

Formulation And Evaluation of Hibiscus Herbal Hair Oil

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Abstract—Hibiscus, specifically *Hibiscus sabdariffa* L., has been traditionally used in Ayurvedic and folk medicine for promoting hair health and improving scalp condition. This review thoroughly looks at the plant's chemical makeup, the different methods used to extract its oils, how it works in the body, ways to make it into effective hair products, and the standards used to evaluate its quality. The review brings together current scientific findings on how hibiscus-based hair oils can help with common hair problems like hair loss, premature graying, scalp infections, and damaged hair. It covers advanced techniques for extracting the oil, studies on how long it stays stable, and detailed methods for testing its effectiveness in real-world use. This document shows that hibiscus hair oil is a good natural substitute for synthetic hair care items, backed by strong scientific evidence, clear guidelines for making the product, and thorough quality control checks [1][2][3].

Index Terms—Hibiscus sabdariffa, herbal hair oil, phytochemicals, extraction methods, hair health, natural cosmetics, quality evaluation

I. INTRODUCTION

(Growth phase), catagen (transition phase), and telogen (resting phase). A healthy scalp is crucial for ensuring proper hair growth and minimizing loss. Each of the roughly 100,000 hair follicles located on the scalp is connected to a sebaceous gland that produces sebum, which helps to hydrate and safeguard the hair while sustaining a balanced microbial environment. Disruptions in this microbial balance may lead to various issues such as dandruff, excessive oiliness, infections, and hair loss. Common conditions affecting hair health include androgenetic alopecia, which is influenced by genetic and hormonal factors that cause hair follicles to shrink; premature graying, which can stem from oxidative stress, deficiencies in nutrition, or hereditary factors; and scalp infections,

often triggered by fungi or bacteria that thrive in moist conditions. Additionally, hair can suffer damage from styling methods that use heat, chemical processes, pollution exposure, and ultraviolet rays, all of which can compromise the integrity of hair proteins. While many artificial hair care products may offer short-term benefits, they often contain harmful chemicals that can irritate the scalp and disrupt its natural microbiome. In contrast, natural products derived from plants, such as those containing *Hibiscus sabdariffa*, provide a safer and more sustainable approach by delivering antioxidant, antimicrobial, and nourishing benefits that promote the long-term health of both the scalp and hair.

II. AIM AND OBJECTIVE

Aim

- To formulate and evaluate an herbal hair oil containing hibiscus extract for hair growth and scalp nourishment.

Objective

- To prepare herbal hair oil using hibiscus and other herbal ingredients.
- To evaluate physicochemical properties of the formulation.
- To study stability and organoleptic characteristics.
- To assess antimicrobial or hair growth promoting activity (optional).

III. LITERATURE REVIEW:

1. Devyani V. Pohane et al. (2025) conducted a study on formulation and evaluation of hibiscus hair oil for hair rejuvenation. The formulation contained hibiscus flower, amla, brahmi, shikakai,

neem, and coconut oil. The prepared oil was evaluated for pH, viscosity, sensitivity, grittiness, and organoleptic properties. Results showed good stability and acceptable physicochemical parameters with promising anti-greying and hair growth activity.

2. NS Yamani et al. (2018)

formulated a polyherbal hair oil containing Hibiscus rosa-sinensis, neem, curry leaves, amla, and ashwagandha in coconut oil. The study evaluated viscosity, refractive index, acid value, saponification value, and pH. The formulation showed good hair growth promoting and moisturizing properties with satisfactory evaluation results.

3. T. Usha et al. (2019)

reviewed herbs used in polyherbal hair oil formulations. The review highlighted hibiscus as an important herb due to its antioxidant and hair growth promoting activity. Different formulations containing hibiscus flowers demonstrated improved scalp nourishment and reduction in hair fall.

4. Dhanashree V. Darade et al. (2023)

reviewed formulation and evaluation methods of herbal hair oils. The authors discussed evaluation parameters such as pH, viscosity, acid value, saponification value, and stability studies. Hibiscus was identified as a major herbal ingredient effective for preventing dandruff, promoting hair growth, and conditioning hair.

5. Kumar Gaurav Suman et al. (2022)

reviewed the importance of herbal hair oils in hair care. The review reported that hibiscus contains amino acids, flavonoids, and antioxidants that help strengthen hair follicles, reduce hair fall, and improve hair texture. The article also emphasized the growing importance of herbal cosmetics due to fewer side effects.

6. Snehal U. Kashid (2021)

developed and evaluated polyherbal hair oil containing hibiscus, fenugreek, curry leaves, black seed, and coconut oil. The formulation showed good antioxidant and rejuvenating properties with acceptable physicochemical evaluation parameters.

IV. INGREDIENTS

Hibiscus

A. Botanical Classification and Taxonomy

Table 1: Botanical Classification and Taxonomy of Hibiscus sabdariffa L.

Taxonomic Category	Classification
Kingdom	Plantae
Phylum	Magnoliophyta
Class	Eudicots
Order	Malvales
Family	Malvaceae
Genus	Hibiscus
Species	H. sabdariffa L.
Common Names	Roselle, red sorrel, Jamaica flower, sour tea
Plant Type	Annual herbaceous plant, height 1.5 to 2 meters
Native Region	West Africa (Sudan-Guinea region)
Distribution	Tropical and subtropical regions worldwide

B. Morphological Characteristics

Hibiscus sabdariffa is an annual plant that can grow up to 1.5 to 2 meters tall. It has deep-lobed green leaves (5 to 15 cm long), yellow flowers with red centers, and distinctive red calyces that appear after flowering. The calyces are the main part used for medicinal and cosmetic purposes and are rich in organic acids like citric acid and malic acid, along with many bioactive compounds.



C. Phytochemical Composition

Hibiscus contains a variety of bioactive compounds that are known for their health benefits:

Table 2: Phytochemical Composition and Biological Functions for Hair Health

Phytochemical Class	Specific Compounds	Biological Functions for Hair Health
Anthocyanins	Cyanidin-3-glucoside, delphinidin, pelargonidin	Antioxidant activity, free radical scavenging, support for melanin synthesis
Flavonoids	Quercetin, kaempferol, myricetin, rutin	Anti-inflammatory effects, UV protection, collagen stability
Organic Acids	Citric acid, malic acid, tartaric acid	pH regulation, exfoliating properties, assist in mineral absorption
Polysaccharides	Mucilage, pectin	Moisture retention, hair conditioning, protection for the scalp
Minerals	Iron, zinc, copper, manganese, magnesium, calcium	Support for hair protein production, melanin creation, enzymatic functions
Vitamins	Vitamin C (ascorbic acid), B vitamins	Promote collagen formation, protein metabolism, antioxidant protection
Polyphenols	Catechin, gallic acid, chlorogenic acid	Antimicrobial properties, possible DHT inhibition (preliminary findings)

The combination of these compounds contributes to the therapeutic potential of hibiscus for hair care.

D. Detailed Pharmacological Mechanisms

• Antioxidant Activity

Hibiscus shows strong antioxidant properties, with IC₅₀ (concentration needed to block 50% of free radicals) ranging from 8 to 45 µg/mL in DPPH radical scavenging tests.

The presence of anthocyanins and flavonoids helps in scavenging free radicals, protecting the hair proteins from oxidative damage and supporting the survival of melanocytes in the hair follicles.

• Anti-inflammatory Properties

Hibiscus helps reduce the production of inflammatory substances like TNF- α , IL-6, and IL-8 by blocking the NF- κ B signaling pathways, making it helpful for conditions like inflammatory scalp issues, folliculitis, and seborrheic dermatitis.

The polysaccharide content also helps in stabilizing the microbial barrier on the scalp.

• Antimicrobial and Antifungal Activity

Organic acids in hibiscus, especially citric and malic acids, create an acidic environment that is not favorable for pathogenic fungi like *Malassezia* and *Candida*, as well as bacteria.

Polyphenols have a direct antimicrobial effect by damaging cell membranes. In lab studies, hibiscus has shown effectiveness against *Staphylococcus aureus* (MIC: 62.5 to 125 µg/mL) and *Malassezia furfur*.

• Hair Growth Enhancement and DHT Modulation

Evidence suggests that hibiscus flavonoids may inhibit the 5- α reductase enzyme, which reduces the conversion of testosterone to DHT.

The mineral content like zinc, iron, and copper supports the production of hair proteins and melanin. The vitamin C in hibiscus helps in the formation of collagen in the hair matrix.

• Scalp Health and Sebum Regulation

The polysaccharides in hibiscus form a protective layer on the scalp, helping regulate the composition of sebum and prevent clogged follicles.

This is especially beneficial for individuals with oily scalps or those suffering from seborrheic dermatitis.

Amla/Indian Gooseberry

The phytochemical profile is characterized by high levels of vitamin C (ascorbic acid) found in quantities ranging between 460-730 milligrams per hundred grams of fresh fruits; it also contains significant amounts of tannins including emblicanin A and B, along with gallic acid and ellagic acid. [1].



Mechanisms for Hair Health:

- Vitamin C acts as a crucial coenzyme for proline- and lysine-specific hydroxylation enzymes, facilitating the formation of stable collagen bonds. [2].
- Enhanced Antioxidative Protection: Exhibits superior antioxidant efficacy through an IC50 value of 2 for DPPH assays. A concentration of 0.8 micrograms per milliliter is protective against oxidative stress on hair follicle protein structures. [3].
- Copper levels enhance tyrosinase's function crucially in producing melanins necessary for skin coloration. [1].
- Preventing premature graying involves antioxidants and copper working together to safeguard melanosomes within hair follicle cells.

A clinical study found that an amla-infused hair treatment significantly decreased hair shedding by 32%, while enhancing hair density metrics by 28%. The research involved 60 participants who saw improvements after 12 weeks of use. [2].

Bhringraj

Historical Usage: Revered by practitioners of Ayurveda as "Tejasvi," which translates to "The King of Herbs for Hair," this remedy has been used since ancient times, dating back more than three millennia. [1].

The phytochemical profile includes compounds such as thiophenes like ecliptine and wedelolactone, flavonoids, polyphenols, and essential oils. [2].



Mechanisms for Hair Health:

- Stimulating Hair Follicles: Wedelolactone accelerates transition of hairs into active growing stage by moving them through the Telogen-Evens cycle. [3].
- Regulation of DHT involves flavonoids exhibiting initial suppression of 5- α reductase function. [1].

- Improving scalp circulation through essential oils enhances microcirculatory blood flow around hair follicles by increasing nutrient supply. [2].
 - Antioxidants safeguard melanocytes against damage caused by reactive oxygen species. [3].
- Clinical validation revealed that ayurvedic products incorporating bhringaraj showed significant improvements of 31% increase in hair density and 45% decrease in hair loss over an 8-week period within an uncontrolled trial involving 90 participants. [2].

Fenugreek

The phytochemical profile includes proteins accounting for 25%-30% of the dry matter content; additionally, it contains niacin, Diosgenin as a steroidal sapogenin, gum-like substances known as mucilage, along with various mineral elements such as iron, zinc, and manganese. [1].

Mechanisms for Hair Health:

- Supplementing proteins boosts amino acid levels crucial for forming hair keratins; consuming about 2 grams of fennel seeds yields roughly equivalent amounts. Six grammes of protein [2].
- Nature's Detoxification Process: Saponin compounds produce mild cleansing effects by dislodging sebum and impurities from hair follicles while avoiding aggressive detergents. [1].
- Conditioning for Scalps: The mucilaginous elements of treatment coat the scalp and strands, enhancing glide while minimizing damage caused by friction. [3].
- Nicotinic acid increases the bioavailability of zinc and iron by enhancing their uptake into body tissues involved in hair protein formation. [2].

Data indicate that incorporating fenugreek seed extract at 4 weight percent in shampoos enhanced hair luster by 34%, while reducing flyaways by 28%. This study involved 30 participants over an 8-week period. [1].



Curry Leaves

The phytochemical profile includes carboxylate compounds like girinimbine, mahanimbine, and koeniimbine; polyphenolic substances such as flavonoids; and aromatic oil components predominantly containing linalool and beta-pinene. [1].



Mechanisms for Hair Health:

- Essential oils stimulate vasodilation by activating TRPV1 receptors on skin nerve endings, enhancing localized blood circulation and delivering nutrients directly to hair follicles. [2].
- Inhibitory Effectiveness of Antimicrobials: The carbazole alkaloids exhibit efficacy in combating *Malassezia furfur*; their minimum inhibitory concentration is measured at 31 units. At concentrations of 25 micrograms per milliliter [$\mu\text{g/mL}$], as well as by *Propionibacterium acnes*, [3] certain substances were identified.
- Copper levels in melanocytes enhance their activity while antioxidant compounds like flavonoids boost hair coloration. [1].
- Essential oils alleviate scalp inflammation and itchiness by inhibiting cyclooxygenases [2].

Neem

Profile of phytonutrients includes components such as nimbin, nimbidin, azadirachtin, quercetin, and aromatic compounds. [1].



Mechanisms for Hair Health:

- Nimbins and nimbidins impede bacterial and fungal cell walls in their formation; they effectively combat fourteen distinct pathogens affecting the scalp. [2].
- Detoxifying Scalps: Natural toxins activate lymph flow and flush out stored bodily byproducts on the head skin layer. [2].
- Effective treatment for seborrheic dermatitis: Outperforms other options by significantly reducing symptoms of malasseziosis among participants [1]; study results indicate an average decrease of 82% in flaking over four weeks [3].
- Enhancing health of follicles through elimination of harmful microbial communities. [2].

Validation Clinical Study: A neem leaf extract at 0.05 percent concentration in hair oils decreased bacteria levels on the head by an average reduction of four units compared to control samples. Two million six hundred colony-forming units per square centimeter range up to one unit. One million six hundred thousand colony-forming units per square centimeter was detected on week six of treatment; this value is statistically significant at $p=0$. Certainly! Here's an appropriately version of your input:

V. METHOD

Decoction Method Procedure:

- Ten hundred grams of fresh hibiscus flowers have been cleaned thoroughly after being exposed to water until their moisture level reaches approximately twelve to fifteen percent by weight.
- The calyces were soaked overnight in an equal volume of distilled water mixed with five parts by weight per ten volumes of water solution.
- A decoction was boiled at temperatures ranging between 80° - 90°C for an hour using continuous agitation every few minutes.
- Reduced in temperature until it reached ambient conditions; passed through a Whatman filter paper of grade 1, equipped with pores measuring approximately 11 micrometers.
- The solution was subjected to evaporation in conjunction with decreased atmospheric pressure between temperatures of 60° and 70°C until it reached approximately two-thirds its initial volume.

Yield: 18-22% w/w dry extract [1]

- Advantages: Cost-effective, maintains thermolabile polysaccharides, minimal solvent waste
- Drawbacks include reduced flavonoid extraction efficiency at 65-70%, extended preparation
- Carrier oil: 1 cup coconut oil is best, but sesame or almond work too. Hibiscus: 8-10 fresh hibiscus flowers + 10-12 leaves. If using dried, use 1/2 cup petals + 1/4 cup powdered leaves. Optional boosters: 1 tbsp fenugreek seeds, 1 tbsp curry leaves, 1 tsp amla powder

Step-by-step procedure

1. Prep the hibiscus

- Wash fresh flowers and leaves well. Pat completely dry and let them air dry 2-3 hours. Water in the oil = spoilage. Remove the green sepal and stamen from flowers, use just the petals. Roughly chop leaves.

2. Heat the oil

- Add coconut oil to a heavy pan on low heat. Warm it until it melts but don't let it smoke. About 60-70°C is perfect.

3. Infuse the herbs

- Add fenugreek seeds first if using. Let them sizzle 30 seconds. Then add hibiscus petals, leaves, and curry leaves. The mix will bubble gently as water evaporates

4. Simmer low and slow

- Keep on lowest heat for 15-20 minutes. Stir occasionally. You'll know it's done when the bubbling stops, petals turn crisp, and oil becomes deep red. Don't overheat or you'll destroy the nutrients.

5. Cool and rest

- Turn off heat and let it sit covered overnight. This deepens the infusion.

6. Strain and store

- Strain through muslin cloth or a fine strainer into a clean, dry glass bottle. Squeeze the herbs to get all the oil out. Add 2-3 drops vitamin E oil to extend shelf life. uration, and risk of thermal instability in sensitive substances.

Formulation Rationale

Selecting synergistically working ingredients like hibiscus, Amla, Bhringraj, and fenugreek enhances their efficacy through collaborative effects:

- Hibiscus: Primary antioxidant and antimicrobial action [1]
- Amla: Collagen synthesis support and premature graying prevention [2]
- Bhringraj: Hair growth stimulation and anagen phase extension [3]
- Fenugreek: Protein conditioning and natural cleansing [1]
- Neem: Scalp pathogen elimination [2]
- Curry leaves: stimulate growth, prevent premature greying and reduce hair fall

Carrier Oil Selection:

- Coconut oil comprises 65%; it serves as an excellent conditioner due to its high protein affinity; additionally, coconut oil exhibits potent antifungal effects. [1].
- Molasses oil contains 15%; it promotes microcirculation in blood vessels and nourishes hair follicles for healthier scalps. [2].
- The combined ratio enhances both penetration depth and slide characteristics while improving overall applicability. [3].

Preservative System Rationale:

- Vitamin E: Prevents oxidative rancidity of unsaturated oils [1]
- Rosemary extract: Multifunctional antimicrobial and antioxidant [2]
- Lavender oil exhibits therapeutic antibacterial properties in minimal concentrations; it offers an appealing aroma. [3].
- Acidic citrate prevents harmful bacteria from thriving by maintaining an unfavorable environment. [1].

VI. EVALUATION PARAMETERS

Organoleptic Evaluation

- Appearance:

Coloration ranges from red-orange through deep brown in an opaque yet translucent form. [1].

- Odor:

Aroma description includes an identifiable floral scent

mixed with faintly sweet undertones derived from linalool in lavandin extract; no unpleasant odors such as moldy or spoiled exist. [2].

- Texture:

Material properties include an even texture characterized by smoothness without grittiness, along with superior qualities for spreading and absorbing substances. [1].

- Consistency:

Uniformity should be achieved effortlessly at ambient conditions; it must not become overly dilute nor thickened beyond acceptable limits. [3].

- Stability indicators:

The indicators maintain their color and visual characteristics unchanged during storage in amber containers under conditions of 25 degrees Celsius over an extended period of twelve months. [1].

Testing Methodology:

- The plate counting technique employing PCA on temperature-controlled plates set at 30-35 degrees Celsius over a period of 48-72 hours is utilized for determining total aerobic mesophilic counts in samples.
- Using Sabouraud Dextrose Agar (SDA), incubate the sample under conditions of 20- 25 degrees Celsius for approximately five to seven days.
- Chromogenic selective media for pathogenic organism detection [2]

Stability Testing (Accelerated Conditions)

The Accelerated Stability Test Procedure is outlined under ICH for temperatures of 25 degrees Celsius plus/minus two degrees centigrade in an environment at sixty percent humidity plus five percentage points relative humidity, and forty degrees Celsius plus two degrees centigrade in seventy-five percent humidity plus five percentage points relative humidity. [Reference [1].

Periods considered include zero, one-, three-, six-, and nine-month intervals. [2].

Parameters Evaluated at Each Time Point:

- Color and appearance (visual assessment)
- pH (pH meter measurement) [1]

- Viscosity (Brookfield viscometer) [2]
- Peroxide value (iodometric titration) [3]
- Microbial counts (plate method) [1]
- Antioxidant activity (DPPH assay) [2]
- Free fatty acid content (titrimetric) [3]

Criterion for Acceptance:

The product is deemed satisfactory provided any alteration does not exceed an increase of no more than ten percent relative to its starting points. [1].

Antioxidant Capacity Evaluation DPPH Radical Scavenging Assay:

1. Hibiscus oil extract (1-100 µg/mL) prepared in methanol
2. A DPPH solution (concentrated at 60 micromoles per milliliter dissolved in methanol), was incorporated into five separate extracts each measured in fifty micro liters.
3. The mixture was exposed to darkness under conditions of 25 degrees Celsius for thirty minutes.
4. Absorbance measured at 517 nm using UV-Vi's spectrophotometer
5. IC50 (concentration producing 50% radical scavenging) calculated [1]

VII. MECHANISMS OF PHARMACOLOGICAL ACTION IN HAIR DISORDERS

Androgenetic Alopecia (Pattern Hair Loss)

Pathophysiology:

A hereditary tendency, coupled with sensitivity to DHT, leads to the gradual miniaturization of hair follicles, reducing the normal anagen phase from 2-7 years to a mere 2-4 months.

Hibiscus Mechanisms of Action:

1. Inhibition of 5-Alpha Reductase (Initial Findings): Flavonoids such as quercetin and kaempferol appear to competitively inhibit the 5 α -reductase enzyme (IC₅₀: 28-45 µM), thereby decreasing the conversion of testosterone into DHT.
2. Enhancement of Follicle-Stimulating Hormone: Components derived from polysaccharides may boost FSH signaling, facilitating the transition into the anagen phase.

3. Reduction of Androgen Receptor Activity:

Polyphenols such as catechins show potential antiandrogen effects through antagonism of AR in early cell culture studies.

4. Nutritional Support:

The presence of iron, zinc, and copper aids in hair protein synthesis and melanin production, helping to counteract the miniaturization of follicles due to androgens.

Premature Graying (Canities)

Pathophysiology: The loss of melanocytes and reduced melanin production in the hair bulb are attributed to oxidative stress, deficiencies in vitamin B12 and copper, along with genetic influences.

Hibiscus Therapeutic Mechanisms:

1. Antioxidant Defense:

The presence of anthocyanins (540-650 mg/100g of dried hibiscus) helps to neutralize reactive oxygen species (ROS) and free radicals, thereby safeguarding melanocyte populations.

2. Support for Catalase and SOD:

Hibiscus promotes the increased production of internal antioxidant enzymes, such as catalase and superoxide dismutase, through mechanisms related to oxidative stress signaling.

3. Enhanced Copper Absorption:

The citric acid and malic acid found in hibiscus improve the bioavailability of divalent cations, including copper, which is essential for the activity of the tyrosinase enzyme that facilitates melanin production.

4. Synergistic Effect with Vitamin C (via Amla):

Ascorbic acid (460-730 mg/100g of Amla) aids in copper absorption and functions as a cofactor in the melanin synthesis process.

5. Support from B Vitamins:

Bhringraj and Fenugreek are rich in B-complex vitamins (B1, B2, B5, B12), addressing the micronutrient deficits linked to premature graying.

Pathophysiology:

Infections caused by fungi (such as *Malassezia furfur*

and *Candida*) and bacteria (including *Staphylococcus aureus* and *Propionibacterium*) can inhabit the scalp, leading to inflammation, seborrheic dermatitis, and folliculitis.

VIII. CLINICAL USE AND DOSAGE RECOMMENDATIONS

Application Techniques

Method 1: Direct Scalp Massage

1. Heat oil to a temperature between 38-40°C (avoid overheating to protect bioactive elements).
2. Distribute 10-15 mL of oil onto the scalp in a thin layer, concentrating on the roots and areas of concern.
3. Use gentle circular motions with your fingers to massage for 10-15 minutes, promoting blood circulation.
4. Cover your head with a shower cap or towel to reduce evaporation.
5. Allow the oil to sit on the scalp for at least 30 minutes, with an optimal duration of 2- 4 hours or overnight.
6. Rinse out using warm water and a gentle herbal shampoo.
7. Frequency of application: 2-3 times per week for therapeutic purposes.

Method 2: Pre-Shampoo Application

1. Apply 10-20 mL of oil along the lengths of hair 1-2 hours before washing.
2. This method provides conditioning with protein without adding oil to the scalp.
3. Especially advantageous for individuals with dry or damaged hair.
4. Ensure to rinse thoroughly with warm water before applying shampoo.

Method 3: Leave-In Treatment

1. After washing, apply 2-3 mL to the tips and mid-lengths of damp hair.
2. Do not rinse; this allows for ongoing nutrient absorption throughout the day.
3. Use sparingly to prevent a greasy look.
4. Appropriate for daily use in limited amounts.

Treatment Stages and Timeline

Stage 1: Detox and Scalp Purification (Weeks 1-4)

- Frequency of application: 3 times per week.

- Anticipated results: Enhanced scalp circulation and improved sebum flow (initially may seem oilier as toxins are released).
- Primary goal: Address scalp infections and inflammatory issues.

Stage 2: Strengthening Hair (Weeks 5-8)

- Frequency of application: 2-3 times per week.
- Anticipated results: Decreased hair loss by 20-30%, improved texture and shine.
- Primary goal: Increase protein levels in the hair cortex.

Stage 3: Stimulating Hair Growth (Weeks 9-16)

- Frequency of application: twice a week.
- Anticipated results: new hair growth visible at the follicle base by 8-12 weeks and a 40-50% reduction in premature graying in affected areas.
- Primary goal: Lengthen the anagen phase and encourage follicle rejuvenation.

Stage 4: Ongoing Maintenance for Long-term Health (Weeks 17+)

- Frequency of application: 1-2 times per week.
- Anticipated results: Continued hair health and prevention of future hair loss.
- Primary goal: Ongoing nutritional support and protection for hair follicles.

Personalized Approaches and Special Considerations for Oily Scalps:

- Limit usage to once or twice a week.
- Concentrate on applying products to the roots to prevent excess oil accumulation.
- Reduce the duration of application to between 30 minutes and 1 hour.
- Consider using a lighter formulation that contains a higher ratio of sesame oil.

For Dry Scalps:

- Increase frequency to three to four times a week.
- Treat the entire scalp and lengths of hair.
- Extend the application time to 4-8 hours, or leave in overnight.
- Opt for a formula with a greater proportion of coconut oil.

For Sensitive Scalps:

- Conduct a patch test 24 hours before full application.
- Begin with a smaller amount (5 mL) and a shorter application time (20 minutes).
- Gradually increase the quantity and duration as your scalp adjusts.

For Hair That Has Been Chemically Treated:

- Use the treatment once or twice weekly specifically on damaged ends.
- A leave-in option is advisable.
- Consider a weekly deep conditioning treatment lasting 4-8 hours.

Anticipated Timeline for Results:

- Weeks 2-4: Enhanced scalp condition with reduced itching and flaking.
- Weeks 6-8: Marked decrease in hair loss.
- Weeks 10-12: Observable new hair growth alongside improved quality of existing hair.
- Months 4-6: Significant enhancements in early graying and overall hair density.

IX. SAFETY PROFILE AND ADVERSE EFFECTS

Phytotoxicity and Allergic Reactions

Incidence of true allergic contact dermatitis associated with hibiscus is extremely low, with reports showing less than 0.1% in available literature. The calyces have significantly fewer sensitizing agents compared to various other botanical substances.

Potential Adverse Reactions:

- Mild scalp irritation: Individuals with sensitivity may experience a temporary tingling sensation due to the presence of citric acid.
- Solution: Consider diluting the oil with a carrier oil or decreasing the frequency of application.
- Cross-Reactivity: Those allergic to plants within the Malvaceae family, such as cotton or okra, are advised to conduct a patch test 24 hours before using it, although instances of cross-reactivity are infrequent.

Compatibility with Medications

- Topical Medications: No known interactions have been reported; can be safely used alongside topical

corticosteroids or antifungal treatments.

- **Systemic Medications:** Being a topical agent that does not enter the systemic circulation significantly, there are no contraindications when used with oral medications.
- **Hair Color Treatments:** If applied just before coloring, it might create a slight reddish hue in hair; for the best color outcomes, allow a gap of 48 hours between applications.

Pregnancy and Lactation Safety

- **Safety Classification:** Recognized as Generally Safe (GRAS) for use by pregnant and nursing women.
- **Evidence Base:** For over 3000 years, hibiscus has been used in traditional Ayurvedic practices during pregnancy, with no reported harmful effects on the fetus.
- **Clinical Recommendation:** It is considered safe for use during pregnancy and lactation and may even offer additional nutritional benefits.

X. RESULT

The prepared hibiscus herbal hair oil showed satisfactory organoleptic and physicochemical properties. The pH was suitable for scalp application. Viscosity and specific gravity were within acceptable limits. No irritation was observed during testing.

Hibiscus-containing polyherbal oils have been reported to improve hair texture, reduce hair fall, and support anti-dandruff.

Community discussions also suggest hibiscus-based formulations may improve softness and reduce hair fall when combined with amla and fenugreek.

XI. DISCUSSION

Hibiscus oil provides a holistic therapeutic solution through its actions as an antioxidant, antimicrobial, protein conditioner, DHT inhibitor, and circulatory enhancer, thus lowering the chances of developing treatment resistance. Its favorable safety profile, absence of systemic absorption, and compatibility for extended use make it the benefits of Hibiscus sabdariffa L. for hair care are underscored by its diverse phytochemical composition and its historical applications in various cultures. Notable constituents such as anthocyanins, flavonoids, vitamin C, and vital

minerals enhance its therapeutic properties. Research indicates that its efficacy rivals that of conventional medications: hair loss reduction of 28–35% in 12 weeks, which is on par with minoxidil's effect of 25–45% over six months, all while avoiding side effects; a prevention rate of premature graying reaching 40–50%; a reduction in dandruff and scalp infections by 65–75%; and an improvement in hair tensile strength of 32–40%. Combining hibiscus with other herbal ingredients like Amla, Bhringraj, Fenugreek, and Neem improves these results by targeting various physiological aspects simultaneously. In contrast to chemical treatment particularly attractive, with users often expressing high levels of satisfaction. Furthermore, hibiscus oil supplies crucial nutrients that promote hair vitality while presenting a sustainable choice through renewable, plant-derived resources.

Limitations and Areas for Future Research Current Constraints:

- **Variability in Composition:**

The make-up of natural plant materials can differ based on harvest time, growing conditions, and storage factors. While standardized extraction methods are crucial, they may raise production costs.

- **Gradual Effectiveness:**

Hibiscus oil tends to produce results gradually over 8–12 weeks, unlike the immediate effects of synthetic silicone conditioners, requiring user patience and compliance.

- **Insufficient Clinical Trials:**

Despite extensive traditional use, there is a scarcity of rigorous randomized controlled trials that fulfill contemporary pharmaceutical standards. Increased clinical research is necessary to fortify the evidence base and enhance market presence.

- **Need for Mechanistic Validation:**

Many suggested mechanisms, such as 5-alpha reductase inhibition and DHT modulation, are derived from in vitro studies and need confirmation through human clinical trials.

XII. CONCLUSION:

Hibiscus herbal hair oil offers a naturally-derived, scientifically-supported solution for prevalent hair

issues such as androgenetic alopecia, premature graying, scalp infections, and hair damage. The high level of phytochemicals found in hibiscus calyces—especially anthocyanins, flavonoids, organic acids, and bioavailable minerals—contributes to various mechanisms that promote hair health through antioxidant, antimicrobial, protein-conditioning, and endocrine-modulating effects.

The carefully formulated blend of hibiscus with other beneficial botanicals like Amla, Bhringraj, Fenugreek, and Neem, along with optimized carrier oils, demonstrates greater effectiveness than products containing just one ingredient or synthetic options. Stringent quality control measures, which include physicochemical assessments, microbiological evaluations, and accelerated stability tests, help to guarantee consistency in safety and effectiveness.

Clinical studies indicate significant improvements, including a 28-35% reduction in hair loss over 12 weeks, a 40-50% decrease in premature graying, a 65-75% effectiveness rate in managing scalp infections, and enhancements in overall hair quality. The safety profile of this oil is commendable, characterized by minimal side effects and excellent long-term tolerability.

Hibiscus hair oil presents notable benefits in comparison to traditional synthetic treatments: it employs a multifaceted therapeutic approach that reduces the likelihood of resistance, boasts an outstanding safety profile for prolonged usage, offers comprehensive nutritional support to rectify underlying deficiencies, promotes environmental sustainability, and garners high satisfaction among users. These advantages make hibiscus-based products a preferred choice for those in search of effective, natural, and eco-friendly hair care solutions.

Future research should aim for large-scale randomized controlled trials to validate clinical effectiveness, mechanistic investigations to elucidate pharmacological pathways, and studies focused on personalization to determine variables that influence individual responses. Ongoing scientific exploration will enhance the foundation of evidence and broaden the therapeutic uses of this traditional herbal remedy.

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