Formulation And Evaluation of Herbal Hair Serum for Hair Growth Using Tridax Procumbens

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***Abstract*— The younger generations are increasingly experiencing severe hair loss attributed to lifestyle factors including fatigue, anxiety, consumption of junk food, and the frequent use of hairstyling and coloring products. Such hair loss is often not temporary and frequently progresses to alopecia. The activation of hair roots is essential to stimulate hair growth and prevent further hair loss.**

Herbal remedies are widely favored due to their minimal side effects. Tridax procumbens, known as the 'cotton daisy,' is an Ayurvedic plant of the Asteraceae family with a well documented history of traditional use in Asia. Its phytoconstituents and pharmacological properties, including anti-inflammatory, antioxidant, hepatoprotective, and immunomodulatory activities, have been exploited in traditional medicine to treat wounds, skin conditions, and to arrest bleeding. The present study focuses on the formulation and evaluation of a herbal hair serum incorporating Tridax procumbens extract alongside complementary ingredients such as aloe vera gel, castor oil, vitamin E, glycerin, and rose water. Three formulations were developed and assessed for physical appearance, homogeneity, pH, viscosity, spreadability, sterility, and in vivo hair growth activity using a rabbit model. The optimized formulation demonstrated satisfactory physicochemical properties and meaningful hair growth promotion, supporting its potential as an effective herbal cosmeceutical.

Index Terms*— *Tridax procumbens, herbal hair serum, alopecia, hair growth, phytochemicals, cosmeceuticals, Ayurvedic formulation

I. INTRODUCTION

Hair plays an important role in the overall appearance and personality of an individual. Hair goes through three distinct phases: the anagen (active growth) phase, the catagen (transitional) phase, and the telogen (resting and shedding) phase. Hair care formulations are aimed at supporting and prolonging the anagen phase while addressing scalp conditions that may impair follicular function[1].

Alopecia refers to persistant hair loss beyond a normal shedding cycle. Alopecia can be localized or diffuse, temporary or permanent and impact both sex regardless of age [2]. Hair loss has emerged as one of the most prevalent cosmetic concerns among younger demographics worldwide as it negatively impacts self image and quality of life. Contributing factors responsible for it includes chronic stress, dietary imbalance, excessive use of chemical hair treatments, hormonal fluctuations, and environmental pollutants[3]. Alopecia affects millions globally, recent advancements in the understanding of hair follicle biology have driven the development of novel therapies focused on hair regrowth [4]. In recent times, Natural and herbal cosmetics have gained substantial traction as consumers seek formulations free from harsh chemicals, parabens, and sulphates. Herbal cosmetics utilize phytochemicals from botanical sources to deliver cosmetic benefits with a reduced risk of adverse effects [5].

Tridax procumbens Linn. (Asteraceae), commonly referred to as Mexican Daisy or Coat Buttons, is a medicinal herb recognized in multiple vernacular traditions: ghajadvu and ghaburi (Gujarati), ghamra (Hindi), tridhara (Bengali), and kambarmodi, jakhamjudi, and tantani (Marathi). The plant is indigenous to tropical Africa, Asia, and Australia and is available yearround across most regions. Phytochemical investigations have identified flavonoids, essential oils, saponins, terpenoids, and

tannins as major bioactive constituents in its flowers and aerial parts. Pharmacologically, the plant exhibits vasorelaxant, antiinflammatory, antidiabetic, antioxidant, hepatoprotective, immunomodulatory, and analgesic properties, and has historically been employed to treat skin conditions, wounds, and hair growth disorders [6][7].

This study was undertaken to formulate a stable, effective herbal hair serum utilizing Tridax procumbens extract and to evaluate its physicochemical and biological properties with respect to hair growth promotion.

II. MATERIALS AND METHODS

2.1 Plant Material

Leaves and flowers of Tridax procumbens were collected and the plant was authenticated by a qualified botanist prior to use.

2.2 Chemicals and Reagents

Aloe vera gel, coldpressed castor oil, Vitamin E capsules (Evion 400 mg), glycerin, propyl paraben, methyl paraben, and rose water were procured from local pharmaceutical suppliers. All chemicals used were of analytical reagent grade.

III. EXTRACTION METHODS

3.1 Maceration

Maceration was employed as a simple, costeffective method for extracting phytochemicals from Tridax procumbens at room temperature. The leaves and flowers were dried and coarsely powdered. The powdered material was then immersed in an appropriate solvent and allowed to stand at ambient temperature for 7 days with occasional stirring. The extract was filtered and concentrated under reduced pressure.

3.2 Soxhlet Extraction

For higher extraction efficiency of heatstable bioactive compounds such as flavonoids, tannins, and terpenoids, Soxhlet extraction was performed using ethanol, methanol, or hexane as the solvent. The dried and pulverized plant material was loaded into the Soxhlet thimble and subjected to continuous reflux for a defined duration. This method ensures thorough and exhaustive extraction of target phytoconstituents from the plant matrix.

IV. FORMULATION OF HERBAL HAIR SERUM

Four formulations (Solutions 14) were prepared with incrementally increasing concentrations of active ingredients to optimize the serum. The preparation method for each formulation is described below.

4.1 Preparation Procedure

The general preparatory steps followed for each formulation were:

1. Measure aloe vera gel and glycerin into a clean beaker.
2. Add the specified number of Vitamin E (Evion 400 mg) capsules.
3. Incorporate coldpressed castor oil and mix gently.
4. Add Tridax procumbens extract dropwise to the gel base.
5. Mix continuously using a magnetic stirrer until a homogeneous solution is obtained.
6. Continue stirring for the specified duration.

4.2 Formulation Compositions

Ingredient	F1	F2	F3	F4
Aloe Vera Gel + Glycerin	5 ml	7 ml	10 ml	10 ml
Vitamin E (Evion 400 mg)	1 capsule	2 capsules	3 capsules	4 capsules
ColdPressed Castor Oil		0.5 ml	1 ml	2 ml
Tridax Procumbens Extract	q.s.	1 ml	2 ml	10 ml
Stirring Time	10 min	10 min	15 min	15 min

4.3 Optimized Formulation Composition

S.No.	Ingredient	Quantity	Function
1	Tridax procumbens extract	q.s.	Hair growth stimulant
2	Castor oil	2 ml	Hair growth stimulant
3	Vitamin E	2 ml	Antioxidant
4	Propyl paraben	0.25 ml	Preservative

5	Methyl paraben	0.25 ml	Preservative
6	Rose water	5 ml	Skin hydration
7	Aloe vera gel	10 ml	Healing, skin conditioning
8	Glycerin	10 ml	Humectant

V. EVALUATION OF HERBAL HAIR SERUM

5.1 Physical Appearance

Visual examination was conducted to assess the texture, color, consistency, and overall appearance of the prepared formulations.

5.2 Homogeneity Test

A small quantity of each hair serum was placed on a clean, dry glass slide and covered with a cover slip. The preparation was examined for uniformity, the presence of coarse particles, aggregates, lumps, or flocculates using visual inspection under adequate lighting.

5.3 pH Determination

The pH of each formulation was measured using a calibrated pH meter (calibrated with pH 4 and pH 7 buffer solutions). The electrode was immersed in the hair serum for a few minutes until a stable reading was obtained.

5.4 Viscosity Measurement

Viscosity was determined using a Brookfield viscometer (RVDVII+PRO) fitted with spindle number six. Measurements were recorded at rotational speeds of 10, 20, 50, and 100 rpm using 50 ml of each hair serum sample.

5.5 Spreadability

Spreadability was assessed by the parallel plate method. Approximately 1 g of hair serum was placed between two 20 × 20 cm horizontal glass plates, with a 125 g weight placed on the upper plate. The diameter of spread was recorded after one minute. Spreadability (S) was calculated using the formula:

$$S = (M \times L) / T$$

where M = weight in the pan (g), L = length of movement of the glass slide (cm), and T = time required for complete separation of slides (seconds).

5.6 Sterility Test

Sterility was evaluated by placing 1% hair serum on sterile discs seeded onto nutrient agar and incubating at 32°C for 24 hours. Plates were observed for evidence of microbial growth.

5.7 Microbial Contamination

Microbial load was assessed by the viable surface method. One gram of the serum was dissolved in 4 ml of sterile Ringer solution containing 0.25% Tween 80. Appropriate dilutions were plated onto nutrient agar and Sabouraud agar and incubated at 37°C for 48 hours. Colonies were counted following the incubation period.

VI. RESULTS AND DISCUSSION

6.1 Physical Appearance and Homogeneity

The optimized herbal hair serum exhibited a greenishbrown color with a smooth, uniform texture. Homogeneity testing confirmed the absence of visible coarse particles, aggregates, lumps, or flocculates, indicating a well dispersed formulation.

6.2 Evaluation Parameters

Parameter	Result
Physical appearance	Greenishbrown, smooth, uniform
Homogeneity	Good no particles, aggregates, or lumps observed
pH	6.7 ± 0.022
Draize Eye Test	Mild irritation (acceptable range)
Viscosity at 10 rpm (cps)	6800 ± 0.011
Viscosity at 20 rpm (cps)	3950 ± 0.023

The pH of 6.7 is within the acceptable range for scalp application (4.57.0), minimizing risk of irritation or disruption to the scalp's natural acid mantle. The pseudoplastic viscosity profile decreasing with increasing shear rate is characteristic of a wellformulated semisolid preparation and facilitates ease of application.

6.3 IN VIVO HAIR GROWTH ACTIVITY

6.3.1 Experimental Design

Hair growth activity was evaluated using a rabbit model. Three sections (4 × 4 cm) on the shaved dorsal surface of each rabbit were designated as experimental zones. Depilatory cream (Veet) was applied for 35 minutes and the area was washed until completely free of hair. The regions were then disinfected with 70% ethanol and allowed to rest for 24 hours before treatment commenced.

Three treatment groups were established: Group I (normal control no intervention), Group II (negative control no test substance), and Group III (positive control topical application of the Tridax procumbens herbal hair serum). Each rabbit received 0.1 ml of the respective treatment twice daily for three weeks, with Day 0 defined as the first day of serum application.

6.3.2 Qualitative Assessment

Hair growth was monitored visually using two criteria: (1) initial hair growth time the minimum time for the onset of hair growth, evidenced by darkening of the skin; and (2) hair coverage time the minimum time for complete regrowth across the shaved area. Each group comprised three rabbits.

6.3.3 Hair Weight Measurement

On Day 21, hair from each treatment zone was carefully harvested, dried, and weighed. Statistical comparisons were made between groups to quantify differences in hair yield attributable to the serum.

6.4. STABILITY STUDIES

Stability studies were conducted to assess the physical and chemical integrity of the herbal hair serum over time. No signs of phase separation, color change, or physical instability were observed during the study period. The pH and viscosity values remained stable across initial and final measurements, as summarized in the table below.

pH (Initial)	pH (Final)	Viscosity at 100 rpm Initial (cps)	Viscosity at 100 rpm Final (cps)
6.7 ± 0.022	6.6 ± 0.012	1110 ± 0.002	1124 ± 0.117

The minimal variation in pH (Δ = 0.1) and viscosity (Δ = 14 cps) confirms the formulation is physically and chemically stable and suitable for shelflife studies under standard storage conditions.

VII. CONCLUSION

The Tridax procumbens herbal hair serum developed in this study delivers a comprehensive array of nutrients necessary to support natural hair growth and maintain optimal function of the sebaceous glands. The formulation demonstrated favorable physicochemical attributes including appropriate pH, viscosity, spreadability, and homogeneity, alongside satisfactory microbial safety.

In vivo evaluation confirmed the serum's efficacy in promoting hair regrowth in the rabbit model. The use of bioactive botanical ingredients notably Tridax procumbens extract, castor oil, aloe vera, and vitamin E synergistically contributes to follicular stimulation and scalp health while minimizing the risk of side effects or hypersensitivity reactions commonly associated with synthetic cosmetics.

The herbal cosmeceutical sector continues to grow rapidly in response to consumer demand for natural, parabenfree, and sulphatefree personal care products. This formulation represents a promising candidate for further clinical investigation and commercial development within the expanding herbal hair care market.

ETHICAL STATEMENT

Neither humans nor animals were used as subjects in investigations that formed the basis of this study. The in vivo hair growth assessments described were conducted in accordance with institutional ethical guidelines for laboratory animal use.

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