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FORMULATION AND EVALUATION OF A NANOEMULSION-BASED HERBAL HAIR MASK FEATURING BLUMEA ERIANTHA DC FOR PREMATURE GRAYING AND HAIR NOURISHMENT

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ABSTRACT

Objective: To formulate and evaluate a stable nanoemulsion-based herbal Hair mask using *Blumea eriantha* DC as the principal bioactive component, aimed at managing premature graying and promoting overall scalp and hair health. **Methods:** The formulation included herbal extracts such as *Blumea eriantha*, *Clitoria ternatea*, Hibiscus rosa-sinensis, *Linum usitatissimum*, and others. A nanoemulsion system was developed using high-speed homogenization followed by ultrasonication. Two formulation trials were conducted to optimize oil-to-water ratios. Evaluation parameters included pH, viscosity, spreadability, washability, sensory analysis, stability testing (freeze–thaw cycles), particle size (DLS), and microbial resistance. **Result:** The optimized formulation exhibited excellent physical stability, a pH of 5.5 ± 0.2, and a particle size of 152 nm. No microbial growth or phase separation was observed. The formulation was found to be safe, effective, and cosmetically appealing with positive feedback from initial sensory evaluation.

KEYWORDS: Herbal Hair Mask, Premature Graying, *Blumea eriantha* DC, Nanoemulsion.

1. INTRODUCTION

Premature graying, defined as the early loss of hair pigmentation before the age of 20 in Caucasians, 25 in Asians, and 30 in Africans, has become an increasingly common condition. It is often attributed to genetic factors, nutritional deficiencies, oxidative stress, and lifestyle

habits. Beyond its biological cause, premature graying can significantly impact an individual's self-esteem, confidence, and social image, especially among younger populations.[1]

Hair health overall is influenced by oxidative stress, pollution, and the use of harsh chemical treatments, leading to not just graying but also thinning, brittleness, and scalp sensitivity. As a result, there is growing interest in natural, plant-based hair care products that offer multi-functional benefits with minimal side effects.[2,3] Among these, *Blumea eriantha* DC stands out for its traditional use in hair care and its rich phytochemical profile including flavonoids, terpenoids, and essential oils beneficial for scalp and follicle health.[4,5] Integrating this botanical ingredient with nanoemulsion technology enhances the penetration and stability of actives, offering a modern approach to herbal hair care.[6]

2. MATERIALS AND METHODS

2.1 Materials Used

Herbs were sourced locally and authenticated in laboratory. Major components include *Blumea eriantha*, *Clitoria ternatea*, *Linum usitatissimum*, Hibiscus rosa-sinensis, Phyllanthus emblica, Trigonella foenum-graecum, cold-pressed Sesamum indicum oil, fresh coconut milk, coconut oil, beetroot extract, rose oil, aloe vera gel, glycerin, Tween 80, Vitamin E, Ascorbic Acid, and distilled water.

2.2 Preformulation Studies

Before formulation, the individual ingredients were evaluated for organoleptic properties, solubility, pH, and storage stability. Blumea, hibiscus, and beetroot extracts exhibited characteristic natural colors and aromas. Solubility analysis guided appropriate phase assignment. pH of herbal extracts ranged from 4.5 to 6.0, with the final product adjusted to pH 5.5. Short-term storage stability was confirmed under room temperature and light exposure.

2.3 Final Formulation Composition (25 g Batch)

Table 1: Formulation table for hair mask.

Sr.No.	Ingredient	Function	% w/w	Quantity (g)
1	Blumea eriantha Leaf Extract	Hair growth[7], antioxidant[8]	12	3.0
2	Clitoria ternatea Extract	Hair darkening[9], antioxidant[10]	8	2.0
3	Flaxseed Gel	Hydration, texture improvement[11]	6	1.5
4	Hibiscus Extract	Growth stimulation, shine[12]	6	1.5
5	Fenugreek Extract	DHT blocker[13], root strengthening[14]	4	1.0
6	Amla Powder	Melanin support, scalp health[15]	5	1.25
7	Cold-pressed Black Sesame Oil	Antioxidant, follicle strength[16]	10	2.5
8	Coconut oil	Moisturizing and Carrier oil[17]	10	2.5
9	Coconut milk	Nutrient source, moisturization[18,19]	10	2.5
10	Beetroot Extract	Natural colorant, antioxidant[20]	4	1.0
11	Aloe Vera Gel	Soothing base, hydration[21]	15	3.75
12	Rose Oil	Fragrance and scalp hydration[22]	2	0.5
13	Tween 80	Emulsifier/surfactant[23]	3	0.75
14	Glycerin	Humectant – moisture retention[24]	2	0.5
15	Vitamin E	Antioxidant[25]	2	0.5
16	Ascorbic Acid	Preservative, antioxidant[26]	2	0.5
17	Distilled Water	Volume makeup	-	q.s. to 25.00 g

2.4 Formulation Trials

Two formulation trials were conducted to optimize the oil-to-water phase ratio, stability, and spreadability of the herbal hair mask:

- Phase 1 Trial: Used Aqueous Phase: Oil Phase in 2:1 ratio. Resulted in moderate viscosity and mild oil separation.
- Phase 2 Trial (Optimized): Used Aqueous Phase: Oil Phase in 3:1 ratio. Achieved improved emulsion stability, better texture, and user acceptability.

The final formulation was selected from Phase 2, which provided superior emulsion characteristics.

2.5 Preparation Method

1. Herbal Extract Preparation: Herbal ingredients were subjected to hot aqueous infusion. Flaxseeds were boiled to obtain mucilage gel. Fresh coconut milk was manually extracted.

2. Phase Separation

Oil Phase: Oil phase included cold-pressed black sesame oil, coconut oil, rose oil, Vitamin E, and Tween 80.

Aqueous Phase: Aqueous phase included aloe vera gel, herbal extracts, glycerin, amla powder, coconut milk, flaxseed gel base and ascorbic acid.

3. Pre-Emulsification: Oil phase was added slowly drop by drop to aqueous phase with continuous magnetic stirring for 10 minutes.

4. Homogenization: Pre-emulsion was subjected to high-speed homogenization at 10,000 rpm for 30 minutes.

5. Ultrasonication: Further subjected to ultrasonication at 40 kHz for 15 minutes to achieve nanoscale droplets.

6. Packaging: The product was weighed and filled into sterilized amber containers.

2.6 Evaluation Parameters

The finalized formulation was subjected to various physicochemical and performance-based evaluations to assess its quality, stability, and cosmetic acceptability:

1. **pH Measurement**[27,28]
   - Measured using a digital pH meter at room temperature.
   - Ensures skin and scalp compatibility.

2. **Viscosity**[27,28]
   - Evaluated using a Brookfield viscometer.
   - Indicates consistency and application performance.

3. **Spreadability**[28]
   - Assessed by the slip-and-drag method using glass plates.
   - Reflects ease of application.

4. **Washability**[28]
   - Determined qualitatively by rinsing under tap water.
   - Affects user experience.

5. Particle Size Analysis (DLS)[28]

- Particle size distribution measured using dynamic light scattering (DLS).
- Confirms nanoemulsion droplet size and stability.

6. Freeze–Thaw Stability[28]

- Subjected to 5 cycles between 4°C and 40°C.
- Indicates long-term physical stability.

7. Microbial Stability[28]

- Plate-count method over 7 days to assess microbial resistance.
- Ensures safety and shelf life.

8. Moisture Retention Test[28]

- Evaluated qualitatively via patch test method.
- Measures the formulation's hydrating potential.

3. RESULTS AND DISCUSSION

The final formulation was physically stable with no phase separation, ideal pH, and uniform consistency. Observed results are as follows:

- Physical Appearance: Pale brown-green gel with herbal aroma, smooth consistency.
- pH: 5.5 ± 0.2, suitable for scalp application.
- Viscosity: ~1500–2000 cps, ensuring ease of application and hold.
- Spreadability: Covered ~20 cm^2/g; tested by slip and drag method.
- Washability: Easily removable with water; left no greasy residue.
- Particle Size: Dynamic light scattering (DLS) showed 152 nm with a PDI of 0.21, indicating a stable and uniform particle distribution suitable for topical delivery.
- Freeze–Thaw Stability: Passed 5 cycles without any phase separation or degradation.
- Microbial Stability: No microbial growth was observed after 7 days on agar plates.
- Moisture Retention: Good hydration due to presence of flaxseed gel, aloe vera, and glycerin.

4. CONCLUSION

The present study successfully formulated a stable nanoemulsion-based herbal hair mask featuring *Blumea eriantha* DC as the principal bioactive component. The use of supportive herbal ingredients such as *Clitoria ternatea*, *Hibiscus rosa-sinensis*, *Linum usitatissimum*,

and others enriched the formulation with multi-dimensional benefits. The nanoemulsion system significantly enhanced the penetration, stability, and overall cosmetic acceptability. Evaluation results confirmed favorable pH, spreadability, particle size (152 nm), and microbial stability. This study highlights how the integration of traditional herbal knowledge with nanotechnology can lead to innovative, consumer-friendly cosmeceutical formulations that are both safe and effective.

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