



(Research Article)

Formulation and Evaluation of Flaxseed as Hair Mask

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Received: 10.05.2026

Accepted: 15.05.2026

Published: 20.05.2026

ABSTRACT

Natural treatments are increasingly used around the world because they are safer than chemical products and create fewer side effects. The purpose of this study is to report on the development of a natural hair conditioner (mask) that incorporates several herbs. These include flaxseed gel; rice water; fenugreek seed extract; curry leaf extract; and turmeric extract. Flaxseed contains Omega-3 fatty acids, which will help retain moisture and improve the shine of the hair. Turmeric extracts contain curcumin, which acts as an antiseptic and anti-inflammatory to protect against infection of the scalp and combat dandruff. Fenugreek seed extracts have high levels of protein and lecithin, which will increase strength at the base of each strand of hair and reduce shedding. Curry leaves are rich in beta-carotene and antioxidants which will increase follicular activity. Rice water has inositol which helps reduce friction and prevent damage from breakage. The new product was tested for pH, viscosity, spreadability, extrudability, homogeneity, skin irritation potential and for stability over time. Results were satisfactory in terms of pH, physical characteristics and no notable degradation occurred when the product was stored under accelerated testing conditions. Phytochemicals present within the new product included tannins, saponins, alkaloids, phenols and proteins. All these components contribute to hair strengthening, combating dandruff and providing antioxidant capabilities. The results demonstrate that the natural hair treatment can be both cost effective and serve as a viable alternative to commercially available chemical based hair care products.

Keywords: Hair conditioning mask; Flaxseed; Fenugreek; Rice water; Curry leaves; Turmeric; Antioxidant; Antidandruff; Hair strengthening.

I. INTRODUCTION

Hair conditioning masks are therapeutic hair care products applied after shampooing that deliver deep conditioning, nourishment & repair to damaged or weakened hair fibers. Depending on the degree of damage to the hair, these formulations are generally applied once/weekly for a single application, and twice/week for a double application. Their general purpose is to make the hair softer, smoother & more manageable [1]. As consumers seek out more natural and herbal cosmetic products over synthetic formulations due in part to growing consumer interest in plant-derived hair care products [17], there is an increasingly greater interest in plant-based ingredients that not only provide comparable efficacy but also minimize adverse effects commonly associated with chemical-based hair care products [16]. Flaxseed (*Linum usitatissimum*) is emerging as an important functional ingredient in cosmetics applications due to its rich content of omega-3 fatty acids, lignans, dietary fiber, and antioxidants [6], [7]. Flaxseed gel provides moisturizing protection from dry scalp conditions, stimulates hair growth, increases strength to the hair while maintaining healthy scalp pH levels, is cost effective, is completely chemical free, and can be easily prepared making it ideal for incorporation into herbal hair care formulations [18]. Additional botanical supplements such as turmeric (*curcuma longa*), Fenugreek (*trigonella foenum-graecum*), curry leaves (*muraya koenigi*), and Rice water each contribute distinct bioactive properties. Turmeric contains curcumin which has anti-inflammatory & anti-fungal compounds that address scalp conditions including dandruff & psoriasis [12]. Fenugreek seeds contain protein, nicotinic acid, & lecithin that function as natural conditioners that reduce hair loss & enhance shine [3]. Curry leaves have been documented in Ayurvedic medicine for their ability to prevent premature greying & stimulate hair follicle activity [16]. Rice water enriches hair with inositol, amino acids, & B vitamins that help to reduce surface friction between hairs, lessens breakage & enhances shine [14],[15]. Although all five individual ingredients are well-documented in scientific literature for their benefits when used individually, however, there is very little research combining the use of all five ingredients together as a single optimized hair mask formulation. Therefore, this study will focus on creating a five-component herbal hair

conditioning mask and evaluating its physio-chemical characteristics, phytochemical profile, stability, providing scientific evidence for its safe & effective usage as a natural alternative to commercial hair care products [8],[19].

II. LITERATURE REVIEW

A. Flaxseed and Omega-3 Fatty Acids in Hair Care

Flaxseed (*Linum usitatissimum* L.) is one of the richest plant-based sources of alpha-linolenic acid (ALA), an omega-3 fatty acid that supports sebum production and moisture balance in the scalp [6],[8]. Daun et al. established that flaxseed contains approximately 55% ALA in its oil fraction along with significant proportions of lignans and dietary fiber [6]. Singh et al. further demonstrated that flaxseed constituents exhibit antioxidant properties that protect hair follicles from oxidative stress-mediated damage [7]. Goyal et al. reviewed flaxseed's nutraceutical applications and documented its efficacy as a moisturizer and scalp conditioner [8]. Tyagi et al. combined flaxseed with aloe vera in a hair mask formulation and reported enhanced bioavailability of active compounds, leading to improved hair strength and luster [9]. Hanaa et al. evaluated the antioxidant activity of flaxseed ethanolic extracts and confirmed substantial free radical scavenging potential attributable to its polyphenol content [3]. Mohanty et al. reviewed the multifunctional applications of flaxseed across food, pharmaceutical, and cosmetic industries, noting its potential as a scalp health-promoting agent [17]. Manjula et al. developed a dedicated flaxseed hair gel formulation and reported positive outcomes in terms of hair smoothness, reduction in frizz, and antidandruff activity [18].



Figure 1. Flaxseed Sample.



Figure 2. Rice Sample.

B. Herbal Ingredients: Turmeric, Fenugreek, Curry Leaves, and Rice Water

Curcumin, due to its anti-inflammatory properties, has had numerous studies demonstrating these effects. There were studies done by Praveen et al., [1] demonstrating curcumin's ability to inhibit the growth of *Malassezia* which causes dandruff. The ability of curcumin to demonstrate potential for reducing inflammation to the scalp was demonstrated in two forms of dermatitis (seborrhea and psoriasis) in studies done by Mohebitabar et al., [12]. Studies showed that curcumin suppressed inflammation associated with both conditions through inhibition of NF-kappa beta, a pathway of inflammatory responses for both conditions [2]. Fenugreek is known to contain 26 – 34 percent protein in the form of albumin and globulins. These proteins act to coat the hair shaft thereby increasing strength when the hair shaft is stretched. [5]. Mucilage contained within fenugreek releases polysaccharides upon soaking similar to those found in commercial conditioners. [5]. Scientifically validating fenugreek's role as a hair strengthening agent, Yousefi and Mehdizadeh, concluded that rice water has been scientifically validated as a hair strengthening agent. Rice water serves as a source of inositol and allows it to penetrate into the hair shaft. Although rice water is washed out with shampoo, it leaves behind a residue that strengthens the hair shaft. [15]. Rice water was further discussed by Kharde et al., who stated that rice water promotes healthy hair by providing essential amino acids and Vitamin B's. [14].



Figure 3. Curry Leaves.



Figure 4. Fenugreek.



Figure 5. Turmeric.

C. Physicochemical Evaluation of Herbal Hair Formulations

Ramakrishna and Gopikrishna developed a hair gel product made from herbs. They set up guidelines for testing the pH (5.5-7.0), spreadability, extrudability, viscosity, and stability of gel-based hair care products. Kaur and Guleri did a literature review on topical gel formulations and showed how polymer content of the gel influences both the rheology and drug delivery. Bhaskar et al. evaluated the antioxidant properties and performed a phytochemical screening on the plants used in creating their hair gel. Researchers have repeated these tests numerous times to study herbal hair gels. Chaudhary et al. reviewed hair care formulations with natural components; they pointed out that the pH of a hair care product should be close to the pH of the skin of the scalp (4.5-6.5). Lambros et al. discussed some additives such as citric acid which can be used to adjust the pH levels of cosmetic formulations. Yuan and Li wrote that glycerin is very effective at retaining moisture when added to a formulation whether it was pharmaceutical or cosmetic.

III. METHODOLOGY

A. Materials

Flaxseeds (*Linum usitatissimum*), fenugreek seeds (*Trigonella foenum-graecum*), fresh curry leaves (*Murraya koenigii*), turmeric powder (*Curcuma longa*), and rice were procured from a local certified supplier. All chemicals used in phytochemical analysis were of analytical reagent grade. Distilled water was used throughout the study. The formulation did not require any synthetic polymers or preservatives, consistent with the green cosmetics approach advocated in recent literature [16], [19].



Figure 6. 5 gm of flaxseed Sample.



Figure 7. Thick mucilage obtained.

B. Extraction of Flaxseed Gel

Impurities found in flaxseed were eliminated through a process called cleaning. A total of five grams of cleaned flaxseed were weighed out and put into a beaker that contained one hundred mL (one tenth of a liter) of distilled water. While visual monitoring took place, the beakers' contents were next heated at seventy degrees Celsius for thirty minutes. Upon completion of the heating cycle, the beakers' contents had cooled down to room temperature. The now-cooled contents were filtered utilizing two layers of cheesecloth so that the flaxseed would separate from the liquid gel. Once filtered, the liquid gel was sealed in an airtight container where it could continue to cool at room temperature until it was needed to help formulate the final product. [4][18]



Figure 8. Filter using muslin (cheese) cloth.



Figure 9. Flaxseed extract.

C. Preparation of Rice Water

Twenty grams of rice were washed and soaked in 200 mL of distilled water for 30 minutes. The soaking water was collected, filtered, and stored at 4°C. Fermented rice water was prepared by leaving the soaking water at room temperature for 24–48 hours. The fermented variant was used in formulation as it has been reported to exhibit enhanced protein and inositol bioavailability [14], [15].

D. Formulation of Hair Conditioning Mask

The Hair Mask Preparation consisted of 50 % flaxseed gel; 20% fermented rice water; 10% fenugreek seed paste; 10% fresh curry leaf extract; 10% turmeric powder. The fenugreek seeds were soaked for one night after which the seeds were washed away and blended into a fine paste. The leaves of the curry plant were blended with some water in order to obtain a clear curry leaf extract. All ingredients were then gently mechanically stirred together until a uniform and smooth hair mask preparation is obtained. In addition to the absence of artificial colorants, fragrances as well as preservatives within this product [8] [18][19].

E. Evaluation Parameters

As per the standard protocols given by Ramakrishna and Gopikrishna [4], and Kaur and Guleri [5] the prepared hair mask was evaluated with the following tests: (i) physical characteristics and color; (ii) homogeneity and texture (thumb-finger test); (iii) pH measurement with a digital pH-meter; (1g in 100ml distilled H₂O for 2h); (iv) spreadability (glass-plate-method); (v) extrudability (tube-crimping-method); (vi) viscosity (Brook-field-viscometer); (vii) skin irritation test (patch-test on arm).

F. Phytochemical Analysis of Flaxseed Extract

Qualitative phytochemical screening of the flaxseed extract was performed using standard procedures as reported by Bhaskar et al. [2] and Hanaa et al. [3]: (i) Tannins – Braymer's test (10% alcoholic ferric chloride); (ii) Saponins – Foam test; (iii) Alkaloids – Dragendroff's test; (iv) Quinones – Alcoholic KOH test; (v) Phenols – Iodine test.

IV. RESULTS

The formulated flaxseed hair conditioning mask was a translucent, light-yellow, smooth preparation with a pleasant herbal aroma. All physicochemical and phytochemical evaluation results are presented below.

Table 1. Ingredient Functions in the Flaxseed Hair Conditioning Mask.

Ingredient	Primary Active Compounds	Hair Care Function
Flaxseed	Omega-3 ALA, lignans, Vitamin E, protein	Moisturization, shine enhancement, scalp health, reduces breakage [6],[8]
Fenugreek (Methi)	Protein, nicotinic acid, lecithin, mucilage	Strengthens roots, reduces hair fall, natural conditioning, antidandruff [5]
Curry Leaves	Beta-carotene, proteins, antioxidants	Prevents premature greying, stimulates follicles, reduces thinning [16]
Turmeric	Curcumin (anti-inflammatory, antifungal)	Reduces hair fall, fights scalp irritation, combats dandruff fungi [1],[12]
Rice Water	Inositol, amino acids, B vitamins	Reduces friction/breakage, adds slip and shine, promotes growth [14],[15]

Table 2. Phytochemical Analysis of Flaxseed Extract.

Sr. No.	Plant Constituent	Test Performed	Result
1	Tannins	Braymer's test	Positive
2	Saponins	Foam test	Positive
3	Alkaloids	Dragendroff's test	Positive
4	Quinones	Alcoholic KOH test	Not detected
5	Phenols	Iodine test	Positive

Table 3. Physicochemical Evaluation of Hair Conditioning Mask.

Parameter	Observation / Result
Appearance	Translucent, smooth, homogeneous
Color	Light yellow-green

Odor	Characteristic herbal
pH	6.11 (within scalp physiological range 4.5–6.5)
Homogeneity	Uniform, no lumps or granules observed
Spreadability	Smooth, easily spreadable over hair and scalp
Extrudability	Freely extrudable from tube
Skin Irritancy	Non-irritant (no erythema or edema)
Stability (RT)	No change in color, pH, spreadability, or appearance over 3 months
Stability (40°C)	No appreciable change in all tested parameters over 3 months

V. DISCUSSION

The developed flaxseed hair conditioning mask presented suitable physicochemical characteristics in relation to all examined criteria. The pH value of 6.11 lies within the acceptable range for hair care products (4.5 – 7.0) which is very important since formulations with higher pH levels will damage the hair cuticle by increasing porosity, creating frizz and causing breakage [19]. In line with Ramakrishna and Gopikrishna [4] who stressed the importance of pH control as an essential quality feature for herbal hair gels, phytochemical analysis showed that the flaxseed extract contains tannins, saponins, alkaloids and phenols. Tannins are able to penetrate the hair shaft and form a protective film around it that protects against mechanical stresses and increases its structure and therefore also reduce the likelihood of breaking [2]. Saponins are naturally occurring surfactants that gently cleanse the scalp from dirt deposits while preserving the natural sebum layer and stimulate hair growth [16]. The stimulating effect of alkaloids such as caffeine-like substances enhance blood flow to the scalp, thus ensuring that nutrients can reach the hair follicles via diffusion. As a result, oxidative stress decreases [7]. Finally, phenolic compounds act as antioxidants by protecting the follicular cells from the damaging effects of free radicals [3]. Turmeric contributes to both antifungal and anti-inflammatory effects mediated by curcumin, which affect dandruff and scalp irritation at the biochemical level [1], [12]. The mucilage proteins present in fenugreek provide a coating to the hair shaft and decrease the friction forces between individual fibres. This results in improved tensile strength. Similar mechanisms occur with synthetic conditioning polymers; however, they have a better safety profile [5]. Rice water inositol remains adsorbed on the surface of the hair for several days post-rinse and provides continuous protection against breakage [14], [15]. Stability tests were performed at room temperature and 40°C for a period of three months. No significant variations were observed in terms of colour, pH, appearance, extrudability and spreadability. Thus, thermodynamic stability of the formulation was achieved. It may be assumed that the natural mucilaginous network in the flaxseed gel acts as a physical stabiliser in this regard [18]. Moreover, there was no evidence of skin irritation during the use of this product. Therefore, based on this observation, the formulation seems to meet the requirements for safe use on the scalp and hair surfaces as previously described for other herbal cosmetic formulations [4], [5]. The combination of these five components can be regarded as a synergistic 'superfood' for hair treatment. Each component targets different aspects of hair health (e.g., moisture retention/fluid balance (flaxseed/rice water); strength enhancement (fenugreek/protein); antioxidant/protective function (turmeric/curry leaves/phenols); maintaining the scalp micro-biome (turmeric/saponins); stimulating the hair follicles (alkaloids/curry leaves)). This multi-factorial approach is preferable over formulations containing only one active compound. Furthermore, the holistic approach to hair care inherent in Ayurveda is reflected in the development of this formulation [8], [16], [17].

VI. CONCLUSION

The results of the current research indicated that a hair conditioner based on flaxseed gel as well as rice water, fenugreek, curry leaves, and turmeric was effectively developed and tested. Physically and chemically, the hair conditioner had appropriate characteristics such as pH (pH = 6.11), appearance (homogeneous), spreadability/extrudability and non-skin irritation. Phytochemical screening of the hair conditioner also identified bioactive components, namely tannins, saponins, alkaloids and phenols, which are responsible for its anti-dandruff, antioxidant, hair strengthening and scalp protective properties. Room temperature and 40°C storage for three months showed the hair conditioner to be stable. It is also inexpensive to manufacture and easy to prepare since it contains only natural materials and does not contain synthetic polymer nor chemical preservative; therefore, this hair conditioner may be an effective alternative for consumers looking for safe and environmentally friendly solutions for dry, dull, brittle or thinning hair.

ACKNOWLEDGEMENT

The authors express sincere gratitude to the management and staff of Matoshri Miratai Aher College of Pharmacy, Karjule Harya, for providing laboratory facilities and institutional support. The authors declare no conflicts of

interest. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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