Research Article:

BOTANICAL BOOST: FORMULATING A MULTI-HERBAL HAIR OIL WITH HIBISCUS AT ITS CORE

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ABSTRACT:
Hair is an important skin appendage contributing significantly to human appearance and confidence. However, it is prone to several common issues, including hair loss, dandruff, lice, premature greying, and split ends. To manage these conditions, a range of cosmetic solutions is utilized, with hair oils being among the most preferred due to their versatility. The rising interest in herbal-based products has more efficacy, minimum side effects, and accessibility of ingredients. Among these, herbal hair oils are increasingly favoured for supporting hair growth, enhancing texture, and nourishing the scalp.
This study aimed to develop and assess a polyherbal hair oil combining coconut and orange oils with botanicals such as curry leaves, Bhringraj, hibiscus leaves and flowers, fenugreek, onion seeds, and cinnamon. Two formulations were prepared using different techniques, with the first using hot maceration. Physicochemical evaluations showed that this method resulted in the lowest acid and saponification values, suggesting improved product stability and reduced rancidity.
A central focus of the formulation was *Hibiscus rosa-sinensis* Linn (HRS), a plant traditionally valued for its therapeutic effects, including antioxidant, antibacterial, and skin-protective properties. Despite its traditional use, limited scientific data supports its role in hair regeneration. Therefore, HRS extracts were tested on Sprague Dawley rats, and histological observations indicated promising results in promoting hair growth.
These findings suggest that polyherbal oils, especially those incorporating HRS, offer a safe and effective alternative in natural hair care and warrant further investigation.

Keywords: *Hibiscus rosa-sinensis, P*olyherbal Hair Oil, Formulation, Maceration, Scalp Protective, Hair Fall

INTRODUCTION:-

Hair, a specialized epidermal structure, plays a crucial role not only in protecting the scalp but also in enhancing physical appearance and self-esteem. However, various hair-related concerns such as hair fall, dandruff, lice infestations, split ends, and premature greying are commonly experienced by individuals across all age groups [1]. In response, a variety of cosmetic products are used to address these problems, with hair oil being one of the most widely utilized remedies [2].
In recent years, herbal-based cosmetics have seen a surge in popularity, driven by increasing consumer preference for natural, effective, and safer alternatives to synthetic formulations. Herbal ingredients are often favoured for their low toxicity, ease of access, and historical use in traditional medicine systems [3]. In the field of hair care, the incorporation of medicinal plants into oil formulations has been recognized as a promising approach to support hair growth, reduce hair fall, and enhance hair texture and strength [4,5].
The current study aims to formulate and evaluate a polyherbal hair oil enriched with coconut oil and orange oil, infused with medicinally significant plants including curry leaves, Bhringraj, hibiscus flowers and leaves, fenugreek seeds, onion seeds, and cinnamon. These botanicals have long-standing traditional use in maintaining scalp health and promoting hair regeneration [6].
Natural plant-derived compounds have historically served as substitutes for synthetic drugs, many of which carry adverse side effects [7,8]. Key plant constituents such as alkaloids, flavonoids,

tannins, and phenolic compounds are known for their bioactivity and therapeutic potential [9,10]. There is ongoing research to identify plant species with pharmacological value that can be integrated into modern cosmetic and medicinal formulations. One such plant is *Hibiscus rosa-sinensis* Linn (HRS), which has demonstrated multiple pharmacological properties.

Traditional practices have utilized all parts of the HRS plant—including roots, stems, flowers, and leaves—for their healing properties [10,11]. The flowers are commonly consumed in herbal teas, used for food coloring, or eaten in salads and pickles in various cultures, indicating the plant's general safety for human use. Notably, the leaves of HRS are known for their antioxidant, antibacterial, and anti-tyrosinase activities [12,13]. Despite these traditional applications, its specific role in stimulating hair growth remains underexplored in scientific literature, where most studies focus on its antimicrobial functions.

While pharmaceutical options exist for treating hair loss, concerns over adverse effects have driven interest in herbal alternatives. Yet, limited scientific validation has restricted their incorporation into mainstream dermatological care. Given its traditional reputation and bioactive profile, HRS may offer a promising natural approach to manage hair loss. In this study, extracts from the leaves and flowers of HRS will be tested for their ability to stimulate hair growth using Sprague Dawley rats, with progress monitored via histological analysis.

HUMAN HAIR:-

Human hair primarily consists of proteins, comprising approximately 65–95% of its total weight, along with water, lipids, pigments, and trace elements. Among these, keratin—a sulphur-rich structural protein-constitutes around 80% of the hair's composition. This complex, layered protein framework imparts strength, elasticity, and durability to the hair shaft [14].

The structural characteristics and mechanical properties of hair are largely determined by the organization and interaction of its protein components. Hair morphology is established at the follicular level: larger follicles produce thick terminal hairs (e.g., scalp hair), while smaller ones give rise to finer vellus hairs found on the body. Additionally, the curvature of the follicle influences hair texture, with curved follicles generating curly hair regardless of ethnicity [15].

STRUCTURE OF HAIR:-

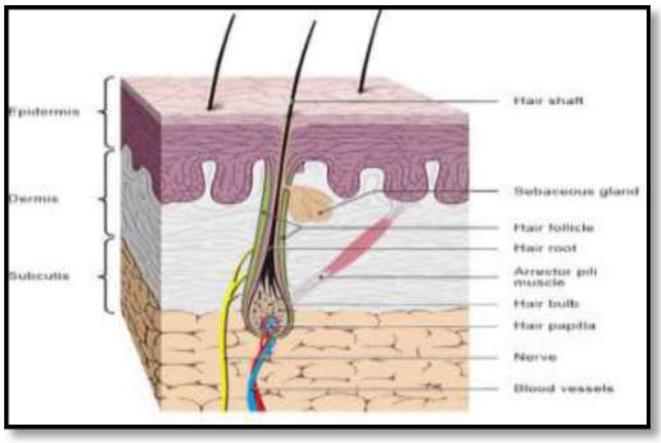

Figure 1: structure of hair

Each strand of hair is composed of two main parts: the **hair shaft**, which is the visible portion above the skin surface, and the **hair root**, which lies beneath the skin and extends into its deeper layers. The hair root is encased in a **hair follicle**, a tubular structure made up of skin cells and connective tissue. Each follicle is also connected to a **sebaceous (oil) gland**, which helps lubricate the hair and skin.

Additionally, a small muscle known as the **arrector pili** is attached to each follicle. This muscle can contract, causing the hair to stand upright (commonly known as "goose bumps"). The follicles are surrounded by sensory nerves that can detect even minor hair movement.

At the base of the follicle, the hair root enlarges into a **hair bulb**. Inside the bulb is the **dermal papilla**, structure rich in blood vessels that supply essential nutrients and oxygen to the growing hair. New hair cells are continuously generated in this region, where they harden (keratinize), bond

together, and form the hair shaft. As more cells are added, the strand is pushed upward through the skin.

Hair color is determined by the concentration of **melanin** in the hardened cells. Melanin levels vary by individual and tend to decrease with age. As melanin production declines and air becomes trapped within the hair shaft, hair turns grey or white [16].

HAIR GROWTH CYCLE:-

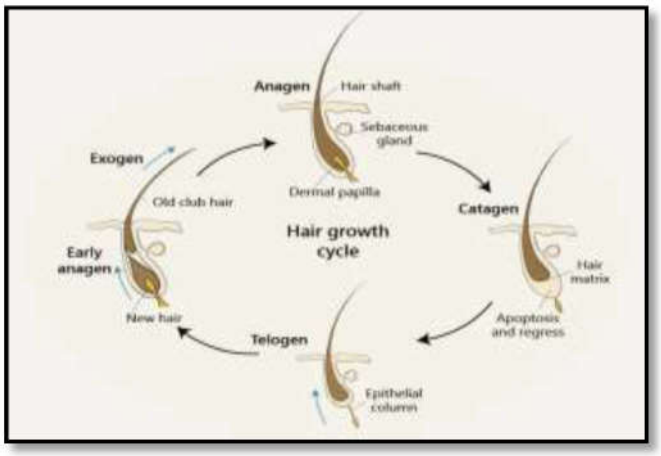

Figure 2: stages of growth cycle[17]

Hair growth occurs in a cyclical process consisting of four key phases:

Stage	Key Features
Anagen	Active growth phase; nourished by blood supply; lasts 2–6 years.
Catagen	Transitional phase; follicle detaches from blood supply; lasts 1–2 weeks.
Telogen	Resting phase; follicles are inactive; lasts 5–6 weeks.
Exogen	Shedding phase; mature hair is released and falls out.

Table 1: The main phases of hair growth [18]

HAIR FOLLICLE CYCLING:-

Hair follicles (HFs) of mammals-including humans-undergo continuous cycling throughout life. This cycle includes four distinct stages:

1. **Anagen (Growth)**
2. **Catagen (Regression)**
3. **Telogen (Rest)**
4. **Exogen (Shedding)** [18,19]

The duration of each stage varies based on factors such as body location, nutrition, hormones, age, and species [20]. For instance, in mice, the first mature hair shaft appears approximately 17 days after birth [21], while human scalp follicles can cycle 10–30 times throughout life. Human HF cycling is also thought to be influenced by surrounding white adipose tissue clusters known as **dermal cones** [22].

1. Anagen (Growth Phase):

Anagen is the period of active hair production. True anagen typically begins about four weeks after birth [23]. Hair follicle stem cells, located in the bulge area, become activated and proliferate, forming the lower part of the follicle. These cells are rich in **keratin 15 (K15)** and **β1-integrin** [24]. The rapidly dividing **matrix cells** derived from these stem cells differentiate into the various layers of the hair shaft and follicle lining [25]. The human scalp anagen phase can last from 2 to 8 years [26].

2. Catagen (Regression Phase):

During catagen, which lasts about 2–3 weeks, the lower two-thirds of the hair follicle degenerate through **programmed cell death (apoptosis)**? Cells of the inner root sheath (IRS), outer root sheath (ORS), and dermal matrix are lost, while the bulge stem cells are preserved [27]. This leads to the formation of a condensed structure called the **epithelial strand**, which keeps the **dermal papilla** close to the stem cell niche [28]. In mice, the remaining hair (club hair) often stays in the follicle, adding volume to the coat and causing bulging in the ORS [29].

3. Telogen (Resting Phase):

Telogen follows catagen and marks the follicle's resting phase [30]. In young mice, hair follicles cycle in a synchronized manner, but this synchrony diminishes with age [31]. In humans, desynchronization begins shortly after birth [32]. Telogen duration increases with age, slowing hair turnover. Although often viewed as inactive, telogen is a dynamic stage crucial to preparing the follicle for the next anagen phase [31]. The **anagen: telogen ratio** varies by body region—scalp hairs have longer anagen phases, while eyelashes and limb hairs spend more time in telogen, leading to shorter lengths [34].

4. Exogen (Shedding Phase):

Exogen refers to the active release of the fully grown hair shaft [35]. While some hairs may fall out due to mechanical forces, exogen is a biologically regulated process. On average, human hair follicles go through a complete cycle every 2 to 8 years. At any given time, about **86%** of scalp hairs are in anagen, **1%** in catagen, and **13%** in telogen [36].

ESSENTIAL NUTRIENTS FOR HAIR HEALTH:-

Proper nutrition plays a vital role in maintaining healthy hair growth and structure. Several vitamins, minerals, and amino acids are key contributors to hair vitality. The table below lists some of the most important nutrients:

Vitamins & Compounds	Minerals & Amino Acids
Beta-carotene	Calcium
Biotin	Zinc
Vitamin B1, B2, B5, B6, B12	Iron
Vitamin D, Vitamin E	Selenium
Folic acid, Inositol	L-Methionine
	L-Cysteine, L-Lysine, L-Taurine
	Polyunsaturated fatty acids (PUFAs)

Table 2: Essential nutrients for hair health [37]

FOODS THAT SUPPORT HEALTHY HAIR:-

Maintaining optimal hair health involves a diet rich in essential nutrients. The following foods provide the key vitamins, minerals, and proteins required to support hair growth and prevent damage:

- **Salmon**: Contains omega-3 fatty acids, vitamin B12, iron, and high-quality protein, all of which nourish hair follicles and promote a healthy scalp.
- **Leafy Greens**: Vegetables like spinach, broccoli, and Swiss chard are packed with vitamins A and C, which aid in producing sebum—a natural scalp conditioner. These greens are also good sources of calcium and iron.
- **Beans**: Rich in plant-based protein, iron, biotin, and zinc. A lack of biotin can lead to weak, brittle hair.
- **Nuts**: Brazil nuts provide selenium, an important trace element for hair health. Walnuts contain both zinc and alpha-linolenic acid (an omega-3 fat), which can help improve hair texture. Almonds, cashews, and pecans are also high in zinc, which helps prevent excessive hair shedding.
- **Poultry**: A reliable source of lean protein and iron. Protein deficiency can cause thinning and brittle strands.
- **Eggs**: Offer essential nutrients such as biotin, protein, and vitamin B12 that are critical for maintaining strong and vibrant hair.

- **Whole Grains**: Supply complex carbohydrates, zinc, iron, and B vitamins—nutrients required for healthy hair follicles.
- **Oysters**: Extremely rich in zinc, which helps regulate the hair growth cycle.
- **Low-Fat Dairy Products**: Skim milk and yogurt are excellent sources of calcium and hair-nourishing proteins like casein and whey.
- **Carrots**: High in vitamin A, which supports the maintenance and growth of tissues, including the scalp and hair.

A diverse diet including lean meats, vegetables, fruits, whole grains, legumes, fatty fish, and low-fat dairy promotes optimal hair growth and scalp health.

CLASSIFICATION OF HAIR LOSS:-

Hair loss can occur for numerous reasons and presents in several distinct forms:

- **Alopecia Areata**: An autoimmune condition causing small, smooth, circular bald patches, typically on the scalp.
- **Mild Recurrent Alopecia Areata**: Involves occasional, temporary hair loss episodes without progression to complete baldness.
- **Advanced Alopecia Areata**: May develop into more severe forms such as alopecia totalis or universalis.
- **Ophiasis Pattern Alopecia**: Hair loss occurs in a band-shaped pattern, commonly along the lower scalp and is often difficult to treat.
- **Alopecia Totalis**: Refers to the total loss of scalp hair.
- **Alopecia Universalis**: Results in complete loss of body hair, including eyebrows and eyelashes.
- **Scarring (Cicatricial) Alopecia**: Permanent hair loss due to inflammation, infection, burns, or trauma that destroys the hair follicle.
- **Trichotillomania**: A psychological condition involving compulsive pulling of one's own hair.
- **Traction Alopecia**: Caused by hairstyles that pull the hair tightly, placing strain on the hair follicles.
- **Anagen Effluvium**: Sudden hair loss typically triggered by chemotherapy, which affects rapidly growing cells including those in hair follicles.
- **Diffuse Hair Loss**: Generalized thinning without any localized bald spots.
- **Telogen Effluvium**: A condition in which hair prematurely enters the resting phase, often triggered by stress, hormonal shifts, or illness.
- **Chemical-Induced Hair Loss**: Caused by harsh cosmetic treatments like dyes, relaxers, or straightening chemicals.

CAUSES AND SYMPTOMS OF HAIR LOSS:-

Several physiological and environmental factors can lead to hair loss, including:

- Severe illness or physical trauma
- Autoimmune conditions
- Chemical exposure (e.g., hair dyes or styling products)
- Certain medications or chemotherapy
- Endocrine disorders such as diabetes or thyroid imbalance
- Iron deficiency and anaemia
- Childbirth-related hormonal changes
- Stress or psychological conditions
- Malnutrition or restrictive dieting
- Fungal infections (e.g., ringworm)
- Poor scalp circulation
- Radiation therapy
- Skin conditions
- Sudden weight loss or surgical procedures

HERBS USED IN HAIR CARE:-

Many traditional and herbal remedies are known to enhance hair quality and growth:

- **Jatamansi (Spikenard)**: Stimulates hair follicle activity, extends the growth phase, strengthens hair shafts, and increases overall volume.
- **Amla (Indian Gooseberry)**: Enhances scalp strength, prevents premature greying, supports growth, and combats dandruff.
- **Reetha (Soapnut)**: Acts as a natural cleanser, supports growth, reduces dryness and dandruff, and combats lice.
- **Neem**: Encourages growth by improving scalp health and reducing itchiness, dandruff, and dryness.
- **Olive Oil**: Enhances strength, promotes softness, and contains natural antifungal and antibacterial agents.

INGREDIENT SELECTION FOR FORMULATION:-

The following natural ingredients were selected for their scientifically supported hair benefits:

- **Hibiscus Flower**: Rich in amino acids, promotes keratin production and encourages follicle regeneration.
- **Hibiscus Leaves**: Reduce excess oil, limit fungal growth, and help control dandruff.
- **Cinnamon**: May increase scalp circulation, promoting follicular activity and reducing fungal infections.
- **Fenugreek Seeds**: Contain plant-based protein, iron, flavonoids, and saponins that stimulate growth and reduce inflammation.
- **Onion Seeds**: Provide sulfur, essential for hair structure, while maintaining pH balance and preventing early greying.
- **Curry Leaves**: Contain antioxidants and proteins that protect and strengthen hair.
- **Bhringraj**: Offers antifungal and anti-inflammatory properties, boosts blood flow to the scalp, and reduces dandruff.
- **Coconut Oil**: Penetrates deeply due to its lauric acid content, moisturizing and repairing damaged strands.
- **Orange Oil**: Hydrates, improves hair texture, and encourages growth.

MATERIAL COLLECTION:-

- **Hibiscus** (flowers and leaves): Freshly sourced from plants.
- **Cinnamon, Fenugreek, Onion Seeds**: Purchased from the market.
- **Curry Leaves**: Collected from home grown or market sources.
- **Bhringraj**: Bought from pharmaceutical or herbal stores.
- **Coconut Oil**: Commercially obtained virgin coconut oil.
- **Orange Oil**: Sourced through verified online retailers

EXTRACTION METHODS:-

Extraction is the process of isolating biologically active compounds from plant materials using appropriate solvents. This process can yield extracts used in either internal or topical formulations.

Hot Maceration

Plant materials are submerged in warm oil to rupture cellular walls, releasing active constituents into the oil, which is then filtered and stored.

Cold Maceration

Involves soaking powdered or whole plant matter in a solvent at ambient temperature for 3–7 days. The solution is stirred periodically and then filtered to separate the liquid extract.

CHEMICAL ANALYSES:-

Acid Value (AV)

The acid value measures the concentration of free fatty acids in oils. It is defined as the amount of potassium hydroxide (KOH) in milligrams needed to neutralize the acids in one gram of oil.

Formula:
AV=(Veq−beq) ×N×56.1WoilAV = \frac{(V_{eq} - b_{eq}) \times N \times 56.1} {W_{oil}}
AV=Woil(Veq−beq) ×N×56.1
Where:

- VeqV_{eq}Veq = Titrant volume for sample
- beqb_{eq}beq = Titrant volume for blank
- NNN = Normality of KOH
- WoilW_{oil}Woil = Mass of the sample (g)

A lower acid value indicates fresher, more stable oil with better shelf life and quality.

Saponification Value (SV):-
The saponification value is an indicator of the average molecular weight of fatty acids in oils. It shows how much KOH (mg) is needed to saponify 1 gram of fat.
Formula:-
SV=(B−S)×M×56.1WSV = \frac{(B - S) \times M \times 56.1}{W}SV=W(B−S)×M×56.1
Where:

- BBB = Volume of HCl for blank
- SSS = Volume of HCl for sample
- MMM = Molarity of HCl
- WWW = Sample mass (g)

Higher SVs suggest shorter fatty acid chains—ideal for soap production.

INTRODUCTION TO HERBS USED IN THE CURRENT STUDY:-

A. Hibiscus:-

Figure 3: Hibiscus [38]

1. Description:
Hibiscus plants typically have lobed leaves that may either be smooth or covered with fine hairs called trichomes. The flowers usually appear singly or in small clusters, often lasting only a single day. A characteristic feature is the presence of an epicalyx-a set of leaf-like structures encasing the sepals. The stamens are often fused, forming a tube surrounding the pistil. The genus is also noted for its spiny pollen grains and capsule-type fruits.
2. Botanical Information:

- *Scientific Name*: Hibiscus rosa-sinensis
- *Source*: This species belongs to the tropical hibiscus group within the Hibisceae tribe.
- *Family*: Malvaceae

3. Taxonomic Classification:

- Kingdom: Plantae (Plants)
- Subkingdom: Viridiplantae (Green plants)
- Superdivision: Embryophyta (Land plants)
- Division: Tracheophyta (Vascular plants)
- Subdivision: Spermatophytina (Seed plants)

- Class: Magnoliopsida (Dicotyledons)
- Family: Malvaceae (Mallow family)
- Genus: Hibiscus
- Species: Hibiscus rosa-sinensis (commonly known as Chinese hibiscus or shoe-black plant)

4. Chemical Composition:

Hibiscus rosa-sinensis contains a variety of bioactive compounds such as tannins, anthraquinones, quinones, phenols, flavonoids, alkaloids, terpenoids, saponins, cardiac glycosides, proteins, free amino acids, carbohydrates, reducing sugars, mucilage, essential oils, and steroids.

5. Pharmacological Effects:

The plant exhibits numerous health benefits including antidiabetic, reproductive health support, fibrinolytic, lipid-lowering, antioxidant, anti-inflammatory, antipyretic, analgesic, immune-modulating, anticonvulsant, antidepressant, memory-enhancing, cytotoxic, antimicrobial, antiparasitic, dermatological, anti-hemolytic, urinary system support, hepatoprotective, neuroprotective, and antitussive activities.

6. Relevance of Hibiscus for Hair Care:

In Ayurvedic philosophy, the body is influenced by three fundamental energies or doshas—Vata, Pitta, and Kapha—which also reflect in hair characteristics. Each dosha impacts hair in unique ways, influencing texture, growth, and health. Most individuals exhibit traits of multiple doshas in their hair, while rare cases show dominance of a single dosha.

- **Vata**: Hair tends to grow quickly, is often unruly, and can be thin or coarse with a mix of curls and straight strands. An imbalance leads to dry, brittle, frizzy hair with split ends.
- **Pitta**: Hair is typically fine, soft, straight, and of moderate thickness. Excess heat from Pitta can damage hair roots, causing premature thinning and greying.
- **Kapha**: Hair tends to be thick, wavy, strong, and voluminous with a glossy texture. However, too much Kapha can result in oily scalp and sticky hair strands.

Due to these properties, hibiscus is an excellent herb to incorporate into hair care, as it balances doshas and promotes hair vitality.

7. Benefits of Hibiscus for Hair:

- **Promotes Hair Growth:** Hibiscus, commonly used in herbal hair oils, is rich in vitamin C, flavonoids, amino acids, mucilage, moisture, and antioxidants. These components nourish the scalp and hair, encouraging healthy and abundant hair growth while imparting a silky texture.
- **Protects the Scalp:** The plant's resilient qualities shield the scalp from environmental damage, acting like a natural sunscreen against harmful UVB rays. It also maintains scalp pH balance, combats excess oil and dandruff, and stimulates dormant follicles.
- **Strengthens Hair Roots:** The flavonoids in hibiscus improve blood circulation to hair follicles, promoting new growth, while amino acids support keratin synthesis crucial for strong hair strands.
- **Prevents Premature Greying:** Rich in natural pigments and antioxidants, hibiscus may help delay early greying by nourishing hair with color-enhancing nutrients.
- **Controls Dandruff:** With antimicrobial effects, hibiscus helps eliminate dandruff-causing fungi and reduces flakes, whether oily or dry.
- **Deeply Conditions Hair:** Its mucilage content traps moisture within hair shafts, restoring elasticity and reducing breakage, especially beneficial for dry, brittle hair.
- **Balances Sebum Production:** Hibiscus regulates oil secretion from sebaceous glands, helping to avoid excessively oily or sticky hair conditions.

8. Common Methods of Using Hibiscus for Hair Care:

- **Hibiscus Oil Preparation for Hair Growth:**
  Blend hibiscus petals and leaves into a paste and infuse it into warmed coconut oil. This oil helps reduce protein loss and moisturizes hair, supporting healthy growth.
- **Hibiscus-Based Shampoo:**
  Boil hibiscus leaves and petals in water to create a natural cleanser. Adding gram flour enhances its ability to remove build up and soothe the scalp without stripping moisture.

B. Hibiscus Leaf:-

Figure 4: Hibiscus leaves

1. Description:
Hibiscus leaves usually display two shades of green, with the upper surface being brighter. Each leaf ranges from 2 to 7 inches in length, and supports a single flower along its axis. Fresh leaves tend to be lighter in color and are composed primarily of water (over 85%). The leaves also contain various phytochemicals that provide medicinal benefits.

2. Plant Details:

- Botanical Name: *Hibiscus rosa-sinensis*
- Biological Source: A tropical flowering plant belonging to the Hibisceae tribe
- Family: Malvaceae

3. Scientific Classification:

- Kingdom: Plantae
- Subkingdom: Viridiplantae
- Superdivision: Embryophyta
- Division: Tracheophyta
- Subdivision: Spermatophytina
- Class: Magnoliopsida
- Family: Malvaceae
- Genus: Hibiscus
- Species: *Hibiscus rosa-sinensis*

4. Chemical Constituents:
Phytochemical studies show the presence of tannins, anthraquinones, quinines, phenols, flavonoids, alkaloids, terpenoids, saponins, cardiac glycosides, proteins, free amino acids, carbohydrates, reducing sugars, mucilage, essential oils, and steroids.

5. Benefits for Hair:

- Helps prevent hair loss
- Promotes healthy, lustrous hair
- Reduces premature greying
- Adds thickness and volume
- Controls dandruff
- Conditions hair to reduce frizz, dryness, and breakage
- Prevents split ends

C. Onion Seeds:-

Figure 5: Onion seeds

1. Description:
Onion seeds, often called "seeds of blessings," are renowned for their medicinal properties. Also known as Kalonji or Nigella, these small black seeds are triangular in shape and widely cultivated in India. They are commonly used as a spice and a natural remedy for various health issues.

2. Plant Details:

- Botanical Name: *Allium cepa* L.
- Biological Source: Seeds harvested from the onion plant's flowering bulbs
- Family: Alliaceae

3. Scientific Classification:

- Kingdom: Plantae
- Class: Magnoliopsida
- Family: Amaryllidaceae
- Genus: Allium
- Species: *Allium cepa*

4. Chemical Constituents:
Onion seeds exhibit antioxidant, mucolytic, anti-inflammatory, and anti-diabetic properties. They aid digestion by improving appetite and reducing intestinal gas. In Ayurveda, they are used to treat conditions like bad breath, cough, asthma, skin diseases, hair loss, and fever.

5. Hair Benefits:

- Promote healthy and shiny hair
- Possess antifungal properties that prevent scalp infections
- Nourish hair with essential oils to support growth

D. Fenugreek (Methi) Seeds:-

Figure 6: Methi seeds

1. Introduction:

Trigonellafoenum-graecum (Fenugreek), known as Methi in Hindi, has a long history as both a spice and a medicinal herb. It is a leguminous crop grown primarily for its seeds, which are used to enhance flavor, color, and texture in food.

2. Plant Details:

- Botanical Name: *Trigonellafoenum-graecum*
- Biological Source: Dried mature seeds of *Trigonellafoenum-graecum*
- Family: Fabaceae

3. Scientific Classification:

- Kingdom: Plantae
- Division: Magnoliophyta
- Class: Magnoliopsida
- Order: Fabales
- Family: Fabaceae
- Genus: Trigonella
- Species: *foenum-graecum*

4. Chemical Constituents:

Fenugreek seeds contain fibers, flavonoids, polysaccharides, saponins, fixed oils, alkaloids, amino acids, fatty acids, vitamins, and folic acid. The seed's endosperm is rich in galactomannan, a type of polysaccharide.

5. Hair Benefits:

- Prevents hair loss by deeply conditioning and moisturizing the scalp through lecithin content
- Revives damaged hair
- Controls dandruff
- Reduces scalp inflammation
- Adds shine and softness
- Delays premature greying

E. Cinnamon:-

1. Description:

Cinnamon is a spice derived from the inner bark of trees belonging to the genus *Cinnamomum*. It is widely used as a fragrant flavoring agent in various culinary dishes, including sweets, savory recipes, teas, and traditional foods. The distinct aroma and taste come from its essential oils, predominantly cinnamaldehyde, along with other components such as eugenol.

2. Plant Details:

- *Botanical Name:* Cinnamomumverum
- *Source:* Obtained from the dried inner bark of *Cinnamomumzeylanicum* (true cinnamon tree)
- *Family:* Lauraceae

Figure 7: Cinnamon

3. Scientific Classification:

- Kingdom: Plantae
- Division: Magnoliophyta
- Class: Magnoliopsida
- Order: Laurales
- Family: Lauraceae
- Genus: Cinnamomum
- Species: Cinnamomumverum

4. Chemical Constituents:

Cinnamon contains several resinous compounds such as cinnamaldehyde, cinnamate, and cinnamic acid, alongside various essential oils. The distinctive spicy aroma and flavor mainly come from cinnamaldehyde.

5. Benefits of Cinnamon for Hair:

- **Prevents Hair Loss and Baldness:**
  The polyphenols in cinnamon serve as natural antioxidants, while its antimicrobial traits help protect the scalp from infections that could cause hair loss.
- **Enhances Hair Growth and Density:**
  Topical use of cinnamon essential oil improves blood circulation by dilating scalp blood vessels due to cinnamaldehyde, which encourages hair growth and increases hair density.
- **Protects Hair and Extends Growth Phase:**
  Cinnamon's anti-inflammatory, antioxidant, and antifungal properties shield the scalp and hair from damage caused by free radicals, irritation, and dandruff.
- **Antifungal Action:**
  Its antifungal capabilities make cinnamon useful for managing scalp conditions such as seborrheic dermatitis and chronic dandruff.

F. Curry Leaves:-

Figure 8: Curry leaves

1. Description:

The curry tree, scientifically known as *Murrayakoenigii*, is a tropical to subtropical tree belonging to the Rutaceae family, which also includes plants like rue and citrus. Native to Asia, this tree is often called "sweet neem," although it is unrelated to the neem tree (*Azadirachtaindica*) from the Meliaceae family. The aromatic leaves, commonly referred to as curry leaves, are widely used in South Asian cooking for their distinctive flavor.

2. Plant Details:

- *Botanical Name:* Murrayakoenigii
- *Source:* Dried leaves of the curry tree
- *Family:* Rutaceae

3. Scientific Classification:

- Kingdom: Plantae (Plants)
- Subkingdom: Tracheobionta (Vascular plants)
- Superdivision: Spermatophyta (Seed plants)
- Division: Magnoliophyta (Flowering plants)
- Class: Magnoliopsida (Dicotyledons)
- Subclass: Rosidae
- Order: Sapindales
- Family: Rutaceae (Rue family)
- Genus: Murraya
- Species: Murrayakoenigii

4. Chemical Composition:

The plant contains numerous bioactive substances, including alkaloids, flavonoids, carbohydrates, and sterols. These compounds are extracted using solvents such as petroleum ether, ethyl acetate, chloroform, ethanol, and water, demonstrating a diverse chemical profile.

5. Hair Care Benefits:

- **Promotes Hair Growth:**
  Rich in proteins vital for hair development, curry leaves also provide beta-carotene and amino acids that help reduce hair fall, strengthen follicles, and stimulate new growth, making hair appear thicker and fuller.
- **Prevents Premature Greying:**
  Containing natural darkening agents, antioxidants, and vitamin B complex, curry leaves can restore the hair's original color and delay greying. Essential minerals like iodine, selenium, zinc, and iron further support this effect.
- **Enhances Scalp Health:**
  With antibacterial, antifungal, and cleansing properties, curry leaves help maintain scalp hygiene by removing dead skin cells, reducing dandruff, and soothing itchiness, while leaving hair nourished and soft.

G. Bhringraj:-

Figure 9: Bhrignraj

1. Description:

Ecliptaprostrata, commonly known as bhringraj, false daisy, or Guntakalagaraku, belongs to the sunflower family (Asteraceae). It is widely found across tropical and warm temperate regions globally, including countries like India, Nepal, China, Thailand, and Brazil. The plant has grayish, cylindrical roots and small white flowers approximately 6–8 mm in diameter.

2. Plant Details:

- *Botanical Name:* Ecliptaprostrata
- *Source:* Eclipta alba from the composite family
- *Family:* Asteraceae

3. Scientific Classification:

- Kingdom: Plantae
- Subkingdom: Viridiplantae
- Superdivision: Spermatophytina
- Division: Tracheophyta
- Class: Magnoliopsida
- Family: Asteraceae
- Genus: Eclipta
- Species: Eclipta alba

4. Chemical Composition:

Bhringraj contains a variety of active compounds, including coumestans, alkaloids, flavonoids, glycosides, polyacetylenes, and triterpenoids. Its leaves are rich in stigmasterol, a-terthienyl methanol, wedelolactone, and its glucoside derivatives.

5. Hair Care Benefits:

- **Prevents Hair Loss:**
  Bhringraj nourishes the scalp and hair, reducing hair fall while stimulating scalp cells to encourage growth.
- **Combats Dandruff:**
  Thanks to its antimicrobial properties, bhringraj helps control dandruff and scalp infections like lice by inhibiting microbial growth.
- **Treats Baldness and Delays Greying:**
  By supplying essential vitamins and antioxidants, bhringraj supports hair thickness, prevents dryness, and helps restore natural hair color. Using bhringraj powder mixed with yogurt is a traditional remedy to prevent baldness.

H. Coconut Oil:-

Figure 10: Coconut Oil

1. Description:

Coconut oil, also known as coconut butter, is extracted from the meat, milk, and wick of the coconut fruit (*Cocos nucifera*). It is a white solid at room temperature but melts into a clear liquid in warmer climates. It is widely used in cooking, cosmetics, and detergents, though high saturated fat content suggests moderated dietary use.

2. Plant Details:

- Botanical Name: *Cocos nucifera*
- Biological Source: Fruit of the coconut palm
- Family: Arecaceae

3. Scientific Classification:

- Kingdom: Plantae
- Phylum: Angiospermae
- Class: Monocotyledonae
- Family: Arecaceae

- Genus: Cocos
- Species: *nucifera*

4. Chemical Constituents:

Coconut oil primarily contains saturated fats, with only 6% monounsaturated and 2% polyunsaturated fatty acids. Partial hydrogenation can produce some trans fats.

5. Hair Benefits:

- Rich in lauric acid, an essential fatty acid for hair health
- Contains proteins and vitamins C, E, B1, B3, B5, and B6
- Slows hair loss
- Restores dry scalp and hair
- Helps eliminate dandruff

I. Orange Oil:-

Figure 11: Orange Oil

1. Description:

Orange oil, commonly known as Sweet Orange Essential Oil, is extracted from the fruit of *Citrus sinensis*. Bitter Orange Essential Oil comes from *Citrus aurantium*. The sweet orange is believed to be a hybrid between pummelo and mandarin, originating from the region between southwest China and the Himalayas.

2. Plant Details:

- Botanical Name: *Citrus aurantium*
- Biological Source: The peel (fresh or dried) of the orange fruit
- Family: Rutaceae

Formulation of Herbal Hair Oil:-

Formulation 1: Hot Maceration

Sr. No.	Ingredients	Quantity
1	Hibiscus Flower	8 flowers (fresh)
2	Hibiscus Leaf	8 leaves (fresh)
3	Onion Seed	5 gm
4	Fenugreek Seed	5 gm
5	Cinnamon	2.5 gm
6	Curry Leaves	2.5 gm
7	Coconut Oil	100 ml
8	Orange Oil	10 ml

Formulation 2: Cold Maceration

Sr. No.	Ingredients	Quantity
1	Hibiscus Flower	10 gm (dried)
2	Hibiscus Leaf	10 gm (dried)
3	Onion Seed	5 gm
4	Fenugreek Seed	5 gm
5	Cinnamon	2.5 gm
6	Curry Leaves	2.5 gm
7	Coconut Oil	100 ml
8	Orange Oil	20 ml

Formulation 3: Hot Maceration

Sr. No.	Ingredients	Quantity
1	Hibiscus Flower	8 flowers (fresh)
2	Hibiscus Leaf	8 leaves (fresh)
3	Onion Seed	5 gm
4	Fenugreek Seed	5 gm
5	Cinnamon	2.5 gm
6	Bhringraj Powder	2.5 gm
7	Coconut Oil	100 ml
8	Orange Oil	10 ml

Formulation 4: Cold Maceration

Sr. No.	Ingredients	Quantity
1	Hibiscus Flower	10 gm (dried)
2	Hibiscus Leaf	10 gm (dried)
3	Onion Seed	5 gm
4	Fenugreek Seed	5 gm
5	Cinnamon	2.5 gm
6	Bhringraj Powder	2.5 gm
7	Coconut Oil	100 ml
8	Orange Oil	20 ml

Evaluation of Formulated Herbal Hair Oil:-
The prepared herbal oils were evaluated for various physicochemical and organoleptic parameters, including acid value, saponification value, refractive index, viscosity, and skin irritation.
Evaluation Methods

- **Organoleptic Properties:** Color, odor, and any skin irritation were assessed manually.
- **Specific Gravity:** Measured using a pycnometer (specific gravity bottle).
- **Viscosity:** Determined using a Brookfield viscometer with spindle no. 63 at 100 rpm.
- **pH:** Measured using a pH meter.
- **Acid Value:**
  - 4 ml of oil was mixed with 10 ml ethanol and 10 ml ether.
  - Phenolphthalein was added as an indicator and titrated with 0.1M potassium hydroxide (KOH).
  - Calculation:
    Acid value=5.61×nw\text {Acid value} = \frac{5.61 \times n}{w}Acid value=w5.61×n
    where n = volume (ml) of 0.1M KOH used, and w = weight of oil (g).
- **Saponification Value:**
  - 2 g of oil was boiled under reflux with 25 ml of 0.5M alcoholic KOH for 30 minutes.
  - Titrated against 0.1N Hcl with phenolphthalein indicator.

- Blank titration performed simultaneously.
- Calculation:
  Saponification Value=28.05× (b−a) w\text {Saponification Value} = \frac{28.05 \times (b - a)}{w}Saponification Value=w28.05×(b−a)

  Where a = ml Hcl for sample, b = ml Hcl for blank, w = weight of oil (g).

- **Refractive Index:** Measured with a refractometer.
- **Sensitivity Test:** The oil was applied to the hand and exposed to sunlight for 5 minutes to check for any skin irritation.

Results:-

Sr. No.	Parameters	F1 (Hot Maceration + Curry Leaves)	F2 (Cold Maceration + Curry Leaves)	F3 (Hot Maceration + Bhringraj)	F4 (Cold Maceration + Bhringraj)
1		Yellowish Green	Blackish Green	Yellowish Green	Blackish Green
2		Citrus	Citrus	Citrus	Citrus
3	Specific Gravity	0.912	0.901	0.916	0.904
4	Viscosity (cp)	15.60	16.00	14.40	14.40
5	pH	5	6	6	5
6	Acid Value (ml)	1.4	4.8	2.3	4.3
7	Saponification Value	250 mg KOH/g	253 mg KOH/g	260 mg KOH/g	259 mg KOH/g
8	Refractive Index	0.4509	0.4532	0.4509	0.4532
9	Irritation Test	No irritation	No irritation	No irritation	No irritation

Table 3: Physicochemical tests result

Discussion:-

- Formulations 1 and 2 showed lower acid values, indicating a reduced rate of rancidity and better oil stability.
- A lower acid value means less free fatty acid content, which correlates with less degradation or oxidation.
- Saponification values reflect the average chain length of fatty acids; higher values suggest shorter fatty acid chains, typical of oils like coconut oil.
- Oils with higher saponification values are generally more suitable for soap making, due to their fatty acid profile.

Conclusion:-

All formulations were within acceptable limits for all evaluated parameters. Among them, **Formulation 1** (Hot Maceration with Curry Leaves) showed the lowest acid value and a good saponification value, indicating better oil stability and quality. Lower acid values reflect less chemical degradation, suggesting that this formulation would be more effective for hair growth and addressing other hair-related issues.

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