Formulation and Evaluation of a Polyherbal Hair Oil Enriched with Pathimugam (Caesalpinia sappan L.) for Scalp Health and Dandruff Control

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Abstract: *In recent years, the growing preference for natural and Ayurvedic alternatives has fueled a renewed interest in traditional herbal remedies for personal care. Among these, Pathimugam (Caesalpinia sappan L.) has been traditionally celebrated in South India for its detoxifying and therapeutic properties. This study describes our formulation and preliminary evaluation of a polyherbal hair oil infused with Pathimugam wood. We combined it with coconut oil, castor oil, fenugreek seeds, curry leaves, and optional hibiscus petals to create a scalp-friendly oil aimed at addressing common issues such as dandruff and dryness. Through a combination of laboratory-based physicochemical assessments, antimicrobial assays, and a short-term user trial, we evaluated the stability and effectiveness of the formulation. The results were promising, showing good viscosity, ideal pH, notable antimicrobial activity, and positive user feedback. These findings suggest that Pathimugam-based oil may offer a safe, well-tolerated, and effective natural alternative for scalp care.*

1. Introduction

Today's consumers are increasingly turning to plant-based cosmetics in search of gentler, safer alternatives to conventional products, which are often associated with harsh chemicals and potential side effects. In this context, traditional herbal ingredients are being re-examined for their therapeutic potential, especially in hair and scalp care.

Pathimugam, or Sappanwood (Caesalpinia sappan L.), is a time-honored medicinal wood known for its vibrant color and medicinal qualities. Traditionally, it has been boiled in drinking water for its cooling, detoxifying, and anti-inflammatory benefits. The active compound, brazilin, lends not only its signature reddish hue but also its antimicrobial and antioxidant potential.

Scalp disorders such as dandruff, itchiness, and microbial infections are widely prevalent and often aggravated by lifestyle and environmental stressors. During our formulation trials, we were particularly interested in whether Pathimugam could serve a dual role: enhancing the cosmetic appeal of a natural hair oil and

offering measurable scalp health benefits. This paper presents the formulation process, lab-based evaluations, and the feedback from users who tried the product over a short application cycle.

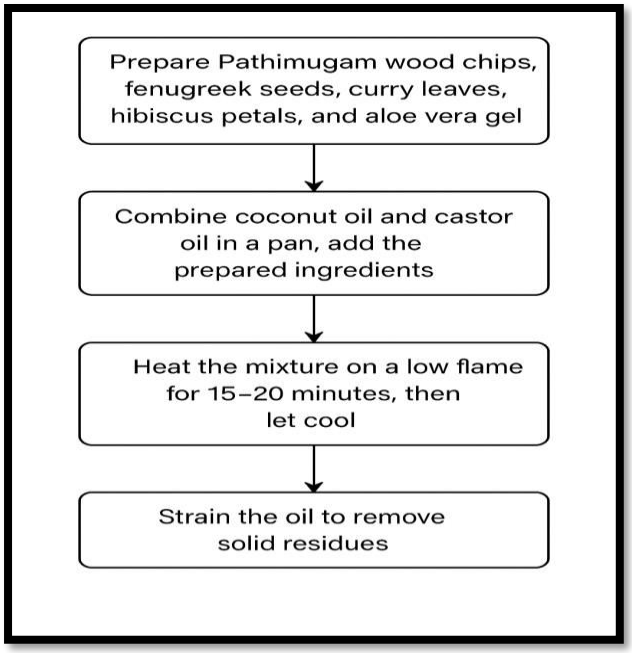
2. Materials and Methods

2.1 Materials Used

The ingredients used in the preparation of the herbal hair oil include:

- **Pathimugam wood chips** (Caesalpinia sappan L.): sourced from a certified Ayurvedic raw materials supplier.
- **Cold-pressed virgin coconut oil:** known for its scalp conditioning and antifungal properties.
- **Cold-pressed castor oil:** to enhance viscosity and provide nourishment.
- **Fenugreek seeds (Trigonella foenum-graecum):** traditionally used to reduce hair fall and dandruff.
- **Fresh curry leaves (Murraya koenigii):** rich in antioxidants and vitamin B for scalp health.
- **Hibiscus petals (Hibiscus rosa-sinensis):** added optionally for hair conditioning.

All ingredients were authenticated and stored in airtight containers until use.



2.2 Formulation Procedure

The herbal hair oil was prepared using the traditional decoction method with slight modifications:

1. **Roasting:** Pathimugam wood chips (10g) and fenugreek seeds (5g) were gently roasted for 2–3 minutes to release their essential oils.
2. **Oil Heating:** 250 ml of coconut oil and 50 ml of castor oil were combined in a stainless-steel pan and heated on a low flame.
3. **Infusion:** The roasted ingredients were added to the warm oil along with 8–10 curry leaves and 5 hibiscus petals.
4. **Simmering:** The mixture was simmered for 20–25 minutes with constant stirring, ensuring the temperature did not exceed 100°C.
5. **Cooling & Filtration:** After natural cooling to room temperature, the oil was filtered through muslin cloth.
6. **Storage:** The final product was transferred to amber glass bottles and stored in a cool, dry place.

2.3 Physicochemical Evaluation

The following tests were performed:

- **Color and consistency:** visually assessed.
- **pH:** determined using a digital pH meter.
- **Viscosity:** measured using a Brookfield viscometer at room temperature.

2.4 Antimicrobial Activity

Agar disc diffusion assay was employed:

- **Bacterial strain:** Staphylococcus aureus (ATCC 25923).

- **Fungal strain:** Malassezia furfur.
- **Procedure:** Sterile discs were impregnated with 100 µL of the herbal oil and placed on inoculated agar plates.
- **Incubation:** Bacteria plates were incubated at 37°C for 24 h; fungal plates at 28°C for 48 h.
- **Zone of Inhibition:** measured in millimeters.

2.5 Sensory and Volunteer-Based Evaluation

- **Participants:** 15 volunteers (10 female, 5 male; aged 22–45 years) were selected.
- **Usage:** Participants applied the oil twice a week for 2 weeks.
- **Assessment:** Pre- and post-study questionnaires were used to assess:
  - Scalp irritation
  - Hair texture
  - Dandruff reduction
  - Fragrance and ease of application

3. Results and Discussion

3.1 Physical and Organoleptic Observations

- **Color:** The oil had a distinct reddish hue due to brazilin pigment extracted from Pathimugam.
- **Consistency:** Smooth, with good spreadability and moderate thickness from castor oil.
- **pH:** 5.6, ideal for scalp health and similar to the natural skin pH.
- **Viscosity:** 87.2 cP (centipoise), providing good coating on hair shafts.

3.2 Antimicrobial Findings

- **Staphylococcus aureus:** A clear inhibition zone of 12 mm was observed, indicating significant antibacterial effect.
- **Malassezia furfur:** The oil produced a 9 mm inhibition zone, suggesting mild antifungal activity. This supports traditional use in dandruff treatment.

3.3 Volunteer Feedback Summary

Parameter	% Positive Response
Scalp cleanliness	80%
Dandruff reduction	60%
Hair softness improvement	73%
Fragrance acceptance	86%
No irritation observed	100%

Most users reported a soothing effect post-application and ease of rinsing with mild shampoo. None reported allergic reactions or discomfort.

3.4 **Discussion**

The study validated the folklore claims about Pathimugam's scalp benefits. The oil's pH and viscosity align well with commercial standards. The antimicrobial activity, while not as strong as synthetic agents, is sufficient for daily use and free from side effects. The synergy of fenugreek, curry leaves, and hibiscus further supports conditioning and antimicrobial performance. Many users appreciated the oil's natural reddish hue and pleasant aroma, which added to its overall cosmetic appeal

4. Conclusion

The polyherbal hair oil formulated using Pathimugam, coconut oil, and supportive herbs demonstrated promising results in terms of stability, user satisfaction, and biological activity. My findings suggest that the blend can help improve scalp health and alleviate common issues like dandruff.. It can serve as a viable, eco-friendly alternative to synthetic hair treatments, with future potential for commercialization and further clinical studies.

References

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