

FORMULATION AND EVALUATION OF *Chloris barbata* EXTRACT HAIR OIL

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ABSTRACT

The important role of hair is to improve personal appearance and to protect the scalp from peripheral environmental factors. Due to their natural origin, safety, effectiveness, and minimal side effects, herbal hair products are attaining increased acceptance worldwide when compared to synthetic formulations. The current study emphasizes on the formulation and evaluation of hair oil prepared using *Chloris barbata*, a medicinal plant known for its beneficial properties in maintaining hair and scalp health. In this study, *Chloris barbata* was selected as the main herbal ingredient due to its traditional medicinal importance and its impending ability to promote hair growth and improve scalp condition. The formulated *Chloris barbata* extract hair oil was evaluated for several physicochemical parameters such as colour, odour, pH, viscosity, specific gravity, and stability. These evaluation tests were done to ensure the quality, safety, and stability of the prepared formulation. The results achieved from the evaluation studies showed that the formulated hair oil possessed acceptable physicochemical properties and showed good stability during the study. The existence of natural plant constituents may add to the therapeutic effectiveness of the formulation in endorsing healthy hair growth and retaining scalp health. Based on the study, the developed *Chloris barbata* hair oil can be considered a safe, natural, and effective herbal formulation for sustaining healthy hair, taming scalp condition, and foiling common hair-related problem.

Keywords: *Chloris barbata* extract, herbal hair oil, natural hair care, Rosemary oil, hair growth, viscosity

INTRODUCTION

The traditional preparation of hair oils in India smears various hair growth promoting drugs. Indian women are famous for their long, shine and healthy hair, so it is not amazing that hair care features prominently in their self-care rituals. Hair plays a crucial role in human bodies as a protective obstruction and a key element of the appearance. It is a intricate structure with three main parts:

- Bulb - A swelling at the base located in the dermis.
- Root - The portion of hair below the skin surface.
- Shaft - The visible part of hair protruding above the skin.

Hair care products are those formulations which are used for washing, modifying the smoothness of hair changing of the colour, giving life to the stressed hair, providing nourishment to the hair and giving the healthy appearance to the hair. Hair type is primarily based on the curl pattern of the hair, which is determined by the hair follicle. Genetics play a key role in shaping hair type. Andre walker, who has been opera winery's stylist for decade is recognized with creating a system that classifies hair into one of four curl patterns like, straight, wavy, curly and coyly.

Hair oil is a cosmetic product mainly composed of oils derived from various natural sources like plants, nuts, and seeds. It is proposed for application to the hair and scalp to nourish, moisturize, and improve the condition and appearance of hair. Hair oils typically contain a blend of carrier oils (such as coconut, castor, almond, jojoba, olive, and argan oils) and may include essential oils for fragrance and additional benefits.^[1]



Fig.1: Healthy hair

The application of hair oil also creates a protective barrier that locks in moisture, adds shine, and can relieve scalp irritation. Hair oils are used in traditional and modern haircare routines worldwide for conditioning, strengthening hair, improving manageability, and sometimes treating hair loss. Different formulations may target specific issues like dandruff control, hair fall reduction, scalp cooling, and even conditions like psoriasis. Overall, hair oil is a versatile personal care product with both cosmetic and therapeutic advantages for maintaining healthy hair and scalp.^[2]

Hair oils serve multiple purposes: they moisturize the scalp, reduce dryness, and help prevent dandruff and scalp infections due to their antimicrobial properties. Oils like castor oil contain

fatty acids that nourish hair follicles, promoting hair growth while protecting hair strands from breakage and split ends. Coconut oil smooths the hair cuticle, enhancing shine and reducing frizz, while almond oil is rich in vitamin E, which acts as an antioxidant to maintain hair health. Others like argon and sesame oils add elasticity, protect against UV damage, and help regulate sebum production. ^[3]

Chloris barbata belonging to the family Poaceae, commonly known as swollen finger grass or purple top Chloris, is widely documented as the grass family, and it blooms mostly in tropical and subtropical regions, where it can often be seen growing along roadsides, in harsh environment, and even in cultivated fields, signifying its irrepressible and adaptive nature. ^[4]

The leaves of *Chloris barbata* are typically long and narrow, exhibiting a linear-lanceolate shape that tapers to a pointed tip, and they are arranged alternately along the stem, with a rough or slightly hairy texture that gives the foliage a distinctive tactile quality and serves as a natural defense mechanism against herbivorous insects and animals.

The leaves are usually green, occasionally with subtle purplish tinges, chiefly near the flowering stems, and they vary in size, often ranging from approximately five to twenty centimeters in length and about half a centimeter to one centimeter in width, making them relatively slender but quite functional for photosynthesis and water retention within the plant.

Conventionally, the leaves of *Chloris barbata* have been used in several folk medicine practices for their claimed therapeutic properties, including applications aimed at reducing fever, aiding in wound healing, and providing anti-inflammatory benefits, although it is important to note that scientific research to fully validate these medicinal uses remains limited and should be approached cautiously. ^[5]

Roots of *Chloris barbata* serves ecological and agricultural functions, such as helping to prevent soil erosion through its dense root system, providing occasional fodder for livestock, and in some experimental settings, being a source for essential oil extraction, which can potentially be used for aromatic or medicinal purposes, dazzling the versatile utility of the leaves and the plant as a whole. ^[6]

HAIR OIL:

Hair oils can be smeared before washing (pre-wash treatment), after washing (to lock moisture), or even as a daily grooming product depending on hair type. The hair oil preparations are used to treat dandruff, hair fall process, split ends etc. The hair oil preparations are mainly used to cool the scalp for luxurious growth of hair in both men and women. Various types of oils like coconut oil, almond oil, castor oil, onion oil is applied to scalp in admixture with suitable herbal drugs. Among these oils' coconut oil is the foremost worthy oil has because it gets absorbed into the hair strands better than other oils and also economical compared to other hair oils. Hair on exterior head is the first line defence against the sun's UV rays. Hair care products are nothing but those formulations which are used for modifying the texture of hair. Hair oils are formulated using both synthetic and natural ingredients. ^[7]

Advantages of hair oil

- Nurtures scalp and hair.
- Rallies blood circulation under hair follicles.
- Decreases hair fall & strengthens hair roots.
- Thwart split ends & form a protective layer on hair shaft.

- Guards from damage for hair from pollution, sun and heat. ^[8]

Disadvantages of hair oil

- Excess oil fascinates dust can make hair look greasy.
- Challenging to wash off, requires strong shampoo, leading to dryness.
- Consistent heavy oiling causes residue on scalp.
- Hostile rubbing may weakness roots of hair. ^[9]

Ideal characters:

- Should breach hair shaft
- Opulent in nutrients and antioxidants
- Safeguards from heat and damage
- Calms scalp issues
- Rivets easily, non-greasy ^[10]

HAIR GROWTH:

Hair care practices play a energetic role in supporting growth, including gentle scalp massage to improve blood circulation and nutrient transfer, the application of nourishing oils like coconut, argon, castor, or herbal oils such as Amla and Bhringraj, maintaining a balanced diet, staying hydrated, and dealing stress through relaxation or exercise, which together help prolong the anagen phase, lessen breakage, and maintain the strength, shine, and density of hair. Hair growth disorders, including androgenetic alopecia, alopecia areata, telogen effluvium, and trichotillomania, illustrate how sensitive hair follicles are to genetic, hormonal, nutritional, and environmental factors, and medical intervention may be necessary in severe cases to restore normal follicle function and prevent permanent hair loss. ^[11]

Hair growth is a natural, continuous, and highly regulated biological process in which hair follicles, specialized organs entrenched in the skin, produce hair shafts made primarily of keratin, a strong structural protein, and this process occurs in cycles where each follicle functions independently, so while some hairs are actively growing, others are resting or shedding. ^[12]

At the minute level, hair growth depends on the division and differentiation of matrix keratinocytes in the bulb, signaling from dermal papilla cells, and the activation of follicular stem cells in the bulge region, which together ensure the cyclical regeneration of hair shafts and the continuity of hair renewal throughout life. Eventually, hair growth is a dynamic and multifactorial process, replicating overall health, hormonal balance, genetic programming, and lifestyle habits, and by understanding the hair cycle and supporting follicle health through proper nutrition, scalp care, and gentle hair handling, it is possible to maintain healthy, strong, and aesthetically pleasing hair over the long term. ^[13]

THERAPEUTIC PROPERTIES OF *Chloris barbata*

Chloris barbata (purple top Chloris) is a medicinal grass with substantial therapeutic properties, with anti-inflammatory, antidiabetic, antioxidant, and antibacterial activities. It is opulent in phytochemicals like flavonoids and phenols; it is used for curing rheumatism, urinary stones and skin disorders. ^[14]

PHYTOCHEMICAL EVALUATION OF *Chloris barbata*

Phytochemical evaluation of *Chloris barbata* was performed on the pulverized plant material for the existence of various bioactive components such as alkaloids, flavonoids, tannins, saponins and glycosides.

ALKALOIDS

The crude powder of *Chloris barbata* was dissolved in 2N HCl. The mixture was clarified and the remainder was divided into 3 equal portions. One portion was treated with little drops of Mayer's reagent. Another portion was treated with an equal amount of Dragendroff's reagent and another portion was added with an equal amount of Wagner's reagent. The creamy white precipitate obtained by Mayer's test, orange precipitate obtained by Dragendroff's test and brown precipitate obtained by Wagner's test show the presence of alkaloids. ^[15]

FLAVONOIDS

The mixture of crude drug with ethanol was filtered and the filtrate was used for the testing flavoids. One portion was treated with a few fragments of magnesium ribbon followed by addition of concentrated hydrochloric acid (Shinoda test). Another portion was treated with a few drops of sodium hydroxide solution. Another portion was treated with lead acetate solution. The development of pink/red color, intense yellow color and yellow precipitate indicates the presence of flavonoids.

TANNINS

The crude powder was dissolved in distilled water. The mixture was filtered and the filtrate was used for the following tests.

* One portion was treated with a few drops of ferric chloride solution.

* One portion was treated with lead acetate solution. The formation of blue-black or greenish coloration and white precipitate indicates the presence of tannins.

SAPONINS

The presence of saponins was determined by the frothing test. The crude powder was vigorously shaken with distilled water and allowed to stand undisturbed for 10 minutes. The formation of persistent froth indicates the presence of saponins, whereas absence of froth indicates their absence. A froth height of about 1–1.5 cm confirms the presence of saponins. ^[16]

GLYCOSIDES

Keller–Kiliani Test was performed for checking the presence of cardiac glycosides. The crude powder was treated with 1.0 ml mixture of 5% FeCl₂ and glacial acetic acid (1:99 v/v). To this solution, a few drops of concentrated H₂SO₄ were added. Appearance of greenish blue colour within few minutes indicated the presence of glycosides.

FORMULATION OF HERBAL HAIR OIL

Active ingredients:

Chloris barbata

Chloris barbata (swollen Finger grass) contains various bioactive compounds, with antibacterial, anti-diabetic, anti-inflammatory, rheumatism, skin disorders, anthelmintic activities.

Hibiscus



Fig.4: Hibiscus

Name of ingredient: - Hibiscus

Synonym: shoeblack plant, mahagua, mahoe, cotton rose, roselle

Family: Malvaceae

Order: malvales

Genus: Hibiscus

Species: rosa-sinensis

Biological sources: Genus of numerous species of herb, shrubs, and trees in the mallow. ^[17]

Excipients profile

Flavouring agent – Floral oil



Fig.6: Floral oil

Floral oils are added for a sweet, long lasting aroma. Floral oils used in hair care are primarily derived from the flower of plants.

Preservatives - Vitamin E oil



Fig.7: Vitamin E oil

Prevents oils from going rancid, extending the shelf life of oil- only blends. Vitamin E oil is not technically a preservative, but rather a powerful natural antioxidant that prevents oil-based hair products from turning rancid. ^[18]

Nutritional booster - Rosemary oil



Fig.8: Rosemary oil

Rosemary oil is scientifically validated for enhancing scalp circulation and encouraging new growth, often compared to minoxidil for hair regrowth. Rosemary oil used in hair products is extracted from the leaves and flowering tops of the *Rosmarinus officinalis* plant.

Vehicle - Coconut oil



Fig.9: Coconut oil

Coconut oil is the expressed from the dried solid part of endosperm of coconut, *Cocos nucifera* L, largely cultivated in African and southeast asian countries. ^[19]

PLANT PROFILE

Chloris barbata: [20]**Fig.10: *Chloris barbata* plant**

Synonym	-	<i>Chloris inflata</i>
Kingdom	-	Plantae
Subkingdom	-	Tracheobionta
Super divisions	-	Spermatophyta
Division	-	Magnoliophyta
Class	-	Liliopsida
Subclass	-	Commelinid
Phylum	-	Tracheophyte
Order	-	Poales
Family	-	Poaceae
Genus	-	<i>Chloris</i>
Species	-	<i>Chloris barbata</i> sw
Common Names:		
English	-	Swollen finger grass, Purple top Chloris, Feather finger grass.
Malayalam	-	Kuthirapullu, Pallupullu
Tamil	-	PulVellaiPul
Hindi	-	Barbata ghaas
Kannada	-	Hulluhullu
Telugu	-	Gaddi puvvu

Morphology of leaves

Colour : Bright green, dull green or yellowish green.

Length : 10- 30 cm

Width : 0.5- 1cm

Shape : Linear- lanceolate (long & narrow)

Texture: Rough surface with hairy margins.

Geography:

- India
- Africa
- Australia

Traditional use:

- Helps in wound healing
- Used for fever & cough
- Used as a diuretic.
- Acts as a digestive aid

METHOD OF PREPARATION

Fresh leaves of *Chloris barbata* were collected, washed thoroughly with tap water followed by distilled water thoroughly to remove dirt. Leaves were cut into small pieces to increase the surface area for oil extraction. Hibiscus and the shade dried leaves of *Chloris barbata* were drenched in coconut oil using maceration method. The mixture was kept in a clean, airtight container and permitted to stand for 7-10 days with occasional stirring to facilitate extraction of the active constituents into the oil. After maceration, the mixture was filtered through muslin cloth. Added rosemary oil and floral oil to the obtained *Chloris barbata* leaf oil and stored in amber-colored bottle for further analysis. ^[21]

Analysis (oil):

The oil prepared from the leaves of *Chloris barbata* was subjected to various analytical evaluations. The physical characteristics such as colour, odour, consistency, and pH were observed. The physicochemical parameters including specific gravity, refractive index, acid value, saponification value, and iodine value also analyzed for its phytochemical constituents to identify the presences of bioactive compound such as alkaloids, flavonoids, terpenoids, and phenolic compounds. This parameter was used to assess the purity, quality, and therapeutic potential of the oil. ^[22]

In this hair oil formulation, *Chloris barbata* is used as active ingredient. Vitamin E oil is used as anti-oxidant to prevent oxidation and rancidity of the oil. Vitamin E oil act as preservative to inhibit microbial growth and increase shelf life. Floral oil added as flavouring agents provides a pleasant smell. Thickening agent, hibiscus, helps in maintaining proper viscosity and consistency of the oil. Rosemary oil is used as nourishment booster to provide additional nourishment and strengthen the hair. Coconut oil is used as vehicle. Since the formulation itself has green colour, colouring agent is not added.

Table 1. Formulation of Chloris barbata hair oil

Sl. No	Ingredients	F1	F2	F3	F4	F5
1	Chloris barbata	1g	2g	3g	4g	5g
2	Hibiscus	5g	10g	15g	20g	25g
3	Floral oil	2ml	2ml	2ml	2ml	2ml
4	Vitamin E oil	1ml	1ml	1ml	1ml	1ml
5	Coconut oil	50ml	50ml	50ml	50ml	50ml

Evaluation Tests

Organoleptic Test

The organoleptic test of the prepared hair oil was carried out by visual observation and smelling.^[23] The oil was examined for colour, appearance and odour. The hair oil should be clear, uniform in appearance and free from suspended particles and it should possess a pleasant characteristics odour with no rancid smell, indicating good quality and adaptability of the hair

oil. The prepared herbal hair oil formulations (F1–F5) were evaluated for organoleptic properties such as colour, odour, appearance, and texture. F1 and F2 showed a dark green colour, F3 was green, F4 was yellow, and F5 was yellowish green. All formulations had a pleasant odour, clear appearance, and smooth texture. The green colour in F3 may be due to the increased quantity of herbal ingredients like *Chloris barbata* and hibiscus. On comparison of all parameters, F3 was found to be the best formulation because of its attractive green colour along with pleasant odour, clear appearance, and smooth texture. Therefore, F3 was selected as the optimized formulation.

pH test

The pH of the *Chloris barbata* extract hair oil was evaluated by placing a drop of the oil on pH paper. [24] The change in colour was observed and matched with the standard pH chart. The observed pH was found to be near neutral, and suitable for regular use on the scalp without causing irritation. The pH of the five formulations hair oil formulations was determined using a calibrated digital pH meter. All the formulations showed an indicating the compliance with the acidic state of hair. This pH suggests that the oil is safe for application on hair and is unlikely to causes irritation or dryness. Hence, oil formulations F1, F2 and F3 have the pH within the acceptable range of 4.8, whereas the formulations F4 and F5 have a slightly increased pH of 4.9 which may be due the increase in the concentration of *Chloris barbata*.

Skin irritation Test

A small quantity of the prepared hair oil was applied on a 1cm square area of skin on the hand. The applied area was exposed to sunlight for 4-5 minutes and absorbed for any signs of redness, itching or irritation. No irritation or adverse reaction was absorbed during the test. [25]

Acid value Test

The Acid Value of *Chloris barbata* hair oil was determined by accurately weighing a known quantity of the sample and dissolving it in a mixture of ethanol and ether. A few drops of phenolphthalein indicator were added, and the solution was titrated against standard potassium hydroxide (KOH) solution until a permanent pale pink colour appeared. The volume of KOH consumed was noted, and the acid value was calculated using the standard formula. The Acid value of *Chloris barbata* hair oil formulations (F1–F5) ranged from 4.3 to 4.5. The values show very slight variation, indicating uniform formulation. The low acid values suggest less free fatty acid content, confirming good quality, stability, and suitability for topical use. Overall, the formulations are stable and less prone to rancidity.

Iodine value Test

Iodine Value of *Chloris barbata* hair oil was determined by weighing a known quantity of the sample and dissolving it in chloroform, followed by the addition of Wij'ss iodine solution and keeping the mixture in the dark for complete reaction. Then potassium iodide and distilled water were added, and the liberated iodine was titrated with standard sodium thiosulphate using starch as an indicator until the blue colour disappeared. A blank was also performed, and the iodine value was calculated using the standard formula. The obtained value generally falls within the ranging between 6 and 11 g I₂/100 g oil, indicating a moderate level of unsaturation and good quality of the oil. The Iodine value of *Chloris barbata* hair oil formulations (F1–F5) ranged from 10 to 11.4. A gradual increase in iodine value from F1 to F5 indicates a slight increase in the degree of unsaturation in the oil. However, the overall values remain low, suggesting that the

formulations contain a higher proportion of saturated fatty acids. This contributes to better oxidative stability and reduced chances of rancidity. The minimal variation among formulations also indicates uniform composition and good formulation consistency, making the oil suitable for topical application.

Saponification Test

The saponification test of the prepared hair oil was carried out to check the presence of fatty acids. In this test, 2ml of hair oil was taken in a clean test tube and mixed with 2ml of alcoholic potassium hydroxide (KOH) solution. The test tube was closed and heated gently in a water bath for 10-15 minutes, allow in the ester bonds in the oil to break down and react with the alkali. After heating the mixture was cooled and diluted with distilled water. The formulation of soap or lather confirmed a positive saponification test, indicating that the hair oil contains fatty acids. The saponification value which represent the amount KOH required to saponify 1g of oil, gencarcy ranges from 180-200 mg KOH/g for vegetable – based oil used in hair care. The result obtained for hair oil falls within this normal ranges, confirming the presence of fatty acids and providing that the oil is suitable for cosmetic and hair care application. The variation in saponification values among F1–F5 may be attributed to the difference in the concentration and combination of herbal ingredients incorporated into each formulation. Higher saponification values observed in F4 and F5 indicate the presence of comparatively lower molecular weight fatty acids, while the lower value in F1, F2 and F3 suggests relatively higher molecular weight fatty acids. The average saponification value of all five formulations was found to be 34.21 mg KOH/g. The values obtained for all formulations confirm the presence of fatty acid content in the prepared herbal hair oil and indicate that the formulations are suitable for topical application.

Viscosity Test

The viscosity test of hair oil is performed to determine its thickness or flow property, which is an important quality parameter for cosmetic oils.^[26] In this test, a small amount of hair oil is taken in a clean beaker or viscometer, and its flow is observed at room temperature or using a simple glass tube method in the glass tube methods, the oil is allowed to flow through a narrow tube under gravity, and the time taken for a fixed volume to pass through is recorded. A thicker oil weight taken more time to flow, were as a thinner oil fill flow quickly. For hair oils, the normal viscosity ranges are approximately 30-100 centipoise at room temperature, depending on type of oil and addictive. During the test, the hair oil showed smooth flow without separation or dripping too fast, indicating moderate viscosity, the results confirms that the oil as suitable thickness for easy application on hair, ensuring proper coating and absorption while maintaining a non- greasy feel. The viscosity of the prepared hair oil formulations (F1–F5) was evaluated. The results showed that the viscosity gradually increased from F1 to F5. Formulation F1 showed the lowest viscosity value of 30.37, while formulation F5 showed the highest viscosity value of 47.11. The average viscosity of all formulations was found to be 36.83. The increase in viscosity may be due to the variation in the concentration of active ingredients used in different formulations. Higher viscosity indicates that the oil is slightly thicker and may provide better coating and nourishment to the hair. Among all the formulations, F5 showed the highest viscosity which may help in better application and retention on hair.

Specific gravity Test

The specific gravity test is used to determine the density of a liquid by comparing it with the density of water. The test is commonly carried out using a pycnometer. The normal range of specific gravity for most pharmaceutical liquids lies between 0.8 -1.3. Result if the obtained value falls within the specified standard range, the sample is considered to be pure and of acceptable quality. The specific gravity of the prepared herbal hair oil formulations (F1–F5) was determined to evaluate their density and uniformity. The values obtained were 0.75 for F1, 0.85 for F2, 0.86 for F3, 0.88 for F4, and 0.88 for F5. The average specific gravity was found to be 0.84. The results indicate that all formulations possess suitable density characteristics comparable to standard hair oil preparations. The slight variation observed in F1 to F5 may be due to differences in the concentration of herbal ingredients or oil composition. Overall, the values confirm that the formulations have acceptable specific gravity and are suitable for topical application.

CONCLUSION

The current study was carried out to formulate and evaluate herbal hair oil using *Chloris barbata* extract as the key ingredient. Hair oils prepared using natural plant sources are widely accepted due to their safety, effectiveness, and minimal side effects compared to synthetic products. In this study, the plant material was carefully processed and incorporated into a suitable oil base to prepare the formulation. The prepared *Chloris barbata* extract hair oil was evaluated for numerous physicochemical parameters such as colour, odour, pH, viscosity, specific gravity and stability. The results found from the evaluation revealed that the formulation possessed satisfactory physicochemical properties and good stability. These properties indicate that the prepared hair oil is suitable for application on hair and safe for daily use. The natural phytoconstituents in *Chloris barbata* may help in nourish the scalp, strengthens hair follicles, promotes healthy hair growth, and reduces common hair problems such as hair fall. Therefore, the formulated hair oil can be considered an effective herbal preparation for maintaining healthy hair and scalp. Further studies such as pharmacological evaluation and clinical studies may support to approve the therapeutic potential and efficacy of this formulation.

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