

Preparation and Evaluation of Fermented Hair Serum with Herbal Ingredients

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Abstract: *Hair is an integrated framework with a unique chemical And physical behaviour.(1)Hair care products are used to make it look better. Hair shaft conflation, extension, and shedding are all cyclical processes (2) Hair care Products are used to improve its appearance, and it is a Cyclical medium involving hair shaft conflation, extension, And shedding.(3)Extensive studies and research suggest it could be a useful ingredient in targeted formulations for personal care items, oral products, and the pharmaceutical industry.*

Keywords: *Hair*

I. INTRODUCTION

Hair is an integrated framework with a unique chemical And physical behaviour.(1)Hair care products are used to make it look better. Hair shaft conflation, extension, and shedding are all cyclical processes (2) Hair care Products are used to improve its appearance, and it is a Cyclical medium involving hair shaft conflation, extension, And shedding.(3)Extensive studies and research suggest it could be a useful ingredient in targeted formulations for personal care items, oral products, and the pharmaceutical industry.(4)

Human Hair :

Human hair is a vital part of the human body. The main protein component of human hair is keratin, a spongy, sulfur-rich protein that makes up 65–95% of hair's weight and gives it strength, flexibility, and durability.

Structure and order of these proteins also greatly influence the physical characteristics of hair, including its texture and appearance. Smaller follicles form thin, "vellus" hair, similar to body hair, while larger follicles form thicker, "terminal" hair, similar to scalp hair. Serum is one of the cosmetic products with very high Concentration of active ingredient in their formula for Providing intensive nutrition to the deeper skin layer and non-greasy finish product which suitable for skin. Hair serum is the styling product that coats the surface of hair. Serum is intended to be used on wet or dry hair, serums can act as both a pre-styling treatment and a finishing product stylist-free days.² The ornamental word concluded from Greek word "kosmetikos" means to "beautify". According to the drug and ornamental act 1940 and rules 1944,

cosmetics are any composition intended to be rubbed, poured, sprinkled, scattered on, introduced into or otherwise applied to the mortal body or any part thereof for cleaning, beautifying, promoting, attractiveness or altering the appearance. The word cosmetics stems from its use in ancient Rome. The material used to promote appearance or enhance beauty is called as ornamental. Cosmetics are used to promote appearance. Nowadays, makeup plays an important role for both women and men. Cosmetics are available in the different form's creams, lipsticks, perfumes, eye shadow, nail polish, hair serum etc.

The demand for cosmetics has increased as a result of the cost growth in living standards worldwide. Because more individuals want to seem young and handsome, cosmetics have become more important. The term "cosmeceuticals" describes the union of the pharmaceutical and cosmetics industries. Pharmaceutical firms make medications, whereas



cosmetics companies make cosmetics. Hair serum is the styling product that coats the surface of hair. Serum is intended to be used on wet or dry hair, serums can act as both a pre-styling treatment and a finishing product stylist-free days.[5]

ANATOMY OF HAIR:

The composition of hair is primarily 95% keratin, a fibrous protein with a helical structure that is a component of the skin and its derivatives (such as body hair and nails).

The structure of hair is divided into three distinct layers: The Medulla: which is the innermost section of the hair shaft, consists of a soft, oily, amorphous material. (6)

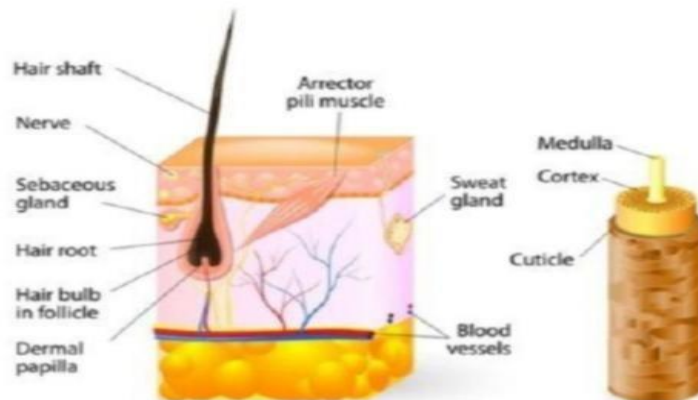


Fig 1: Hair anatomy

Medulla: - Deepest layer of hair shaft seen in large & thick hair. Honeycomb like keratin structure

- Middle layers of hair shaft provide Strength, color & texture of hair fiber. Made thin layer of keratin. Hair cortex Contain melanin. Made from specialized cells called as melanocytes (7)

- Outer layer of hair shaft. Thin and colorless protect the cortex. Made up of 6-11-layer Keratin cells. Take importance care of hair shaft and follicle.(8)

Hair problems :

1) Dantraff: This mild, non-inflammatory skin ailment affects the scalp and may cause hair loss. It sticks to the hair's root and is scaly.

2) Dry hair: A lack of proteins in the diet causes dry hair. Dry hair can also result from menopause, anaemia, hormonal imbalances, and birth control.(6a)

3) Spilt end : These can happen when the hair ends become dry, and they can also happen as a result of exposure to harsh weather. (9)





Fig 2: Hair problem.

In the 1980s and 1990s, a new category of hair care products called hair serums began to gain popularity. These serums were created using lightweight oils, silicones, and other conditioning ingredients to improve shine, lessen frizz, and protect the hair from the weather (10)

HIGHLIGHT OF HERBAL SERUM:

- Frizz control: Hair serum helps to tame frizz and flyaways, providing a smoother and sleeker look.
- Shine enhancement: It adds a glossy finish to the hair, boosting its natural shine and luster.
- Heat protection: Many serums contain ingredients that protect hair from the damage caused by heat styling tools like blow dryers and straighteners.
- Moisture retention: Hair serum seals in moisture, keeping hair hydrated and preventing dryness and brittleness.
- Detangling: It helps to detangle hair strands, making it easier to comb through and style. (11)

II. LITERATURE REVIEW

1) Suryakant Jaiswal¹, Twinkle Goyal², Poorvi Sahu³, Riya Dewangan⁴, Hema Rajwade⁵, Praveen Sahu⁶, Dr. Gyanesh Sahu⁷, Dr. Chanchal Deep Kaur⁸ [2026]

(The haircare properties of rice water have made it a popular hair care product, and it's being used worldwide today. Its benefits include nutrients like minerals, amino acids, and antioxidants. Rice water is believed to stimulate hair follicles, improve texture, add shine, and hydrate the scalp, making it a popular natural hair treatment. Although it's been used for a long time, there are few rigorously reviewed research theses. However, new research suggests that rice water improves hair health and reduces breakage.)

2) Anusha R.*, Akhila N., Nikhitha J., Harish K., Abdull Rajjak Shaikh, Sony Y., Inamul [2025]

(In the mammalian system the hair follicle is known to be the most significant organ that determines appearance, gender distinction, provides intense temperature protection and plays a role in self-defence. The younger generations have begun to suffer extreme hair loss problems due to many reasons. The hair loss is not temporary in most cases, but it results in alopecia. Many people suffering from hair loss are in search of multiple treatments due to extreme anxiety and tension. To improve hair growth and to prevent hair loss, hair root activation is required. Citrus sinensis is used to



antidandruff protection hair care. It's had antibacterial and anti-inflammatory properties. Nigella sativa improves the shine, strength, volume, and texture of hair. Flax seed is full of fatty acids and antioxidants that tend to remove pollutants and dead cells from the scalp. Coconut oil may help to moisturise and seal hair. They can help to prevent dry.)

3) Athira J Nair¹, Abhina Sajeevan², Ameer Ul Haque K S³, Nandana Biju⁴, Shalu K S⁵[2023]

¹Associate department of pharmaceuticals, Indira Gandhi Institute of Pharmaceutical Sciences,

Ernakulam^{2,3,4,5}Students of Indira Gandhi Institute of Pharmaceutical Sciences, ErnakulamCorresponding Author:

Athira J Nair (In contemporary society, the demand for cosmetics has surged, with individuals increasingly utilizing various products to enhance their appearance and maintain a youthful demeanor. The significance of cosmetics in daily life is undeniable, particularly as consumers gravitate towards herbal options, which are perceived to offer reduced side effects and enhanced safety. Among the various aspects of personal care, hair, as an essential component of the human body, serves not only a protective function but also contributes to an individual's aesthetic appeal. This study aims to develop an herbal hair serum, suitable for daily application, utilizing a blend of various herbs. The research focuses on evaluating the properties of the cosmetic serum to identify the optimal formulation. Three distinct serum formulations (F1, F2 & F3) each varying in excipient concentrations, were created. Comprehensive assessments were conducted, encompassing physical appearance, pH level, homogeneity, viscosity, spreadability, and antifungal activity. Results indicated that the F1 formulation met established standards, exhibiting satisfactory characteristics)

4) 1.Miss. Telange -Patil P.V., 2.Miss. Pandhare V.B, 3.Miss. Nanaware P.V.[2022]

¹Assistant Professor, ²Student, ³Student, ¹Pharmaceutics Department, ¹College of Pharmacy Paniv, Solapur, Maharashtra, INDIA.(Nowdays, cosmetics are in high demand in everyday life, and many people use them on a regular basis, Herbal cosmetics are popular because they have fewer negative effects and provide higher protection and safety. people who are experiencing hair loss are looking for ways to increase hair development and prevent hair loss. Scalp serum moisturize the skin behind the hair, making them a popular treatment for dry scalp. In the mammalian system, the hair follicle is known to be the most significant organ that determines appearance, gender distinction, provides intense temperature protection, and plays a role in self-defense. The younger have begun to suffer from extreme hair loss problems due to many lifestyle-related changes such as fatigue, anxiety, intake of junk foods, use of different hairstyles/coloring methods, etc. The loss of hair is not temporary in most cases, but it results in alopecia.)

5)Ruchi Tiwari¹,* Gaurav Tiwari¹, Ajeet Yadav²and Vadivelan Ramachandran³[2021]

(In the mammalian system, the hair follicle is known to be the most significant organ that determines appearance, gender distinction, provides intense temperature protection, and plays a role in self-defense. The younger generations have begun to suffer from extreme hair loss problems due to many lifestyle-related changes such as fatigue, anxiety, intake of junk foods, use of different hairstyling/coloring methods, etc. The loss of hair is not temporary in most cases, but it results in alopecia. Many people suffering from hair loss are in search of multiple treatments due to extreme anxiety and tension, from mythology to traditional and therapeutic healing to the use of minoxidil and finasteride. To improve hair growth and to prevent hair loss, hair root activation is required.

III. PLAN OF WORK

1. Selection & Collection of Plant Material

- Selection of suitable herbs based on activity (hair growth, anti-dandruff)
- Collection of plant materials.
- Cleaning, drying, and powdering of crude drugs.

2. Preparation of Herbal Extract

Extraction methods:

- Boil extracted
- Use of suitable solvent (water)



-Filtration and concentration of extract Storage under suitable conditions.

3. Fermentation Process

- Preparation of fermentation medium
- Inoculation of herbal extract
- Incubation under controlled conditions (temperature, time, pH)
- Collection of fermented extract.

4. Formulation of Hair Serum -Selection of excipients:

- Preservatives and stabilizers
- Incorporation of fermented herbal extract
- Adjustment of pH and viscosity
- Preparation of final serum formulation

5. Evaluation of Formulation Physical parameters:

Color, odor, appearance, pH determination, Viscosity measurement, Spreadability test, Stability studies (temperature, time).

6. Data Analysis & Interpretation :

- Comparison of results with standard values.
- Evaluation of effectiveness and stability.

IV. AIM AND OBJECTIVE

1. To formulate and develop an effective herbal hair serum using natural herbal ingredients.
2. To prepare a safe and stable cosmetic formulation for hair care.
3. To promote healthy hair growth and improve scalp condition naturally.
4. To reduce hair fall, dandruff, dryness, and hair damage.
5. To provide nourishment, moisturization, and protection to hair.
6. To improve the smoothness, softness, and shine of hair.
7. To develop a non-greasy and easily spreadable hair serum suitable for daily use.
8. To prepare a herbal alternative to synthetic chemical-based hair products.
9. To protect hair from environmental pollutants, dust, and sunlight.
10. To enhance overall hair appearance and manageability.
11. To formulate a cost-effective and user-friendly herbal cosmetic product.
12. To evaluate the quality, stability, and effectiveness of the prepared serum.
13. To select suitable herbal ingredients beneficial for hair care.
14. To prepare herbal hair serum by using natural extracts and oils.
15. To formulate a serum with good consistency and appearance.
16. To prepare a serum that is non-sticky and non-irritant.
17. To obtain a smooth and homogeneous formulation.
18. To prepare a formulation with acceptable fragrance and color.
19. To formulate a serum that can be easily applied on hair and scalp.
20. To improve the stability and shelf life of the product.
21. To ensure compatibility among all ingredients used in the formulation.
22. To develop a formulation free from harmful chemicals.
23. To promote natural hair growth.



24. To strengthen hair follicles and hair roots.

25. To reduce hair fall and hair breakage.

V. MATERIAL AND EQUIPMENTS

Materials and Equipment for Herbal Hair Serum

Sr. No.	Materials (Ingredients)	Use in Herbal Hair Serum
1	Hibiscus	Promotes hair growth and reduces hair fall
2	Curry leaves	Helps strengthen hair and reduce dandruff
3	Rice water	Improves hair shine and smoothness
4	Rose water	Provides fragrance and scalp soothing effect
5	Glycerine	Moisturizes hair and scalp
6	Aloe vera	Provides conditioning and hydration
7	Sodium benzoate	Prevents microbial growth in serum
8	Vitamin E	Acts as antioxidant and nourishes hair
9	Distilled water	Used as solvent/base

Equipment Required

Sr. No.	Equipment	Use
1	Beaker	Mixing ingredients
2	Measuring cylinder	Measuring liquid volume
3	Glass rod / Stirrer	Stirring the formulation
4	Weighing balance	Accurate weighing of materials
5	Mixer grinder / Blender	Grinding herbal materials
6	Muslin cloth / Filter paper	Filtration of extract
7	pH meter / pH paper	Checking pH of serum
8	Storage bottle	Packing and storage of serum
9	Funnel	Easy transfer of serum
10	Water bath / Hot plate	Heating during extraction



EXPERIMENTAL WORK

1) CURRY LEAVES

Curry leaves have anti-inflammatory and antioxidant properties, which can help soothe an irritated scalp and protect hair from damage. They may also help promote hair growth

- Synonym: *Murraya Koenigii*.
- Family: Rutaceae.
- Chemical Constituents: linalol, elemol, geranylacetate, myrcene, allo-ocimene.
- Use: stimulate hair growth, antioxidant(13)



Fig 3: Curry leaves

2) HIBISCUS FLOWER

Hibiscus flowers are a rich source of vitamins and antioxidants, which can help nourish and protect hair. They also contain anthocyanins, which may help prevent premature greying.

- Synonym: *Hibiscus mutabilis*.
- Family: Malvaceae.
- Chemical Constituents: anthocyanins and polyphenols. (14)



Fig 4: Hibiscus Flower



3) VITAMIN E CAPSULE

- An oil enriched with vitamin E can help restore shine by rebuilding the hair's protective barrier.
- oils lock in moisture, reduce breakage, and shield the hair from damage. Vitamin E, • rich in natural antioxidants, may promote a healthy scalp and encourage hair growth. • These vitamins and antioxidants help lower oxidative stress and neutralize free radicals that • Contribute to the weakening and damage of hair follicle cells.



Fig 5: Vitamin E Capsule

4) ALOE VERA

- Synonyms: Grihakanya, Kanya, Ghritakumari, Vipulasrava, Sthuladala
- Botanical Name: Aloe ferox Mill., A. perryi Baker, A. vera (L.) N.L. Burm. (= A. barbadensis Mill.)
- Family: Liliaceae
- Biological Source: Obtained from the dried latex of Aloe ferox Mill., A. perryi Baker, and A. Vera (L.) N.L. Burm. (= A. barbadensis Mill.)
- Chemical Constituents: Aloe vera is a rich source of anthraquinone glycosides and contains Compounds such as aloin, barbaloin, and aloe-emodin.
- Uses: Aloe vera strengthens the hair and exhibits antioxidant and emollient properties. It helps Improve hair texture, repairs damaged scalp tissue, and its slightly viscous, transparent gel Offers excellent moisturizing effects (15)



Fig 6: Aloe vera



5) Fermented Rice water:

1. Fermented Rice water for hair Strength: Use Fermented rice water for hair if you Want strong, healthy hair.
2. The rice water's amino Acids fortify the hair roots. Additionally, it contains Inositol, an antioxidant that gives the hair strength.
3. It is simple to detangle hair using fermented rice Water, which reduces hair breakage and nourishes Hair.
4. Hair-care with fermented rice water sparkle, Smoothness, and shine.
5. Fermented rice water can be used to give Hair a shiny, full-of-lustrous appearance. The added Layer of defence provided by fermented rice water
6. Is particularly effective against air pollution and Dirt, heat-producing electronic hair appliances, Chemicals in hair care products, etc.
7. These cause The hair to lose its sheen, while the fermented rice Water makes sure that it stays silky, smooth, and Shining.
8. A natural conditioner that provides the hair Fantastic bounce is fermented rice water.
9. Rice water fermented for hair growth, The fact that fermented rice water Promotes hair growth and prevents hair loss—and That you can notice the rise in just a short period of Time—is another crucial factor.
10. The hair remains Healthy as the fermented rice water helps shield it From harm. The fermented rice water's protein, Vitamin, and antioxidant boost to the hair promotes Rapid hair growth.
11. Fermented Rice water for to eliminate Dandruff and flakes The growth of Malassezia, a fungus that Can cause dandruff, is inhibited by fermented rice .
12. it moisturises The hair and scalp, preventing dry skin, which leads To skin flaking, from developing. Weekly Application of fermented rice water to the hair will Prevent flakes and dandruff.
- 13.. It is a chemical free hair cleanser Using it as a shampoo to wash out your Hair may not be as convenient as a store bought Shampoo, but it comes without chemicals and Preservatives, and you don't even need to follow it Up with a conditioner. (16-18)



Fig 7: Rice Water

6) SODIUM BENZOATE :

Sodium benzoate is a widely used, water-soluble preservative that prevents mold, bacteria, and yeast growth in acidic foods, beverages, and personal care products. It is generally recognized as safe (GRAS) by the FDA when used at concentrations below 0.1% by weight, though some studies suggest potential risks when combined with vitamin

USES :

- Preservative to prevent growth of bacteria, fungi, and yeast

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- Increases shelf life of products
- Used in herbal hair serum, syrups, cosmetics, and food products
- Helps maintain product stability and safety(19)

7) GLYCERINE :

Glycerin is commonly used in fermented hair serums as a humectant — it helps attract and retain moisture in the hair and scalp. In formulations that contain fermented extracts (rice water, fermented botanicals, probiotics, yeast filtrates, etc.), glycerin improves hydration and texture while helping stabilize the product.

- What glycerin does in a fermented hair serum
- Hydrates hair strands by drawing water into the hair shaft
- Reduces dryness and frizz
- Improves slip and spreadability of the serum
- Helps protect the scalp barrier
- Can slightly preserve moisture balance in alcohol-free formulas (20)



Fig 8: Glycerin

8) ROSEWATER

Rosewater works very well in a fermented hair serum as part of the water phase. It adds mild soothing, fragrance, and scalp-conditioning benefits.

- Benefits of rosewater in hair serum(21-22)
- Helps soothe irritated or dry scalp.
- Adds light hydration
- Can improve scalp freshness.
- Mild antioxidant properties
- Gives a natural floral scent
- Pairs well with fermented botanical extracts





Fig 9: Rose Water

PREPARATION OF SERUM :

1) EXTRACTION OF HIBISCUS FLOWER AND CURRY LEAVES.

- Hibiscus Flowers and Curry Leaves Dried Completely
- Crush the Flowers and Leaves to Form powder
- 5 gm of each is dissolved in 50 ml of water and boiled on water bath.
- Extract screened and separated
-

2) ALOE VERA GEL FORMULATION .

- Fresh Aloe vera Collected
- Washed and Clean
- Aloe vera Gel Collected And Filterd through Muslin Cloth.

3) FERMENTED RICE WATER.

Rice are washed and dissolved in water overnight

Next day water is extracted and collected

• PROCEDURE :

- Extration Of Herbs measured and Took in beaker
- Mix Aloe vera Gel and extracted herbs
- Add rice water and glycerin
- Makeup Volume with rose water
- Add preservative
- Add vitamin E Tablet

INGREDIENTS

Herbal Extract	25 ML
Aloe vera Gel	10 ML
Rice Water	5 ML
Glycerin	5ML
Rosewater	5ML
Preservative	0.5 Gm
Vitamin E	0.5ML



VII. EVALUATION PARAMETERS

EVALUATION PARAMETERS OF FORMULATED HERBAL HAIR SERUM

1. Physical Appearance :-

The formulated herbal hair serums (F1-F5) were visually assessed for their color, clarity, Consistency, and overall appearance. The sample were observed under natural daylight to Confirm uniformity and to ensure the absence of phase or visible particles.(23)

2. Homogeneity Test :-

A small amount of each serum was placed on a clean glass slide and covered with a coverslip. The samples were examined for uniform texture and to check for the presence of lumps, coarse Particles, or aggregates. A smooth and consistent surface indicated good homogeneity.(24)

3.pH Determination :-

The pH of the formulation was measured using a 1 pH paper at room Temperature. About 10ml of each sample was transferred into a beaker and the PH Paper was Immersed until a stable reading was obtained. The pH values were recorded to confirm Compatibility with scalp and hair.(25)



Fig 10: PH paper

4. Viscosity :-

The viscosity of the prepared serums was determined using Brookfield viscometer fitted with a spindle number 6. Approximately 50 ml of each formulation was taken in a beaker, and the readings were noted at different rotational speeds(10,20,50 and 100 rpm). The qaverage viscosity was used to evaluate consistency.

5. Spreadability :-

A small quantity of the formulation was placed between two slides, and a known weight was applied. The time required for the slides to move apart was recorded. Lesser separation time indicated better spreadability and ease of application.

6. Washability :-

A small amount of the serum was applied on the skin surface and rinsed with water to test removability. Formulation that could be easily washed off without leaving any sticky residue were considered satisfactory.

7. Skin Irritation Test:

After applying the serum to the skin, it is checked for any redness or itching after two hours.



8. Sensitivity Test:

The procedure involves putting the serum to the skin, exposing it to sunlight for 10 minutes, and checking for rashes or itching. (26-27)



Fig 11: Skin Sensitivity

VIII. RESULT AND DISCUSSION

The fermented herbal hair serum containing hibiscus extract, curry leaf extract, fermented rice water, aloe vera gel, rose water, glycerine, Vitamin E, and sodium benzoate was successfully prepared and evaluated for different parameters.

1. Physical Appearance

Parameter	Observation	Colour	Light brown to dark brown
Odor.	Pleasant herbal odor	Texture.	Smooth and non-sticky
Appearance	Homogeneous and clear	Consistency.	Slightly viscous

Discussion

The serum showed a uniform appearance without phase separation. Fermented rice water gave a slightly sour odor due to natural fermentation products, while rose water improved fragrance. Glycerine and aloe vera provided smooth texture and moisturizing effect.

2. pH Determination

Storage Condition	Observed pH
Room temperature	5.0 – 5.5
Sunlight exposure	4.5 – 5.0
Fresh serum	5.5 – 6.0
Refrigerated condition	5.5 – 6.0

Discussion

The pH remained within the acceptable scalp range. Slight decrease in pH during storage occurred because of continued fermentation and formation of organic acids. Refrigerated storage maintained better stability compared to sunlight exposure.



3. Viscosity Evaluation

Parameter	Observation
Flow property	Easy flowing
Viscosity nature	Moderate viscosity

Discussion

Aloe vera gel and glycerine increased viscosity and improved spreadability. Proper viscosity helped easy scalp application and prevented excessive dripping.

4. Stability Study

Condition.	B Observation After Storage
Room temperature	Slight color change
Refrigeration	Stable
Sunlight.	Mild odor change
Dark place.	Good stability

Discussion

The serum was most stable under refrigerated and dark storage conditions. Exposure to sunlight accelerated oxidation and reduced product stability. Sodium benzoate helped prevent microbial contamination during storage.

5. Spreadability Test

Parameter.	Result
Spreadability.	Good

Discussion

The serum spread uniformly on scalp and hair surface due to the presence of glycerine and aloe vera gel, improving user acceptability.

6. Homogeneity Test

Parameter.	Observation
Homogeneity.	Uniform preparation

Discussion

No lumps or particle aggregation were observed. Proper mixing of herbal extracts resulted in a homogeneous serum.

7. Skin Irritation Test

Parameter	Observation
Redness.	Absent
Itching	Absent
Irritation.	Absent

Discussion

No signs of irritation were observed after application on skin, indicating that the formulation was safe for topical use.



Overall Discussion

The fermented herbal hair serum showed satisfactory physicochemical properties, stability, spreadability, and safety. Fermentation of rice water enhanced nutrient availability and improved hair conditioning properties. The combination of herbal ingredients demonstrated synergistic effects in reducing hair fall and improving hair texture.

The serum remained stable under refrigerated and dark conditions but showed slight pH and odor changes under sunlight exposure. The formulation was found suitable for topical application and may be useful as a natural hair care product.

Summary :

The present study was carried out to prepare and evaluate a fermented herbal hair serum using natural ingredients such as hibiscus extract, curry leaf extract, fermented rice water, aloe vera gel, rose water, glycerine, Vitamin E, and sodium benzoate. The main objective of the study was to develop a safe, stable, and effective herbal formulation that can improve hair health naturally and reduce the side effects associated with synthetic hair care products.

Fermented rice water was prepared by soaking and fermenting rice in water for a specific period to enhance the availability of nutrients, amino acids, vitamins, and antioxidants beneficial for hair growth and scalp nourishment. Herbal extracts were prepared separately and incorporated into the serum base with suitable excipients. The prepared serum was then evaluated for various physicochemical and stability parameters.

The evaluation tests included organoleptic properties, pH determination, viscosity, homogeneity, spreadability, stability study, and skin irritation test. The prepared serum showed good appearance, pleasant odor, smooth texture, and acceptable consistency. The pH of the formulation remained within the suitable range for scalp application, indicating compatibility with scalp physiology. Moderate viscosity and good spreadability improved ease of application and user acceptability.

The stability study showed that the formulation remained more stable under refrigerated and dark storage conditions compared to sunlight exposure. Slight changes in color and odor were observed at higher temperatures due to oxidation and continued fermentation. However, the addition of sodium benzoate effectively prevented microbial spoilage and enhanced shelf life.

The skin irritation study indicated that the formulation was safe for topical application and did not produce redness, itching, or irritation. Regular application of the serum improved hair smoothness, shine, and softness while reducing hair dryness and hair fall. Fermented rice water, hibiscus, curry leaves, aloe vera, and Vitamin E showed synergistic effects in nourishing the scalp and strengthening hair follicles.

The study demonstrated that natural and fermented ingredients can be effectively utilized in preparation of herbal hair care formulations with good stability, safety, and cosmetic benefits.

IX. CONCLUSION

From the present study, it was concluded that the fermented herbal hair serum was successfully prepared and evaluated. The formulation showed satisfactory physicochemical properties, good stability, acceptable pH, and non-irritant nature. The serum effectively improved hair texture, reduced hair fall, and provided nourishment to the scalp and hair.

Fermentation of rice water enhanced the nutritional value and beneficial activity of the formulation. The combined action of hibiscus, curry leaves, aloe vera, glycerine, and Vitamin E contributed to better hair conditioning and scalp health. The prepared serum was found to be safe, stable, easy to apply, and cosmetically acceptable.

Therefore, the fermented herbal hair serum may serve as a promising natural alternative to synthetic hair care products and has potential for further research and commercial application in herbal cosmetics.



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