
Sustainable solution for scalp: Utilizing herbs for healthy hair growth

Taniya Thakur, Kanika Rair, Reena Chandel and Simerjit Kaur*

Department of Life Sciences, Rayat Bahra University, Mohali-140104, India

Abstract: *This review paper explores the thorough analysis of the various approaches used in the formulation of herbal hair oil. Due to their natural origins and effectiveness in maintaining good hair health, herbal hair oils have gained considerable interest in recent times. This review aims to study the advantages of herbal hair oil over the synthetic hair care products, various therapeutic and nutraceutical properties of herbs helping in maintenance of hair health by combating certain hair disorders. This overview covers recent advancements like supercritical fluid extraction, steam distillation, and ultrasonication in addition to conventional methods like infusion, maceration, and decoction. Additionally, the review also looks at the phytochemical properties, shelf life, evaluation of herbal hair oil preparation. The study aims to explore the various herbal formulations that can be a best possible solution to issues such as dandruff, itching in scalp, hair loss and premature greying. It also promotes an extensive understanding of the complex interactions between botanical ingredients, extraction techniques, and formulation strategies in the development of sustainable and effective hair care solutions.*

Keywords: Hairs, Herbs, Herbal hair oil, scalp protection, hair follicles.

*Corresponding author: Dr. Reena Chandel
e-mail: reena.19185@rayatbahrauniversity.edu.in

1. Introduction

The custom of oiling one's hair has been an integral part of many nations' cultural rituals for hundreds of years. This age-old custom has its roots in holistic health practices which represents a close relationship to nature's abundant healing resources as well as a beauty routine. Herbal hair oils have become popular now a days as people want bright, shiny, healthy hairs because herbs are full of medicinal properties that helps to nourish and provides good care for their hair. The concept of beauty and cosmetics is as ancient as human civilization [1]. Hair is an important and distinctive symbol that not only plays a major role in beautification, self-expression but also has several functions like protection from heat, cold etc. Hairs are made up of hair follicles and hair shaft. Each strand of hair represents individual's genetic makeup, complex structure of keratinized fibers, and lifestyle choices. The development of specialized care solutions is aided by knowing the intricate details of hair anatomy—such as the medulla, cortex, and cuticle—helps formulate customized care solutions by illuminating the hair's resilience and susceptibility to outside stimuli. The field of herbal hair care is full of riches from the botanical world, each with unique properties to help with a variety of hair issues. Herbs are known for their capacity to strengthen roots, nourish the scalp, and improve

hair structure. Various herbs like neem, hibiscus, aloe-vera, amla, onion, reetha, fenugreek seeds, curry leaves are filled with abundant amount of benefits [2]. Herbal hair oils provide many advantages over conventional cosmetics, including sustainability and overall health. Use of herbal hair oil not only enhances the better hair growth but also reduces exposure to artificial chemicals that could harm the environment and the health of the scalp. In today's world customers are being conscious while purchasing anything from market, they are prioritizing transparency, efficacy, and ethical sourcing in their beauty rituals, which is reflected in the comeback of herbal hair care. Using natural substances reduces exposure to synthetic chemicals that can harm the environment and the health of the scalp. The rapid rise in the trend of herbal hair care is the indication of consumers consciousness about what they are using and is the product they are using gives them benefits. The formulation of herbal hair oil involves a use of traditional and modern methods of herbal oil extraction. Some of traditional methods used to formulate herbal hair oil are- Infusion, Sun infusion, decoction etc. The modern methods used are - Cold pressing, solvent extraction, super critical fluid extraction and steam distillation [3]. This review aims to cover the various traditional and modern methodologies adopted to formulate herbal hair

oil. Through this review we aim to explore the diversity in the development of modern and traditional in the creation of herbal hair oil that not only acts as an emerging sustainable solution

for the nourishment of scalp but also being a sustainable choice to protect environment.

1.1 Structure of Hair

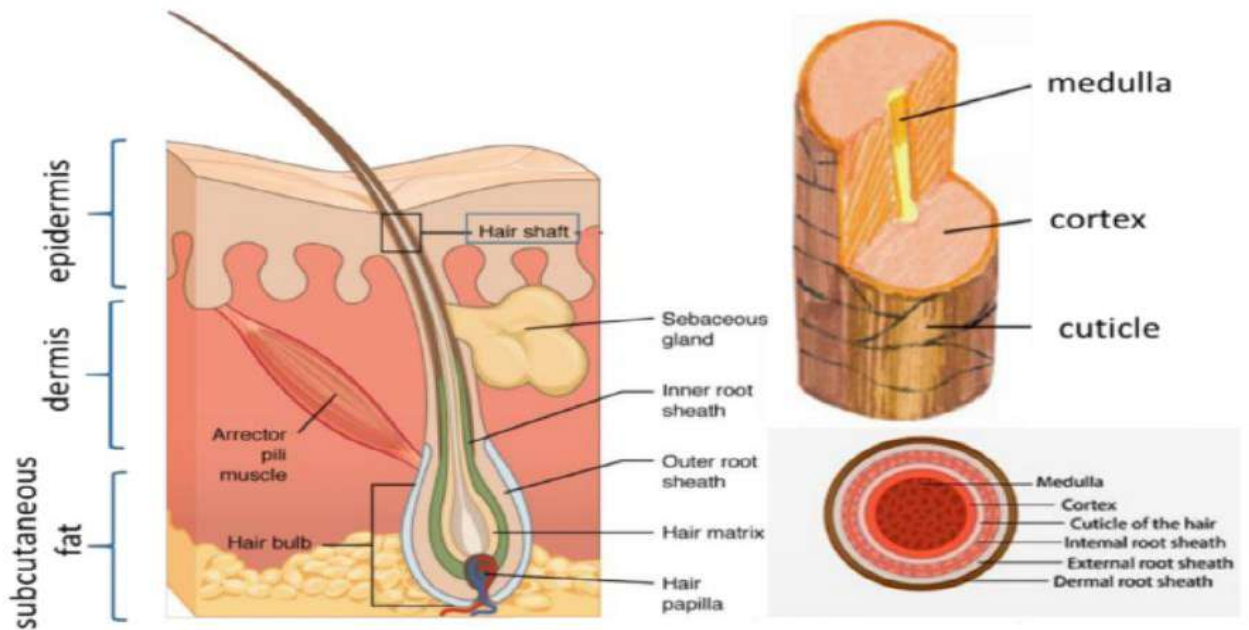


Fig-1. Structure of hair [4].

1.1 Hair follicles

The area where hairs begin to grow is called as follicles. A structure that resembles like stocking, originate in the epidermis. It goes up to the dermis. Inner and outer sheaths lining the follicles helps the growing hairs to protect and shape it, terminating immediately before the sebaceous gland opening.

1.2 Hair shaft

The part of hair with three keratin layers is called the hair shaft. Three layers are as follows-

- Inner layer - Also called as medulla, it is the first layer among the three layers of hair shaft.
- Middle layer- It is often known as cortex; the majority part of hair shaft comprises of middle layer.
- Outer layer - It is known as cuticle. This layer comprises of closely spaced scales that overlap to resemble roof shingles [5].

1.3 Growth Cycle of Hairs

Growth cycle of hairs consists of 3 phases that are:

- ❖ Anagen phase: This phase is often known as the growth phase of hair. The duration of the anagen phase is 2 to 6 years, during this phase fresh hair pushes out from the follicle and creates new hair.
- ❖ Catagen phase: This phase is called as transitional phase and this phase affects about 3% of all hair at any given time.
- ❖ Telogen phase: This phase lasts for around 2 to 3 months and it's usually a resting period. In this phase fully, developed club hairs are formed while hair follicles are at rest [6].

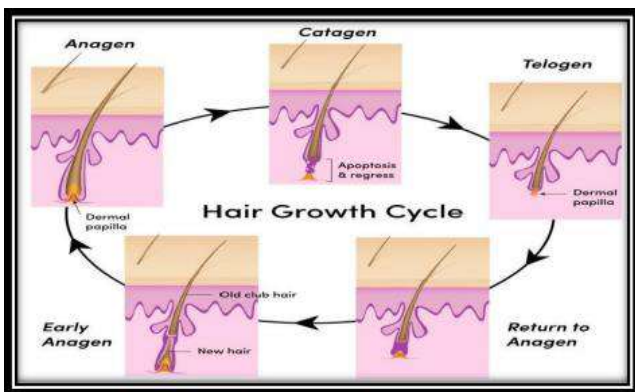


Fig-2. Hair Growth Cycle [7].

1.4 Symptoms of hair follicle disease

Hair follicles disease consists of wide range of conditions that have several symptoms, prevalence rate and stages of progression. Some of the common symptoms associated with hair follicles condition are given below:

1. Texture of hair changes, hairs become thin and brittle due to hair follicles damage.

These symptoms are generally associated with nutritional deficiencies and alopecia. It's mostly prevalent in 50% of males and females who are above the age of 50. In the early stage of progression, the hairs slowly become thin and brittle. In stage 2 hairs loss become more frequent and thinning of hairs increases. And in final stage rapid hair loss occur that causes bald patches commonly in case of alopecia.

2. Swelling and redness around the hair follicles. These symptoms are related to a condition called folliculitis. Its more prevalent in individuals with weak immune system. In the early stage of progression, inflamed lumps and redness can be observed around the hair follicles. In 2nd stage the inflammation begins to spread causing pustule formation. In the final stage there is high chances of chronic infection leading to scarring.
3. Frequent hair loss due to thinning or bald patches on the scalp. Such symptoms are linked with a condition called alopecia areata. This condition is prevalent in about 2% of population either male or female. The small rounded bald patches are observed in the early stage of progression. In intermediate stage of progression there is addition of new patches or the previous ones started to extend. In final stage there is complete hair loss on scalp or body mostly in severe cases.

4. Itching in scalp with rashes. These symptoms are associated with a disorder known as seborrheic dermatitis and psoriasis. Seborrheic Dermatitis is usually prevalent in 3-5% of population and psoriasis affects approximately 2-3% of population with about 50% of cases involving scalp issues. In the early stage of progression individuals suffers from irritation in scalp and flaking. Irritation leads to rashes, swelling and discomfort in the 2nd stage. Severe itching, irritation leads to infection due to continuous scratching in the final stage of progression.
5. Scalp infection that leads to pus filled bumps. Various disorders like bacterial folliculitis and furuncles are linked with these symptoms. Such disorders are prevalent in individuals with weak immune systems and people with poor hygiene. Small red pimples or lumps are observed in the early stage of progression. In 2nd stage of progression the lumps becomes large and formation of pus filled lumps occur. And in the final stage of progression there is development of large clusters leading to serious infection if untreated.

Table 1.: Herbal Hair Oils Available in Market [8].

Herbal Hair Oil	Benefits of Herbal Hair Oil
Neelgiri herbal hair oil	Neelgiri is well known for its calming and cooling effects, neelgiri oil is made from eucalyptus. It helps in reducing itching, irritation in scalp and promotes hair growth.
Bhring amla hair oil	Bhring and amla are the traditional herbs which helps in scalp nourishment, strengthens the hair follicles and prevents premature greying of hairs.
Rosemary hair oil	Rosemary oil helps in reducing dandruff, helps in enhancement of scalp circulation and maintains healthy hair growth. It's rich in anti-bacterial properties.
Onion hair oil	Onion oil is rich in sulfur content which helps in promoting healthy hair growth and also provide strength to hair follicles. It prevents dandruff and alopecia.
Jasmine hair oil	Jasmine is known for its good hydrating properties that aids in conditioning the hairs and scalp and makes hair look shiny and glossy.
Henna hair oil	Henna oil maintains the scalp health leading to good hair growth, it helps in conditioning the hair and adds natural sheen to them.
Navratna ayurvedic hair oil	This oil is made up of combination of nine different herbs each having specific therapeutic qualities. It helps in relieving the stress, providing soothing effect to scalp and promotes hair development.
Coconut hair oil	Coconut oil helps in preventing the protein loss and damage to scalp, it's moistening qualities helps penetrates deep into the hair shaft. It is well known for its anti-bacterial properties.
Almond hair oil	Almond oil provides nourishment to hairs and scalp as it's rich in vitamins and minerals. It makes hair softer, shiner, stronger and also prevents the hair from breaking.

2. Material

For the formulation of hair oil different herbs are used in different ratio. These herbs have different medicinal properties and have a great effect on hair health [9].

1) Amlaa

Scientific name - *Phyllanthus ambllica*

Found mostly in Uttar Pradesh and Himachal Pradesh. Fruit are pale yellow in color and is round in shape. High in vitamin C.

Role - Helps to retain moisture of scalp

Repairs hair tissue Maintain pH



Fig-3. Amlaa [10].

2) Neem

Scientific Name - *Azadirachta indica*

Found mostly in southern tip of Kerala and Himalayan hills. Its fruit and seeds are the source of oil, having vitamin E, triglycerides, limonoids .

Role – Strengthen hair follicles

Increase blood circulation in scalp

Reduce dandruff



Fig -4. Neem [11].

3) Curry leaves

Scientific name - *Bergera Koenigii*

Found in subtropical and tropical region of Asia.

Curry leaves are high in Beta Carotene and protein content.

Role – Helps to remove dead hair follicles

Prevent premature greying

Conditions hair



Fig -5. Curry leaves [12].

4) Fenugreek seed

Scientific name – *Trigonella feonum graecum*

Found in Maharashtra. Fenugreek seeds are rich in protein and nicotine.

Role – Prevent flakiness and itching

Prevent hair loss

Provide hydration to scalp



Fig - 6. Fenugreek seeds[13].

5) Onion

Scientific name – *Allium cepa*

Mostly cultivated in Maharashtra, Karnataka, Madhya Pradesh, Gujarat, Bihar, Andhra Pradesh, Rajasthan, Haryana and Telangana. Onion is rich in vitamin C Sulphur and potassium

Role – Improves blood flow to hair follicles

Decrease infection at scalp

Fight dandruff and improve texture



Fig - 7. Onion [14].

6) Aloe Vera

Scientific name - *Aloe barbadensis miller*

Aloe Vera mostly found in some areas of Europe , Asia, Africa and in India found in Rajasthan, Andhra Pradesh, Gujarat, Maharashtra and Tamil Nadu. Aloe Vera is rich in Vitamin A, C and E.

Role – Strengthen and repair hair strands

Deep cleans oily hairs

Calms an itchy scalp



Fig. 8 Aloe Vera [15].

7) Walnut

Scientific name – *Juglans regia*

Found in Jammu and Kashmir, Uttaranchal, Himachal Pradesh and Arunachal Pradesh
Walnuts are rich in omega 3 fatty acids.

Role – Enhance texture of hair

Fight with dandruff

Stimulate hair growth



Fig -9. Walnuts [16].

8) Reetha

Scientific name – *Sapindus mukorossi*

Found in outer Himalayas of Himachal Pradesh .

Reetha is rich source of protein

Role – Prevent breakage and split ends

Promote hair thickness

Reduce frizz



Fig- 10. Reetha [17].

9) Garlic

Scientific name – *Allium sativum*

Mostly cultivated in Gujrat, Madhya Pradesh, Maharashtra and Rajasthan. Garlic is rich in Vitamin B6, Potassium and iron

Role – Provide protection against heat

Prevent Hair loss

Fight scalp infection



Fig - 11. Garlic [18].

9) Coconut oil

Scientific name – *Cocos nucifera*

Mostly found in Southern India. Coconut oil rich in lauric acid, fatty acids , capric acid

Role – Provide moisture to hair follicles

Repair damage hair

Prevent dandruff



Fig -12. coconut oil [19].

11) Castro oil

Scientific name – *Ricinus communis*

Found mostly in tropical belt of India. Castro oil is rich source of ricinoleic acid and linoleic acid.

Role – Hydrated hair strands

Prevent scalp from infection

Boost hair growth



Fig-13. Castro oil [20].

2.1 Methods

Formulation of herbal hair oil can be done by different methods one is traditional methods and other is modern methods. These two methods have different principals and different advantages for the formulation of herbal hair oil.

There are various traditional methods which are used in the formulation - Infusion, Decocotion, sun infusion and fire Distillation

1) Sun Infusion - Sun infusion is an ancient technique which is also known as solar maceration. This technique provides natural method for extraction of hair oil with the help of sun light. Sun light helps to breakdown the cell walls which release the essential oil. Sun light accelerate infusion process and increase the antimicrobial activities.

Advantages - This method is eco friendly

Helps in preservation of phytochemical

Oils have aromatherapy benefits

2) Fire Distillation - Fire distillation is one of traditional method which is used for the formulation of hair oil and extraction of oil and aromatic material from the plants with the help of heat and open flame. This method involves an open flame which helps to heat the water and botanical compound present in the container. The heat produces help plants to release their volatile oils. Which are in the form of vapor and steam. These vapour condensed in liquid form.

Advantages- Helps in preservation of natural properties

Oil is of high quality

Selective extraction can be done

3) Decocotion - This method involves natural process of simmering of plants in water for the extraction of botanical material. This method realizes on principal of heat extraction to release

the bioactive compound in solvent or water. Simmering help to break the cell wall and release the essential oil from the plant.

Advantages - Oils have long shelf life

High efficiency extraction can be done

Extraction of water-soluble compounds can be done

3. Modern method

Modern method used for formulation of herbal hair oil are - Cold pressing, steam distillation, solvent extraction, super critical fluid extraction.

1) Cold pressing - This is the mechanical extraction method also known as cold expeller pressing. This method is used for extraction of oil from seeds and plant without help of heat and chemical solvent. Cold pressing realize on mechanical force. Mechanical pressure is used to crush and squeeze the oil from oil rich plant. This is done at below 50°C to ensure the retention of heat sensitivity of compound .

Advantages - Preserve nutrition value of plants

The oil is of high quality and pure

Helps to retain aroma and oil is residue free

2) Steam Distillation - This method is a gentle extraction method which have been used from many years for the extraction of oil from aromatic plants. This method is done with the help of steam. The steam carries the volatile oil is condensed into the liquid form which results

in mixture of oil and water. The layers of oil are less dense and is separate from water. Then the oil is collected.

Advantages - Preserve the natural compounds of plants

The oil is of high purity

Helps in gentle extraction

3) Solvent extraction - This method is also known as solvent maceration. Used for extraction of lipophilic compound, essential oil from plants. This involves dissolution of compound into suitable solvent and separation of the solvent extract mixture. This method depends upon the factor's polarity toxicity with compounds.

Advantages - The product is high yield

Through this method efficient extraction is done.

Helps to prevent bioactivity of compounds

4) Supercritical fluid extraction - In this method extraction of oil is done with the help of solvent. Carbon dioxide is commonly used as solvent because of its low critical temperature which is suitable for extracting delicate compound from herbs and it behave as both gas and liquid, carbon-dioxide has solvating properties which help to penetrate the plant matrix and extract the compound from herbs. Separation of oil and carbon-dioxide become easy as carbon-dioxide return to its gaseous phase

Advantages - Extraction is residue and solvent free

Selective extraction can be done of desired compound

Efficient extraction is done in short extraction time [21].

2.2 Formulation Of Hair Oil -

All Ingredients which are used in formulation of herbal hair oil like amlaa, reetha, coconut oil, curry leaves and all other were weighed accurately. After weighing all the ingredients were dried and grinded into a fine powder. For the formulation of oil Coconut oil were heated in the pan and all ingredients were mixed in the oil. The mixture of oil and powered ingredients were boiled for at least 15 to 20 minutes. After boiling the mixture was filtered with the help of muslin cloth. Castro oil were added to the mixture with small amount of color and flavoring agent for fresh aroma [22].

3.1 Evaluation of herbal oil

The formulated hair oil was evaluated on basis of physical and chemical tests.

1) Sensitivity Test - The formulated hair oil was applied on the hand and kept in sunlight for 7 to 8 minutes

2) pH -The pH value was determined with the help of pH meter

3) Viscosity - The viscosity was determined with the help of Ostwald viscometer

4) Acid value - For acid value the formulated oil was added with ethanol and ether. Phenolphthalein was taken as indicator and titrated in potassium hydroxide solution

5) Specific Gravity - Specific gravity of formulated oil was determined with the help of specific gravity bottle

6) Colour Test - Determined by naked eyes [23].

3.2 Shelf life and efficiency

Shelf life and efficiency of formulated herbal hair oil depends on different factors which includes extraction method, quality of herbs, formulation technique and storage conditions.

★ Extraction method - Different methods are used for extraction of hair oil, oil with higher susceptibility have shorter shelf life

★ Storage conditions - Proper storage condition is required to increase the shelf life and maintain the efficiency of formulated oil. Herbs oil should be stored in glass bottle and cool environment.

★ Formulation technique - Proper technique are required for the formulation of herbal hair oil which includes proper mixing of the ingredients, filtration, testing, packaging and storage of the hair oil. Proper formulation technique can help to reduce the risk of contamination which can increase the shelf life.

★ Quality of ingredients - Efficiency and shelf life of formulated oil also depends on the quality of the ingredients. Fresh herbs, herbs free from pesticides can help in making stable and high-quality hair oil.

3.3 Consumer preference

Consumer preference of formulated herbal hair oil depends on various factors-

1. Therapeutic properties - Consumer prefer herbal oil which provide therapeutic benefit to their problem for ex - hairfall, dandruff
2. Culture tradition - Consumer may prefer oil which is formulated with method rooted to their culture
3. Aroma - Some consumer prefer oil with pleasant and natural aroma
4. Product value - Many consumers may pay high for premium herbal oil but some consumer may consider price over quality
5. Efficiency and safety - Some consumer may look for the certification from reputed organization for safety

Table 2: Phytochemical Screening of Herbal Hair Oil [24].

Alkaloids Screening	Alkaloids are nitrogenous substances that are known to maintain healthy scalp and promotes hair growth. Quantitative techniques such as spectrophotometry are used to detect the alkaloid content.
Flavonoid Screening	Flavonoids are rich in antioxidant and anti-inflammatory properties that supports healthy scalp and hair follicles development. Colorimetric tests and chromatography techniques including HPLC (High-Performance Liquid Chromatography) are used for the screening process.
Phenols Screening	Phenols are rich in antioxidant and antibacterial properties, it helps in protecting hairs from any microbial infection and oxidative damage. Folin-Ciocalteu reagent is used to screen phenols in oil.
Saponins Screening	Saponins are good foaming agents that helps in cleaning the pollutants from scalp, also cleans the scalp and improve hair texture. Foam test and TLC (Thin Layer Chromatography) are used for the screening purpose.
Terpenoids Screening	Terpenoids contributes to aroma and medicinal properties to plant oil. Techniques like GC (gas Chromatography) and MS (mass spectrometry) are used to determine the terpenoids.
Steroid Screening	Steroids helps in regulation of hair growth cycles, and promotes healthy scalp. TLC (thin layer chromatography) and HPLC (high performance liquid chromatography) are used for the analysis of steroids.

4. Conclusion

The present review signifies the utilization of herbs as a sustainable choice in order to nourish scalp for healthy hair growth. Using the combination of herbal oil formulation will not only maintain good hair health but also reduces the chances of many hair problems like dandruff

and hair fall. The thorough analysis of both traditional and modern methods of oil extraction have been reviewed both having some pros and cons regarding the sustainability factor. Techniques like super critical fluid extraction and cold pressing are more sustainable and environment friendly since they utilize fewer

solvents, require less energy, and maintain the integrity of the herbal ingredients. Traditional techniques like infusion and decoction requires large amount of plant material and greater energy inputs which makes these techniques less environment friendly and less efficient in resources. The use of methods generally depends upon the various herb and their properties. In order to improve the sustainability of herbal hair oil investments should be made in renewable energy sources, effective waste management procedures, and source herbs from ethical and certified organic suppliers. Additionally, reduction of the ecological footprint of herbal hair oil can be achieved by adopting innovative

packaging techniques like packaging with biodegradable material.

Being the part of natural formulation herbal hair oil have various benefits over the synthetic hair care products available in the market. Even though synthetic hair oil seems promising at first, but over time, they end up harming hair and the environment due to the presence of harsh chemicals. On the other hand, herbal hair oil are the botanical components and helps in providing nourishment and protection to scalp as well as poses sustainable effects to the environment. The herbal hair oil formulation practices will surely set the standard for a more sustainable future for the upcoming generations by emphasizing eco-conscious practices.

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