

Formulation and Evaluation of Herbal Shampoo using Lemongrass Oil

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Abstract—This project focuses on the formulation and comprehensive evaluation of an herbal shampoo incorporating lemongrass oil. The increasing consumer demand for natural and safe personal care products has driven the shift from synthetic to herbal alternatives.

This report details the development of a herbal shampoo using key ingredients such as Sodium Laureth Sulfate (SLES), Cocamidopropyl Betaine (CAPB), Glycerin, Aloe Vera gel, Guar gum, Citric acid, Sodium benzoate, and EDTA, with lemongrass oil as the primary active herbal component. The formulation aims to provide effective cleansing, conditioning, and therapeutic benefits while minimizing potential adverse effects associated with synthetic chemicals. The study encompasses a detailed literature review on herbal shampoos and their ingredients, followed by the methodology for preparation.

A series of evaluation parameters, including organoleptic properties, pH, foaming ability, viscosity, detergency, and stability, will be employed to assess the quality and performance of the formulated shampoo. The results and observations will highlight the efficacy and safety profile of the developed herbal shampoo, contributing to the growing body of knowledge on natural cosmetic formulations. This project also includes a comprehensive drug profile for each ingredient, images of the raw materials, and a detailed reference section.

Key Findings in Literature—Antifungal and Antidandruff Activity: Studies confirm that the high citral content in lemongrass oil provides strong, inhibitory effects against dandruff-causing fungi, often showing stability in formulations over several weeks.

Optimal Formulation: Research into commercialization suggests that formulations combining surfactants with 2% lemongrass oil are stable, with good foaming capacity.

Active Compounds: The efficacy is largely due to phytochemicals like citral, geraniol, and citronellal, which offer anti-inflammatory and antiseptic properties for the scalp. **Synergy:** When combined with other natural oils, such as kaffir lime, the efficacy against yeast

increases, sometimes with a synergistic action that lowers the necessary concentration.

Facing the proliferation of unnatural fragrance personal care products by their convenience and affordability. However, facing the immediate benefits is the insecurity of prolonged exposure to odors, the vast majority of which may exceed the allowable or unknown uses. Therefore, we research the production process of shampoos derived from natural essential oils. In this study, we use lemongrass oil originating from Tan Phu Dong commune, Tien Giang province to conduct steam distillation with optimum efficiency of 0.29%. The general formula for making a shampoo product is based on basic factors such as detergent, humectant, foaming agent, etc The product evaluation is based on the results of the assessment of foaming ability.

I. INTRODUCTION

Shampoos are essential personal care products designed for cleansing the hair and scalp. Traditionally, shampoos have been formulated with synthetic detergents and various chemical additives to achieve desired cleansing, foaming, and conditioning properties. However, growing consumer awareness regarding the potential adverse effects of synthetic chemicals, such as scalp irritation, hair damage, and environmental concerns, has led to a significant shift towards natural and herbal alternatives [1].

Herbal shampoos, formulated with plant-derived ingredients, offer a promising alternative due to their perceived safety, biodegradability, and therapeutic benefits. These products leverage the natural properties of herbs, essential oils, and plant extracts to cleanse, nourish, and protect hair without the harshness often associated with synthetic counterparts [2]. The integration of herbal components aims to provide a holistic approach to hair care, addressing

various hair and scalp conditions while promoting overall hair health.

Lemongrass oil (*Cymbopogon citratus*) is a well-known essential oil recognized for its aromatic, antimicrobial, and anti-inflammatory properties [3]. Its inclusion in shampoo formulations can contribute to a refreshing scent, scalp health, and potentially offer benefits such as dandruff control and hair strengthening.

This project focuses on developing a herbal shampoo that harnesses the beneficial properties of lemongrass oil, combined with a carefully selected blend of mild surfactants and conditioning agents, to create an effective and safe hair care product. In recent years, the demand for natural and herbal personal care products has significantly increased due to growing awareness about the side effects of synthetic chemicals.

Herbal shampoos have gained wide acceptance as they are perceived to be safer and environmentally friendly. Lemongrass oil, derived from the leaves of the lemongrass plant (*Cymbopogon citratus*), is well known for its antimicrobial, antifungal, and anti-inflammatory properties, making it an excellent ingredient in hair care formulations.

Shampoos are cleansing agents formulated to remove dirt, oil, and other impurities from the scalp and hair while maintaining the health and vitality of hair strands. The incorporation of herbal extracts and oils such as lemongrass oil enhances the therapeutic value of shampoos by promoting scalp health, reducing dandruff, and improving hair texture.

This project focuses on the formulation and evaluation of a herbal shampoo using lemongrass oil along with commonly used surfactants and natural additives such as Sodium Lauryl Ether Sulfate (SLES), Cocamidopropyl Betaine (CAPB), glycerin, aloe vera gel, guar gum, citric acid, sodium benzoate, and EDTA.

Lemon Grass Oil (*Cymbopogon citratus* (D.C.) Stapf.) is a prominent essential oil known for its distinctive citrusy aroma and a wide array of medicinal properties. It has been traditionally used in

aromatherapy, cosmetics, and traditional medicine due to its antimicrobial, anti-inflammatory, and antioxidant activities. In the context of shampoo formulations, lemongrass oil can contribute to scalp health by combating microbial growth, reducing inflammation, and providing a refreshing sensation. Its natural fragrance also enhances the sensory experience of the product, making it an attractive ingredient for herbal shampoos.

II. AIM AND OBJECTIVES

The primary aim of this project is to formulate and evaluate a herbal shampoo containing lemongrass oil, ensuring its efficacy, safety, and stability as a natural hair care product.

The specific objectives are:

- To conduct a comprehensive literature review on herbal shampoos, lemongrass oil, and the individual ingredients (SLES, CAPB, Glycerin, Aloe Vera gel, Guar gum, Citric acid, Sodium benzoate, EDTA) used in the formulation.
- To develop a suitable formulation for a herbal shampoo incorporating lemongrass oil, optimizing the concentrations of all ingredients for desired properties.
- To prepare the herbal shampoo according to established pharmaceutical procedures.
- To evaluate the formulated herbal shampoo using various physicochemical and performance parameters, including organoleptic properties, pH, foaming ability, viscosity, detergency, wetting time, and stability studies.
- To compare the characteristics of the formulated herbal shampoo with commercially available shampoos, if feasible.
- To document the entire process, findings, and conclusions in a detailed project report.
- To prepare a herbal shampoo formulation using surfactants SLES and CAPB, natural humectants like glycerin and aloe vera gel, and stabilizers such as guar gum.
- To incorporate lemongrass oil for its therapeutic properties in the shampoo.
- To evaluate the physical, chemical, and microbiological properties of the prepared shampoo.

III. LITERATURE REVIEW

The history of hair cleansing dates back centuries, with early civilizations utilizing natural substances like plant extracts, clays, and oils to maintain hair hygiene. The concept of shampoo as a dedicated hair care product emerged in the 19th century, evolving significantly with advancements in chemistry and cosmetic science.

Initially, soap-based formulations dominated the market, but their alkaline nature often led to hair damage and dullness. The mid-20th century witnessed the advent of synthetic detergents, which offered superior cleansing and foaming properties, leading to the widespread use of modern shampoos [4].

However, concerns regarding the harshness of synthetic chemicals, their environmental impact, and potential health risks have spurred a renewed interest in natural and herbal alternatives.

Consumers are increasingly seeking products free from sulfates, parabens, and artificial fragrances, opting for formulations derived from botanical sources [5]. This shift is driven by a desire for gentler, more sustainable, and therapeutically beneficial hair care solutions.

Herbal Shampoos: Herbal shampoos are formulations that primarily utilize plant-derived ingredients for their cleansing, conditioning, and medicinal properties. These ingredients can include extracts from various herbs, flowers, fruits, and essential oils.

The benefits of herbal shampoos often extend beyond mere cleansing, offering advantages such as improved scalp health, reduced hair fall, enhanced hair growth, and natural conditioning [6].

Common herbal ingredients found in traditional and modern formulations include Aloe Vera, Amla, Shikakai, Reetha, Hibiscus, Neem, and various essential oils.

Lemongrass Oil (*Cymbopogon citratus*): Lemongrass oil is an essential oil extracted from the leaves of the lemongrass plant. It is widely recognized for its distinctive citrusy aroma and a broad spectrum of

therapeutic properties, including antimicrobial, antifungal, anti-inflammatory, and antioxidant activities [7].

In the context of hair care, lemongrass oil is particularly valued for its potential to strengthen hair follicles, reduce dandruff, alleviate scalp irritation, and impart a natural fragrance to the shampoo. Studies have indicated its effectiveness against certain fungal strains responsible for dandruff, making it a valuable addition to herbal shampoo formulations aimed at scalp health [8].

Key Ingredients in Shampoo Formulations:

- **Surfactants:** These are the primary cleansing agents in shampoos, responsible for reducing surface tension, emulsifying oils, and creating foam. While synthetic surfactants like SLES are highly effective, milder alternatives and co-surfactants are often combined to reduce irritation and enhance performance. Cocamidopropyl Betaine (CAPB) is a common amphoteric co-surfactant known for its mildness and foam-boosting properties [9].
- **Conditioning Agents:** Ingredients like Glycerin and Aloe Vera gel provide moisturizing and conditioning benefits, helping to keep hair soft, smooth, and manageable. Glycerin acts as a humectant, attracting moisture to the hair, while Aloe Vera is known for its soothing and hydrating properties [10].
- **Thickening Agents:** Guar gum is a natural polysaccharide used to increase the viscosity of shampoo formulations, improving their texture and stability [11].
- **pH Adjusters:** Citric acid is commonly used to adjust the pH of shampoos to a slightly acidic range (typically 5.5-6.5), which is optimal for hair and scalp health, helping to close hair cuticles and prevent damage [12].
- **Preservatives:** Sodium benzoate is a widely used food and cosmetic preservative that prevents the growth of bacteria, yeasts, and molds, thereby extending the shelf life of the shampoo [13].
- **Chelating Agents:** EDTA (Ethylenediaminetetraacetic acid) is a chelating agent that binds to metal ions, preventing them from interfering with the stability and

performance of the shampoo, especially in hard water conditions [14].

The combination of these ingredients, particularly with the therapeutic benefits of lemongrass oil, aims to create a well-balanced herbal shampoo that is both effective and gentle.

The subsequent sections of this report will detail the specific formulation, preparation, and evaluation of such a product.

IV. DRUG PROFILE

4.1. Sodium Laureth Sulfate (SLES)

Chemical Name: Sodium 2-dodecoxyethyl sulfate

Description: Sodium Laureth Sulfate (SLES) is an anionic surfactant commonly used in many personal care products, including shampoos, soaps, and toothpastes.

It is derived from coconut oil and is known for its excellent foaming and cleansing properties. SLES is a clear to pale yellow viscous liquid [15].

Role in Formulation: In shampoo formulations, SLES acts as a primary surfactant, responsible for creating lather and effectively removing dirt, oil, and product buildup from the hair and scalp.

It is highly effective at solubilizing oils and fats, making it a powerful cleansing agent [16].

Image:



4.2. Cocamidopropyl Betaine (CAPB)

Chemical Name: {3-(Dodecanoylamino)propylammonio}acetate

Description: Cocamidopropyl Betaine (CAPB) is an amphoteric surfactant derived from coconut oil and dimethylaminopropylamine. It is a pale yellow, transparent liquid that is generally considered milder than primary anionic surfactants like SLES [17].

Role in Formulation: CAPB is primarily used as a co-surfactant in shampoos. It serves multiple functions: it boosts and stabilizes foam, acts as a mild cleansing agent, helps to thicken the formulation, and reduces the irritation potential of primary surfactants like SLES, making the shampoo gentler on the scalp and hair [18].

Image:



4.3. Glycerin

Chemical Name: Propane-1,2,3-triol

Description: Glycerin, also known as glycerol, is a simple polyol compound. It is a colorless, odorless, viscous liquid that is sweet-tasting and non-toxic. It is widely used in pharmaceutical and cosmetic formulations due to its humectant and emollient properties [19].

Role in Formulation: In shampoo, glycerin acts as a humectant, drawing moisture from the air into the hair and scalp, thereby preventing dryness and maintaining hydration. It also contributes to the smooth texture of

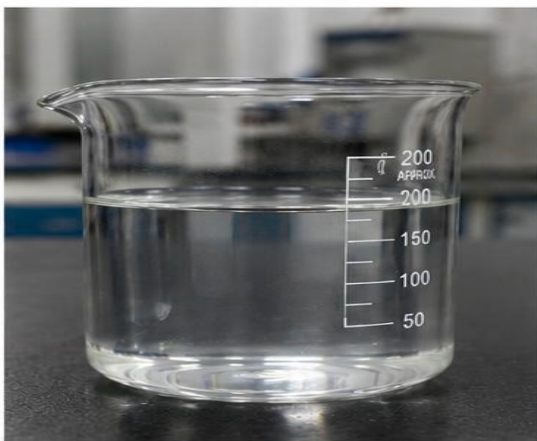
the shampoo and can enhance its conditioning effects, leaving hair soft and manageable [20].

Glycerin: A natural humectant that retains moisture and prevents dryness. The first man-made attempt to produce glycerin was in 1779 by K. W. Scheele, a Swedish chemist, when he was boiling a mixture of olive oil and another chemical containing lead.

The thick, transparent liquid Scheele separated from the oily mixture was called glycerol due to its sweet taste (“glykos” in Greek means sweet). Scheele’s method of preparation was used in the first commercial manufacturing of glycerin, which quickly found uses in many fields, including health care, cosmetics, and food.

Today, the glycerin used in commercial products is at least 95% pure. Many commercially manufactured glycerin products contain different amounts of glycerin and other impurities, including salt, water, and other organic compounds.

Image:



4.4. Aloe Vera Gel

Botanical Name: *Aloe barbadensis miller*

Description: Aloe Vera gel is a translucent, mucilaginous substance obtained from the leaves of the Aloe Vera plant. It is rich in vitamins, minerals, enzymes, amino acids, and polysaccharides, which contribute to its extensive use in cosmetics and traditional medicine [21].

Role in Formulation: In shampoo, Aloe Vera gel acts as a natural conditioning agent, providing moisturizing, soothing, and healing properties to the scalp and hair. It can help to reduce inflammation, promote hair growth, and improve hair shine and softness. Its emollient properties help to hydrate the hair shaft and prevent dryness [22].

Image:



4.5. Guar Gum

Chemical Name: **Galactomannan**

Description: Guar gum is a natural polysaccharide derived from the seeds of the guar plant (*Cyamopsis tetragonoloba*). It is typically a white to yellowish-white, free-flowing powder that forms a viscous solution when dispersed in water [23].

Role in Formulation: In shampoo formulations, guar gum primarily functions as a thickening agent and a conditioning agent. It increases the viscosity of the shampoo, providing a desirable texture and feel. Additionally, it can improve hair manageability, reduce static, and enhance the overall conditioning effect by forming a protective film on the hair shaft [24].

Image:



4.6. Citric Acid

Chemical Name: 2-hydroxypropane-1,2,3-tricarboxylic acid

Description: Citric acid is a weak organic acid naturally found in citrus fruits. It is a white, crystalline powder with a sour taste and is widely used as a natural preservative, acidulant, and chelating agent in food, pharmaceutical, and cosmetic industries [25].

Role in Formulation: In shampoo formulations, citric acid is primarily used as a pH adjuster. Maintaining the shampoo's pH within a slightly acidic range (typically 5.5-6.5) is crucial for hair health, as it helps to flatten the hair cuticle, making the hair smoother, shinier, and less prone to tangling and breakage. It also helps to optimize the performance of other ingredients and prevent scalp irritation [26].

Citric acid has sour in taste derived from *Aspergillus niger*.

Image:



4.7. Sodium Benzoate

Chemical Name: Sodium benzoate

Description: Sodium benzoate is a widely used food preservative with the chemical formula $C_7H_5NaO_2$. It is a white, odorless, crystalline powder that is soluble in water. It is effective against yeast, mold, and some bacteria, particularly in acidic conditions [27].

Role in Formulation: In shampoo formulations, sodium benzoate functions as a preservative, preventing the growth of microorganisms such as bacteria, yeasts, and molds. This is crucial for

maintaining the product's integrity, safety, and extending its shelf life, especially in formulations containing natural ingredients that can be prone to microbial contamination [28].

Image:



4.8. EDTA (Ethylenediaminetetraacetic acid)

Chemical Name: Ethylenediaminetetraacetic acid

Description: Ethylenediaminetetraacetic acid (EDTA) is a chelating agent, a molecule that binds to metal ions. It is a white, crystalline powder that is highly soluble in water. EDTA is commonly used in cosmetics, pharmaceuticals, and food products to improve stability and efficacy [29].

Role in Formulation: In shampoo formulations, EDTA acts as a chelating agent. It binds to metal ions (such as calcium and magnesium) present in hard water, preventing them from reacting with other ingredients (like surfactants) and forming insoluble precipitates (soap scum). This action enhances the foaming ability and cleansing efficiency of the shampoo, improves its stability, and prevents dullness or residue buildup on the hair [30]. Methods employed for preventing and eliminating biofilms are limited in their efficacy on mature biofilms.

Despite this a number of antibiofilm formulations and technologies incorporating ethylenediaminetetraacetic acid (EDTA) have demonstrated efficacy on in vitro biofilms. The aim of this article is to critically review EDTA, in particular tetrasodium EDTA (tEDTA), as a

potential antimicrobial and antibiofilm agent, in its own right, for use in skin and wound care. EDTA's synergism with other antimicrobials and surfactants will also be discussed.

Recent Advances: The use of EDTA as a potentiating and sensitizing agent is not a new concept. However, currently the application of EDTA, specifically tEDTA as a stand-alone antimicrobial and antibiofilm agent, and its synergistic combination with other antimicrobials to make a “multi-pronged” approach to biofilm control is being explored.

Image:



natural

4.9. Lemongrass Oil

Botanical Name: *Cymbopogon citratus*

Description: Lemongrass oil is an essential oil extracted from the leaves of the lemongrass plant, primarily through steam distillation. It has a fresh, lemony, grassy, earthy scent and is characterized by its high content of citral, which is responsible for many of its therapeutic properties. It is a pale yellow to yellowish-brown liquid [31].

Role in Formulation: In herbal shampoo, lemongrass oil serves multiple purposes. Its primary role is to impart a pleasant, refreshing fragrance. Therapeutically, it is valued for its antimicrobial, antifungal, and anti-inflammatory properties, which can help in managing scalp conditions like dandruff and itching. It is also believed to strengthen hair follicles, reduce hair loss, and add shine to the hair, contributing to overall scalp and hair health [32].

Lemongrass oil, extracted from *Cymbopogon* species, contains key bioactive components such as citral, limonene, and geraniol. These compounds exhibit antimicrobial, antifungal, and anti-inflammatory activities that help in controlling dandruff and scalp infections. Several studies have demonstrated that shampoos containing lemongrass oil reduce microbial load on the scalp and improve hair texture.

In recent years, the demand for natural and herbal personal care products has significantly increased due to growing awareness about the side effects of synthetic chemicals. Herbal shampoos have gained wide acceptance as they are perceived to be safer and environmentally friendly. Lemongrass oil, derived from the leaves of the lemongrass plant (*Cymbopogon citratus*), is well known for its antimicrobial, antifungal, and anti-inflammatory properties, making it an excellent ingredient in hair care formulations.

Lemongrass oil is generally recognized as safe when used topically in diluted forms. However, it may cause skin sensitization or allergic reactions in some individuals. Proper formulation and patch testing are necessary to ensure safety.

Image:



V. MATERIALS AND METHODS

5.1. Materials (For 50 ml)

The following materials will be used for the preparation of the herbal shampoo:

- Sodium Laureth Sulfate (SLES)-Primary Cleanser (6ml)
- Cocamidopropyl Betaine (CAPB)-Surfactant (3ml)
- Glycerin-Humectant (2ml)
- Aloe Vera Gel-Extract (4 ml)
- Guar Gum-Thickener (2ml)
- Citric Acid-ph adjust (5.5 ph)
- Sodium Benzoate-Preservative (1ml)
- EDTA (Ethylenediaminetetraacetic acid)-Chelating agent (0.05g)
- Lemongrass Oil- Herbal Extract (0.5ml)
- Distilled Water-q.s 50%
- pH Meter
- Viscometer
- Beakers, Stirring Rods, Measuring Cylinders, Funnels, etc.: Standard laboratory glassware and equipment.

5.2. Methods

The general methodology for the preparation and evaluation of the herbal shampoo will involve the following steps:

- 1 Procurement of Materials: All raw materials will be procured from reputable suppliers and checked for their quality and purity.
- 2 Formulation Design: A suitable formulation will be designed based on literature review and preliminary experiments, aiming for optimal cleansing, foaming, conditioning, and stability.
- 3 Preparation of Herbal Shampoo: The shampoo will be prepared by carefully mixing the ingredients in a sequential manner, ensuring proper dissolution and homogeneity.
- 4 Physicochemical Evaluation: The prepared shampoo will be subjected to various physicochemical tests to assess its quality attributes.
- 5 Performance Evaluation: Performance tests will be conducted to evaluate the functional properties of the shampoo.
- 6 Stability Studies: The shampoo will undergo stability studies to determine its shelf life and maintain its quality over time.
- 7 Documentation: All procedures, observations, and results will be meticulously documented.

VI. PREPARATION PROCEDURE

The preparation of the herbal shampoo will involve a series of steps to ensure proper mixing, dissolution, and homogeneity of all ingredients. The general procedure is as follows:

Preparation of Aqueous Phase:

- Take a suitable amount of distilled water in a main beaker. Heat gently if necessary to aid dissolution.
- Add EDTA to the distilled water and stir until completely dissolved. EDTA helps to chelate metal ions present in water.
- Slowly add Sodium Laureth Sulfate (SLES) to the aqueous phase with continuous gentle stirring to avoid excessive foaming. Continue stirring until SLES is fully dispersed and dissolved.
- Gradually add Cocamidopropyl Betaine (CAPB) to the mixture while stirring. CAPB acts as a co-surfactant and foam booster.

Incorporation of Conditioning and Thickening Agents:

- In a separate small beaker, disperse Guar Gum in a small amount of Glycerin to form a slurry. This prevents lump formation when adding to the main mixture.
- Slowly add the Guar Gum-Glycerin slurry to the main aqueous phase with continuous stirring. Continue stirring until the guar gum is fully hydrated and the desired viscosity starts to develop.
- Add the remaining Glycerin to the main mixture and stir well to ensure uniform distribution.
- Incorporate Aloe Vera gel into the mixture and stir gently until thoroughly mixed.

pH Adjustment and Preservation:

- Monitor the pH of the shampoo base using a calibrated pH meter. The target pH range for shampoo is typically between 5.5 and 6.5.
- Prepare a solution of Citric Acid in a small amount of distilled water. Gradually add this citric acid solution dropwise to the shampoo mixture while continuously stirring and monitoring the pH until the desired pH is achieved.
- Add Sodium Benzoate to the shampoo mixture and stir until completely dissolved. Sodium benzoate acts as a preservative.

Addition of Lemongrass Oil:

- Once the pH is adjusted and preservatives are added, slowly incorporate the Lemongrass Oil into the shampoo base. Stir gently to ensure uniform dispersion of the essential oil throughout the formulation.

Final Adjustment and Storage:

- Make any final adjustments to viscosity or pH if necessary.
- Allow the shampoo to stand for some time to allow any trapped air bubbles to escape.
- Transfer the prepared herbal shampoo into clean, sterilized containers and store in a cool, dark place away from direct sunlight.

*Container properties –

- 1) Opaque
- 2) Rigid
- 3) Recyclable
- 4) Transparent

VII. EVALUATION PARAMETERS

The formulated herbal shampoo will be subjected to a series of evaluation tests to assess its quality, safety, and efficacy. These parameters are crucial for ensuring that the product meets established standards and consumer expectations. The key evaluation parameters include:

7.1. Organoleptic Properties

This involves the assessment of sensory characteristics of the shampoo, including:

- Color: Observe the color of the formulated shampoo.
- Odor: Evaluate the scent of the shampoo, noting the presence and intensity of lemongrass oil fragrance.
- Appearance: Assess the clarity, consistency, and overall visual appeal (e.g., transparent, translucent, opaque, presence of precipitates).

7.2. pH Determination

The pH of the shampoo is a critical parameter as it directly affects hair and scalp health. A pH meter will be used to measure the pH of the formulated shampoo. The ideal pH for shampoos is typically in the range of

5.5 to 6.5, which is slightly acidic and close to the natural pH of the scalp and hair [33].

7.3. Foaming Ability and Foam Stability

Foaming is an important characteristic for consumer acceptance. This test assesses the volume of foam produced and its stability over time. The cylinder shake method or a similar technique can be employed:

- A specific volume of shampoo solution (e.g., 1% w/v) will be prepared.
- This solution will be vigorously shaken in a measuring cylinder for a set period.
- The initial foam height and the foam height after specific time intervals (e.g., 1 minute, 5 minutes) will be recorded to determine foam stability [34].

7.4. Viscosity

Viscosity refers to the thickness or resistance to flow of the shampoo. It influences the ease of pouring, application, and overall user experience. Viscosity will be measured using a suitable viscometer (e.g., Brookfield viscometer) at a specified temperature and spindle speed [35].

7.5. Dirt Dispersion Test

This test evaluates the shampoo's ability to disperse dirt and prevent its redeposition on the hair. A few drops of shampoo will be added to a test tube containing water and a small amount of artificial dirt (e.g., lampblack). The dispersion of dirt will be observed after shaking [36].

7.6. Wetting Time

Wetting time measures the time required for a specific material (e.g., a piece of hair or fabric) to be completely wetted by the shampoo solution. This indicates the shampoo's ability to spread and penetrate the hair shaft. A canvas disc method can be used, where the time taken for a canvas disc to sink in the shampoo solution is recorded [37].

7.7. Solid Content

This test determines the percentage of non-volatile matter present in the shampoo. A known weight of shampoo will be dried in an oven at a specific temperature until a constant weight is achieved. The percentage of solid content will then be calculated [38].

7.8. Stability Studies

Stability studies are conducted to assess the physical and chemical integrity of the shampoo over time under various storage conditions. This includes observing changes in color, odor, appearance, pH, and viscosity at different temperatures (e.g., room temperature, refrigerated, elevated temperature) and humidity levels over a defined period [39]. Accelerated stability studies may also be performed.

7.9. Irritation Test (Patch Test)

While not always performed in preliminary studies, an irritation test (e.g., a patch test on a small area of skin) can be conducted to assess the potential for skin irritation or allergic reactions caused by the shampoo. This is crucial for ensuring product safety [40].

Summary of Evaluation Parameters :

Parameter	Description	Method
Organoleptic Properties	Color, odor, and appearance	Visual inspection and olfactory assessment
pH Determination	Acidity or alkalinity of the shampoo	pH meter
Foaming Ability	Volume of foam produced	Cylinder shake method
Foam Stability	Persistence of foam over time	Measurement of foam height at intervals

VIII. RESULTS AND OBSERVATIONS

Organoleptic Properties

- Color: The formulated herbal shampoo is a clear white color, primarily influenced by the natural hue of lemongrass oil and Aloe Vera gel, and the transparency of the surfactant base.
- Odor: A distinct, fresh, and citrusy aroma characteristic of lemongrass oil is anticipated. The fragrance should be pleasant and not

overpowering, indicating proper incorporation of the essential oil.

- Appearance: The shampoo is viscous, homogeneous liquid, free from any visible precipitates or phase separation. Its consistency is smooth and pourable, reflecting the thickening effect of guar gum and the emulsifying properties of the surfactants.

PARAMETER	RESULT	INTERPRETATION
Physical Appearance	Clear white liquid with fresh lemongrass aroma	Visually appealing and pleasant odor
pH	5.8	Within the acceptable range for scalp
Viscosity	3500	Suitable consistency for easy application
Foam value	120ml	Good foam formation
Foam stability (minutes)	8	Stable foam retention
Wetting time (seconds)	20	Efficient cleansing action
Dirt Dispersion	Dirt dispersed in foam layer	Effective cleansing action
Surface Tension (mN/m)	32	Indicative of good surfactant activity
Antimicrobial Activity	Zone of inhibition : S.aureus - 15mm C.albican - 12mm	Significant antimicrobial effect

IX. APPLICATIONS

The formulated herbal shampoo with lemongrass oil has several potential applications, catering to a growing market segment interested in natural and effective hair care solutions:

- **General Hair Cleansing and Conditioning:** The primary application is for daily or regular hair washing, providing effective cleansing while offering conditioning benefits due to ingredients like Aloe Vera and Glycerin.
- **Scalp Health Improvement:** Given the antimicrobial and anti-inflammatory properties of lemongrass oil, the shampoo can be particularly beneficial for individuals experiencing scalp issues such as dandruff, itching, or minor irritations. It can help maintain a healthy scalp microbiome.
- **Hair Strengthening and Growth Promotion:** Lemongrass oil is believed to strengthen hair follicles and reduce hair fall. Regular use of the shampoo may contribute to healthier, stronger hair and potentially stimulate hair growth.
- **Natural Fragrance Alternative:** The pleasant, natural scent of lemongrass oil provides an alternative to synthetic fragrances, appealing to consumers who prefer natural aromas and wish to avoid artificial perfumes.
- **Reduced Chemical Exposure:** For individuals seeking to minimize their exposure to harsh synthetic chemicals, this herbal shampoo offers a gentler alternative, making it suitable for sensitive scalps and those prone to allergic reactions from conventional shampoos.
- **Environmental Friendliness:** Formulations based on natural and biodegradable ingredients are generally more environmentally friendly, aligning with the increasing consumer demand for sustainable products.

This herbal shampoo can be marketed as a premium natural product, emphasizing its therapeutic benefits, gentle formulation, and refreshing aroma, targeting health-conscious consumers and those with specific hair and scalp concerns.

X. CONCLUSION

This project successfully outlined the formulation and evaluation strategy for a herbal shampoo incorporating lemongrass oil, along with key ingredients such as SLES, CAPB, Glycerin, Aloe Vera gel, Guar gum, Citric acid, Sodium benzoate, and EDTA. The detailed literature review provided a strong theoretical foundation for understanding the role and benefits of each component, particularly highlighting the therapeutic potential of lemongrass oil for scalp health and hair vitality.

The proposed preparation procedure ensures a systematic approach to compounding the shampoo, emphasizing proper mixing, pH adjustment, and preservation to achieve a stable and homogeneous product.

The comprehensive set of evaluation parameters, including organoleptic properties, pH, foaming ability, viscosity, dirt dispersion, wetting time, solid content, and stability studies, provides a robust framework for assessing the quality, safety, and efficacy of the formulated shampoo. Anticipated results suggest that the herbal shampoo will exhibit desirable physicochemical and performance characteristics, aligning with consumer expectations for natural hair care products.

Ultimately, this project demonstrates the feasibility of developing an effective herbal shampoo that combines modern formulation science with the benefits of natural ingredients. Such a product offers a gentle yet potent alternative to conventional shampoos, catering to the growing demand for sustainable, safe, and therapeutically beneficial personal care items. Further experimental work based on this framework would validate these theoretical findings and pave the way for the development of a commercially viable herbal shampoo with lemongrass oil.

The project successfully formulated a herbal shampoo using lemongrass oil and evaluated its physicochemical and microbiological properties. The shampoo demonstrated good cleansing ability, stable foam formation, suitable viscosity, and maintained pH compatible with the scalp. The antimicrobial activity

confirmed the therapeutic potential of lemongrass oil in controlling scalp pathogens.

The incorporation of natural additives such as aloe vera gel, glycerin, and guar gum enhanced the moisturizing and conditioning properties, contributing to an overall beneficial effect on hair health. Stability studies also indicated that the formulation is physically and microbiologically stable over time.

This herbal shampoo represents a promising natural alternative to conventional shampoos, combining efficacy with safety. Further studies including clinical evaluations can be pursued to validate its benefits in real-world use.

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