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FORMULATION AND EVALUATION OF HERBAL HAIR CONDITIONER

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ABSTRACT

Hair is an important part of the human body that protects the scalp. Hair conditioners are skin care product that are applied to the ends of the hair and later used for cleansing, conditioning the hair, and rinsing. It is used to make the hair shiny and smooth. Increases the luster of hair. Mainly prevents hair breakage, reduces split ends and improves manageability. Its main purpose is to reduce friction between hairs, making brushing and combing easier. Fenugreek, hibiscus flowers and curry leaves are used as the main ingredients in herbal conditioners. It was evaluated and analyzed based on physicochemical parameters such as efficiency, stability studies. A more radical approach to popularizing herbal conditioners would change consumer expectations and emphasize safety and efficacy. The purpose is to manufacture herbal hair conditioners. All herbal conditioners exhibited pH within the specified range, comparable solids %, stable lather and high viscosity properties along with good wetting properties compared to synthetic conditioners.

KEYWORD: Herbal Cosmetics, Natural Hair Conditioner, Hair Conditioning Agents, Herbal Extracts, Fenugreek Extract, Hibiscus Extract, Aloe Vera Gel, Amla Extract, Green Tea Extract, Coconut Oil, Lavender Oil.

1. INTRODUCTION

Hair is considered an important part of human beauty and personality. Healthy hair improves appearance and confidence, while damaged hair may lead to problems such as

dryness, dandruff, split ends, roughness, and hair fall. Continuous exposure to pollution, sunlight, chemical treatments, shampoos containing harsh surfactants, and unhealthy lifestyle habits can damage the hair structure. Therefore, the use of hair care products has increased significantly in recent years.[1,2]

Hair conditioners are cosmetic preparations used after shampooing to improve the texture, softness, smoothness, and manageability of hair. They help in reducing friction between hair strands, prevent tangling, and provide shine and moisture to the hair. Conventional conditioners usually contain synthetic chemicals such as silicones, parabens, sulfates, and artificial fragrances. Long-term use of these synthetic ingredients may cause scalp irritation, dryness, allergic reactions, and environmental concerns.[1,6]

Due to the growing awareness regarding the harmful effects of synthetic chemicals, herbal cosmetics have gained popularity worldwide. Herbal hair conditioners are preparations made using natural plant-based ingredients that nourish and protect the hair with minimal side effects. Herbal formulations are considered safer, biodegradable, eco-friendly, and more compatible with the scalp and hair.[8]

Many medicinal plants have excellent hair conditioning properties. Ingredients such as fenugreek, hibiscus, amla, green tea, aloe vera, and natural oils are commonly used in herbal hair care formulations. Fenugreek contains proteins and nicotinic acid that strengthen hair roots and reduce hair fall. Hibiscus helps in conditioning and improving hair growth. Amla is rich in vitamin C and antioxidants that nourish the scalp and strengthen hair follicles. Green tea contains polyphenols that help in protecting hair from oxidative damage. Castor oil and almond oil provide moisture, softness, and shine to the hair.[5,10]

In the formulation of herbal hair conditioners, polymers such as guar gum are used to improve viscosity, texture, stability, and spread ability of the product. Preservatives may also be added to prevent microbial growth and improve shelf life.[4,5]

The present study focuses on the formulation and evaluation of an herbal hair conditioner using herbal extracts and natural oils. The formulated conditioner is evaluated for various parameters such as appearance, pH, spread ability, stability, washability, and conditioning performance. The main aim of the study is to develop a safe, effective, economical, and eco-friendly herbal hair conditioner with good consumer acceptability.[4,1]

1.1 Human hair

Human hair is a natural fiber that grows from hair follicles present in the skin, mainly on the scalp. Hair is mainly made up of a protein called keratin, which gives strength, softness, and flexibility to the hair. Hair plays an important role in protecting the scalp from dust, sunlight, and environmental pollution. It also improves a person's appearance and personality.

The structure of human hair consists of three main layers namely cuticle, cortex, and medulla. The cuticle is the outer protective layer that protects the hair from external damage. The cortex is the middle layer that contains keratin fibers and melanin pigment responsible for hair strength, texture, and color. The medulla is the innermost layer present mainly in thick hair strands. Healthy hair appears smooth, shiny, and strong, whereas damaged hair becomes dry, rough, weak, and prone to hair fall.[11]

Human hair differs from person to person in terms of texture, thickness, density, and curl pattern. Factors such as genetics, nutrition, stress, pollution, hormonal imbalance, and excessive use of chemical-based cosmetic products may affect hair health. Therefore, proper hair care and use of suitable hair care products are necessary for maintaining healthy hair and scalp condition.[12]

- **Types of Human Hair**

Human hair is mainly classified into four types based on texture and curl pattern:

1. **Straight Hair (Type I)**

Straight hair is smooth, soft, and naturally shiny because scalp oils spread easily throughout the hair length. This type of hair usually looks silky and is less prone to tangling.

2. **Wavy Hair (Type II)**

Wavy hair has slight "S"-shaped waves and moderate volume. It is thicker than straight hair and may become frizzy in humid conditions.

3. **Curly Hair (Type III)**

Curly hair contains well-defined curls or ringlets. It generally appears dense and voluminous but becomes dry easily because natural oils do not spread evenly.[13]

4. **Coily or Kinky Hair (Type IV)**

Coily hair consists of tightly curled or zig-zag patterned strands. This type of hair is delicate

and more prone to dryness and breakage. Proper conditioning and moisturization are important for maintaining healthy coily hair.[14]

Hair can also be classified according to scalp condition as normal hair, dry hair, oily hair, and combination hair. Understanding different hair types helps in selecting suitable cosmetic and herbal hair care formulation.[15]

1.2 Hair Anatomy

Hair is an integrated system with specific chemical and physical behavior. It is a complex structure composed of multiple morphological components that work as a unit. All hair has a shaft and a root. The shaft is the visible part of the hair that attach to the skin. Hair roots are located within the skin and reach the deeper layers of the skin. It is surrounded by hair follicles (coverings of skin and connective tissue) that are also connected to sebaceous glands. Each hair follicle is connected to a small muscle (pillar muscle) that can straighten the hair. Many nerves also end in hair follicles. These nerves sense hair movement and are sensitive to even the slightest breeze. At the hairline, the hair root spreads into a round bulb. There is a dermal papilla inside the hair bulb, which supplies blood to the hair root. New hair cells are constantly forming in the hair bulb near the papilla.[16-18]

The hair shaft of mammals is divided into three main regions

A. Cuticle.
B. cortex.
C. medulla.

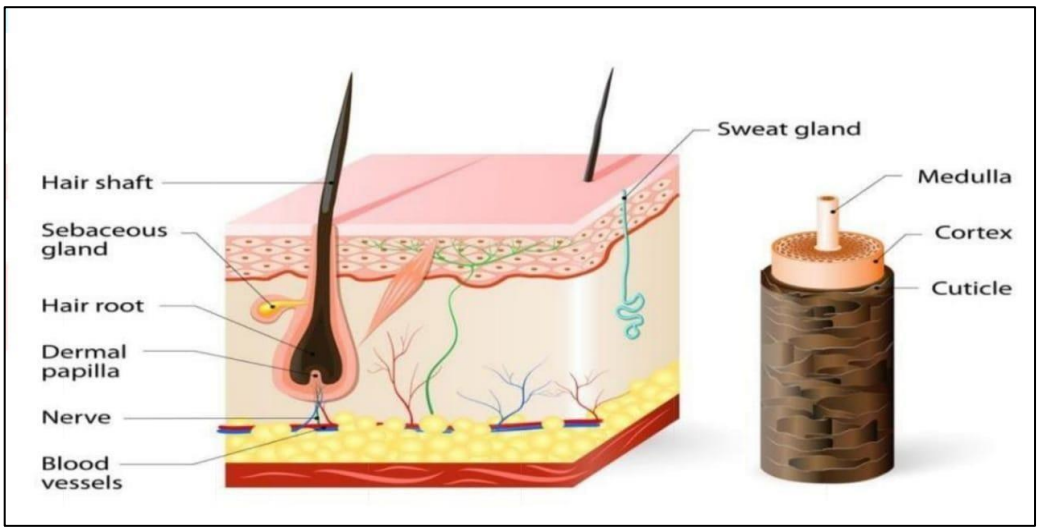

Fig No. 1: Hair Anatomy.

A) Cuticle: The cuticle of the hair is naturally coated with an oily substance called sebum, which protects the hair from drying out. So, when the cortex of the hair penetrates, it removes the protective sebum. The cuticle is open and natural. must be closed to return to a healthy state. The cuticle, made up of overlapping cells like fish scales or roof tiles, is the protective layer of the hair that faces downwards. A healthy cuticle is smooth and flat. It adds luster to the hair and protects the inner layers from damage. It also minimizes the movement of moisture in and out of the underlying cortex, maintaining the hair's moisture balance and flexibility. However, chemical treatments and exposure to the elements can lift the cuticle and upset this balance, making hair dry and brittle.[16]

B) Cortex: Cortex makes up the bulk and pigment (color) of the hair. It consists of long strands of keratin held together by disulfide and hydrogen bonds. Cortical health is highly dependent on the integrity of the cuticle that protects the cortex. The cortex is the largest part of the hair, accounting for approximately 75% of its weight. The cortex, located in the center of each hair fiber, is composed of long, tightly packed keratin spindles stabilized by disulfide bonds. These keratin spindles are arranged hierarchically starting from the smallest structure, the keratin protein itself, to the largest and final structure, the cortex itself. The cortex gives strength to the hair and also houses melanin granules. These are the pigment packets responsible for the color of the hair. Cortex is also responsible for giving the hair its shape and texture, resulting in it being either straight, wavy, curled or frizzy.[18]

C) Medulla: The medulla is the inner layer of the hair shaft. This almost invisible layer is the softest, most fragile, and serves as the marrow or core of the hair. Some mammals do not have a medulla in their hair. The presence or absence of this layer and the characteristics of the medulla help taxonomists to identify which tax on a hair comes from. Features include whether the medulla contains air pockets and histology of the medulla.

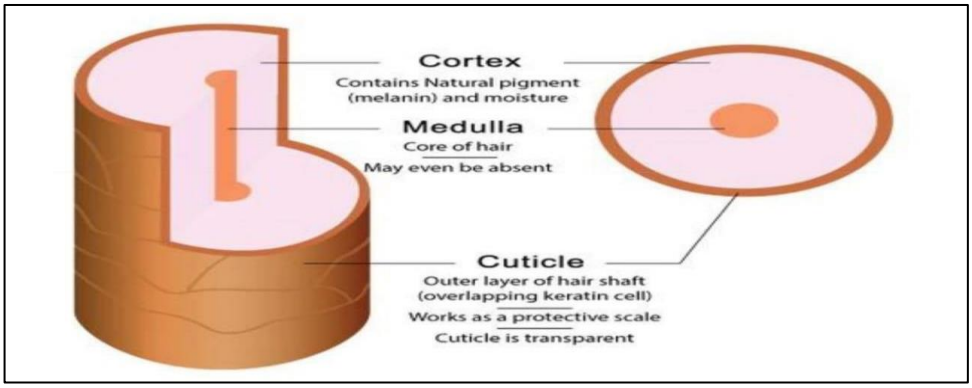

Fig No. 2: Human hair shaft.

Scalp

The scalp is that part of the skin which extends from the eyebrows to the nape of the neck. Laterally it is anchored by each ear. The details of this anatomy are important for treating scalp trauma, creating successful surgical flaps, removing scalp tumors, treating scalp pain, and describing lesions encountered on imaging studies.

It is divided into 2 sections.

- The first gives clinical in-formation on regional vascular, lymphatic, and nervous territories together with the epi cranial muscles.
- The second discusses the traditional anatomic layers, but regroups them into 3 clinically useful coverings that are distinct on modern imaging. These are the epidermis/dermis, the subcutaneous layer, and thin galea/subgalea/periosteum complex that normally blends with the outer table of the skull.

Functions of scalp

1. It serves as an area where hair can grow physically.
2. Acts as a barrier that defends the body from foreign irritation.

2. LITERATURE REVIEW

1. Balsam MS and Sagarin E (1972)

Science and Technology discussed the scientific and technological aspects of cosmetic formulations. The authors explained the preparation and stability of creams, lotions, and hair conditioners along with evaluation parameters such as spread ability, viscosity, stability, and phase separation. The book also emphasized the role of ingredients in enhancing cosmetic safety and effectiveness.[2]

2. Harry's Cosmetic ology by Harry RG (2000)

Explained the basic principles of cosmetic formulation and evaluation. The book described different hair care products including shampoos and conditioners, their ingredients, functions, preparation methods, and quality control parameters. It highlighted the importance of emulsifying agents, conditioning agents, preservatives, and pH balance in improving hair smoothness, shine, and manageability.[1]

3. Kapoor VP (2005)

In Herbal Cosmetics for Skin and Hair Care reviewed the use of herbal ingredients in cosmetic preparations for skin and hair care. The study highlighted the benefits of natural ingredients such as hibiscus, aloe vera, amla, and fenugreek in promoting hair growth, conditioning, nourishment, and reducing hair fall.[8]

4. Chanchal D and Swarnlata S. (2008)

Reviewed recent advancements and innovative approaches in herbal cosmetics. The authors discussed the use of natural herbs and bioactive compounds in cosmetic formulations for improving product safety, efficacy, and consumer acceptance. The study also highlighted the importance of herbal products in hair care applications such as conditioning, nourishment, and scalp protection.[11]

5. Pandey S, Meshya N, and Dhyani A. (2010)

Discussed the growing demand for herbal cosmetics because of their safety, effectiveness, and minimal side effects compared to synthetic products. The authors highlighted the importance of plant-based ingredients in hair and skin care formulations and explained future opportunities in herbal cosmetic research and development.[9]

6. Sharma et al. (2011)

Discussed the growing demand for herbal hair care products due to increasing consumer awareness regarding harmful effects of chemical-based cosmetics. Their work highlighted that herbal conditioners prepared from natural ingredients are biodegradable, eco-friendly, and effective in improving hair manageability, softness, and shine.[15]

7. Ali SA and Yosipovitch G (2013)

From Basic Science to Basic Skin Care explained the importance of maintaining suitable pH in cosmetic and skin care products. The authors reported that proper pH helps in maintaining scalp health, preventing irritation, and improving the effectiveness of hair care formulations.[7]

8. Kokate CK, Purohit AP, and Gokhale SB (2014)

In Pharmacognosy provided detailed information about medicinal plants and herbal drugs used in cosmetics. The book described the therapeutic properties of herbal ingredients such as hibiscus, fenugreek, aloe vera, and amla which are useful in herbal hair conditioners for

improving hair growth, nourishment, conditioning, and scalp health.[3]

9. Joshi et al. (2015)

Explained that herbal formulations containing plant extracts rich in proteins, flavonoids, vitamins, and antioxidants help nourish hair follicles and maintain healthy hair growth. The researchers observed that herbal conditioners exhibit good wetting ability, stable lather, and proper consistency, making them suitable for regular use.[32]

10. Sharma PP (2017)

Formulation, Manufacturing and Quality Control explained the principles of cosmetic formulation, manufacturing processes, and quality control parameters for cosmetic products. The author emphasized the importance of stability, pH, texture, and safety evaluation in the development of herbal hair care formulations. This book provides useful guidance for preparing stable and effective herbal hair conditioners.[4]

11. Miss B. Jyothi et al. (2021)

According to et al. (2021), hair conditioners are cosmetic preparations used after shampooing to improve hair smoothness, shine, softness, and manageability. The authors formulated and evaluated different hair conditioner formulations and studied parameters such as pH, appearance, spread ability, stability, texture, and conditioning effect. The study reported that herbal ingredients help nourish the hair, reduce hair damage, and provide safer conditioning effects with fewer side effects compared to synthetic chemical products.[33]

12. Singh et al. (2022)

Reported that herbal hair conditioners prepared from natural ingredients like fenugreek, hibiscus, aloe vera, and curry leaves improve hair smoothness, reduce hair breakage, and increase shine. Their study emphasized the importance of herbal cosmetics because of their better compatibility with hair and lower irritation potential compared to synthetic conditioners.[34]

3. AIM AND OBJECTIVE

AIM: Formulation and evaluation of herbal hair conditioner.

OBJECTIVE

1. To prepare a herbal hair conditioner using natural ingredients.
2. To improve hair smoothness, softness, and shine naturally.

3. To nourish and strengthen hair roots using herbal extracts.
4. To reduce hair fall, dryness, and hair damage.
5. To maintain scalp health and improve hair texture.
6. To develop a safe and eco-friendly hair conditioning formulation with minimum side effects.
7. To evaluate the stability, pH, appearance, and washability of the prepared formulation.
8. To provide conditioning effect without using harmful synthetic chemicals.

4. DRUG PROFILE

Ingredients (Active herbs)

1. Fenugreek extract.

Biological Source: Dried ripe seeds of Trigonella foenum-graecum Linn.

Scientific name: Trigonella foenum-graecum.

Family: Fabaceae (Leguminosae).

Common names: Methi, Greek hay.

Chemical Constituents: Proteins, Saponins, Alkaloids and Flavonoids.

Uses of Fenugreek Extract

- Promotes hair growth.
- Reduces dandruff.
- Conditions and softens hair.
- Prevents hair fall.

Fig No. 3: Fenugreek extract.[19]

2. Hibiscus extract

Common name: hibiscus.

Kingdom: plantae. **Family:** malvaceae.

Active Constituents

- Flavonoids (antioxidant activities).
- Anthocyanins (nature pigment, hair nourishment).
- Vitamins (vitamin C, A).
- Amino acids.

Uses

- **Natural conditioner:** make hair soft, smooth, and shiny.
- **Promote hair growth:** nourishes hair follicles and support growth.
- **Prevent hair fall:** strengthens hair roots.

Fig No. 4: Hibiscus extract.[19]

3. Aloe vera gel

Synonyms:- Aloe barbadensis, aloe indica, aloe perfoliate.

Scientific Name:- Aloe barbadensis miller.

Family:- Asphodelaceae (Or Liliaceae/Xanthorrhoeaceae).

Biological Source:- Aloe vera gel is obtained from the fresh leaves of aloe barbadensis miller.

Chemical Constituents:- Polysaccharides(Acemannan), vitamins (a, c, e, b_{12}), minerals (calcium, magnesium, zinc), enzymes, amino acids, anthraquinones (aloin), saponins, sterols,

salicylic acid.

Properties

- Moisturizing Property.
- Soothing And Cooling Effect.
- Antimicrobial Activity.
- Hydrating Effect.
- Helps Reduce Irritation and Tanning.

Fig No. 5: Aloe vera gel.[19]

4. Coconut oil

Synonyms: Nariyal oil, Coconut fat, Copra oil

Biological Source: Coconut oil is obtained from the dried kernel (copra) of Cocos nucifera

Family: Arecaceae.

Chemical Constituents

- Lauric acid.
- Palmitic acid.
- Caprylic acid.
- Vitamin E.
- Polyphenols.

Properties / Uses

- Moisturizes hair and scalp.

- Reduces hair protein loss.
- Improves hair shine and softness.
- Acts as a conditioning agent.
- Helps reduce dandruff and dryness.
- Provides nourishment to damaged hair.

Fig No. 6: Coconut oil.[19]

5. Green tea extract

- **Biological name:** camellia sinensis.
- **Kingdom:** plantae.
- **Family:** thecae.
- **Common name:** green tea.

Active Constituents

- Green tea extract is rich in bioactive compound.
- Polyphenol.
- Flavonoids.
- Tannins.

Uses

- Reduce hair fall: strengthens root and prevents breakage.
- Control dandruff: antimicrobial action reduces scalp infection.
- Improve scalp health: soothes irritation and inflammations adds shine and smoothness condition hair naturally.

Fig No. 7: Green tea extract.[19]

6. Amla extract

Synonyms: Indian gooseberry, Amlaki, Emblica.

Biological Source: Amla extract is obtained from the dried or fresh fruits of Phyllanthus emblica / Emblica officinalis.

Family: Phyllanthaceae.

Chemical Constituents

- Vitamin C (Ascorbic acid).
- Tannins.
- Gallic acid.
- Polyphenols.
- Pectin.

Properties / Uses

- Promotes hair growth.
- Strengthens hair roots.
- Provides antioxidant activity.
- Nourishes scalp and hair.
- Improves hair texture and shine.

Fig No. 8: Amla extract.[19]

7. Citric acid

Synonyms: 2-Hydroxypropane-1,2,3-tricarboxylic acid, Sour salt.

Chemical Formula: $C_6H_8O_7$.

Source: Naturally present in citrus fruits like lemon and orange.

Category: Acidulant / pH adjusting agent.

Chemical Constituents

- Citric acid monohydrate.
- Citrate ions.

Properties / Uses

- Maintains pH of formulation.
- Improves product stability.
- Acts as preservative enhancer.
- Helps in smooth texture formation.
- Reduces alkalinity in cosmetic product.
- Provides mild chelating action.

Fig No. 9: Citric acid.[19]

8. Lavender oil

Synonyms: Lavender essential oil.

Family: Lamiaceae.

Chemical Constituents

Major constituents of lavender oil include

- Linalool.
- Linalyl acetate.

Uses of Lavender Oil

Hair Care

- Helps reduce dandruff.
- Promotes healthy scalp.
- May help reduce hair fall.
- Adds shine and fragrance to hair.
- Used in herbal hair conditioners and shampoos.

Fig No. 10: Lavender oil.[19]

9. Glycerin

Synonyms: Glycerol, Propane-1,2,3-triol.

Chemical Formula: C3H8O3.

Source: Obtained from vegetable oils and animal fats.

Category: Humectant / Moisturizing agent.

Chemical Constituents

• Glycerol

- Water traces.
- Fatty acid esters.

Properties / Uses: • Moisturizes hair and scalp

- Prevents dryness.
- Improves smoothness and softness.
- Enhances hair shine.
- Helps retain moisture in formulation.
- Provides conditioning effect.

Fig No. 11: Glycerin.[19]

10. Phenoxy Ethanol

Chemical Information

Chemical Name: Phenoxyethanol.

Molecular Formula: $C_8H_{10}O_2$. **Molecular Weight:** 138.16 g/mol. **Appearance:** Colorless oily liquid. **Odor:** Mild rose-like smell.

Solubility: Slightly soluble in water; soluble in alcohol and oils.

Uses of Phenoxyethanol

Phenoxyethanol is commonly used in

- Hair conditioners.
- Shampoos.
- Face washes.
- Makeup products.
- Pharmaceutical preparations.

Fig No. 12: Phenoxy Ethanol.[19]

11. Emulsifying Wax

Synonyms

- E-wax.
- Self-emulsifying wax.
- Emulsifying ointment wax.
- Nonionic emulsifying wax.

Chemical Constituents

Emulsifying wax is commonly composed of

- Cetearyl alcohol (mixture of cetyl alcohol and stearyl alcohol).
- Cetyl alcohol.
- Stearyl alcohol.

Uses

- Emulsifying agent.
- Thickening agent.

- Stabilizing agent.
- Texture enhancer.[19]

Fig No. 13: Emulsifying Wax.[19]

12. Guar gum

Synonym: Guaran, Guar flour, Cluster bean gum

Biological Source: Guar gum is obtained from the endosperm of seeds of Cyamopsis tetragonoloba.

Family: Fabaceae (Leguminosae) **Chemical Constituents**

- Galactomannan polysaccharides.
- Mannose and galactose sugars.
- Protein (small amount).
- Fiber.

Properties

- Excellent thickening property.
- Good water binding capacity.
- Improves viscosity and texture.
- Provides smooth consistency.
- Stabilizes emulsions.
- Non-toxic and biodegradable.
- Soluble in cold water.

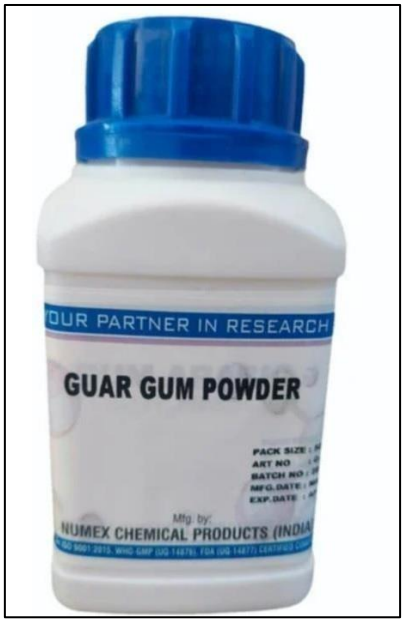

Fig No. 14: Guar gum.[19]

5. PLAN OF WORK

Present purposed research work was planned as follow

- Literature survey.
- Selection of herbal ingredient.
- Preparation of herbal powder.
- Preparation of formulation.
- Evaluation of conditioners formulation .
- Data collection and result analysis.
- Documentation.

The herbal conditioner was evaluated for various parameters as follows

- Physical parameter.
- pH test.
- Spread ability Test.
- Washability Test.
- Phase Separation.
- Irritancy Test.
- Stability test.

➢ **Need of study**

- Herbal hair conditioner having many advantages as it is free from chemicals hazardous

and protects hair from dandruff, dullness, and dry hair.

- As it is herbal so it has minimum side effects.
- Hair conditioner plays a significant role in the shine and nourishment of hair.

6. MATERIAL AND INSTRUMENTS

6.1. Material

- The list of chemicals/excipients used in the study.

Table No. 1: List of chemicals/excipients used in the study.

Sr. No.	Ingredients	Manufacturer
1.	Hibiscus extract	Natural Remedies Pvt. Ltd.
2.	Fenugreek extract	Herbo Nutra Extract Pvt. Ltd. (India)
3.	Green tea extract	Natural Remedies Pvt. Ltd.
4.	Amla extract	Natural Remedies Pvt. Ltd. (Bangalore)
5.	Coconut oil	Kerala Oils (India)
6.	Aloe vera gel	Dhirajlal Jagjivan, Akola, Maharashtra - 444001
7.	Emulsifying wax	Galaxy Surfactants Ltd.
8.	Guar gum	Hindustan Gum & Chemicals Ltd.
9.	Citric acid	TTCA India Pvt. Ltd.
10.	Phenoxyethanol	Viniti Organics Limited, Mumbai
11.	Lavender oil	Ultra International Ltd.
12.	Glycerin	Wilmar India Pvt. Ltd.

6.2. Instruments

- The list of instruments used in the formulation and evaluation study.

Table no. 2: List of instruments used in the formulation study.

Sr.no.	Name of instrument	Uses
1.	Magneti stirring	Creating homogeneous mixtures, dissolving active pharmaceutical ingredients (APIs), and preparing stable emulsions or buffers.
2.	Centrifugation	Uses rapid rotational force to separate, purify, or accelerate the stress-testing of complex mixtures based on particle size, shape, and density.
3.	Digital pH meter	Measures electric potential using two electrodes inserted into liquid into liquid to create an electric circuit Citizen CY107, Mumbai.
4.	Weighing Machine	To determine weight or mass of solid or powder material used.
5.	Hot plate	Hot plate is an electrically powered device used to uniformly heat glassware and chemical solutions without the safety hazards of an open flame.

7. FORMULATION OF THE HERBAL HAIR CONDITIONER

The herbal hair conditioner is prepared as per general of conditioner formulation.

7.1.Extract Procedure/Method

1. Fenugreek Extract Procedure

- Clean the fenugreek seeds properly to remove dust and impurities.
- Dry the seeds and grind them into coarse powder.
- Weigh about 10 g of fenugreek powder.
- Add the powder into 100 mL distilled water in a beaker.
- Heat the mixture at 60–70°C for 20–30 minutes with continuous stirring.
- Allow the mixture to cool
- Filter using muslin cloth or filter paper.
- Collect the filtrate; this is the fenugreek aqueous extract.
- Store the extract in a clean airtight container under refrigeration until use.[20]

2. Hibiscus Extract Procedure

- Wash and dry the hibiscus petals properly.
- Grind dried petals into powder if required.
- Take 10 g hibiscus powder in a beaker.
- Add 100 mL distilled water.
- Heat at 60–70°C for 20 minutes with gentle stirring.
- Cool the mixture to room temperature.
- Filter through muslin cloth or filter paper.
- Collect the filtrate as hibiscus extract.
- Store in refrigerator for further formulation use.[21]

3. Amla Extract Procedure

- Take 10 g of amla powder in a clean beaker.
- Add 100 mL distilled water.
- Heat the mixture at 60–70°C for 20–30 minutes.
- Stir continuously during heating.
- Allow the mixture to cool.
- Filter using filter paper.
- Collect the clear filtrate as amla extract.

- Store in airtight container under refrigeration.[22]

4. Green Tea Extract Procedure

- Take 10 g green tea leaves/powder in a beaker.
- Add 100 mL distilled water.
- Heat at 60–70°C for 15–20 minutes.
- Stir gently during extraction.
- Cool the solution.
- Filter through filter paper.
- Collect the filtrate as green tea extract.
- Store in refrigerator until use in formulation.[23]

7.2.Procedure/Method of conditioner

Step 1: Preparation of Aqueous Phase

- Take a clean beaker and add required quantity of distilled water.
- Add guar gum slowly into water with continuous stirring to avoid lump formation.
- Add glycerin and mix properly until a smooth solution is formed.
- Add aloe vera gel and stir continuously.
- Add hibiscus extract, fenugreek extract, amla extract, and green tea extract into the mixture.
- Heat the aqueous phase to about 70–75°C.[24]

Step 2: Preparation of Oil Phase

- In another beaker, add coconut oil and emulsifying wax.
- Heat the mixture to 70–75°C until the emulsifying wax melts completely.
- Stir properly to obtain a uniform oil phase.[25]

Step 3: Emulsification

- Slowly add the oil phase into the aqueous phase with continuous stirring.
- Stir continuously using a mechanical stirrer or glass rod until a smooth cream-like emulsion is formed.
- Continue stirring while cooling the formulation to room temperature.[26]

Step 4: Addition of Heat Sensitive Ingredients

- After cooling below 40°C, add phenoxyethanol as preservative.

- Add lavender oil for fragrance and conditioning effect.
- Dissolve citric acid in a small quantity of water and add dropwise to adjust pH between 4.5– 5.5.
- Mix thoroughly to obtain a homogeneous conditioner.[27]

Step 5: Packaging

- Transfer the prepared herbal hair conditioner into a clean and airtight container.
- Store in a cool and dry place.[28]

Storage: Conditioner was store in cool and dry place.

8. DIFFERENT BATCHES OF PREPARED HERBAL HAIR CONDITIONER

Table No. 3: Formulation of herbal conditioner 20ml.

Ingredient Name	F1	F2	F3	F4	F5	F6
Hibiscus extract	1ml	1ml	1ml	1ml	1ml	1ml
Fenugreek extract	1ml	1ml	1ml	1ml	1ml	1ml
Emulsifying wax	1g	1g	1g	1g	1g	1g
Green tea extract	0.2ml	0.4ml	0.6ml	0.3ml	0.5ml	0.7ml
Amla extract	0.3ml	0.5ml	0.7ml	0.4ml	0.6ml	0.8ml
Coconut oil	0.5ml	1ml	1.5ml	2ml	2.5ml	3ml
Aloe vera gel	3ml	4ml	5ml	4.5ml	3.5ml	5.5ml
Guar gum	0.1g	0.2g	0.3g	0.15g	0.25g	0.35g
Citric acid	q.s	q.s	q.s	q.s	q.s	q.s
Phenoxyethanol	0.2ml	0.2ml	0.2ml	0.2ml	0.2ml	0.2ml
Lavender oil	2drop	2drop	3drop	3drop	3drop	3drop
Glycerin	0.5 ml	1ml	1.5ml	0.8ml	1.2ml	1.8ml
Distilled water	q.s	q.s	q.s	q.s	q.s	q.s

Fig. No. 15. Formulatoin batch of hair conditioner.

9. EVALUATION TEST

- **Physical parameter**

The prepared herbal hair conditioner is evaluated for its color, Oduor, texture, consistency, and appearance. The formulation should be smooth, homogeneous, and free from phase separation or grittiness. A pleasant Oduor and attractive appearance increase consumer acceptability.

pH test

The pH of the conditioner is determined using a digital pH meter by dispersing a small quantity of conditioner in distilled water. The ideal pH for hair conditioner ranges between 4.5–5.5.

- **Spread ability Test**

A small amount of conditioner is placed between two glass slides and spread ability is evaluated by applying a specific weight.

The was calculated using the following formula.

L/T x **M**..... **Formula No. 1.**

Where, S= spread ability.

M= weight in the pan.

L= length moved by the glass slide.

T= time (in sec) taken to separate the slides completely.

- **Washability Test**

The conditioner is applied on hair and washed with water to observe easy to removal.

- **Centrifugation Test**

Formulation were centrifuged at 25^{o}C for 30 minutes, and no phase separation was observed, indicating good gel stability. this step is crucial for understanding gel properties.

- **Irritancy Test**

A small amount of conditioner is applied on the skin patch to check for redness, itching, or irritation.

Stability test

The formulation is stored at different temperatures such as room temperature, refrigeration temperature, and elevated temperature for a specific period. Changes in color, Oduor, pH, and phase separation are observed.[29-31]

In this study, six batches (Batch 1 to Batch 6) of herbal hair conditioner were prepared and subjected to stability testing. The samples were stored at different temperatures such as 4°C ± 2°C (refrigeration condition), 25°C ± 2°C (room temperature).

10. RESULT AND DISCUSSION

1. Physical Parameter

The physical parameters of the formulated herbal hair conditioner were evaluated by visual inspection. The formulation showed a smooth and homogeneous appearance with white to light brown color due to the presence of herbal extracts. The Oduor of the conditioner was pleasant and characteristic herbal with mild fragrance of lavender oil. The texture of the formulation was smooth, creamy, and soft without any grittiness or lump formation. Batch F6 showed good consistency, aesthetic appearance, and remained stable throughout the evaluation study. Therefore, Batch F6 successfully passed the physical parameter evaluation test.

Table No. 4: Physical Parameter.

Sr. No.	Formulation	Physical Appearance			
		Colour	Odour	Texture	Observation
1.	F1	Light brown	Mild herbal	Slightly	bad
2.	F2	Brown	Pleasant herbal	Smooth	fair
3.	F3	Brownish	Herbal	Smooth	fair
4.	F4	Creamish brown	Mild herbal	Creamy	fair
5.	F5	Whitens brown	Pleasant herbal	Thick	good
6.	F6	Whites brown	Pleasant herbal	Smooth and creamy	good

2. pH Test

The pH test was performed to determine the suitability of the herbal hair conditioner for hair and scalp application. The pH of all formulations (F1–F6) was found between **4.8 to 5.2**, which is suitable for hair care products. Hence, all batches passed the pH evaluation test successfully**.**

Table No. 5. pH Test.

Sr. No.	Formulation	pH	Observation
1.	F1	4.8	Fair
2.	F2	5.0	Good
3.	F3	5.1	Good
4.	F4	4.9	Good
5.	F5	5.1	Good
6.	F6	5.2	Good

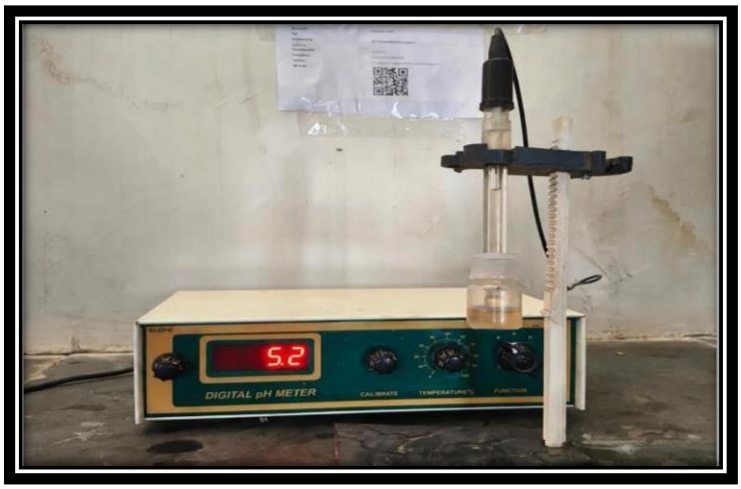

Fig No. 16: pH Test.

3. Spread ability Test

The spread ability test was performed to evaluate the ease of application of the herbal hair conditioner. Formulations showing spread ability in the range of 4–5 cm were considered acceptable. F3 and F6 showed good spread ability and passed the test successfully.

Table No. 6: Spreadability Test.

Sr. No	Formulation	Spread ability (cm)	Observation
1	F1	2-2.3 cm	Low
2	F2	3-3.3 cm	Moderate
3	F3	4-4.5 cm	Good
4	F4	3-4.3 cm	Moderate
5	F5	2-2.3 cm	Low
6	F6	4-5 cm	Excellent

Fig. No. 17: Spreadability Test.

4. Washability Test

All formulations were easily washable, indicating: Good water compatibility Absence of excessive oily residue Suitable cleansing performance This is an important characteristic for herbal conditioner preparations.

Table No. 7: Washability Test.

Sr. No	Formulation	Wash ability
1	F1	Easy to wash
2	F2	Easy to wash
3	F3	Easy to wash
4	F4	Easy to wash
5	F5	Easy to wash
6	F6	Easy to wash

Fig No. 18: After apply.

Fig No. 19: After wash.

5. Centrifugation Test

Among the six formulations, F1, F3, F5, and F6 showed good stability without any phase separation after centrifugation. F2 showed slight separation and was considered unstable, while F4 showed mild creaming and was considered fairly stable. Overall, the majority of formulations exhibited acceptable physical stability.

Table No. 8: Centrifugation Test.

Sr. No	Formulation	Speed (rpm)	Time	Observation	Result
1	F1	3000 rpm	30 min	No separation observed	Stable
2	F2	3000 rpm	30 min	Slight separation observed	Unstable
3	F3	3000 rpm	30 min	No separation observed	Stable
4	F4	3000 rpm	30 min	Mild creaming observed	Fairly stable
5	F5	3000 rpm	30 min	No separation observed	Stable
6	F6	3000 rpm	30 min	No separation observed	Stable

Fig No. 20: Centrifugation Test.

6. Irritancy Test

All formulations were found to be non-irritant: No redness, no itching, no burning sensation observed This confirms that the herbal ingredients and pH range were safe for topical application.

Table No. 9: Irritancy Test.

Sr.no	Formulation	Skin irritation
1.	F1	No irritation
2.	F2	No irritation
3.	F3	No irritation
4.	F4	No irritation
5.	F5	No irritation
6.	F6	No irritation

Fig No. 21: Hand during application.

Fig No. 22: Hand after application.

7. Stability Test

Stability testing is an important evaluation parameter for cosmetic formulations like herbal hair conditioner. It is used to determine the ability of the product to maintain its physical, chemical, and microbiological properties under different storage conditions over a period of time.

In this study, six batches (Batch 1 to Batch 6) of herbal hair conditioner were prepared and subjected to stability testing. The samples were stored at different temperatures such as 4°C ± 2°C (refrigeration condition), 25°C ± 2°C (room temperature).

The stability study of all formulations was carried out at 25°C ± 2°C. Formulation F1 showed a change in texture and was found to be slightly stable, while F2 also showed a change in texture but remained stable under the same conditions. F3 exhibited a change in consistency and was considered slightly stable. F4 was observed to be slightly stable with moderate stability during the study period. In contrast, F5 showed no change and remained stable, whereas F6 showed no change and was found to be highly stable at 25°C ± 2°C.

Table No. 10: Stability Test.

Sr.no	Formulation	Observation	Stability	Observation
1	F1	Change in texture	Slightly Stable	$25^{O}C \pm 2^{0}C$
2	F2	Change in texture	Stable	$25^{O}C \pm 2^{0}C$
3	F3	Change in consistency	Slightly Stable	$25^{O}C \pm 2^{0}C$
4	F4	Slightly stable	Moderately stable	$25^{O}C \pm 2^{0}C$
5	F5	No change	stable	$25^{O}C \pm 2^{0}C$
6	F6	No change	Highly stable	$25^{O}C \pm 2^{0}C$

11. CONCLUSION

The study successfully demonstrated the formulation and evaluation of a herbal hair conditioner using natural plant-based ingredients. The prepared conditioner showed satisfactory physicochemical properties and good conditioning effects on hair. Herbal ingredients such as fenugreek, hibiscus, aloe vera, amla, and green tea provided nourishment, moisturization, scalp protection, and improved hair texture naturally. Among all the prepared batches, formulation F6 was found to be the most stable and effective based on evaluation parameters. The herbal conditioner was safe, non-irritant, economical, and environmentally friendly compared to synthetic hair conditioners. Therefore, the formulated herbal hair conditioner can be considered a promising natural alternative for maintaining healthy, smooth, and manageable hair with fewer side effects.

All the prepared batches (F1–F6) of the herbal hair conditioner were successfully formulated and evaluated for various parameters such as appearance, pH, spread ability, washability, irritancy, centrifugation, and stability. The formulations showed suitable pH for scalp application, good washability, and no irritation on the skin, indicating their safety for use. Batch F1 showed low spread ability and slight instability in texture, while F2 showed slight phase separation during centrifugation. Batch F3 exhibited good spread ability but slight changes in consistency during storage. Batch F4 showed moderate stability with mild creaming, whereas F5 remained stable without major changes. Among all formulations, Batch F6 showed the best overall performance with smooth and creamy texture, excellent spread ability, good stability, no phase separation, and satisfactory conditioning properties. Therefore, Batch F6 was considered the optimized and most effective formulation for the herbal hair conditioner.

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