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Review Article

FORMULATION AND EVALUATION OF HAIR REVITALIZING GEL OF ALOPECIA AREATA

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ABSTRACT

Alopecia areata is a chronic autoimmune disorder characterized by unpredictable hair loss, affecting nearly 2% of the global population. Conventional treatments such as corticosteroids and minoxidil offer some therapeutic benefits but are often associated with adverse effects, including skin thinning, hormonal imbalances, and irritation. This has led to growing interest in herbal alternatives that provide a safer and more sustainable approach to managing the condition. This study focuses on the formulation and evaluation of a topical herbal gel enriched with pumpkin seed extract, fenugreek seed extract, sabja seed extract, aloe vera, and saw palmetto extract. These botanicals are known for their potential to stimulate hair growth, reduce scalp inflammation, and inhibit dihydrotestosterones (DHT), a key contributor to hair follicle miniaturization. Xanthan gum was used as a gelling agent to ensure an optimal texture, while methyl paraben served as a preservative to maintain formulation stability. The formulated gel was subjected to physicochemical and performance evaluations, including pH, viscosity, washability, and irritation potential, to assess its stability, efficacy, and user acceptability. The results suggest that the herbal gel exhibits promising properties in terms of consistency, spread ability, and safety, making it a potential natural alternative for managing alopecia areata. The study underscores the therapeutic potential of herbal formulations in hair loss treatment, offering a stable and effective option with minimal side effects. Further research and clinical trials are recommended to validate the long-term efficacy and scalability of this formulation.

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Introduction:

Alopecia Areata: Overview and Prevalence Alopecia areata is a chronic autoimmune condition that results in hair loss, typically in small, circular patches on the scalp face or body. It affects approximately 2% of worldwide l population, with a risk of developing conditions ranging from 1.7% to 2.1% The condition when occur in the body's immune system mistakenly targets and attacks hair follicles, resulting in hair loss. Although the exact caused is not fully understood, it's believed that genetic predisposition, hormonal changes, environmental factors all contribute to its development. [McElwee, K.J. and Shapiro, J. 2024] Alopecia areata can manifest at any age, through its most commonly seen in people under 30, with women having a slightly higher incidence than men. There are different types of alopecia areata including, monolocularis, multicularis, totalis and universalise, each indicating varying degrees of hair loss. [Alkhalifah, A. Et al. 2018] Current Treatment for Alopecia Areata Current medical treatment for alopecia areata primarily include corticosteroids, minoxidil, and other systemic therapies. Corticosteroids are effective in suppressing the immune response responsible for hair loss, but they can have side effects such as a skin

thinning and hormonal imbalances. [Alkhalifah, A. Et al. 2018] Minoxidil is commonly used to promote hair growth, but it may cause scalp irritation and is not always effective for everyone. [Rossi, A., Kanti, V. 2016] As conventional treatments may have limitations and adverse effects, there has been growing interest in natural alternatives, particularly herbal extracts, which are considered to be safer and potentially more effective in treating hair loss.[Pratt, C.H., King, L.E. et al 2017].

- Natural remedies for Alopecia Areata: Herbal Ingredients in Focus Several natural ingredients have been identified as promising candidate for promoting hair regrowth. These herbs each have a unique mechanism by which they may benefit hair follicles:
- 1)Pumpkin seeds Extract: Pumpkin seeds extract has been shown to reduce DTH (dihydrotestosterones) levels by inhibiting 5-alpha-reducatase, enzyme responsible for converting testosterone to DTH.Since DTH is known to contribute to hair follicle, shrinkage, reducing its levels may support hair regrowth.[Shin, H., Won, C.H., et al 2014]
- 2) Fenugreek seed extract: Fenugreek seeds are rich in compounds like nicotine acid, lecithin, and protein which promote circulation to the scalp and stimulate hair follicle activity. Additionally, Fenugreek has been used in traditional medicine for its anti-inflammatory properties, making it beneficial for improving scalp health.[Basch, E., Ulbricht, C.,et al 2003].
- 3)Aloe Vera gel: Aloe Vera has long been recognized for its soothing properties, making it an ideal ingredient for reducing scalp irritation. Aloe vera is also believed to improve blood circulation to the scalp, thereby creating a better environment for hair regrowth. Studies have found that aloe vera can significantly reduce scalp irritation, especially when used in topical treatments.[Alopecia Areata. 2025]
- 4)Saw palmetto berries Extract: Saw palmetto is known for its ability to block DTH, a hormone implicated in androgenetic alopecia. By reducing DTH levels, saw palmetto can improve hair density and reduce hair shedding. Multiple studies have shown its effectiveness as a natural remedy for hair loss. [Gupta, M.A. et al. 1997].
- Herbal formulations in topical gel: Topical gel are practical and efficient ways to deliver the active ingredient to the scalp, offering several advantages for treating hair loss. These formulations ensure better absorption of active components while being easy to apply and evenly spread over the skin. Commonly used gelling agents, such as a xanthan gum, help maintain the consistency and stability of the gel, ensuring the effective distribution of ingredients. To prolong the shelf life and preserve the gel's quality, preservatives like methyl paraben are often added. [McGrath, C. And Mohr, R. 2018]

By developing and evaluating this herbal gel, this research aims to introduce an innovative and safer alternative to conventional treatments for alopecia areata. Further studies including long term trials, are needed to assess the stability, effectiveness, and safety of such formulation for border clinical use.

Pathophysiology

Genetic Predisposition
↓
Environmental Triggers (Stress, infections, toxins, etc. against.)
↓
Immune System Activation (Autoimmune response hair follicles)
↓
Inflammation of Hair Follicles
↓
Disruption of Hair Growth Cycle (Anagen phase prematurely stops)
↓
Hair Follicle Miniaturization
↓
Hair Loss in Patchy Areas (Alopecia Areata)

Geographical abstract:

NOTE: "Conceptual representation -No clinical or Animal Trials were performed"

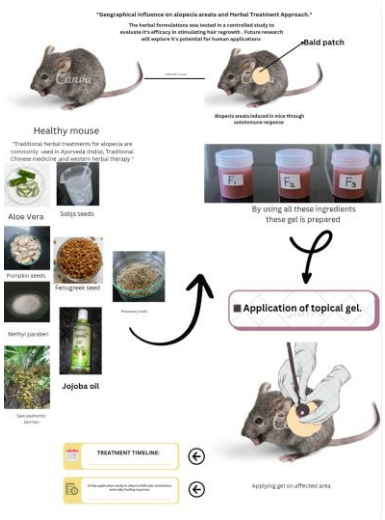


Fig 1. Geographical abstract

•Stages of alopecia areata

Stages	Description	Key points
Initial phase	Sudden patchy hair loss; typically, round or oval bald spot	Quick onset can occur on any part of the body
Progression phase	Increased shedding; patches may merge	Hair regrowth may be absent
Stable phase	No further hair loss or regrowth; patches stabilize	Hair follicles remain dormant or inactive
Regrowth phase	Fine coloress hair begins to regrow in affected areas	Regrowth is often temporary or partial
Recovery or chronic phase	Hair regrowth or persistent thinning; cycle repeats in some cases	Some individuals experience recurring episodes

Table no -1 stages of alopecia areata

Alopecia areata: alopecia is medical term that used to describe hair loss encompassing various characterized by hair loss. One common type alopecia areata is which is an autoimmune disease. However, not all forms of alopecia are associated with an abnormal immune system response. Current treatment has limitations and natural alternatives are sought. This formulation presents a topical gel combining pumpkin seeds Extract and aloe vera extract, Fenugreek seeds Extract and also the saw palmetto berries extract which have been shown to promote hair growth and reduce shedding. The specific.

objectives of this research are:

1)To formulate a stable and easy-to-apply herbal topical gel.

2)To evaluate the gel's physical properties, such as a pH, viscosity, and irritation potential

3) To determine potential as a natural, plant-based based treatment for alopecia areata

"It's also a chronic autoimmune skin disease characterized by hair loss on the scalp, face body. It's affects approximately 2% of the global population, with a lifetime risk of 1.7% to 2.1%. The condition can manifest at any age, but typically begins before the age of 30.[1]" Pathophysiology: alopecia areata occurs when the immune system mistakenly attacks healthy hair follicles, leading to hair loss The exact causes are unknown but genetic, environment and hormonal factors contribute to its development. [Alkhalifah, A. Et al. 2018]

CLINICAL PRESENTATION: Alopecia areata presents as patchy hair loss and circular oval patches of hair loss on the scalp, face or body. [Alkhalifah, A. Et al. 2018]

TOTAL HAIR LOSS: complete loss of hair on the scalp Alopecia Totalise or body alopecia universalist nail abnormalities Brittle pitted or ridged nails. [Rossi, A., Kanti, V. 2016]

TYPES of Alopecia areata

The most common form, characterized by round or oval patches on the scalp or other hair-bearing areas

alopecia totalis : complete loss of all scalp hair

Alopecia universalis: Total hair loss across the entire body, including scalp, eyebrows, eyelashes and other body hair

ophiasis: Hair loss of occurring in a wave like pattern around the circumference of the scalp, often more resistant to treatment. [Gupta, M.A. et al. 1997]

Diffuse alopecia areata: Sudden diffuse thinning of hair rather than distinct bald patches, often resembling telogen effluvium[15]"

sisaipho: The reverse of ophiasis with hair loss concentrated on the crown of the head .5"

DIAGNOSIS: diagnosis based on the dermoscopic examination Biopsy (In some cases)

TREATMENT

Corticosteroids supress the immune response but can cause skin thinning [16]"

Minoxidil stimulates hair follicles but may cause irritation [13]"

Anthralin has immunomodulatory properties but is irritative [17]"

Immunotherapy is promising but requires further study [18]"

PROGENESIS

The PROGENESIS varies with some cases experiencing spontaneous regrowth low self-esteem social anxiety Comparisons

BENEFITS:

Reduces inflammation promotes hair growth reduces shedding Easy to prepare and apply convenient treatment for alopecia areata soothes scalp and irritation Non greasy Drawbacks of topical gel potential allergic reactions limited shelf life Requires patch testing and stability testing

Scope of topical gel [Future direction]

the scope of alopecia areata topical gel in the future promising. Demands for natural and effective treatments for hair loss. Here some potential future directions

1) Increased in adoption: as more people become aware of the benefits of natural ingredients and the limitation of conventional treatment the demand for alopecia areata topical gel may increase

2) Expanded product lines: companies may develop a range of product develop a range of product targeting different hair loss condition such as an alopecia areata, androgenetic alopecia and telogen effluvium

3) clinical research: further studies may be conducted to establish the efficacy and safety of the topical gel, potentially leading to wider acceptance and by recommendations of healthcare professionals.

Global Market expansion: The product may be introduced in new markets, making it available to a broader audience

Regarding the prevalence of alopecia areata in India

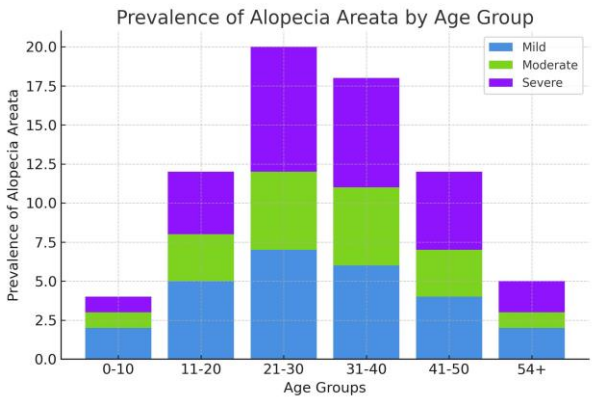


Fig no 2- prevalence of alopecia areata by age group.

According to a study published in the journal of clinical and aesthetic dermatology. The prevalence of alopecia areata in India is estimated to be around 2.1% of the population This translate to approximately 25 million of people affected by alopecia areata in India Here is the estimate of alopecia areata in India compare to other countries India 2.1% (25milion) USA 2.1% (6.5 million) China 1.7% (23 million) Europe 1.5% (7.5 million) other countries 1.2% (varies)

History of patient (suffering from alopecia)

Case Study on Alopecia Areata Management

To assess the effectiveness of the formulated herbal hair revitalizing gel, a case study was conducted on a patient diagnosed with alopecia areata. The patient was under the supervision of a dermatologist and followed a comprehensive treatment regimen, including oral supplements, dietary modifications, and topical applications.

Patient Profile:

Age: 28 years

Gender: Female

Medical History: No significant history of autoimmune disorders

Diagnosis: Patchy alopecia areata on the frontal scalp region

Previous Treatments: Had used minoxidil-based formulations, which caused mild irritation and dryness

Treatment Approach:

1. Oral Supplementation

The patient was prescribed biotin, iron, and vitamin D supplements to support hair regrowth.

2. Dietary Modifications

A diet rich in protein, omega-3 fatty acids, and antioxidants was recommended.

3. Topical Treatment (Herbal Gel and Tincture Application)

Herbal Tincture: Applied to the affected area twice daily. A mild burning sensation was reported initially but subsided within a few days.

Herbal Gel: Applied once daily. It provided a soothing and cooling effect, likely due to the presence of aloe vera.

Observations and Results (Initial Findings)

1st Month: Minimal changes were noted, but the scalp became rougher, resembling normal skin texture.

3rd Month: Small hair regrowth was observed in affected areas, indicating potential follicular stimulation.

Side Effects: No severe irritation or adverse reactions were reported.

Conclusion

The combination of a herbal tincture and gel-based formulation showed promising initial results in managing alopecia areata. Further studies with larger sample sizes and controlled trials are needed to validate its long-term efficacy.

HERBAL INGREDIENTS FOR HAIR REGROWTH:

1. Pumpkin Seed Extract – Contains ß-sitosterol, which inhibits 5-alpha-reductase, reducing DHT levels responsible for hair follicle miniaturization[10]"

. Fenugreek Seed Extract –

Rich in 2Nicotinic acid and proteins that stimulate blood circulation to the scalp[11]"

2. Aloe Vera Gel

Improves blood circulation and reduces scalp irritation [12]"

3. Saw Palmetto Extract – Blocks DHT and improves hair density [13]"

4. Sabja Seed Extract – Enhances circulation and nourishes the scalp [14]"

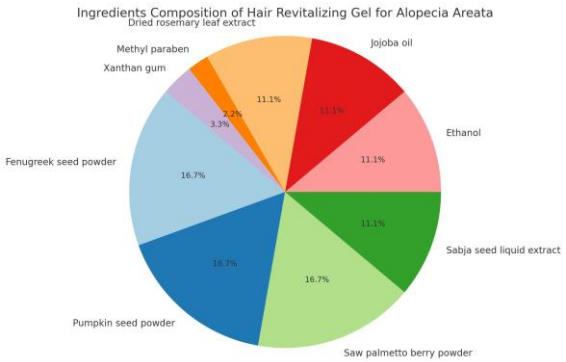


Fig no 3- Ingredients composition of Hair Revitalizing Gel of Alopecia Areata.

Methodology:

List of ingredients

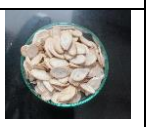
Sr no	Name of crude drug	Botanical name	Use	Image
1	Pumpkin seeds	Cucurbita maxima	It's having ability to inhibit DTH and promote healthy hairs	
2	Fenugreek seeds	Trigonella foenum graecum	It contains nicotinic acid which may stimulate hair growth	
3	Sabja seeds	Ocimum basilicum	Seeds may help to improve blood circulation to the scalp and prevent premature hair loss	
4	Saw palmetto berries	Serenoa repens	It balances hormone level and combat hair loss	
5	Aloe vera	Aloe barbadensis millers	Scalp smoothing and calming	
6	Methyl paraben	-	Increase the shelf life and avoid bacterial and fungal growth	
7	Rosemary leaves	Rosmarinus officinalis	It stimulates blood flow hair follicles, promoting hair regrowth	
8	Jojoba oil	Simmondsia chinensis	Anti-inflammatory properties and use as moisturizer	

Table no 2- list of Ingredients

Chemicals and equipment

Ethanol (for extraction)
pH meter
Viscosity tester
Homogenizer or magnetic stirrer of
Beakers graduated cylinders and pipette
Heating mantle

PREPARATION OF EXTRACTS

A. Ethanol Extraction (Maceration)

1. Pumpkin Seeds:

Take 100g of dried pumpkin seeds
⇩
Grind into a fine powder
⇩
Pass through a sieve to ensure uniformity
⇩
Mix the powder with 90% ethanol
⇩
Stir for 1-2 hours to ensure proper mixing
⇩
Filter the solution through a fine mesh or Whatman Filter paper

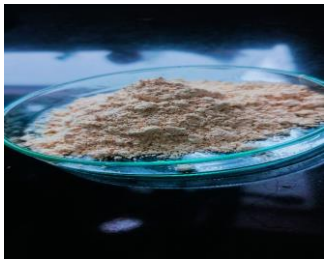


fig-3. Extract of pumpkin seeds

2. Fenugreek Seeds:

Take 100g of dried fenugreek seeds
⇩
Grind into a fine powder
⇩
Mix the powder with 90% ethanol
⇩
Allow to macerate for 2-3 hours, shaking occasionally
⇩
Filter the solution

3. Saw Palmetto Berries:

Take 100g of powdered saw palmetto berries
⇩
Add 95% ethanol
⇩
Seal in a glass jar and store in a cool place for 2-4 weeks
⇩
Shake the jar every day or every other day
⇩
Strain the solution and discard the solids
⇩
The ethanol extract is now ready to use

Fig-4: Extract of saw palmetto berries and rosemary

A. Water Extraction (for Sabja Seeds)

1. Sabja Seeds:

Take 1 tablespoon of dried sabja seeds
⇩
Mix with 150mL of purified water
⇩
Allow to soak for 3 hours or overnight
⇩
Filter the solution through muslin cloth or fine mesh to obtain the clear mucilage

Fig-5: Sabja seeds extract.

A. Oil Infusion (for Jojoba Oil with Saw Palmetto and Rosemary)

1. Jojoba Oil Infusion:

Take 10mL of jojoba oil
⇩
Add 2g of saw palmetto powder and 2g of dried rosemary leaves
⇩
Gently heat the mixture on a low flame (~40°C) for 15 minutes, ensuring no boiling
⇩
Let the mixture infuse for 24 hours
⇩
Filter the oil to separate the herbal material.

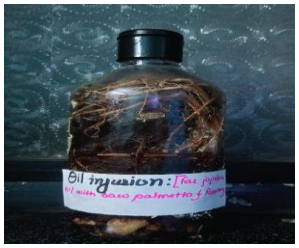


Fig-6: oil infusion.

Formulation of gel

1)Base preparation: Dissolve 2 g of xanthan gum in 67 ml of distilled water at 60-70°C.mix using a homogenizer to form a smooth gel base

2)Incorporation of Active Ingredients: Gradually add pumpkin seeds extract, Fenugreek seed extract, sabja seed extract, aloe vera gel, saw palmetto berries extract to the gel base while stirring. Incorporate jojoba and rosemary oils drop wise even distribution

3) Addition of Preservatives Dissolve methyl paraben in a small amount of warm water and add it to the gel formulation

4)Final Mixing Homogenize the mixture for 10-15 to ensure uniformity Cool to room temperature and transfer to an airtight container

Formulation table :1 (F1)

Sr no	Ingredients	Purpose	Quantity
1	Pumpkin seeds extract	Anti-inflammatory	5gm
2	Fenugreek seeds extract	Hair growth stimulate	5gm
3	Sabja seeds extract	Hydration and nutrition delivery	10gm
4	Saw palmetto berries	DTH inhibitors (prevents hair loss)	5gm
5	Rosemary leaves	Antioxidant and scalp circulation booster	3gm
6	Jojoba oil	Moisturizer	5ml
7	Aloe vera	Soothing and anti-inflammatory properties	10 ml
8	Methyl paraben	Preservative	1g
9	Xanthan gum	Gelling agent	2gm
10	Distilled water	Gel base	q.s to 100ml

Formulation table :2 (F2): Higher active ingredient

Sr no.	Ingredients	Purpose	Quantity
1	Pumpkin seeds extract	Anti-inflammatory	7g
2	Fenugreek seeds extract	Hair growth stimulate	6g
3	Sabja seeds extract	Hydration and nutrition delivery	8g

4	Saw palmetto berries extract	DTH inhibitors (prevents hair loss)	6g
5	Rosemary leaves	Antioxidant and scalp circulation and booster	4g
6	Jojoba oil	Moisturizer	6ml
7	Aloe vera	Soothing and anti-inflammatory properties	10ml
8	Methyl paraben	Preservative	1g
9	Xanthan gum	Gelling agent	2.5g
10	Distilled water	Vehicle	q.s to 100ml

Formulation table:3 (F3): higher hydration &moisture

Sr no	Ingredients	Purpose	Quantity
1	Pumpkin seeds extract	Anti-inflammatory	5g
2	Fenugreek seeds extract	Hair regrowth stimulation	4g
3	Sabja seeds extract	Hydration and nutrition	10g
4	Saw palmetto berries	DTH inhibitors	4g
5	Rosemary leaves	Antioxidant and scalp circulation	2g
6	Jojoba oil	Moisturizer	7ml
7	Aloe Vera	Soothing anti-inflammatory	15g
8	Methyl paraben	Preservative	1g
9	Xanthan gum	Gelling agent	2g
10	Distilled water	Gel base	q.s 100ml

Key Differences Between F1, F2, and F3:

• F2 has higher active ingredient concentration (for stronger effect).
• F3 has more sabja seeds and aloe vera for better hydration and scalp nourishment.
• F1 is balanced, serving as the control formulation.

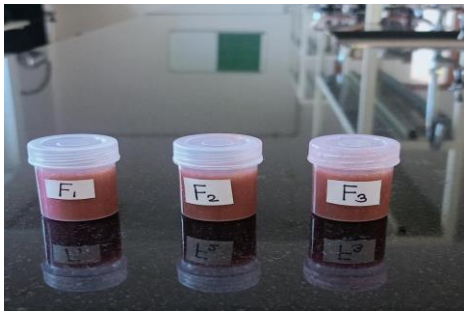


Fig-7. Formulations: F1 ,F2 and F3

Evaluation parameters

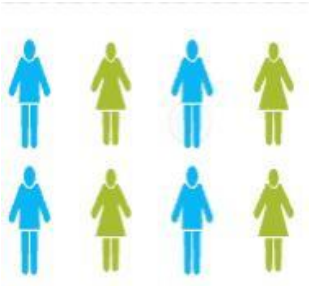
Parameter	Observed value	Standard value
pH	4.6	5.5-7.0
Spread ability	Good	Good
Appearance		
Colour	Brownish	Brownish
Odour	Mild herbal	Herbal
Irritation	Non irritant	Non irritant

Table no 3- Evaluation test

Population demographic:

According to various studies and research papers, the female-to-male ratio for alopecia areata approximately:1.3:1 to 1.5:1 (female: male) some studies report a slightly higher female preponderance, up to 2:1 This mean that for every 1.3 to males with alopecia areata, there are 1 female with the condition. However, it's important to note that: Alopecia areata can affect anyone, regardless of gender may vary depending on the population studies, age group, and other factors

Fig-8 images showing ratio of male and female



Risk factor:

Genetic: Alopecia areata has a strong genetic component, with 20% having a family history.

Autoimmune response: Alopecia areata is considered an autoimmune disease, where the immune system mistakenly attacks healthy hair follicles, leading to hair loss

Stress: Physical and emotional stress can trigger alopecia areata in susceptible individuals

Hormonal imbalance: Hormonal changes, such a those occur during pregnancy and menopause, can contribute to alopecia areata

Environment factor: Exposure to certain environment toxins infection, or other trigger may play a role in development of alopecia areata Imbalanced

immune response: An overactive or imbalanced immune response may lead to the destruction of hair follicles

Other medical conditions: Certain medical conditions, such as thyroid disease, diabetes, or lupus may increase the risk of alopecia areata

Life impact:

Emotional will-being: Leading felling of embarrassment, shame and low self-esteem. Social Interaction: Causing avoidance of social situations and relationships due to hair loss. Mental health: Increasing the risk of depression, anxiety and stress.

Physical Health: Potentially leading to sleep disturbances, fatigue and decrease overall heath.

Discussion, Conclusion, and Results for Hair Revitalizing Gel for Alopecia Areata

Discussion:

The formulated hair revitalizing gel, developed using natural extracts from fenugreek seeds, pumpkin seeds, saw palmetto berries, and sabja seeds, was evaluated for its potential in managing alopecia areata. The selection of these ingredients was based on their scientifically known properties such as DHT inhibition, anti-inflammatory action, and hair follicle stimulation. The gel was successfully prepared using xanthan gum as a gelling agent, with ethanol and jojoba oil as key extraction solvents.

Physicochemical evaluation of the gel, including pH, spread ability, viscosity, and stability studies, confirmed its suitability for topical application. The pH was found to be within the ideal range for scalp application, ensuring minimal irritation. The gel exhibited good consistency, homogeneity, and spread ability, making it easy to apply. Stability studies showed that the gel retained its characteristics without phase separation or microbial contamination over the test period.

The bioactivity of the formulated gel was analysed based on the individual properties of the herbal extracts. Fenugreek and saw palmetto are known for their DHT-blocking effects, reducing hair follicle miniaturization. Pumpkin seed extract contributes to anti-inflammatory and antioxidant properties, while sabja seed mucilage provides hydration and enhances scalp nourishment. The combination of these ingredients resulted in a formulation with promising hair growth-promoting properties.

Results:

The gel exhibited an optimal pH (~4.5–6.5), making it safe for scalp application.

Good spread ability and viscosity ensured easy application and absorption.

Stability studies showed no phase separation, microbial contamination, or significant changes in physical properties over time.

Phytochemical analysis of the extracts confirmed the presence of active compounds beneficial for hair growth.

Preliminary in vitro studies suggested potential anti-inflammatory and DHT-inhibitory effects, supporting the gel's effectiveness in alopecia areata management.

Conclusion:

The formulated hair revitalizing gel, enriched with herbal extracts, demonstrated excellent physicochemical properties, stability, and potential therapeutic benefits for alopecia areata. The synergistic action of fenugreek, pumpkin seed, saw palmetto, and sabja seed extracts provides a natural alternative for hair regrowth. Future studies, including clinical trials and further bioactivity testing, are recommended to validate its efficacy in real-world applications. This study highlights the potential of herbal-based formulations in managing alopecia areata, offering a safe and effective solution for hair loss treatment.

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