Research Article

Formulation and Evaluation of Herbal Hair Gel Containing Curry Leaf Extract and Flax Seed Extract

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ABSTRACT

Herbal hair gels are chemical-free products that promotes hair health. It aims to nourish the scalp, moisturize hair, reduce hair fall, promote growth, and address scalp issues like dandruff. Herbal gels offer styling benefits without damaging the hair and are suitable for various hair types. Additionally, they focus on using environmentally sustainable, biodegradable ingredients. The main objective of present work is to formulate and evaluate herbal hair gel containing flax seed and curry leave extract. Extracts from flax seed and curry leaves were obtained through aqueous extraction. Formulation of herbal hair gel was done by varying drug concentration of ingredients as F1–F5. Methyl paraben was used as preservative, Triethanolamine use as pH adjuster in formulation. Five different gel formulations, with varying concentrations of these extracts, were prepared and evaluated. The formulations F1 to F5 were analyzed based on following parameters colour, odor, texture, clarity, pH, viscosity, spreadability, extrudability, gel strength, homogeneity, stability, washability, antimicrobial activity and antifungal activity. Consistency testing confirmed that the gel spreads evenly and provides a lightweight feel without leaving a sticky residue. The pH level helps prevent scalp irritation and maintains the natural hair balance, promoting healthier hair. Viscosity testing verified that the gel was neither too runny nor overly thick, making it suitable for both styling and conditioning purposes. The herbal hair gel formulation demonstrated good texture, stability, and sensory appeal, with a balanced pH and effective hair and scalp benefits. These results indicate that the product meets quality standards for a natural, non-irritating hair styling solution suitable for regular use.

Keywords: Flaxseed, Curry leaf, Hair Gel, Hair Growth.

INTRODUCTION

Hair care is essential for maintaining healthy, strong, and beautiful hair. It helps prevent damage and breakage, supports scalp health, promotes hair growth, and improves hair texture and appearance. Good hair care routines also reduce hair loss, protect against environmental damage, and make hair easier to style. Beyond physical benefits, caring for hair boosts confidence and self-esteem, as healthy hair enhances overall appearance and personal expression

Hair damage is caused by factors like excessive heat styling, chemical treatments, environmental exposure, harsh products, and lack of moisture. Poor diet, rough handling, and health issues also weaken hair, making it more prone to breakage, dryness, and dullness. Reducing these damaging factors helps maintain healthier, stronger hair. Malassezia furfur, Candida albicans, ringworms etc. can cause various scalp problems like Dandruff, Red or Purple rashes, cracks, patches, white flaky scales etc.[1] The beauty and personal care sector have seen a notable movement in favor of natural and herbal products in recent years. This trend is particularly pronounced in hair care, where consumers are increasingly seeking alternatives to synthetic formulations. Herbal hair care products derived from plant-based ingredients, have gained popularity due to their perceived safety, reduced side effects, and potential for providing multiple benefits to hair and scalp health.[2]

Herbal hair gels offer a natural alternative to chemical-based styling products. They use plant-based ingredients that nourish and strengthen hair while minimizing irritation and damage. These gels are free from harmful chemicals, provide hydration, reduce frizz, and are more eco-friendly[3]. Herbal gels are great for those looking to style their hair while also promoting hair health and being kind to the environment.

Most topical gels utilize organic polymers, giving them an attractive, clear appearance. These semisolid preparations are typically applied to the skin to deliver medications, act as emollients, or provide protective barriers [4].

The global market for natural and organic personal care products, including haircare, has been growing steadily, with projections indicating continued expansion. This growth is driven by increasing consumer awareness of the potential harmful effects of certain synthetic ingredients, as well as a broader trend towards sustainable and environmentally friendly products.

Properties of hair gel:

- The gel should be clear.
- The formulation of gel should not be sticky non greasy[5].
- The gelling agent should be inert as well as safe.
- Gelling agent should not react with the active ingredients as well as other excipients
- It ought to apply to the skin with ease.

- Entrapped the drug by swelling property[6]

Herbal ingredients in hair care offer natural benefits to promote stronger, healthier hair. Key ingredients include aloe vera for moisturizing, neem for antibacterial scalp care, amla for strength and shine, hibiscus for conditioning and preventing premature graying, fenugreek for root strengthening, and flaxseed for enhancing shine and reducing frizz with its high omega-3 content. Bhringraj promotes hair growth, rosemary improves scalp circulation, green tea provides antioxidants, tea tree oil cleanses the scalp, lavender offers calming, anti-inflammatory effects, and curry leaves boost hair pigmentation, reduce hair loss, and add softness. Together, these herbs nourish the scalp, support healthy hair growth, and enhance hair strength and texture naturally.

Flaxseed (*Linum usitatissimum*)

Figure 1: Flaxseed

Flaxseed promotes hair growth due to its rich content of omega-3 fatty acids, which nourish hair follicles, and vitamin E, which improves scalp health. Its lignans help balance hormones linked to hair loss, while its fiber content supports overall nutrient absorption for hair health. Flaxseed also provides moisturizing benefits, reducing dryness and promoting stronger, healthier hair growth. Flaxseed oil, fiber, and flax lignans have inherent health benefits such as reducing atherosclerosis, diabetes, cancer, cardiovascular disease, osteoporosis, autoimmune and neurological disorders [7].

Hair gels are products designed to stiffen hair and hold specific styles. [8]Herbal hair gels have fewer side effects, can encourage hair growth, and help prevent hair loss. Many commercial gels contain silicone and chlorides, which can damage hair, making herbal options more desirable. Hair gels also help retain moisture, which is essential for healthy hair growth, and provide necessary nutrients. Gels are a relatively new form of dosage created by trapping large amounts of aqueous hydroalcoholic liquids within a three-dimensional polymeric network made from either natural or synthetic gums, which have undergone significant physical or chemical cross-linking. [9] They consist of a colloidal network that can include inorganic substances like aluminum salts or organic polymers from various origins.

Uses of Flaxseed:

Rich in adipose acids and antioxidants, flaxseed aids in the junking of adulterants and dead skin cells from the crown. You can use flax seed gel as a moisturizer on your hair and crown. Aid in promoting new hair development and strengthening being hair. Topical phrasings come in the form of canvases, creams, ointments, pastes, and gels; among these, gels are getting more and more well- liked these days due to their increased stability and capability to offer controlled release in comparison to other circumfluous medications. The gel phrasings can give better immersion characteristics and hence the bioavailability of medicine. Flaxseed, also known as linseed, has been used for centuries in colorful societies for its nutritive and medicinal parcels. In hair care, flaxseed is valued for several reasons

- Rich in omega-3 fatty acids, which can nourish hair follicles and promote hair growth
- Contains lignans, antioxidants that may help protect hair from environmental damage
- When soaked in water, flaxseed produces a gel-like substance that can provide hold and definition to hair styles
- May help in reducing scalp inflammation due to its anti-inflammatory properties [10]

Traditionally, flaxseed gel has been used as a natural styling agent, particularly in curly hair care routines.

Curry Leaves (*Murraya koenigii*)

Figure 2: Curry Leaves (Leaf)

Utmost of the population relies upon herbal drugs because they've been considered as safe, effective and provident. *Murraya koneigii* (Curry Leaves, Kadhi Patta ,Mitha Nimba/ Giri Nimba) is one similar medicinally important condiment which is extensively used as spice, seasonings and also used to treat colorful conditions in India. It's a chief in Indian dishes and is well known for its subtle flavor and used confidently in diurnal cuisine. Curry leaves contain numerous important constituents like carbohydrates, proteins, filaments, calcium, phosphorus, iron, magnesium, minerals and vitamins like nicotinic acid, vitamin B, C, A and E, antioxidants, factory sterols,

glycosides and flavonoids. The oil painting is used externally for bruises, eruption, in cleaner and incense assiduity. The essential oil painting from leaves yielded di-α- phellandrene, D- sabinene, D- αpinene, dipentene, D-α- terpinol and caryophyllene. M. koenigii is extensively used in Indian cuisine for centuries and have a protean part to play in traditional drug. The factory is credited with alcohol and stomachic parcels. Dinghy and roots are used as goad and externally to cure eruptions and mouthfuls of toxic creatures. Green leaves are eaten raw for cure of dysentery, diarrhea, hair growth and for checking vomiting.

Uses of curry leaves

- Anti-Dandruff: Curry leaves when used regularly remove dead hair follicles, which is one ofthe reasons behind dandruff.[11]
- Prevent Premature Greying.
- Stimulates Hair Growth.
- Rejuvenation of Hair Follicles.
- Strengthening of Hair Shafts.
- Prevents Hair Thinning. [12,13]
- It has a rich source of beta-carotene and proteins. They also contain amino acids and antioxidants which strengthen the hair follicles and moisturize the scalp [14]
- It also helps remove the dead hair follicles, which can be the reason behind Dandruff. [15]
- Leaves and roots are also used traditionally as bitter, anthelmintic, analgesic, curing piles, inflammation, itching and are useful in leukoderma and blood disorders.

Rationale for Combining Ingredients in a Gel Formulation

The combination of flaxseed and curry leaves in a hair gel formulation presents an innovative approach to herbal hair care:

Synergistic effects: The nutrient profiles of both ingredients may complement each other, potentially offering enhanced benefits for hair health and appearance.

Multi-functional product: The gel can serve as both a styling agent (thanks to flaxseed's gel forming properties) and a hair treatment (due to the nourishing properties of both ingredients).

Meeting consumer demands: This formulation aligns with the growing consumer preference for multi-benefit, natural hair care products.

Novel application of traditional ingredients: While both flaxseed and curry leaves have beenused separately in hair care, their combination in a gel format represents an innovative application of these traditional ingredients.

MATERIALS AND METHODS

Table 1: Materials used in herbal hair gel

Si. no	Ingredients	Role
01	Curry leaves	Strengthening of hair
02	Flaxseed	Hydration and moisture
03	PEG	Gelling agent, emulsifier
04	Methyl paraben	Preservative
05	Glycerin	Moisture
06	Triethanolamine	Thickening agent
07	Carbopol	Gelling agent
08	Distilled water	Vehicle

METHODOLOGY

Preparation of flaxseed extract

The flaxseed extract was prepared by weighing suitable quantity of flaxseed and added to a beaker and pour in distilled water. Boil it, a thick mucilage was obtained by constant stirring. Cover the beaker with a foil paper. Place the beaker at room temperature or lower temperature. After that, strain the mixture through a cheese cloth or fine mesh strainer into a clean beaker. Store the extract in a clean, air tight container in a cool place.

Preparation of curry leaves extract

The curry leaves extract was prepared by weighing suitable quantity of curry leaf and added to a beaker and pour in distilled water. Boil it & cover the beaker with a foil paper. Place the beaker at room temperature or lower temperature. After that, strain the mixture through a filter paper into a clean beaker. Store the extract in a clean, air tight container in a cool place.

Preparation of Hair gel:

Five herbal hair gel formulations were prepared by using varying amount of herbal extracts. Weighed quantity of methyl paraben, polyethylene glycol and glycerin were dissolved in water and incorporated to carbopol. Using magnetic stirrer, the mixture was stirred at high speed. Finally varying concentrations of aqueous extract of flax seed [16] and curry leaves were incorporated into the above mixture. The preparation was neutralized by dropwise addition of triethanolamine. A gel was obtained by mixing. The prepared herbal hair gel formulation was stored at room temperature.

Table 2: Five Herbal hair gel formulations

Formulation	F1	F2	F3	F4	F5
Curry leaf extract (%)	1%	2%	3%	4%	5%
Flaxseed extract (%)	5%	4%	3%	2%	1%
Carbopol (gm)	2	2	2	2	2
Methyl paraben (mg)	75	75	75	75	75
PEG (ml)	6.25	6.25	6.25	6.25	6.25
Glycerine (ml)	3	3	3	3	3
Trietanolamine (ml)	0.5	0.5	0.5	0.5	0.5
Water (ml)	80	80	80	80	80

Figure 3: Herbal hair gel formulations F1-F5

Phytochemical Screening of Aqueous flaxseed extract:

1. Protein test:

(a) **General test (Biuret test):** To 3 ml of T.S., add 4% NaOH and a few drops of 1%CuSO4 solution. The blue shifts to violet or pink.

(b) **Million's test**: Mix 3 ml of T.S. White PowerPoint with 5 ml of Million's reagent. Warm. Ppt. either turns brick-red or dissolves to reveal a red solution.

2. **The Molisch test (general test) for carbohydrates**: To 2-3 ml of aqueous extract, shake a few drops of alpha-nap solution in alcohol. Then, add the concentrated H2SO4 from the test tube's sidewalls. At the intersection of two liquids, a violet ring appears.

3. **Tannin Compound Test**: Add a few drops of the following reagents to two to three milliliters of alcoholic or aqueous extract:

(a) A vivid blue-black solution containing 5% $FeCl_3$.

(b) White ppt solution of lead acetate.

4. **Alkaloids Test**: Evaporate the aqueous extract. Add 1 diluted to the residual. After giving it a thorough shake, strain. Proceed with the following tests using filtrate:

(a) **Hager's test**: adding Hager's reagent to 2-3 ml of filtrate produces yellow ppt.

5**. Acidic Compound Test**:

(a) Make effervescence in the test solution by adding sodium bicarbonate.

6.**Saponin Glycoside Test**:

(a) Foam Test: Use water to agitate the medication extract or dry powder thoroughly. Stable, long-lasting foam was noted

Phytochemical screening of Aqueous Curry leaf extract:

The aqueous *Murraya koenigii* leaf extract was subjected to phytochemical analysis which was carried out by following the procedures. Tannins, Saponins, Flavonoids, Alkaloids, Proteins, Steroids, Quinones, Terpenoids, Cardio glycosides and Phenols were estimated by ensuring the Successive methods.

1.Tannins: 1ml of aqueous *Murraya koenigii* leaf extract and 2-3 drops of 0.1% ferric chloride were combined and checked for the appearance of blue/black/brownish green colour.

2.Saponins: 1ml of aqueous *Murraya koenigii* leaf extract and 2ml of water were added, shaken forcefully and checked for foam appearance.

3.Flavonoids: 1ml of aqueous *Murraya koenigii* leaf extract, 1ml of concentrated hydrochloric acid and 1ml of magnesium chloride were combined and checked for the appearance of pink or tomato red colour.

4.Alkaloids: 1ml of aqueous *Murraya koenigii* leaf extract and 2-3 drops of Dragondorff reagent were combined and checked for the formation of orange red colour.

5.Proteins: 1 ml of aqueous *Murraya koenigii* leaf extract and 2-3 drops of Bradford reagent were combined and checked for the development of blue colour.

6.Steroids: 1 ml of aqueous *Murraya koenigii* leaf extract and 1ml of 10% Con. H2SO4 was combined and checked for the appearance of green colour.

7.Quinones: 1 ml of aqueous *Murraya koenigii* leaf extract and 2-3 drops of aqueous ammonia were combined and checked for colour change in the aqueous layer from light brown to red, pink or violet colour.

8.Terpenoids: 1 ml of aqueous *Murraya koenigii* leaf extract and 2-3 drops of Con. H2SO4 was combined and checked for the appearance of yellow colour.

9.Cardio glycosides: 1 ml of aqueous *Murraya koenigii* leaf extract and 2-3 drops of glacial acetic acid, 0.4ml of Ferric chloride and 2-3 drops of Con. H2SO4 were added. The solution was checked for the appearance of brown coloured ring.

10.Phenols: 1 ml of aqueous *Murraya koenigii* leaf extract, 2ml of distilled water and 2-3 drops of Ferric chloride were combined and checked for the formation of green or blue colour.

Evaluation of herbal hair gel formulations

1. Physical appearance/ Visual inspection

The formulated herbal hair gel was evaluated for color, transparency, odor, visual appearance, and foreign particles. [17]

2.Determination of pH

The digital pH meter was used to calculate the pH of different hair gel compositions. In 100ml of distilled water, one gram of gel was dissolved and allowed to stand for two hours. The pH of the hair gel formulations was measured after fully submerging the electrodes.

3.Spreadability:

Spreadability was determined by the apparatus which consists of a wooden block, which was provided by a pulley at one end. By this method spreadability was measured on the basis on slip and drag characteristics of gels. An excess of gel (about 2 gm) under study was placed

on this ground slide. The gel was then sandwiched between this slide and another glass slide having the dimension of fixed ground slide and provided with the hook. A one kg weighted was placed on the top of the two slides for 5 min. to expel air and to provide a uniform film of the gel between the slides. Excess of the gel was scrapped off from the edges. The top plate was then subjected to pull of 80 gm. With the help of string attached to the hook and the time (in sec.) required by the top slide to cover a distance of 7.5 cm be noted. A shorter interval indicates better spreadability.

Spreadability was calculated using the following formula:

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

Where,

S= Spreadability,

M= weight in the pan (tied to upper slide),

L= Length moved by the slide,

T= Time (in sec.)

4.Washability:

All herbal formulations are checked for washability with water.

5. Skin irritation test:

Applied herbal hair gel formulation on the skin and observe for irritation, redness or rashes.

6. Viscosity: Viscosity was measured using a Brookfield viscometer. A sufficient amount of gel was added to each wide mouth jar independently. The gel in the jar should be high enough to allow the spindly to be dipped. The spindle was set to run at 2.5 RPM. The formulas' viscosities were noted [18]

7. Stability Studies: All the formulations were kept at varying conditions of temperature. The system was stable at 25 °C. There were no significant changes in the formulation when kept at room temperature (30±2°C) and also at refrigerated temperature (4±2°C). No much change of pH, Viscosity, Homogeneity, Spreadability, and Extrudability.

8. Antibacterial activity

- Prepare nutrient agar plates by pouring molten agar into Petri dishes and allowing it to solidify.
- Inoculate the agar by streaking the surface evenly with the bacterial culture using a sterile cotton swab.
- Create wells in the agar using a sterile cork borer or pipette tip.
- Apply the test sample (herbal gel), positive control (antibiotic), and negative control (sterile water) into separate wells.
- Incubate the plates at 37°C for 18–24 hours.
- Observe and measure the zones of inhibition around the wells, indicating antibacterial activity.

9. Antifungal activity

- Select Fungal Strain: Choose relevant fungal strains like *Malassezia furfur*, responsible for scalp conditions like dandruff, or other fungi like *Candida albicans* and *Aspergillus niger*.
- Prepare Herbal Gel Sample: Ensure the gel is freshly prepared and may be diluted to different concentrations for comparative analysis [19]
- Prepare Culture Media: Use Sabouraud Dextrose Agar (SDA) or Potato Dextrose Agar (PDA) to culture the fungal strains, and sterilize and pour the media into Petri dishes.
- Inoculate Fungal Strain: Spread the fungal inoculum on the agar surface evenly using a sterile swab or spreader.
- Apply Herbal Hair Gel
- Well Diffusion: Make wells in the agar and fill with herbal gel.

Incubation: Incubate the plates at 25°C to 30°C for 48 to 72 hours, depending on the fungal species.

RESULTS AND DISCUSSION

Table 3: Phytochemical screening of aqueous *Murraya koenigii* leaf extract

Sl no	Constituents	Presence /Absence
01	Tannins	+
02	Saponins	+
03	Flavonoids	-
04	Alkaloids	+
05	Proteins	+
06	Steroids	-
07	Quinones	-

Table 4: Phytochemical screening of aqueous flaxseed extract

Tests	Results
Protein	
a) Biuret test	+
b) Millions test	+
Alkaloids	
Hager's test	+
Carbohydrates	
Molish test	+
Tannins compound	
a) $FeCl_3$	+
b) Lead acetate	+
Acidic compound	
Sodium bicarbonate	+
Saponin	
Foam test	+

Table 5: Evaluation of homogeneity, pH, Viscosity and spreadability of herbal hair gel

Sl no	Formulation	Physical Appearance	Spreadability (gcm/sec)	Homogeneity	pH	Viscosity (cps)
01	F1	Translucent, Green colour, Smooth	14.61 ± 0.002	Good	6.92±0.003	9361 ± 0.002
02	F2	Translucent, Green colour, Smooth	13.11 ± 0.002	Good	6.93±0.002	9365 ± 0.004
03	F3	Translucent, Green colour, Smooth	12.65 ± 0.001	Good	6.95±0.001	9370 ± 0.002
04	F4	Translucent, Green colour, Smooth	10.00 ±0.001	Good	6.98±0.001	9373 ± 0.003
05	F5	Translucent, Green colour, Smooth	8.92 ± 0.002	Good	7.02±0.002	9379 ± 0.003

DISCUSSION

In the present study the work was attempt to carry out the formulation and evaluation of herbal hair gel. Flax seed extract and curry leaf extract was evaluated for physico chemical and phytochemical analysis by using different organic solvents. Phytochemical analysis was performed on curry leave extract and flaxseed extract, confirmed the presence of alkaloids, glycosides, triterpenoid, saponins, tannins, flavonoids, etc. Formulation of herbal hair gel was done by varying drug concentration of ingredients as F1–F5. Methyl paraben was used as preservative, Triethanolamine use as pH adjuster in formulation. All formulations were checked for pH, viscosity, Spreadability, homogeneity. From the above result it can be concluded that the prepared herbal hair gel shows significant hair growth activity.

CONCLUSION

Herbal cosmetics are products designed to enhance appearance using natural ingredients. This research is focused on developing and assessing a herbal formulation hair gel made from curry leaves and flaxseed, aimed at promoting hair growth and reducing hair fall. Extracts from flax seed and curry leaves were obtained through aqueous extraction. Five different gel formulations, with varying concentrations of these extracts, were prepared and evaluated. The formulations F1 to F5 were analyzed based on parameters such as color, odor, texture, clarity, pH, viscosity, spreadability, extrudability, gel strength, homogeneity, stability, washability, antimicrobial activity and antifungal activity. The findings indicate that the herbal hair gel formulated with curry leaves and flax seed is effective for promoting hair growth and reducing hair fall. The formulation highlights the potential of integrating herbal ingredients into cosmetic products, promoting sustainability and consumer preference for natural herbal formulations.

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