Insoluble Ash:

S.NO	Ingredient	Acid Insoluble ash (%w/w)
1	Bringaraja (<i>Eclipta alba</i> Hassk)	11.45%
2	Red Hibiscus (<i>Hibiscus rosa sinensis</i>)	4.47 %
3	Neem (<i>Azadirachta indica</i>)	2.9 %

Table 5.3 (c)- Acid Soluble Ash Value of Herbal Powders

d. Sulphated Ash:

S.NO	Ingredient	Acid Insoluble ash (%w/w)
1	Bringaraja (<i>Eclipta alba</i> Hassk)	11.45%
2	Red Hibiscus (<i>Hibiscus rosa sinensis</i>)	3.12 %
3	Neem (<i>Azadirachta indica</i>)	1.8 %

Table 5.3 (d)- Acid Insoluble Ash Value of Herbal Powders

5.4 THIN LAYER CHROMATOGRAPHY (TLC):

a. Azadirachta indica:

The pure compound and the test compounds were identified under UV light on the TLC plate. The compound showed a similar R_f value (0.56) very much similar to that of the standard compound, azadirachtin (0.57). The results of TLC are shown in Figure1.



Figure 5.4 (a) - TLC of the test compound (azadirachtin) of *Azadirachta indica*

b. *Hibiscus rosa sinensis*:

The pure compound and the test compounds were identified under UV light on TLC plate. The compound showed a similar R_f value (0.72) very much similar to that of the standard compound, azadirachtin (0.72). The results of TLC are shown in

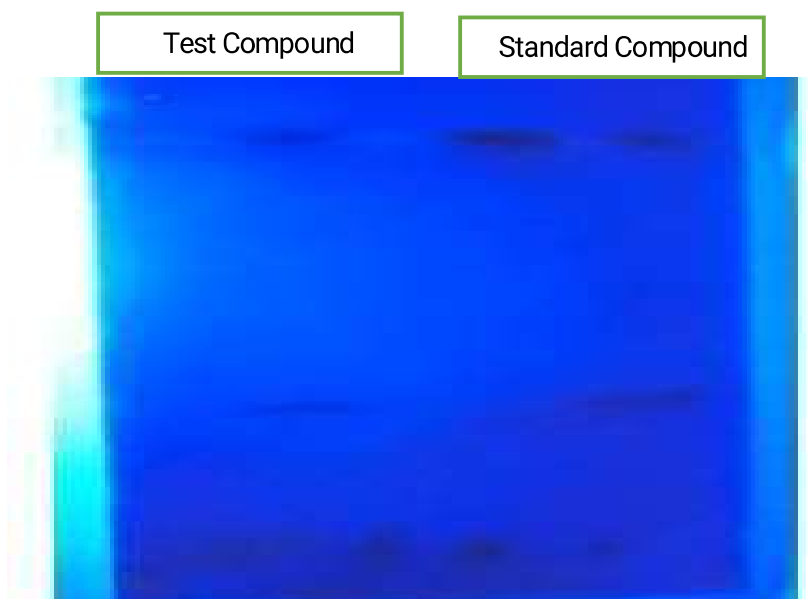


Figure 5.4 (b) - TLC of the test compound *Hibiscus rosa sinensis*

c. *Eclipta alba*:

The pure compound and the test compounds were identified under UV light on TLC plate. The compound showed a similar R_f value (0.45) very much similar to that of the standard compound, azadirachtin (0.45). The results of TLC are shown in

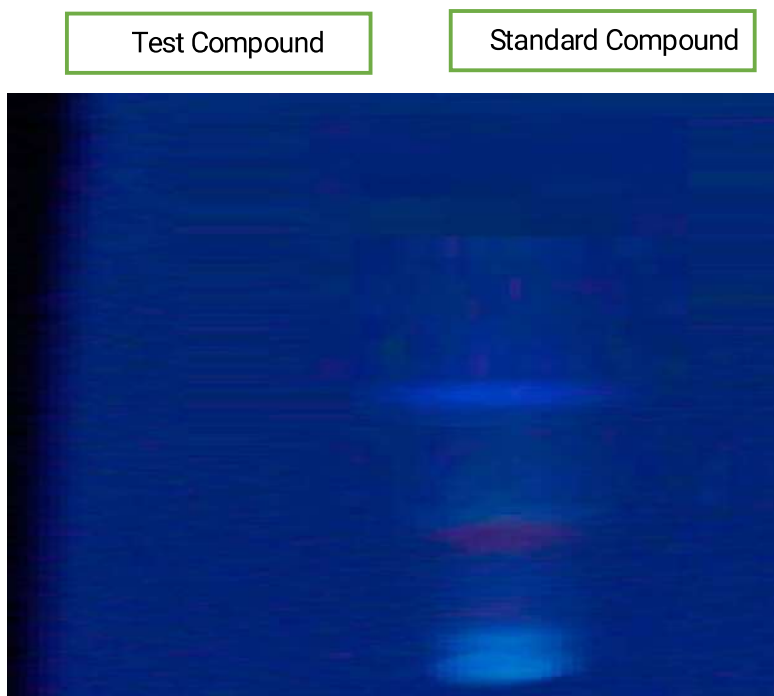


Figure 5.4 (c) - TLC of the test compound Eclipta alba

5.5 QUALITATIVE PHYTOCHEMICAL ANALYSIS:

Fluorescence Analysis:

Fluorescence analysis for the extracts and the powdered drug was carried out with various reagents to identify the presence of chromophores. The importance of fluorescence analysis is that UV light shows the fluorescent nature of the compound whereas fluorescence cannot be observed in daylight. Hence it is performed according to the standard procedures. The results are shown in the Table below.

TREATMENT	Bringaraja (<i>Eclipta alba</i> Hassk)		Red Hibiscus (<i>Hibiscus rosa sinensis</i>)		Neem (<i>Azadirachta indica</i>)	
	SHORT UV (254 nm)	LONG UV (365 nm)	SHORT UV (254 nm)	LONG UV (365 nm)	SHORT UV (254 nm)	LONG UV (365 nm)
Saturated picric acid	Dark green	Blackish brown	Blackish brown	Light green	Dark green	Blackish brown
Nitric acid	green	Dark green	Bright yellow	Bright yellow	Light green	Bright yellow
Hydrochloric acid	green	Blackish brown	Dark green	Bright yellow	Blackish brown	Light green
Sulphuric acid (80%)	green	Bright yellow	Light green	Bright yellow	Dark green	Bright yellow
Glacial acetic acid	green	Dark green	Bright yellow	Blackish brown	Dark green	Light green
Ferric solution	Dark green	Bright yellow	Light green	Bright yellow	Light green	Bright yellow

Table 5.5 - Fluorescence analysis of the Herbal Powders

5.6 FORMULATION OF SEMI-SYNTHETIC HAIR SERUM:

The semi-synthetic serum was prepared as per the procedure and the final formulation was subjected to further characterization studies.



Figure 5.6 (a)- Semi-Synthetic Hair Serum

5.7 EVALUATION OF THE HAIR SERUM:

5.7.1 Physical Appearance-

It was observed that the color of all the Semi-Synthetic hair serum was pale brown with a translucent look, which on application was found to be smooth.

5.7.2 pH Test-

The pH of the whole Semi-Synthetic hair serum was 7.3, which was sufficient for the hair, suggesting that the Semi-Synthetic hair serum was suitable for the hair.

5.7.3 Homogeneity Test-

By visual examination of the appearance and presence of any lumps, flocculates, or aggregates, the produced Semi-Synthetic hair serum was checked for homogeneity. The homogeneity of the prepared serum is fine.

Parameters	Results
Physical appearance	Yellowish-brown
Homogeneity	Good
pH	6.4
Spreadability	Good
Draize eye test	Mild Irritation

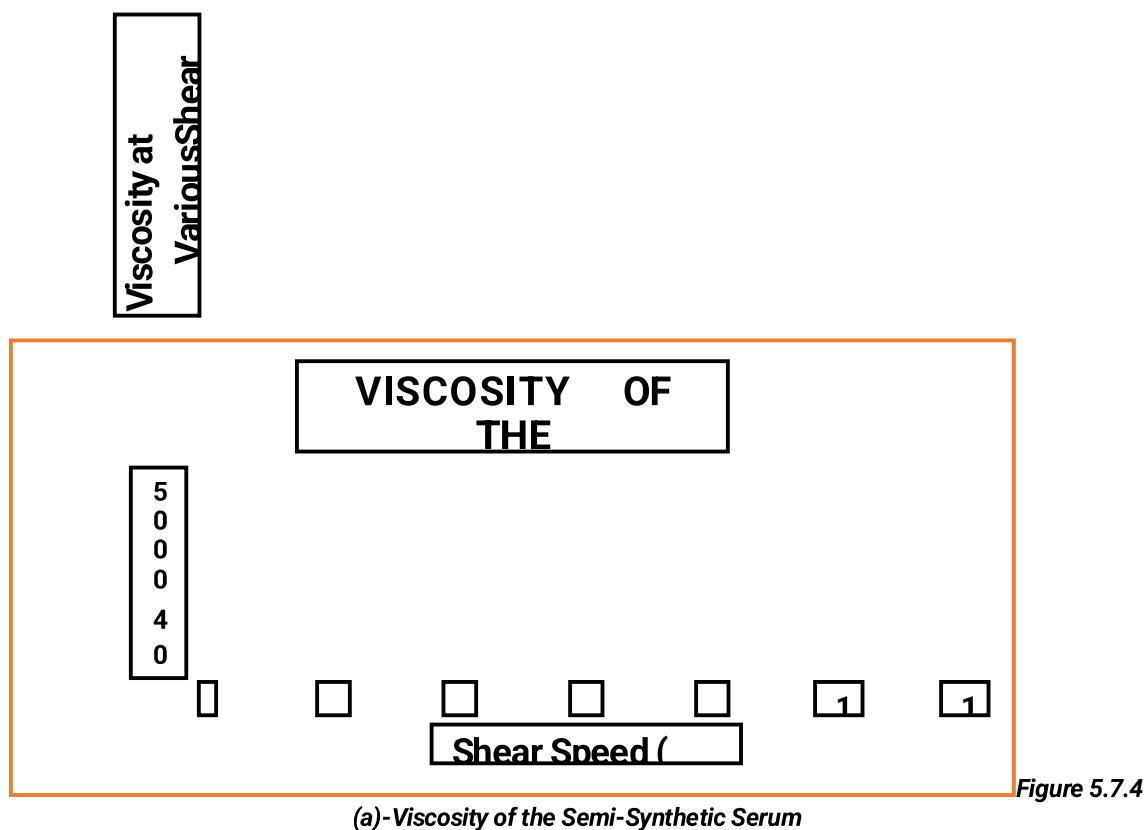
Table 5.7 - Physical Parameters Analysis of the Semi-Synthetic Serum

5.7.4 Viscosity-

The rheological examination of prepared Semi-Synthetic hair serum was conducted, and it was observed that viscosity was reduced as the shear rate increased. The pseudoplastic flow was also described, which is a beneficial attribute for topical Semi-Synthetic hair serum since it guarantees optimum area coverage upon application. The mechanistic explanation for the flow behavior found is as follows: the long-chain molecules of the polymers are spontaneously arranged in dispersion under standard storage conditions. These molecules tend to organize their long axes in the direction of the force exerted when applying shear stress. This stress-induced orientation reduces the internal resistance of the material. In addition, the solvent molecules earlier associated with the polymer molecules will also be released. Thus, the effective concentration and size of the molecules are low. The material allows a progressive increase in the shearing stress.

Shear Speed	10 RPM	20 RPM	50 RPM	100 RPM
Viscosity (CPS)	4110 cps	2933 cps	1645 cps	1010 cps

Table 5.7.4 - Viscosity of the Semi-Synthetic Serum



5.7.5 Spreadability-

The spreadability study is used to find the measurement of spreadability, the formulation showed a better result.

5.7.6 Observations of the Growth of Hair-

From the table, it reveals that there is a substantial hair length difference between both normal control and negative control hair. However, a major difference was reported by comparing the growth behavior displayed by normal control, negative control, and positive control. Thus, it was found that, although using a single formula, the hair serum used in this study displayed a more important hair growth activity of 7.98 mm. It can be seen that in the third week, Semi-Synthetic hair serum induced a greater weight of the hair.

Hair Length (mm)	Day		
	7 th Day	14 th Day	21 st Day

Normal Control	1.22	1.54	2.19
Negative Control	1.45	1.67	2.98
Positive Control (Semi-Synthetic Serum)	3.22	4.01	7.21

Table 5.7.6 - Physical Parameters Analysis of the Semi-Synthetic Serum

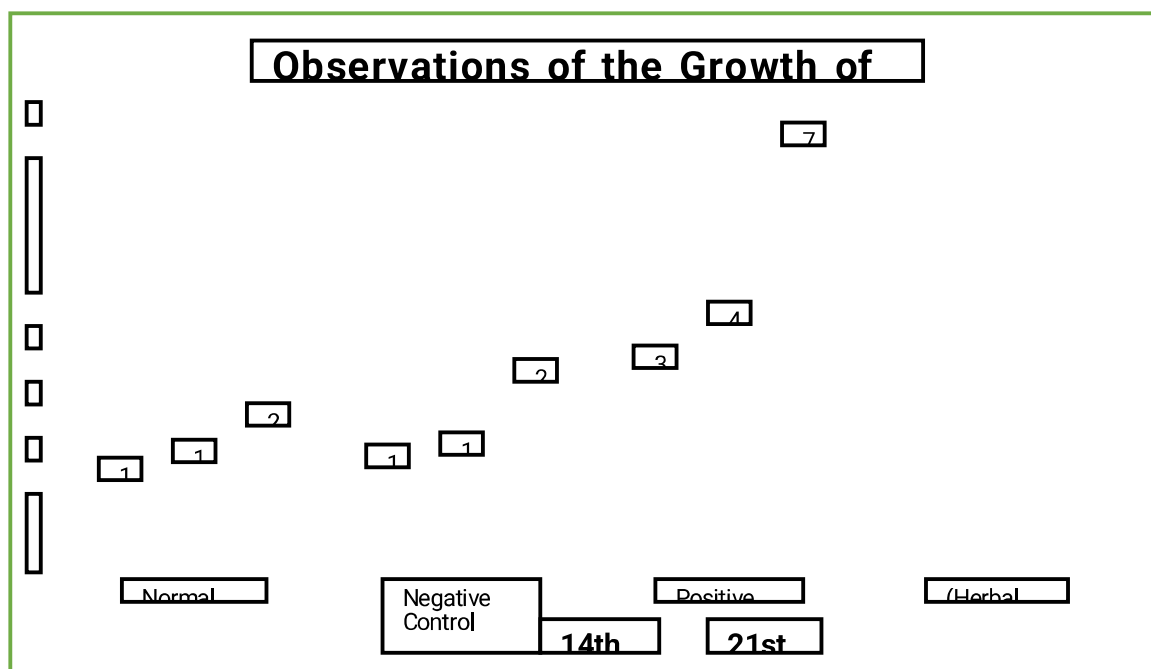


Figure 5.7.6 (a) - Observation of the Semi-Synthetic Hair Serum

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

To evaluate the protection of the Semi-Synthetic hair serum, a sensitivity assessment test was performed. To determine the ocular sensitivity index, the test was conducted on 3 rabbits. Tests on the left eye were conducted with controls on the right eye. In physiological saline, 3 drops of sterile 2.5 percent herbal extract were added to the left eye of the rabbit, and measurements were taken at 30 minutes, 60 minutes, 120 minutes, 240 minutes, 1 day, 2 days, 3 days, and 4 days. There was no image of opacity in the left eye, normal conjunctiva, no swollen eyelid, and the iris image appeared normal. It was seen that the eyes created tears. The index of ocular annoyance was 2 on the first day and 0 on the second, third, and fourth days (maximum ocular irritation index of 110). Thus, it can be inferred that the Semi-Synthetic serum possesses a moderate inflammatory effect.



Figure 5.7.7(a) - Draize test conducted in rabbit model

5.7.8 Microbial Contamination-

The result of the antimicrobial test of Semi-Synthetic serum (Test) against standard pure marketed formulation (Standard) is measured in mm by scale. In this particular evaluation test the anti-microbial activity of Semi-Synthetic serum is found and based on this information we can say that the Semi-Synthetic serum is somewhat near to the marketed formulation. As a result, the bacillus is shown in the zone of inhibition 14mm against pure marketed formulation shown in the zone of inhibition of 16mm.



Figure 5.7.8 (a) - Standard formulation (marketed Semi-Synthetic Serum



Figure 5.7.8 (b) - Test formulation (Semi-Synthetic Serum)

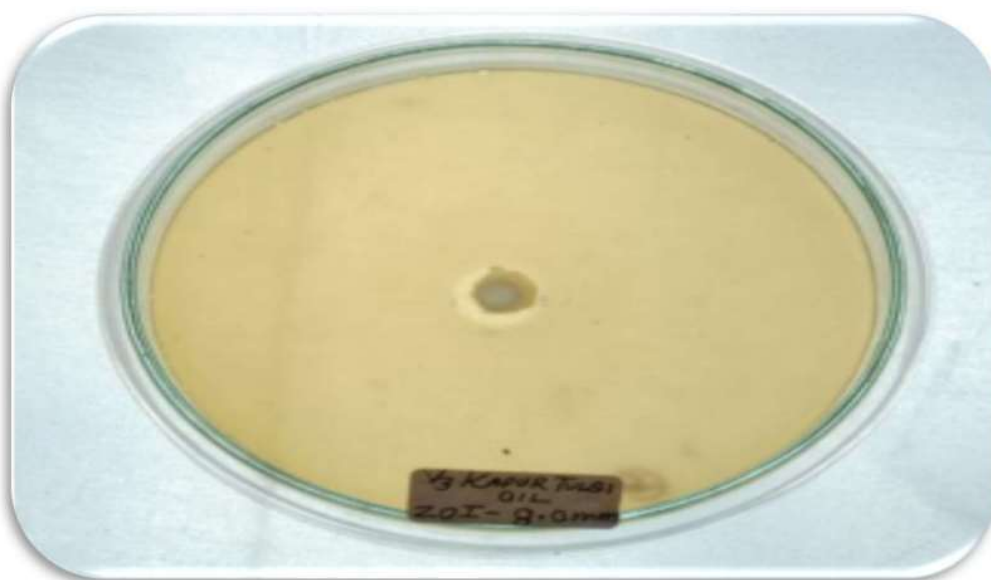


Figure 5.7.8 (c) - Control (without formulation)

S.no	PRODUCT	ZONE OF INHIBITION
1	Control Formulation	0 mm
2	Test Formulation	33.1 mm
3	Standard Formulation	23.3 mm

Table 5.7.8 - Anti-Bacterial Study of the Semi-Synthetic Serum

5.7.9 Stability-

The table reveals that the herbal hair serum was stable during the research time, as these serums showed no physical instability, and there was no noticeable difference in the pH before and after the study.

S.No	Evaluation parameters	Before one month	After one month
1	Color	Pale Yellow	No change
2	Odor	Pleasant	No change
3	Transparency	Transparent	No change
4	pH	6.4	No change
5	Viscosity		No change
6	Spreadability	Good	No change
7	Homogeneity	Good	No change

Table 5.7.9 - Stability Study of the Semi-Synthetic Serum

CHAPTER- VI

CONCLUSION:

All the parameters show they're inside of its limits and since all the ingredients have been added, a lot of advantages, this hair serum is going to help Maintain good hair growth and turn grey hair to black, essential nutrients needed to preserve. The correct function of the sebaceous glands Provide support for the growth of hair from naturally occurring sources. In the personal the use of herbal medicines, hygiene, and health care system. There are several folds of change in the cosmetics. Therefore, there is a lot of glamour in genuinely focusing on and paying extra attention to the creation of herbal cosmetics in the herbal cosmeceuticals individual care or personal health care sector. Given the numerous benefits of all the added constituents, this oil will aid in preserving healthy Hair growth and coloring grey hair to prevent dandruff and provide shiny, healthy-looking hair. The findings demonstrated that Semi-Synthetic hair serum offers the different vital elements required to maintain the sebaceous glands' healthy function and promote the growth of natural hair. The usage of herbal cosmetics products has seen several developments in the personal hygiene and healthcare systems. For this reason, herbal cosmetics the need for individual care, or the personal healthcare sector, is rather high. This industry is concentrating and giving greater attention to the creation of cosmetics based on herbs. India's traditional medical system has received recognition for the wide range of herbal remedies it uses to heal and promote hair growth. The finest part is the herbal extracts; they supplement hair with microproteins and supply the proper quantity of nourishment, resulting in hair that is safe and sound. The personal care industry has seen a rise in the use of herbal cosmetics, which are in high demand because they don't include parabens or other common sulphates.

CHAPTER- VII

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