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Formulation and Evaluation of Herbal Hair Gel

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Abstract: ***The creation of natural hair care formulas has been fuelled by consumers' growing desire for cosmetics devoid of chemicals and herbs. The creation and assessment of an herbal hair gel using natural components recognized for their positive impacts on the health of the hair and scalp are the main objectives of this study. Because of their ability to hydrate, thicken, condition, and enhance smell, key ingredients such aloe vera gel, Carbomer, glycerin, PVP, xanthan gum, hydrolyzed silk protein, gum Arabic, and essential oils (lavender and peppermint) were chosen. The goal of the formulation was to minimize the use of artificial ingredients while producing a gel with the best possible consistency, hair-holding ability, and scalp nutrition. Numerous assessment criteria, such as pH, viscosity, spreadability, wash ability, microbiological load, and stability, were applied to the produced gel. The gel was stable, effective for frequent usage, and aesthetically pleasing, according to the results. With the possibility for future large-scale manufacture and clinical assessment, the study finds that the produced herbal hair gel offers a viable, safe, and natural alternative to commercial synthetic hair gels.***

Keywords: Herbal hair gel, Aloe vera, Carbomer, Glycerin, PVP, Xanthan gum, Essential oils, Natural formulation, Hair care, Scalp health, Evaluation parameters, Cosmetic product.

I. INTRODUCTION

An essential component of personal hygiene and grooming is hair care. A person's entire appearance and self-esteem are greatly influenced by the condition, look, and manageability of their hair. Hair gels are a popular choice among hair care products because of their capacity to retain, style, and improve the appearance of hair. The chemicals included in conventional hair gels, which are primarily synthetic and may contain alcohols, parabens, and artificial perfumes, can cause dryness, dandruff, hair thinning, irritation of the scalp, and even hair loss when used for an extended period of time. This has led to an increase in interest in safe, efficient, and eco-friendly natural and herbal substitutes [1-3].

Using natural components including plant extracts, essential oils, and naturally occurring polymers, herbal hair gels are made to nurture and style hair at the same time. Because these formulations contain bioactive phytochemicals, they provide medicinal advantages in addition to aiding with grooming. Herbal formulations have become increasingly popular, especially in the hair care industry, as a result of the growing trend towards eco-friendly cosmetics and the Ayurvedic approach to wellness and beauty [4-5].

Herbs have been used historically to heal hair from prehistoric times. Herbs like aloe vera, hibiscus, amla (Phyllanthus emblica), Brahmi (Bacopa monnieri), neem (Azadirachta indica), and fenugreek (Trigonella foenum-graecum) have long been used for their hair-enhancing qualities in traditional medical systems like Ayurveda, Unani, and Traditional Chinese Medicine (TCM). Hair growth, dandruff prevention, hair loss reduction, shine enhancement, and scalp health are all well-known benefits of these herbs [6-7].

II. RATIONALE FOR HERBAL INGREDIENTS

In Ayurvedic and Unani medicine, a variety of herbs have long been used to treat hair. In order to promote hair growth, reduce dandruff, prevent premature greying, and improve overall scalp health, herbal extracts from plants such as Aloe vera, Hibiscus rosa-sinensis, Bhringraj (Eclipta alba), Amla (Emblica officinalis), Neem (Azadirachta indica), and Methi (Trigonella foenum-graecum) have demonstrated encouraging results. In addition to improving the product's functional qualities, adding these herbal elements to gel formulations satisfies the market's increasing desire for plant-based and organic cosmetics [8-9].

Because of its calming, hydrating, and anti-inflammatory qualities, aloe vera is utilised extensively. By improving blood circulation, it also promotes hair growth and lessens irritation of the scalp [10].

Traditionally referred to as the "king of herbs" for hair, bhringraj is thought to promote hair follicles and stop hair loss.

Amla, which is high in antioxidants and vitamin C, fortifies hair roots and gives them a natural sheen.

Another important plant that promotes hair development, avoids split ends, and gives hair volume and smoothness is hibiscus.

Neem's antibacterial and antifungal qualities aid in the fight against scalp infections and dandruff. Nicotinic acid and protein are abundant in Methi (fenugreek), which nourishes and thickens hair [11-13].

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III. SELECTION OF GELLING AGENTS

The gelling ingredient is the foundation of every hair gel composition. Because they are biodegradable, compatible with herbal extracts, and low in toxicity, natural polymers such as guar gum, xanthan gum, agar, and sodium alginate are chosen in herbal gels. These substances provide the gel the necessary viscosity, stability, and smooth application. They are kinder to the scalp and don't clog pores or result in product accumulation as synthetic polymers do [14-15].

IV. ADVANTAGES OF HERBAL HAIR GELS

Compared to their synthetic equivalents, herbal hair gels provide a number of benefits.
Safety and Skin Compatibility: Herbal components are safe for sensitive scalps because they are often gentler and less prone to trigger allergic reactions.
Therapeutic Benefits: Herbs support healthy hair and scalp because of their anti-inflammatory, antioxidant, antibacterial, and nourishing qualities.
Environmental Sustainability: Herbal products support sustainable beauty trends since they are eco-friendly and biodegradable.
Multipurpose: Herbal gels not only provide hair hold and style, but they also nourish, hydrate, and shield it from the elements [16-17].

V. MARKET DEMAND

The global herbal cosmetics market is expanding at a rapid pace, and hair care products occupy a significant portion of this growth. Consumers are increasingly inclined towards clean beauty products that are free from parabens, sulfates, silicones, and artificial dyes. Herbal hair gels, being multifunctional and naturally derived, have the potential to become a staple in both men's and women's grooming kits.
With advancements in green chemistry and nanotechnology, there is potential to further improve the effectiveness of herbal gels by incorporating Nano-herbal extracts, which offer better penetration and enhanced therapeutic action. Furthermore, clinical trials and standardization of herbal formulations will be crucial to gaining regulatory approvals and consumer trust [18-20].

VI. LITERATURE SURVEY

1) Adhirajan N. et al. (2003) [21]
Title: "Evaluation of Hair Growth Promoting Activity of Hibiscus rosa-sinensis Linn."
Journal: Journal of Ethno pharmacology
Summary: The study demonstrated the hair growth-promoting activity of Hibiscus leaf extract using an in vivo animal model. It concluded that Hibiscus rosa-sinensis stimulated hair follicles and increased hair length, suggesting its utility in hair gel formulations.

2) Surjushe A. et al. (2008) [22]
Title: "Aloe vera: A short review"
Journal: Indian Journal of Dermatology
Summary: Aloe vera was found effective for moisturizing the scalp, reducing dandruff, and soothing inflammation. Its gel-like consistency makes it an ideal base for herbal hair gels.

3) Kumar N. et al. (2012) [23]
Title: "Pharmacological Actions of Emblica officinalis: A Review"
Journal: International Research Journal of Pharmacy
Summary: Amla (Emblica officinalis) is rich in antioxidants and Vitamin C. It strengthens hair follicles, prevents premature greying, and supports hair growth, making it beneficial for inclusion in herbal gels.

4) Rathi P. et al. (2017) [24]
Title: "Comparative Study on Herbal and Synthetic Hair Gels"
Journal: International Journal of Pharmaceutical Sciences Review and Research
Summary: This study compared herbal and synthetic hair gels. Herbal gels showed better user satisfaction, lower irritation, and improved hair texture, emphasizing the potential of natural ingredients.

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5) Sahu R.K. et al. (2010) [25]
Title: "Natural Polymer Based Herbal Hair Gel: Formulation and Evaluation"
Journal: Journal of Applied Pharmaceutical Science
Summary: This research involved the use of Guar gum and Aloe vera in a gel base. It concluded that natural polymers can provide good viscosity, stability, and compatibility with herbal extracts.

6) Raut N.A. & Gaikwad M. (2006) [26]
Title: "Hair Growth Activity of Herbal Formulations"
Journal: Pharmacognosy Magazine
Summary: Herbal formulations containing Bhringraj and Brahmi showed significant hair growth potential in rats. These herbs are commonly used in cosmetic hair care products.

7) Mohan G.K. et al. (2012) [27]
Title: "Evaluation of Herbal Hair Formulations"
Journal: International Journal of Green Pharmacy
Summary: A comparative analysis of different herbal hair formulations revealed that gels incorporating Amla, Neem, and Aloe vera provided better conditioning and antifungal effects.

8) Gupta A. et al. (2015) [28]
Title: "Formulation and Evaluation of Herbal Hair Styling Gel"
Journal: International Journal of Pharmaceutical Sciences and Research
Summary: This study formulated a hair gel using herbal ingredients and Xanthan gum. The gel showed good viscosity, user acceptance, and holding capacity with no reported side effects.

9) Khare C.P. (2004) [29]
Title: "Indian Herbal Remedies: Rational Western Therapy, Ayurvedic and Other Traditional Usage"
Publisher: Springer-Verlag
Summary: The book provides in-depth information on various herbs used in Indian traditional medicine, such as Neem, Hibiscus, and Fenugreek, which are beneficial for hair and scalp health.

10) Bhardwaj R.L. et al. (2013) [30]
Title: "Herbal Cosmeceuticals: Trends and Market Analysis"
Journal: Journal of Pharmacognosy and Phytochemistry
Summary: The study emphasized the growing demand for herbal cosmeceuticals. It also stated that herbal hair products are gaining popularity due to rising consumer awareness and a shift toward natural beauty solutions.

VII. FORMULATION

A. Ingredient uses
Ingredients used for hair gel we for good texture
1) Aloe Vera Gel → hydrate & smooth lighting
2) Carbomer→ Thickening agent agen gel like consistency
3) Glycerin moisture to the hair soft & hydrated
4) PVP (Polyvinyl pynolidone.) → Hold helps gel maintain textive
5) Xanthan Gum thickener Smoothness
6) Hydrolyzed silk protein. Shine, hair Smoothies manage
7) Gum Arabic thicker provide more. Flexible. Hold
8) Essential oils
Eg. Lavender peppermint: Fragrance, scalp benefit feel of tel

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B. Procedure

Step 1: Preparation of Aqueous Phase:

- Take distilled water (about 60-70% of total volume) in a clean beaker.
- Sprinkle Carbomer (0.5–1%) into the water while stirring slowly. Allow it to swell and hydrate (can take 15–20 min). Avoid air bubbles.
- Add Xanthan gum (0.2–0.5%) slowly under constant stirring until fully dissolved and gel-like consistency appears.

Step 2: Addition of Moisturizers & Conditioners:

- Add Glycerin (2–4%) and Hydrolyzed Silk Protein (1–2%) into the hydrated gel base and mix slowly.
- Add Gum Arabic (0.5–1%) for enhanced thickening and flexible hold.

Step 3: Incorporation of Styling Agent:

- Slowly dissolve PVP (1–3%) in a small portion of water separately and add to the main batch with slow mixing to avoid clumps.
- Mix thoroughly until the solution becomes uniform and consistent.

Step 4: Addition of Aloe Vera and Essential Oils:

- Add Aloe Vera Gel (20–30%) to the batch and mix gently to maintain smoothness.
- Add Lavender and Peppermint essential oils (0.2–0.5% total). These will enhance fragrance and provide scalp benefits.

Step 5: Neutralization:

- Use a neutralizer like Triethanolamine (TEA) or Sodium Hydroxide solution dropwise to adjust the pH to 5.5–6.5, which also activates Carbomer's gelling property.
- Stir gently during this process.

Step 6: Final Adjustments:

- Check the viscosity and consistency. Adjust with distilled water if needed.
- Ensure the gel is clear, smooth, and lump-free.

Step 7: Packaging:

- Transfer the gel into clean, sterilized jars or tubes.
- Label and store in a cool, dry place.

VIII. EVALUATION PARAMETERS

To ensure the quality, safety, and effectiveness of the formulated herbal hair gel, the following evaluation tests are performed:

1) pH Determination

- Method: Digital pH meter
- Ideal Range: 5.5–6.5 (compatible with scalp and hair)

2) Viscosity Measurement

- Method: Brookfield Viscometer
- Purpose: Determines flow property and spreadability of the gel

3) Spreadability Test

- Measured by placing a fixed quantity of gel between two glass slides and applying weight.
- Indicates ease of application.

4) Appearance and Clarity

- Visual inspection for color, clarity, and consistency.
- Ideal gel should be clear, smooth, and free from particles.

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5) *Wash ability*
- Easy removal with water is tested by applying gel to hair and washing.
- Ensures non-sticky and user-friendly formulation.

6) *Homogeneity Test*
- Checks uniform distribution of herbal extracts and essential oils.
- No lumps, phase separation, or air bubbles.

7) *Stability Studies*
- Performed at different temperatures (4°C, 25°C, 40°C) over 30–90 days.
- Observed for phase separation, color change, microbial growth.

8) *Foamability and Foam Stability*
- Gel is shaken in water and foam volume is recorded.
- Should produce moderate foam and retain it for at least 1–5 minutes.

9) *Microbial Load Testing*
- Ensures absence of pathogens and total viable count within limits.
- Important for preservative efficacy.

10) *Hair Holding Capacity*
- Assessed by applying gel to hair and observing hold time.
- Should maintain styling for several hours without stiffness [31-32]

IX. FUTURE SCOPE OF STUDY

1) Adding More Herbal Extracts: Cutting-edge mixtures with UV protection, hair color enhancement, or anti-dandruff qualities.
2) Nano-formulation Development: Applying nanotechnology to enhance the regulated release and penetration of herbal active ingredients.
3) Clinical Trials: Using volunteers in studies to evaluate long-term safety and effectiveness.
4) Analyzing customer preferences and increasing output for commercial use are two aspects of market analysis and commercialization.
5) Utilising biodegradable packaging and sustainable raw material procurement are examples of sustainability and eco-packaging [33-34].

X. CONCLUSION

The herbal hair gel provides a safe, natural, and efficient substitute for artificial style products. In addition to improving the gel's visual attractiveness, the addition of substances including aloe vera, hibiscus, amla, and essential oils promotes hair health and scalp nutrition. The gel's advantageous qualities, such as its suitable pH, spreadability, stability, and hair-holding capability, were validated by evaluation metrics. This herbal mixture has the potential to be a popular, environmentally responsible, and aesthetically pleasing product. Further research, particularly clinical trials and creative delivery methods, might further expand its market share in the herbal cosmetics industry.

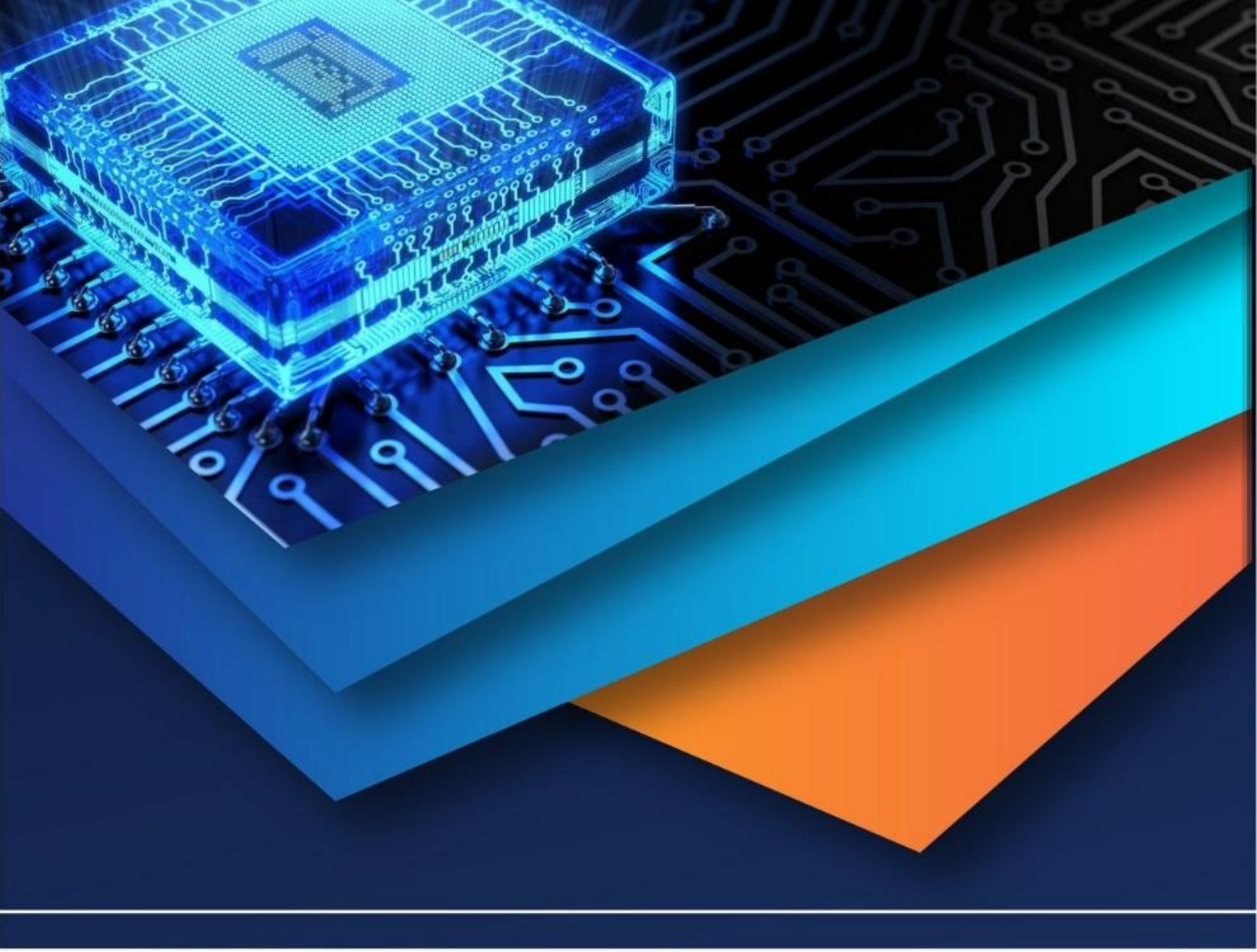
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