Research Article

Synergistic Effect of Herbs in a Cold-Pressed Hair Oil: Formulation and Evaluation Studies

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ABSTRACT

Androgenetic alopecia is a genetic condition characterized by the gradual thinning and shortening of hair, and it is a common cause of pattern baldness in both men and women. In the Indian context, approximately 58% of males aged 30–50 years are affected, and the incidence gradually increases gradually with age. Activation of hair roots is crucial for promoting hair growth and preventing hair loss. Herbal-based cosmetics have gained popularity among the general public lately, due to their perceived lower adverse effects and higher safety. During the present study, we have developed a polyherbal hair oil that supports the normal functioning of hair follicles. The polyherbal hair oil was prepared using an infusion of 18 herbs and a combination of oils fortified with vitamin E. The polyherbal hair oil showed a pH of 5.2 ± 0.1, an acid value of 4.1 mg KOH/g, a saponification value of 76.8 ± 0.52, and positive results in saponification, solubility, and translucent spot tests. It had a specific gravity of 0.812 ± 0.001, a refractive index of 1.264 ± 0.03, and a viscosity of 29.32 ± 1.4 cps. The oil appeared greenish brown with a coconut-like odour and caused no skin irritation. The antimicrobial test showed a clear zone of inhibition against Staphylococcus aureus, where the herbal hair oil demonstrated an inhibition zone of 1.7 ± 0.11 cm, compared to the standard antibiotic amoxycillin (2.1 ± 0.14 cm). We have conducted various tests on the prepared oil, including organoleptic, antimicrobial, saponification, and pH tests, all of which met the standards outlined in the literature. Preliminary tests have shown that it has no adverse effects and is very beneficial for the scalp and hair.

Keywords: Androgenetic alopecia, Polyherbal hair oil, Antimicrobial activity, Staphylococcus aureus, Hair follicle activation, Herbal cosmetics.

INTRODUCTION

The dynamic and ultimately regulated mechanism underlying hair development remains poorly understood. It is a recurring process involving the synthesis, elongation, and eventual shedding of the hair shaft. Human hair typically undergoes three phases, starting from the anagen phase, followed by the catagen phase, and then the telogen phase, after which it re-enters the early anagen phase. During the anagen phase, required protein synthesis is triggered by the hair follicle, allowing the hair shaft to develop with ease. The telogen phase begins when the hair follicle, after completing the anagen stage, temporarily ceases to generate a new hair shaft. Recurrent immune-mediated skin diseases such as Male Pattern Baldness (MPB) and *Alopecia Areata* (AA) cause non-scarring hair loss [1]. According to Indian studies, approximately 58% of males between 30 and 50 years old are affected by this condition. In every case, the incidence of this condition increases with age [2]. The physiology of AA involves inflammatory cascades that include an autoimmune process producing autoantigens linked to melanogenesis and a breakdown of the immune privilege of the hair follicle, both of which are associated with T-lymphocyte invasion. Moreover, alopecia areata can be linked to various factors, including genetic background, family history, environmental influences, illnesses, drugs, injuries, emotional stress, and oxidative stress [3].

Hair plays a role in physical protection, social connection, and thermoregulation. Hair problems such as alopecia hirsute, hypertrichosis, telogen effluvium, anagen effluvium, and miniaturization can adversely affect health. Alopecia is characterized by a loss of hair density and is often an indicator of various illnesses, including infections and inflammation [4]. Between 30 and 50% of men experience androgenic alopecia (AGA). Similarly, 12–40% of women are affected by age fifty [5]. Although ageing and intricate genetic inheritance are major risk factors in the progression of AGA, the onset predominantly occurs within the follicular microenvironment through an inflammation-driven phase, characterized by aberrant transcriptional activation and related processes. This stage is further aggravated by heightened oxidative stress and apoptosis. Multiple mechanisms underline hair loss, including the action of 5-dihydrotestosterone (DHT), inflammatory responses, and oxidative stress, all of which compromise keratinocyte survival.

The hair follicle cycle consisted of anagen, catagen, telogen, and exogen phase[7]. During the anagen phase (lasts two to six years), active growth takes place in the bulge region (where hair follicle stem cells mostly reside), regenerate the lower follicle region, while hair matrix forms new strands with support from a steady blood supply.[7]. In new-borns, a true anagen lasting about four weeks begins follicular expansion. The catagen phase lasts two to three weeks, a brief transition where the lower follicle degenerates, leaving a club hair in an epithelial cap. Keratinocytes in the root sheath are essential, while bulge stem cells remain functional for regeneration. The telogen phase, which lasts

approximately five to six weeks, is a resting period characterised by dormancy and shedding, during which papillary cells are inactive and detached from the follicle. The final exogen phase involves hair shedding, which can occur actively or passively due to mechanical factors.

Importantly, several genes control epithelial HF stem cell proliferation and cycling; their expression, triggered by stem cell density thresholds, initiates new hair growth and ensures the cyclical follicle renewal. The hair follicle begins to develop and remains nestled in the scalp. It's a structure that begins in the epidermis and resembles a stocking, extending into the dermis. An inner and outer sheath surrounds the follicular ends immediately before the sebaceous gland opens, providing protection and shaping the hair follicle. The hair type is inherited and depends on the shape of hair follicles, with curl patterns categorized into four types by Andre Walker: straight, wavy, curly, and coily[11]. Hair oils, an essential part of hair care, are valued for their nourishing, protective, and health-keeping properties, as well as for addressing issues such as baldness, greying, and dryness.

Scalp bacterial infection is commonly referred to as folliculitis. It is characterised by inflammation, itching, and pain, often accompanied by pus-filled, red sores. The primary culprit behind this is Staphylococcus aureus, which enters hair follicles or skin abrasions and leads to hair loss, and sometimes develops into alopecia if inflammation damages the follicles. The increasing demand for herbal cosmetics, appreciated for their natural ingredients, accessibility, and safety compared to synthetic alternatives, has also led to a rise in the popularity of herbal hair oils. Typically, it encompasses Amla, Coconut, Bhringraj, Kesh King, Brahmi, and Onion oils as active ingredients. These formulations embody both traditional significance and contemporary therapeutic and commercial relevance, rendering herbal hair oils a compelling subject within the realms of cosmetology and trichology. Therefore, the prime objective of the present study was to formulate and evaluate a cold-pressed herbal hair oil, which involved sourcing ingredients, producing the herbal oil through infusion, running initial tests, and performing an antimicrobial test against *Staphylococcus aureus*.

MATERIALS AND METHODS

Materials

The polyherbal hair oil was prepared by using the infusion of 18 herbs and oils fortified with vitamin E. The ingredients of polyherbal hair oil were collected from different sources (figure 1). The plant materials, such as Hibiscus, Neem, and Curry Leaves, were obtained from the herbal garden of DLS P.G. College, Bilaspur, Chhattisgarh. Amla, Ginger, Onion, Methi Dana, and Orange Peel were purchased from the local market. Manjistha, Bhringraj, Nagkesar, Brahmi, Black Seed, Yastimadhu, Jatamansi, Vitamin E Capsule, Harra, and Behra were purchased from an Amaranth Shop in Gol Bazaar, Bilaspur, Chhattisgarh. Coconut oil and Castor oil were purchased from "Tilli Tel Wala" of Karbala, Bilaspur, Chhattisgarh.

Preparation of Coconut Oil-Based Herbal Hair Oil

In the study, we used 18 herbs, coconut oil, Castor oil, and Vitamin E to prepare the Herbal Hair Oil (formulation shown in Table 1). The 18 herbs were placed in a clean beaker, and then 950 mL of coconut oil (cold-pressed), 40 mL of castor oil (cold-pressed), and 10 mL of Vitamin E were added. The mixture of herbs and oils was left to infuse for 30 days. After the color change, it was filtered through a three-layer clean muslin cloth and stored in a clean, air-tight glass container for further experimental evaluation. A detailed pictorial representation of polyherbal oil preparation is outlined in Figure. 2.

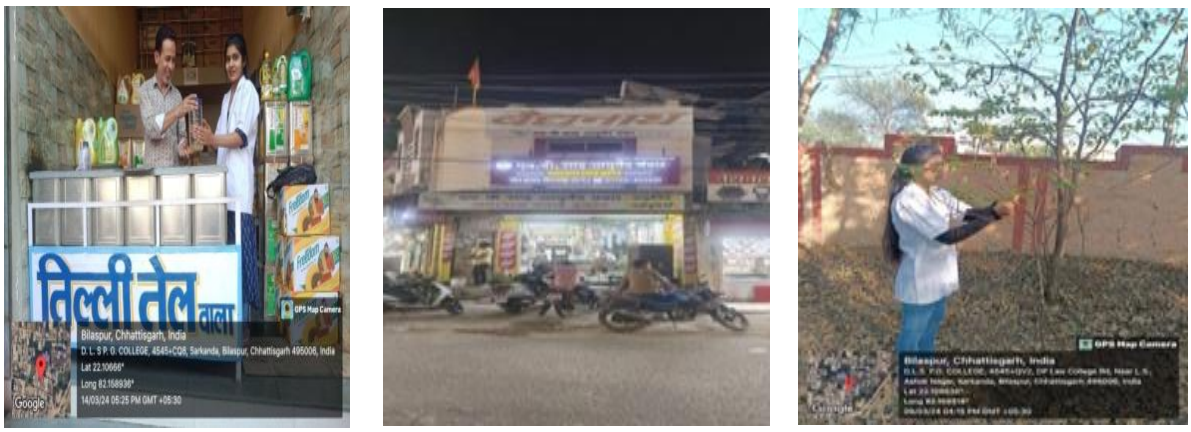

Figure 1: Collection of Plant Material

The biological profile of the selected herbal ingredients utilized for the preparation of polyherbal hair oil is given below in Table 1.

Table 1: Biological profile of active ingredients used for herbal oil

Name of compound	Scientific name	Bioactive compound/secondary metabolites	Quantity (gm)	Effect on overall Hair growth	Reference
Nagkesar	*Mesuaferrea linn*	Phenulcoumarins, xanthones and triterpenoides	1.0	Helps in Hair growth and thickness.	12
Brahmi	*Bacopa monnieri*	Alkaloids, saponins, and sterols.	1.0	Boosts hair growth.	13
Bhringraj	*Eclipta alba*	Phytoconstituents (e.g., alkaloids, steroids, flavonoids, phenolics, steroidal, terpenes, thiophene derivatives), and so on.	0.5	Increases blood circulation to the scalp and root	14
Amala	*Emblica officinalis gaertn*	Phenolic acids, flavonoids, tannins, other phenolics, and their derivatives are compounds.	10	Reduces breakage and improves overall hair health, strengthening hair strands	15
Jatamansi	*Nardostachys jatamansi*	Polyherbal derivatives, e.g., catechin, gallic acid, ferulic acid, p-coumaric acid, morin, quercetin, and vanillic acid.	1.0	Prevents hair loss, dandruff control, premature hair graying, headaches and depression	16
Meethidana	*Trigonella foenum graecum*	Alkaloids, saponins, tannins, phenol, and many others.	0.5	Antibacterial dandruff treatment, hair shining	17
Manjistha	*Rubia cordifolia*	Purpurin, anthaquinon	20	Manages hair issues such as graying, controlling hair fall, reducing dryness, and managing dandruff.	18
Yastimadhu	*Glycyrrhiza glabra linn*	Saponins/Glycosides e.g., triterpenoid saponin, Glycosides, and Glycyrrhizin; Flavonoids e.g., Isoflavones i.e., 7-acetoxy-2-methyl-isoflavone, 7-methoxy-2-methyl-isoflavone, and 7-hydroxy-2-methyl-isoflavone; Flavonols i.e., Quercetin, and Quercetin-3-glucoside; Flavanones & Chalcones i.e., Liquirtigenin (flavanone) and Isoliquiritigenin (chalcone); Coumarins i.e., 4-methyl coumarin, Liqcoumarin	0.5	Antibacterial	19
Harra	*Terminalia chebula*	Chebulic acid, chebulinic acid, gallic acid, and punicalagin, alongside flavonoids such as quercetin and kaempferol	1.5	Helps in improving– hair fall, itching, dandruff, scalp infection, rejuvenating properties	20
Behra	*Terminalia bellirica*	Alkaloids, flavones, lignans, tannins, phenols, coumarin, terpenoids, glycosides, and saponins.	0.5	Promotes hair growth and control dandruff	21
Blackseed	*Nigella sativa*	Alkaloids, coumarins, flavonoids, polyphenols, steroids, saponins, terpenes, and tannins.	1.4	Promotes overall hair growth	22
Ginger	*Zingiber officinale*	Phenolic compounds, e.g., gingerols, shogaols, and parasols; terpene compounds, i.e., beta-bisabolene-alpha curcumin, zingiberene, α-farnesene, and β-sesquiphellandrene).	5.0	Helps to grow stronger and longer hair.	23,24
Onion	*Allium cepa*	S-methyl L-cysteine sulphoxide (SMCSO), e.g., methin; s-trans-prop-1-enyl cysteine sulphoxide (PESO), i.e., isoalliin; s-propyl cysteine sulphoxide (PCSO), i.e., propiin	2.0	Supports strong and thick hair, stops hair fall, and promotes hair growth	25,26
Curry	*Murraya koenigii*	Alkaloids, flavonoids, terpenoids, vitamins, tannins, etc.	1.0	Removes dead hairs	27
Hibiscus	*Hibiscus rosa sinensis*	Anthocyanins, alkaloids, amino acids, flavonoids, lipids, naphthalene groups, polysaccharides, quinines, sesquiterpene, steroids, and terpenoids.	10 (Leaf) 4.21 (Flower)	Stimulates hair growth	28

Tulsi	*Ocimum sanctum*	Monoterpenes and Diterpenes e.g., Linalool, Linalyl (linalyl acetate), Geraniol, Camphor, Citral, Taxol (Paclitaxel), and Ursolic acid; Phenylpropanoids, e.g., Thymol, Eugenol, and Safrol	0.5 (Leaf) 0.5 (seed)	Controls Dandruff	29,30
Orange peel	*Citrus aurantium dulcis*	Flavonoids, limonoids and carotenoids.	14.39	Rich in antioxidants such as vitamin C and protects scalp from damage caused by free radicals	31
Coconut oil	*Cocos nucifera*	Myristic acid, phenolic acids, capric acid, lauric acid, monolaurin, and antioxidants, i.e., tocopherol.	950 ml	Heals damaged hair by softening.	32, 33, 34
Castor oil	*Ricinus communis*	Abrin and ricin belong to toxic species.	40 ml	Boost hair and moisturize scalp	34, 35
Vitamin E	Alpha-tocopherol	-	10 ml	Help in repairing damage and to shine	36

Figure 2: Preparation of Polyherbal Hair Oil

Evaluation of Herbal Hair Oil Preparation

A pH, Acid value, Saponification, Saponification value, Solubility (in ethanol), Translucent Spot test, Viscosity, Specific Gravity, Refractive Index (RI), Organoleptic properties, Skin Irritation test and antibacterial test were evaluated with slight modifications over previous literature 37,38, 39, 40. A brief description of the methodology is written below:

a) **pH**

The herbal oil's pH was determined with a calibrated pH meter, using 1N NaOH and 1N HCl solutions.

b) Acid value

A volume of 10 mL of prepared oil was combined with ethanol (25 mL) and ether (25 mL), then adequately mixed. Phenolphthalein was used as an indicator within the mixture and subsequently titrated with a KOH (0.1 M) (potassium hydroxide) solution. The acid value of the polyherbal hair oil was determined using the following formula.

$$\text{Acid value} = \frac{5.61n}{W}$$

Where *n* represented the volume of KOH (0.1M) used, and *w* was the weight of oil.

c) Saponification

Initially, 2.0 mL of oil was added to a test tube, and then 1.0 mL of a 20% NaOH solution was poured in. Subsequently, 0.5 ml of ethanol was introduced. The test tube was placed in a boiling water bath (BWB) for 15 min. Afterwards, distilled water (5.0 ml) was mixed, and the tube was shaken well. The appearance of bubbles, indicating the presence of lipids in the sample, was observed.

d) Saponification value

A 2.0 mL sample of oil was weighed in an iodine flask and combined with 25 mL of 0.5 M alcoholic potassium hydroxide. Further, refluxed at 80 °C in a water bath for around 30 minutes. Afterwards, phenolphthalein indicator was mixed. Then the reaction mixture was titrated with HCl (0.5 M) against a blank without the sample. The saponification value was determined using following formula.

$$\text{Saponification value} = \frac{28.05\ \{\text{blank (b) titre value(a)}\}}{W}$$

Where *w* represent weight of the sample (in grams).

e) Solubility with Ethanol

A small quantity of herbal oil was introduced into a test tube. Using a dropper, a minute volume of ethanol was subsequently added to the test tube. The test tube was then agitated thoroughly, resulting in the formation of a distinct layer on the surface of the ethanol. Subsequently, the test tube was stored in BWB to facilitate dissolution (proceeding on the principle that like dissolves like), thereby indicating the presence of oil or fat within the sample.

f) Translucent spot test

1.0 ml of herbal hair oil was applied to a filter paper, and then another filter paper was pressed onto it, creating a spot on both papers. The spotted filter paper was held in front of a lit candle and moved back and forth in front of the flame. Light was visible only through the translucent spot made by the sample, due to the diffraction of light.

g) Viscosity

Viscosity measured using a calibrated Ostwald viscometer.

h) ***Specific gravity***

Specific gravity was estimated using a pycnometer

i) ***Refractive index***

The refractive index was measured using a refractometer.

j) ***Organoleptic properties***

Color, odor, and skin irritation were assessed manually.

k) ***Skin Irritation Test***

The oil was applied to the hand (self-tested) and exposed to sunlight for 5 minutes to check for irritation.

l) ***Antimicrobial Test***

A Mueller-Hinton agar medium was prepared and poured into a Petri plate after autoclaving. Staphylococcus bacteria were spread on it. Then, two wells were made: one for oil and another for antibiotics (Amoxicillin trihydrate capsules, IP 500 mg), and it was incubated for 24 hours at 37°C.

RESULTS

During the present study, we have developed a polyherbal hair oil that supports the normal functioning of hair follicles. The polyherbal hair oil was prepared using an infusion of 18 herbs and oils fortified with vitamin E. The evaluation of the polyherbal hair oil was conducted by using several physicochemical, organoleptic, and biological parameters (Table 2). The pH of the formulation was found to be 5.2 ± 0.1, indicating suitability for scalp application, as it falls within the scalp pH range of 4.5 to 5.5. The acid value was 4.1 mg KOH/g, and the saponification test gave a positive result with a saponification value of 76.8 ± 0.52, confirming the quality of the oil. The formulation showed positive solubility in ethanol and passed the translucent spot test, indicating good absorption characteristics. The specific gravity was 0.812 ± 0.001, while the refractive index was 1.264 ± 0.03. The viscosity was measured as 29.32 ± 1.4 cps, confirming appropriate consistency. In terms of organoleptic evaluation, the oil was greenish brown in color with a coconut-like odor. The skin irritation test revealed no irritation, confirming the safety of topical use. Antimicrobial testing against Staphylococcus aureus revealed a zone of inhibition of 1.4 ± 0.09 cm and 1.7 ± 0.11 cm, compared to 2.0 ± 0.12 cm and 2.1 ± 0.14 cm for the standard antibiotic (Amoxycillin). These results suggest that the polyherbal hair

oil exhibits significant antimicrobial activity, albeit slightly lower than the standard drug, along with acceptable physicochemical and safety parameters.

Table 2: Evaluation parameters of Polyherbal hair oil

S. No.	Parameters	Observation	
1.	pH Test	5.2 ±0.1	
2.	Acid Value	4.1 mg KOH/g	
3.	Saponification test	+	
4.	Saponification value	76.8 ±0.52	
5.	Solubility (Ethanol)	+	
6.	Translucent spot Test	+	
7.	Specific Gravity	0.812 ±0.001	
8.	Refractive Index	1.264 ±0.03	
9.	Viscosity	29.32 ±1.4 cps	
10.	Color	Greenish brown	
11.	Odor	Coconut-like odor	
12.	Skin Irritation Test	No irritation	
13.	Antimicrobial test (cm)	Zone of Inhibition *(Staphylococcus aureus)*	
		Antibiotic (Amoxycillin)	Herbal hair oil
		2.1 ±0.14	1.7 ±0.11

DISCUSSION

The formulated herbal hair oil appeared greenish-brown and had a transparent consistency. When applied, it felt smooth on the hair. The saponification and solubility tests were positive. Literature also reported the same results [41]. An antimicrobial test on *Staphylococcus aureus* yielded a positive result, and the same was reported by recent literature [42]. The color is greenish brown, and the odor is characteristic, consistent with the previous findings [34]. Preparing hair oil requires careful evaluation of standard quality parameters to ensure safety, efficacy, and consumer acceptability. These parameters are broadly categorized into physical, chemical, microbiological, and sensory properties [40]. Physical attributes, such as pH, viscosity, specific gravity, and refractive index, are essential indicators of a product's stability and usability. Chemical parameters such as acid value and saponification value provide information about the oil's purity, quality, and shelf life. Microbiological assessment, including microbial load and heavy metal content, is crucial for protecting consumer health and ensuring compliance with regulatory standards. Sensory characteristics, such as color and odor, influence consumer acceptance and market appeal. The acceptable ranges for these parameters vary depending on the type of hair oil and are guided by established references, such as the Indian Standard IS 7123 [43], and other regional regulatory frameworks.

Apart from these quality parameters, several key factors influence the development of formulations. The most important among them is selecting a base oil, such as coconut, castor, or jojoba, which greatly determines the physicochemical and therapeutic characteristics of the final product. Using herbal extracts requires standardized extraction methods and proper concentration levels to maintain their bioactive properties and produce consistent results. It is equally crucial to follow regulatory guidelines, which cover aspects like labeling, safety testing, and overall quality assurance. In India, for example, the Central Drugs Standard Control Organisation (CDSCO) serves as the primary regulatory authority responsible for regulating and monitoring the manufacture and sale of cosmetic products, including hair oils. Its role is to ensure these formulations are safe, effective, and have a favorable risk–benefit ratio, aligning scientific formulation methods with consumer safety and industry standards.

Hair possesses several beneficial qualities, and it creates a protective cushion around the scalp's peak and other vulnerable areas [44]. Hair oils are usually designed to make hair shine and gloss by spreading a thin, even layer of herbal oil on the surface, leaving it non-sticky and smooth [45]. Numerous plants, such as amla, almond, hibiscus, and others, are used in hair oil. Since hair oil encourages hair growth, it is especially popular for enhancing hair beauty and preventing hair loss [46]. The traditional method in India involves making hair oils and mixing them with various medications that promote hair growth. Indian women are celebrated for their long, glossy, and strong hair, so it's no wonder that their self-care routines often focus on nurturing and maintaining beautiful hair. The canonical text on Ayurvedic medicine, the Charaka Samhitha, emphasizes the need to oil the scalp and hair to preserve healthy hair and prevent hair loss. It was recommended to oil hair daily with appropriate herbs that complement other ingredients, and this practice has persisted to this day.

The formulation of a polyherbal hair oil relied on powdered herbs e.g., *Murraya koenigii*, *Trigonella foenum-graecum*, *Hibiscus rosasinensis* Linn., and *Nigella sativa* [22]. These herbal components were mixed with coconut oil (60%), and then sequentially heated, cooled at room temperature, and filtered. The formulation was assessed for various parameters such as physical appearance, viscosity, pH, sensitivity test, hair growth activity, hair weight, antimicrobial activity, stability, and other quality indicators [22]. The results showed that the herbal hair oil was odorless and had a reddish-brown colour. It demonstrated a suitable refractive index, pH, saponification value, and specific gravity, indicating physicochemical stability. Following application, the oil exhibited Newtonian flow characteristics and was correlated with enhanced hair growth and increased hair mass, without inducing irritation or adverse effects. Phytochemical profiling revealed the presence of ascorbic acid, sulfur, and saponin in the formulated oil, thereby enhancing its therapeutic potential. Additionally, the formulation remained stable for 30 days under the tested conditions. Based on these findings, the study concluded that combining effective herbs in a coconut oil base could successfully promote hair growth and maintain scalp health.

The AA affects nearly 50% of men by the fifth decade and has significant psychosocial consequences. Conventional treatments include oral finasteride, which reduces DHT and slows follicular miniaturization, and topical minoxidil, which increases follicular blood flow and prolongs the anagen phase [47]. While topical therapy can be effective, but patient adherence often remains low. Recent studies suggest that a combined oral low-dose regimen, consisting of minoxidil (2.5 mg) and finasteride (1.0 mg), serves as a holistic treatment option. In a study involving 502 patients, this approach resulted in significant and meaningful improvements ($p < 0.001$) over the course of a year. Notably, 92.4% (464 patients) experienced stable or improved results, 47,48, particularly in advanced stages of AA. While the treatment offers better convenience, adherence, and efficacy, modest inter-rater reliability highlights the need for standardized assessment protocols [47,48], potentially supported by AI-based evaluation tools.

The preparation and evaluation of a polyherbal oil have been made using fresh leaves of *Eclipta alba*, *Sphaeranthus indicus*, *Hibiscus rosasinensis*, and *Wrightia tinctoria* [39]. The oil was prepared according to the Ayurvedic Pharmacopoeia and underwent thorough evaluation. Various parameters, including organoleptic properties, phytochemical composition, pH, specific gravity, saponification value, viscosity, refractive index, acid value, and stability tests, were assessed to determine its quality and effectiveness. The antimicrobial activity was evaluated using the inhibition zone assay, while the free radical scavenging activity (antioxidant potential) was assessed through the DPPH radical scavenging assay. Additionally, a preliminary skin irritation test was performed on the forearm to ensure safety. All parameters remained within acceptable standards, indicating good formulation quality. Among the three tested concentrations, the third one demonstrated superior stability, activity, and overall efficacy compared to the other two, highlighting its potential as a safe and effective herbal hair care product.

The study of cold-pressed herbal hair oil preparation and evaluation highlights how phytochemicals, nanocarriers, and traditional botanicals work together to support scalp health and hair regeneration. Recent research on androgenetic alopecia and follicular biology emphasizes the importance of restoring the hair growth cycle through natural methods [49,58]. Phytoconstituents from plants possess antioxidant, anti-inflammatory, and nutritive properties that promote follicular activity and help prevent early hair loss [53,55,57]. Additionally, advancements in nanotechnology and specialized engineering provide promising ways to improve the bioavailability and precise delivery of herbal active ingredients [50,54]. Evidence also supports the safety and effectiveness of natural products and herbal oils as alternatives to synthetic treatments [52,56]. Overall, combining ethnobotanical knowledge with modern pharmacology affirms cold-pressed herbal hair oil as a scientifically validated, sustainable, and culturally meaningful therapeutic option. The study is in its early stages, and the oil will be sent for further testing in an animal model.

CONCLUSION

Poly herbal hair oil is a well-known hair treatment approach used nowadays. It helps treat dry hair and scalp while hydrating the scalp. It contains several essential elements that promote healthy sebaceous gland function and support natural hair growth. In the present study, we have used dried Orange Peel, Amala, Methi Dana, Bhringraj, Nagkeshar, Brahmi, Yastimadhu, Jatamansi, Harra, Mehra, Ginger, Tulsi, Onion, Curry, and Black Seed. These ingredients have evolved into herbal hair oils due to their potential as potent topical formulations that promote hair growth. The eighteen ingredients were crushed, then mixed with cold-pressed coconut oil, cold-pressed castor oil, and a vitamin E capsule, and left to infuse for one month. After this period, the oil's colour appeared greenish brown, and it had a characteristic odour. Present results revealed that the formulated polyherbal hair oil has an acceptable pH and viscosity range, and it was found to be stable at room temperature. It is quickly absorbed into the scalp, providing nourishment for the hair. It serves as a natural hair nourisher, aiding in hair growth by reducing hair fall. This research provides guidelines on using herbal ingredients in the preparation of herbal hair oil with minimal or no side effects. Since all additional substances have numerous benefits and all parameters were within acceptable bounds, this oil can help promote healthy hair, turn grey hair black, prevent dandruff, and produce shiny, healthy-looking hair.

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