

Hair Tonic Formulation of Castor Bean and Clove: A traditional way to Improve Hair Quality

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ABSTRACT: The increasing demand for natural hair care solutions has renewed interest in traditional remedies. This study focuses on developing a hair tonic formulation using castor bean (*Ricinus communis*) and clove (*Syzygium aromaticum*), two plants renowned for their therapeutic properties. Castor oil is widely recognized for its ability to promote hair growth, enhance scalp health, and prevent breakage due to its high content of ricinoleic acid and essential fatty acids. Clove, rich in eugenol, possesses potent antimicrobial and antioxidant properties, contributing to a healthier scalp environment and strengthening hair roots. Combining these ingredients, the formulated hair tonic aims to offer an effective, natural solution for improving hair quality, reducing hair fall, and promoting thicker, shinier hair. Preliminary evaluations suggest that the tonic is safe, easy to apply, and could serve as an affordable alternative to synthetic hair care products. This formulation underscores the potential of traditional knowledge in modern hair care applications.

Keywords: Hair Tonic, *Ricinus communis*, *Syzygium aromaticum*, anagen, catagen, telogen.

INTRODUCTION: Hair tonic is a specialized product formulated to enhance the health and appearance of hair and scalp. Typically, available in liquid form, it often contains a blend of oils, vitamins, and herbal extracts. Regular use of hair tonics can help add shine, reduce dandruff, stimulate hair growth, and improve overall scalp health. Some formulations are also designed to assist in styling and to provide a pleasant fragrance. Hair loss, medically termed alopecia, may be temporary or permanent. The most common type, androgenetic alopecia, results from a combination of hormonal (androgen-related) and genetic factors. Herbal formulations have gained significant attention due to their effective biological activity and minimal side effects compared to synthetic drugs.[1] "Herbal cosmetics" or "natural cosmetics" refer to products that incorporate herbal ingredients into cosmetic bases, aiming to deliver specific cosmetic benefits without synthetic additives. Increasingly, individuals are turning to herbal-based hair products such as shampoos, conditioners, and hair tonics to prevent hair loss and promote healthy hair growth. Several factors contribute to hair loss, including nutritional deficiencies and serious illnesses. Hair oils, particularly those infused with herbal extracts, are widely utilized for preventing baldness and promoting the healthy, luxurious growth of hair. These oils act as hair tonics, often featuring medicinal plant extracts rich in secondary metabolites, essential oils, and other therapeutic compounds. Essential oils such as tea tree oil and carrier oils like jojoba oil remain popular components of modern herbal hair care solutions.[2]

Herbal oils support the scalp and hair follicles nutritionally, facilitating natural restorative and growth processes. Common ingredients in herbal hair oils include Amla, Aloe Vera, Neem, Henna, Tulsi, and Jojoba. Tulsi, renowned for its antioxidant content—such as ursolic acid, apigenin, and luteolin—helps protect against hair loss and premature graying. It strengthens hair roots and can also be combined with castor oil as a remedy for lice. Jojoba oil, originally used by Native Americans, is another potent hair growth stimulant and is often blended with other oils like coconut oil for enhanced effectiveness. Hair, originating from the ectodermal layer of the skin, serves protective and aesthetic functions. It is

considered an accessory structure of the integumentary system, alongside glands and nails. In traditional and therapeutic contexts, "hair tonic" refers to products aimed at repairing, revitalizing, and retexturing hair. The development and application of herbal-based hair tonics illustrate a harmonious blend of traditional knowledge and modern cosmetic science. [3]

Life Cycle of Hair [4,5,6]

The life cycle of hair consists of three main phases: anagen, catagen, and telogen.

- **Anagen (Growth Phase):** This is the active growth phase where hair follicles produce new cells, resulting in the elongation of the hair shaft. It can last anywhere from 2 to 7 years, depending on genetics and other factors. During this stage, hair grows about half an inch per month.
- **Catagen (Transition Phase):** Following the anagen phase, hair enters a short transitional period lasting about 2 to 3 weeks. In this phase, hair growth stops, and the hair follicle shrinks, detaching from the blood supply.
- **Telogen (Resting Phase):** In the final stage, the hair remains in the follicle but is no longer actively growing. After about 2 to 4 months, the old hair is shed naturally, making way for a new hair strand to begin the cycle again.

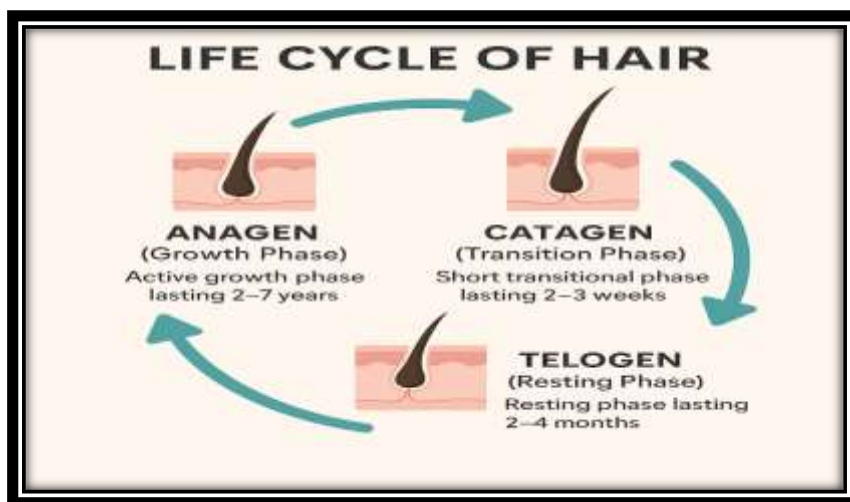


Fig.No.1: Life Cycle of Hair

MATERIALS AND METHODS:

Formulation and Optimization of Base Formulation

Table No.1: Formulation and Optimization of Base Formulation

Sr No.	Ingredients	Quantity for 100%
1.	Butylene Glycol	5%
2.	Propylene glycol	5%
3.	Hydroxy Ethyl Cellulose	1%
4.	Hyaluronic acid	1%
4.	Sodium EDTA	0.1%

5.	Allantion	0.1%
6.	DMDM Hydentoin	0.8%
7.	Active	16%
8.	Water	78.08%

Selection of Active Ingredients

- **Castor Bean**

The primary active constituent of castor bean (*Ricinus communis*) is ricinoleic acid, known for its significant anti-inflammatory and analgesic effects. Additionally, it serves as a precursor for producing bio-based polymers and lubricants. Selection focused on cultivars exhibiting high oil content and resistance to common plant diseases. Genetic variability assessments were conducted to prioritize traits such as seed weight and enhanced oil yield. [7]

- **Clove:**

In clove (*Syzygium aromaticum*), eugenol is the major bioactive compound, valued for its antimicrobial, antioxidant, and anesthetic properties. The selection criteria emphasized sourcing clove varieties with the highest concentrations of eugenol for maximum therapeutic efficacy. [8]

Collection and Authentication [9,10]

Collection:

- **Field Surveys:** Regions with favorable agro-climatic conditions for castor bean and tropical environments for clove were identified through field visits.
- **Sampling:** Representative samples, specifically seeds for castor bean and flower buds for clove, were collected, with detailed documentation of environmental parameters and precise geographical coordinates.
- **Preservation:** Samples were stored in controlled conditions to preserve their chemical stability and morphological characteristics.

Authentication: [11,12]

- **Morphological Analysis:** Physical examination of the samples was conducted by comparing traits such as seed shape (castor bean) and bud structure (clove) against established botanical descriptions.
- **Molecular Identification:** DNA barcoding techniques, targeting genomic markers like **rbcL** and **matK**, were employed for accurate species authentication.
- **Chemical Profiling:** Gas Chromatography-Mass Spectrometry (GC-MS) analysis was used to detect and quantify key components, specifically ricinoleic acid in castor bean and eugenol in clove.

Extraction Method

Vacuum Distillation

The extraction of active compounds was performed using vacuum distillation, a technique that operates under reduced pressure to facilitate the purification of heat-sensitive materials. By lowering the boiling points of the target compounds, this method prevents thermal degradation and improves efficiency. The relationship between temperature and pressure adjustments was calculated using a nomograph based on the Clausius–Clapeyron equation, ensuring optimal extraction of ricinoleic acid and eugenol. [13,14]

The basic setup for vacuum distillation typically includes the following components: [15,16]

Round-Bottom Flask: Used to hold the liquid mixture that needs to be distilled.

Heating Mantle or Water Bath: Provides controlled heating to the round-bottom flask without direct flame, preventing overheating.

Distillation Head: Connects the round-bottom flask to the condenser; it helps guide vapors into the condenser.

Thermometer Adapter and Thermometer: Monitors the vapor temperature to ensure accurate separation based on boiling points.

Condenser: A water- or air-cooled tube that cools the vapor back into liquid form.

Receiving Flask: Collects the distilled liquid (distillate) after condensation.

Vacuum Adapter: Connects the end of the condenser to the vacuum source and receiving flask, allowing reduced pressure distillation.

Vacuum Pump: Creates a vacuum in the system to lower the boiling points of the substances being separated.

Clamps and Stands: Used to secure all glassware in place safely during the operation.

Trap (Optional): Placed between the system and the vacuum pump to protect the pump from vapors or liquids.



Fig.No.2: Extraction of Natural Oil by Vaccume Distillation

Preparation of Hair Tonic

Procedure:

All ingredients were accurately weighed according to the proportions listed in the formulation table, ensuring that the total weight of the prepared hair tonic was 100 grams.

- First, water was taken as the solvent medium, into which Sodium EDTA and Allantoin were added, followed by thorough stirring to achieve uniform dispersion.
- Subsequently, Hydroxyethyl Cellulose (HEC) and Hyaluronic Acid were incorporated into the mixture with continuous stirring until a homogeneous solution was formed.
- In a separate step, Butylene Glycol and Propylene Glycol were added to the mixture.
- Once the solution temperature dropped below 45°C, DMDM Hydantoin (used as a preservative) was introduced.
- Finally, Castor Bean essential oil and Clove Bud essential oil were added with gentle mixing to complete the formulation of the hair tonic.

Evaluation of Extract

Preliminary Phytochemical Screening

The formulated extract underwent basic phytochemical tests to confirm the presence of key secondary metabolites:

Flavonoids Test:

A few drops of sodium hydroxide (NaOH) solution were added to the extract. The appearance of a yellow coloration, which turned colorless upon the addition of dilute acid, indicated the presence of flavonoids. [17,18]

Glycosides Test:

A small quantity of the alcoholic extract was dissolved in 1 mL of water, followed by the addition of aqueous sodium hydroxide. The development of a yellow color confirmed the presence of glycosides. [19,20]

Alkaloids Test (Mayer's Test):

Mayer's reagent was prepared by dissolving 1.36 g of mercuric chloride in 60 mL of water and 5 g of potassium iodide in 10 mL of distilled water, then combining and diluting the solution to 100 mL. When a few drops of this reagent were added to 1 mL of acidic aqueous sample solution, the formation of a blue or green precipitate indicated the presence of alkaloids. [21,22]

Phenols Test (Ferric Chloride Test):

To 1 mL of the alcoholic extract, 2 mL of distilled water and a few drops of 10% aqueous ferric chloride solution were added. The appearance of a blue or green coloration confirmed the presence of phenolic compounds. [23,24]

Tannins Test (Lead Acetate Test):

About 5 mL of an aqueous extract was treated with a few drops of 1% lead acetate solution. The formation of a yellow or red precipitate suggested the presence of tannins. [25,26]

Lipids Test:

In a test tube, 5 drops of the extract were mixed with a pinch of sodium hydrogen sulfate. The emission of a pungent odor, indicative of glycerine release due to hydrolysis of fixed oils, confirmed the presence of lipids. [27,28]

Patch Test

A patch test was conducted to evaluate the skin sensitivity of the formulated product. The test was applied to sensitive areas such as the inner elbow, the popliteal region (behind the knee), and the area behind the ears. [29] A small quantity of the product was applied to approximately 1 cm² of skin, and central patches were also placed for additional observation. After 24 hours, the test sites were carefully examined for any signs of irritation, redness, or allergic reaction. Since no adverse reactions were observed, the test was repeated on the same site for confirmation. As no reactions occurred after the second application, the individual was deemed not hypersensitive, and the product was considered safe based on the patch test results. [30]

RESULTS AND DISCUSSION

Evaluation of Extract:

Preliminary Phytochemical Screening:

Table No.2: Preliminary Phytochemical Screening

Sr. No.	Alkaloids	Flavonoids	Phenols	glycosides	Tannins	Lipids
1	Essential Oils	+	+	+	+	+

Here, + = Present, - = Absent

Vaccume Distillation

Result obtained by is shown in Table below

Table No.3: weight of oil with respect to time

Weight (g)	Time (mins)
0.40	250
0.45	500
0.50	750
0.55	100
0.65	1200

The oil produced by Vaccume Distillation Method is 2.55g weight of oil per 100g of Clove Buds thereby producing 2.55% oil yield at 78°C

Table No. 4: Result of Essential Oils Extraction

Method of extraction	% yield
vacuum Distillation	2.55

Calculation of Percentage Yield of Volatile Oil.

▪ Material Balance for Vacuum Distillation Method

- Weight of Clove Bud = 100g
- Quantity of hexane used= 600ml, Quantity of Ethanol used= 200ml
- Weight of beaker= 105.26g
- Weight ethanol and essential oil= 202.55g

- The weight of oil obtained= 2.55g
- %yield = ME/MC x 100
- Where, ME = Mass of essential oil MC = Mass of Clove Bud sample
- ME = 2.55g MC = 100g
- By substituting values
- %yield = 2.55/100 x 100 =2.55%
- Therefore % yield= 2.55%

The graph below shows the plot of the weight of essential oil with respect to time for solvent extraction method

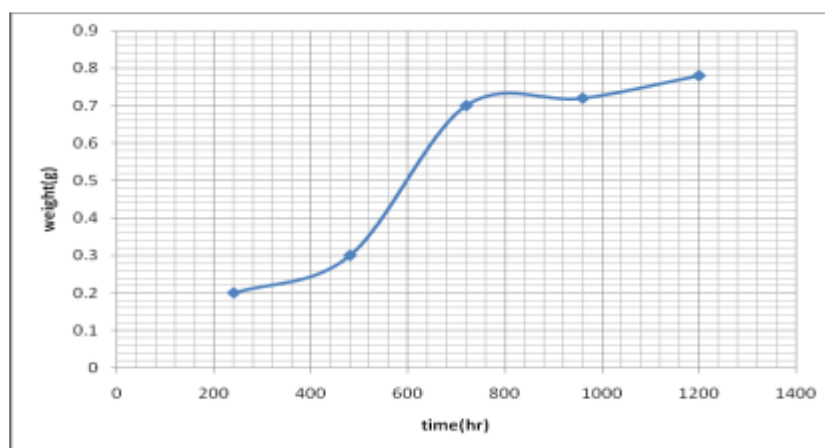


Fig.No.3: Graph below shows the plot of the weight of essential oil with respect to time for Vacuum Distillation Method

Patch test for Hair Tonic:

Table No.5: Patch Test of Hair Tonic

Sr. No.	Parameter	M1	M2
1	Immediately after removal of product	N.R.	N.R.
2	After 24 hrs	N.R.	N.R.
3	After 48 hrs	N.R.	N.R.

N.R = No Reaction

CONCLUSION: The development of a hair tonic formulation utilizing Castor Bean and Clove essential oils represents an effective fusion of traditional knowledge and modern cosmetic science. Castor Bean oil, rich in ricinoleic acid, provides strong anti-inflammatory and nourishing properties that enhance scalp circulation, stimulate hair follicles, and promote healthy hair growth. Clove essential oil, abundant in eugenol, offers powerful antimicrobial and antioxidant effects, which protect the scalp from infections, reduce dandruff, and strengthen the hair shaft.

The careful selection, extraction, and combination of these herbal ingredients resulted in a hair tonic that not only supports hair regrowth but also improves the overall texture, shine, and manageability of hair. Preliminary phytochemical screenings confirmed the presence of beneficial compounds such as flavonoids, alkaloids, phenols, tannins, and lipids, all of which contribute to the therapeutic potential of the formulation. Additionally, the product passed the patch test for skin sensitivity, ensuring its safety for regular topical use.

In conclusion, this hair tonic stands out as a natural, effective, and safe alternative to synthetic hair care products, offering a holistic solution for individuals seeking to improve their hair health naturally. Reviving the traditional use of Castor Bean and Clove for hair care not only honors historical practices but also meets the growing contemporary demand for herbal and organic cosmetic formulations.

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