



FORMULATION AND EVALUATION OF POLYHERBAL HAIR GEL

Shubhangi Kharat¹, Divya Bagade, Dipti Bhosale³, Pradnya Channa⁴, Pratiksha Dhainje⁵,
Snehal Ghatule⁶ (Department of Pharmacology)

Shikshan Prasarak Mandal's College of Pharmacy Akhuj, Solapur (413101), Maharashtra, India

ABSTRACT

The present study aims to develop and assess a polyherbal hair gel using natural extracts for hair care benefits, evaluating its physicochemical properties, stability, and efficacy in promoting hair health. Specifically, the gel will examine the potential benefits of guava leaf, flaxseed, and neem juice extracts in reducing hair loss and eliminating dandruff. This study's primary goal is to create and assess a polyherbal hair gel and identify its physicochemical function, with a focus on the product's quality, safety, and efficacy. The active constituents in this preparation are guava leaves, flaxseed, neem leaves, water, and methyl parabens. These ingredients are combined into a gel that is made with Carbopol 940 at different concentrations, ranging from 0.5 to 2%. The research provides insights into creating polyherbal hair care formulations, highlighting the importance of combining traditional wisdom with modern scientific methods for long-lasting, healthy hair care solutions.

Keywords: Polyherbal, Physicochemical properties, Stability, Efficacy, Guava leaf, Flaxseed

INTRODUCTION

Polyherbal hair gel refers to a hair styling or grooming product that contains a blend of various herbal extracts or ingredients. The term "polyherbal" indicates the use of multiple herbs in the formulation. These herbal extracts are often chosen for their potential benefits to the hair and scalp. The specific herbs used can vary depending on the formulation and the intended effects of the gel.^[1, 2] A major undertaking in the fields of pharmaceutical and cosmetic sciences is the formulation and assessment of polyherbal hair gel. This procedure entails the thoughtful selection and blending of several herbal extracts and active substances to produce a gel that is intended to support hair health and deal with typical hair-related problems. The product's overall efficacy is intended to be increased by utilizing the synergistic effects of numerous herbs in its formulation.^[3] Polyherbal hair gel is a unique formulation that combines the therapeutic properties of various herbal extracts to provide comprehensive solutions for hair-related concerns. The formulation incorporates multiple herbal ingredients for a potent, versatile hair care product, focusing on specific properties like nourishing hair, improving scalp health, and addressing hair loss or dandruff.^[4, 5] Herb selection is crucial for formulation success, with common herbs like Guava leaves, Flaxseed and Neem leaves providing unique benefits like conditioning, strengthening, and antimicrobial properties. Herbal hair treatments address the underlying cause of hair issues, making them an effective natural remedy.^[6] The inherent moisture balance of the hair can be restored and its natural oils, vitamins, and minerals can be deeply absorbed by the hair. This treatment's natural ingredient can help maintain the pH balance of the scalp, control sebum production, and get rid of dangerous germs, all of which contribute to the development and health of healthy hair.^[7]

Hair Scalp Infection

Dandruff is a non-inflammatory, chronic scalp disease caused by excessive scaling of scalp tissues. It is a common hair problem and can be caused by factors like oily scalp, poor hygiene, and poor hair washing.^[8] There are two types: oily and dry dandruff. Candida, a common fungus, causes skin lesions and can become pathogenic as it multiplies. Malassezia, a yeast found in 75-90% of healthy people, is most common in patients with increased sebum production. Folliculitis, a skin syndrome, causes inflammation of the skin when hair follicles are infected with bacteria, viruses, fungi, parasites, drugs, or physical injury.^[9]

Hair Gel

Gels are semi-solid suspensions of small inorganic particles or large organic molecules impregnated with a liquid, consisting of a gelling agent and a liquid component. Ideal hair gel properties include antimicrobial properties, non-stickiness, cost-effectiveness, ease of washing, spreading, and safety.^[10] Herbal extracts from guava leaves, neem, and flax seeds have been proven effective in treating candidiasis. Guava leaves are rich in vitamins B and C, promoting hair growth and antibacterial activity against gram-positive and gram-negative bacteria. Flax seeds are moisturizing, stimulate growth, and improve hair strength. Neem produces antifungal, antibacterial, analgesic, and anti-inflammatory compounds for dandruff.^[11]

Key Features of Polyherbal Hair Gel

- **Natural Ingredients:** Polyherbal hair gel typically includes a variety of herbal extracts, such as guava leaves, flaxseed, neem leaves, and others. These ingredients are chosen for their known benefits in nourishing and strengthening hair.^[12]
- **Moisturizing Properties:** Many polyherbal formulations focus on providing intense hydration to the hair. This helps combat dryness and frizz, leaving the hair feeling soft, smooth, and more manageable.^[13]
- **Styling Support:** Apart from nourishing the hair, polyherbal hair gels often offer styling benefits. They provide a light to medium hold, making it easier to shape and style the hair without the stiffness associated with traditional styling products.
- **Hair Health Enhancement:** The combination of herbal extracts may contribute to overall hair health.
- **Free from Harmful Chemicals:** Polyherbal hair gels are often formulated without harsh chemicals like sulfates, parabens, and artificial fragrances. This appeals to individuals seeking natural and eco-friendly hair care options.
- **Versatile Usage:** Suitable for various hair types, polyherbal hair gels are designed to cater to a broad audience. Whether someone has curly, straight, or wavy hair, these gels aim to provide benefits across different hair textures.
- **Pleasant Fragrance:** With the use of herbal extracts, polyherbal hair gels often have a natural and pleasant fragrance, contributing to a positive sensory experience during application.^[1, 14]

MATERIALS AND METHODS

A) Guava:

The *psidium gujava* leaves were collected from the local farms of Tal: Malshiras, Dist. Solapur, Maharashtra.

Family: Myrtaceae.

Preparation of guava leaf powder:

Fresh guava leaves are collected and dried in the sun for 3 days. The dried leaves were crushed and ground into a coarse powder in a blender. The powder was collected in an airtight container and stored in a cool, dry place, protected from sunlight.

Preparation of methanol extract of guava leaf powder:

- 1) Phytochemical extract of *Psidium guava* is obtained by immersion extraction method. The methanol extract is prepared by mixing 20 grams of guava leaf powder with 160 ml of methanol and 40 ml of distilled water.
- 2) This mixture is kept in a dark place to avoid sunlight for 3 days at room temperature. Beakers are used for storage, the clone bottle is sterilized and wrapped in aluminum foil to prevent evaporation.
- 3) After the 3-day soaking process, the mixtures were filtered with filter paper, and the solvent was allowed to evaporate at 37 °C. 20 g of powder with 180 ml of methanol gives 10 ml of extract.^[1]



Figure 1: Extraction of guava leaves

a) Microbial Assay

1. Determination of Antibacterial Activity:

Procedure:

Antibacterial activity against *S. aureus* bacteria by well diffusion method: The inoculums of the microorganism were prepared from the bacterial cultures. 15 ml of nutrient agar (Hi media) medium was poured into clean sterilized Petri plates and allowed to cool and solidify. 100 μ l of broth of bacterial strain was pipette out and spread over the medium evenly with a spreading rod till it dried properly. Once the agar was hardened, the Sample Slides were placed on the plate in the manner and the plates were incubated at 37⁰C for 24 h. Antibacterial activity was evaluated by measuring the diameters of the zone of inhibitions (ZI).^[15]

Table No 1: Antimicrobial activity of the extract

Sr.no	Samples	Concentrati on(mg/ml)	Zone in diameter (mm) <i>s.aureus</i>
1	Control	-	-
2	Standard (streptomycin)	1mg	22mm
3	Sample	100 μ l	04mm
		200 μ l	08mm

Figure 2: ZOI of P. gaujava extract for *S.Aureus*

2. Antifungal activity against *Candida albicans*: (Agar well plate diffusion Method)

Well diffusion method for the determination of zone of inhibition

Antifungal activity:

Stock solution for antifungal activity:

For the antifungal study sample concentrations of 5 mg and 10 mg were stored in a refrigerator till further used.

Antifungal activities of the sample were evaluated using agar well diffusion assay. The assay was carried out according to the method of (Hufford et al., 1975). Sabouraud dextrose agar (Hi media) was used for the growth of fungus. Media with acidic pH (pH 5.5 to 5.6) containing a relatively high concentration of glucose (40%) is prepared by mixing (SDA) Sabouraud dextrose and distilled water and autoclaved at 121 degrees Celsius for 15 minutes. Twenty-five ml of molten (45°C) SDA medium was aseptically transferred into each 100mm×15mm sterile Petri dish. For counting spores (fungi) were suspended in normal saline to make volume up to 1ml and then counted with the help of a hemocytometer (Neubauer chamber). Once the agar was hardened, 6 mm wells were bored using a sterile cork borer. Then 0.1ml (100µl) from each stock solution of the sample having a final concentration of 5 mg and 10 mg was placed in each well and the plates were incubated for 72 hours at 29 degrees Celsius.^[15, 16] The antifungal activity was measured as the diameter (mm) of the clear zone of growth inhibition.

Table No 2: Antifungal activity of the extract

Sr. No	Samples	Conc.	Zone in diameter(mm) Against <i>Candida albicans</i>
1	STD (Fluconazole)	1 mg	18
2	Sample	5 mg	05
		10 mg	09

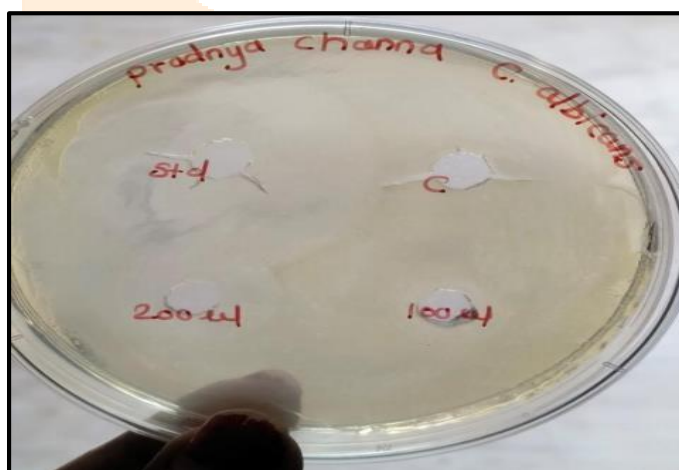


Figure 3: ZOI of P.gaujava extract for C.Albicans

B) Neem:

Collection of plant: The Azadirachta indica leaves were collected from the premises of SPM College of Pharmacy, Akluj.

Preparation of neem juice: First, take fresh and whole neem leaves. Then wash it with distilled water and dry it a little. Place the leaves in a blender and add the required amount of water. Blend until you get a smooth consistency. Use a muslin cloth to strain the mixture.^[17]



Figure 4: Neem juice

C) Flax seed:

Collection of plant: The flax seeds were collected from the local market of Akluj, Tal: Malshiras, Dist. Solapur.

Preparation of flax seed extract: Flax extract was made by boiling the seeds in water. Thick vegetable sludge was obtained by continuous stirring. The mucus was then strained through a suitable sieve and



collected.^[18]

Figure 5: Flaxseed Gel

Preparation of Hair Gel:

1. Three herbal hair gel formulas were prepared using different amounts of extract.
 2. Weigh out the required amount of Carbopol 940 and dissolve it in 37.5 ml of water in a beaker. Set the vessel aside for half an hour to allow the Carbopol 940 to expand, then stir at 1200 rpm using a magnetic stirrer for 30 minutes.
 3. Solution A: Take the required amount of guava extract and propylene glycol in a beaker and mix well.
 4. Solution B: Add neem juice, linseed gel, and methylparaben in propylene glycol to another beaker.
 5. Disperse solution A and solution B in Carbopol 940 with constant stirring.
- Finally, add the remaining ml of formulation and triethanolamine drop by drop until the pH becomes neutral and the gel reaches the required composition.^[1]



Figure 6: Formulation of Hair Gel



Figure 7: Mixing of Hair Gel

Formulation table of polyherbal hair gel 50 gm:

Table No.3: Formulation of polyherbal hair gel

Sr.no	Name of Ingredients	F1	F2	F3
1.	Guava leaves extract	1ml	2ml	3ml
2.	Neem juice	3ml	2ml	1ml
3.	Flaxseed gel	2ml	2ml	2ml
4.	Carbopol 940	1g	1g	1g
5.	Propylene glycol	4ml	4ml	4ml
6.	Methyl paraben	1g	1g	1g
7.	Triethanolamine	1-2 drop	1-2 drop	1-2 drop
8.	Lemon oil	1-2 drop	1-2 drop	1-2 drop
9.	Distilled water	38ml	38ml	38ml

Phytochemical analysis of the extract:

Table No.4: Phytochemical analysis of the extract

Phytochemical Analysis	Test Method	Observation/Result
Alkaloids	Wagner's test	Positive: Reddish brown precipitate
Saponins	Shaken with distilled water, warmed	Positive: Formation of stable foam
Tannins and Phenols	Mixed with 5% ferric chloride solution	Positive: Formation of blue color
Flavonoids	Mixed with 10% lead acetate solution	Positive: Formation of yellow precipitate
Glycosides	Dissolved in glacial acetic acid, heated	Positive: Pale green color in upper layer
Terpenoids	Aqueous extract in chloroform, sulfuric acid	Positive: Reddish brown interface

EVALUATION**Organoleptic Properties:**

Color: Yellowish Green

Odour: Pleasant

Appearance: Evaluation done by Visual perception. The gel was smooth in appearance and homogenous.

pH Measurement: Neutral

Table No 5: Evaluation parameters

Property	Test Method	Observation/Result
Spreadability	Measure spreading diameter between two horizontal glass plates (10cm*20cm) with 1ml of sample, 20gm weight applied Formula: $S = wl/t$	Spreadability: 18 cm, Good spreadability S (Spreadability) = 18 gcm/sec
Extrudability	Squeezable gel in a closed tube, expel a 0.5 cm long gel ribbon in 10 seconds, calculate load in grams	Extrusion pressure: [Result in grams]
Skin Irritating	Apply a small quantity on the dorsal part of the hand, check for irritation and redness	Non-irritant, No redness
Washability	Apply on skin, wash with normal water, observe for clean and clear skin	Clean and clear skin observed after washing

RESULTS AND DISCUSSION

The polyherbal gel's formula was assessed at several parameters. Visual inspection was performed for every organoleptic property, including color, odour, homogeneity, and appearance. Consequently, the color was perceived as green. The texture and uniformity of the preparation on the discovered skin were examined using particles. Good washability qualities were discovered, as it washes off easily with regular water. The formulation's pH was examined and determined to be skin-friendly. Utilizing an empty collapsible tube filled with hair gel and verifying for quantity, an extrudability test was conducted. Glass plates were used to assess the spreadability quality, and the results showed that the preparation was easily spreadable and had good consistency. Redness and itchiness are absent.

Table No 6: Evaluation parameters

Sr. no	Parameters	Observations		
		F1	F2	F3
1	Colour	Green	Yellowish green	Yellowish green
2	Odour	Pleasant	Pleasant	Pleasant
3	Appearance	Smooth	Smooth	Smooth
4	pH	6.8	6.9	6.5
5	Viscosity	5130 cP	5240 cP	5260 cP
6	Homogeneity	Good	Excellent	Good
7	Spreadability	16gmcm/sec	18gmcm/sec	15gmcm/sec
8	Extrudability	Good	Excellent	Good
9	Skin irritation	No irritation	No irritation	No irritation
10	Washability	Easily washable	Easily washable	Easily washable

The study involved the assessment of various parameters for formulations labeled as F1, F2, and F3. In terms of color, F1 exhibited a green hue, while F2 and F3 displayed a yellowish-green shade. The odour for all formulations was found to be pleasant. The appearance of each formulation was smooth, indicating uniformity in texture. The pH values for F1, F2, and F3 were measured at 6.8, 6.9, and 6.5, respectively. Viscosity, measured in centipoise (cP), showed values of 5130 cP for F1, 5240 cP for F2, and 5260 cP for F3. Homogeneity assessment revealed that F2 had excellent uniformity, while F1 and F3 exhibited good homogeneity. Spreadability, measured in gmcm/sec, indicated rates of 16 for F1, 18 for F2, and 15 for F3. Extrudability was rated as good for F1 and F3, while F2 exhibited excellent extrudability. Skin irritation tests yielded a consistent result of no irritation for all formulations. Additionally, washability assessments confirmed that all formulations were easily washable. These observations provide a comprehensive understanding of the physical and sensory characteristics of the three formulations under investigation.

CONCLUSION

The formulation and evaluation of the polyherbal hair gel have provided valuable insights into the potential benefits of combining various herbal extracts for hair care. The developed formulation exhibited promising characteristics, including desirable physical properties, stability, and compatibility with the skin and hair. The herbal ingredients chosen for the formulation were selected based on their traditional use in promoting hair health, and the results indicate that the polyherbal blend has a positive impact on aspects such as hair strength, texture, and shine. The gel also demonstrated good spreadability and ease of application, making it user-friendly. In conclusion, polyherbal hair gel holds promise as a natural and effective option for individuals seeking an herbal-based solution for hair care. With continued research and refinement, this formulation has the potential to contribute to the growing market of natural and sustainable hair care products.

REFERENCE

1. Khan, N., Jadhav, P., Jagadale, S., Kachare, K., Kamble, S., Gandhe, S., Yewale, R., Kale, M. and Kshirsagar, S., 2022. Formulation and evaluation of polyherbal hair gel formulation. *Journal of Pharmacognosy and Phytochemistry*, 11(1), pp.32-36.
2. Roy, R.K., Thakur, M. and Dixit, V.K., 2007. Development and evaluation of polyherbal formulation for hair growth-promoting activity. *Journal of cosmetic dermatology*, 6(2), pp.108-112.
3. Pinto Durazno, V.A., 2021. Development of a range of hair growth promoting products and preliminary design of their manufacturing process.
4. Gubitosa, J., Rizzi, V., Fini, P. and Cosma, P., 2019. Hair care cosmetics: From traditional shampoo to solid clay and herbal shampoo, a review. *Cosmetics*, 6(1), p.13.

5. Mohamed, A.A.B., 2020. *Determination of Natural and Mineral Ingredients in Sudanese hair Cosmetic Products* (Doctoral dissertation, Sudan University of Science and Technology).
6. Idu, M., 2009. The plant called medicine.
7. Nadeeshani Dilhara Gamage, D.G., Dharmadasa, R.M., Chandana Abeysinghe, D., Saman Wijesekara, R.G., Prathapasinghe, G.A. and Someya, T., 2022. Global perspective of plant-based cosmetic industry and possible contribution of Sri Lanka to the development of herbal cosmetics. *Evidence-Based Complementary and Alternative Medicine*, 2022.
8. Jain, S., Arora, P. and Nainwal, L.M., 2022. Essential oils as potential source of anti-dandruff agents: a review. *Combinatorial Chemistry & High Throughput Screening*, 25(9), pp.1411-1426.
9. Pal, R.S., Saraswat, N., Wal, P., Wal, A. and Pal, Y., 2020. Preparation & assessment of poly-herbal anti-dandruff formulation. *The Open Dermatology Journal*, 14(1).
10. Almoshari, Y., 2022. Novel hydrogels for topical applications: An updated comprehensive review based on source. *Gels*, 8(3), p.174.
11. Priya Dharshini, S., 2019. *Formulation and Evaluation of Herbal Antidandruff Gel and Determination of the Effect of Herbal Adjuvants on the Enhancement of Antidandruff Activity* (Doctoral dissertation, Periyar College of Pharmaceutical Sciences, Tiruchirappalli).
12. Nair, R.V., 2022. Current Clinical Evidences of Promising Benediction of Nutraceutical and Dietary Supplements for Hepatic Disorders. In *Clinical Studies on Nutraceuticals and Dietary Supplements* (pp. 117-127). CRC Press.
13. Okole, B., Pillai, S.K., Ndzotoyi, P. and Phasha, V., 2022. Use of herbal extract-based nanoemulsions for hair care application. In *Nanotechnology for the preparation of cosmetics using plant-Based extracts* (pp. 203-233). Elsevier.
14. Kopperundevi, R., 2017. *Development and Standardisation of Poly Herbal Gel and Clinical Evaluation of Its Hair Growth Stimulation* (Doctoral dissertation, Madras Medical College, Chennai).
15. Biswas, B., Rogers, K., McLaughlin, F., Daniels, D. and Yadav, A., 2013. Antimicrobial activities of leaf extracts of guava (*Psidium guajava* L.) on two gram-negative and gram-positive bacteria. *International journal of microbiology*, 2013.
16. Shetty, Y.S., Shankarapillai, R., Vivekanandan, G., Shetty, R.M., Reddy, C.S., Reddy, H. and Mangalekar, S.B., 2018. Evaluation of the efficacy of guava extract as an antimicrobial agent on periodontal pathogens. *J Contemp Dent Pract*, 19(6), pp.690-7.
17. Kumar, D., Rahal, A. and Malik, J.K., 2016. Neem extract. In *Nutraceuticals* (pp. 585-597). Academic Press.
18. Tehrani MH, Batal R, Kamalinejad M, Mahbubi A. Extraction and purification of flaxseed proteins and studying their antibacterial activities. *Journal of Plant Sciences*. 2014;2(1):70-6.