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FORMULATION AND EVALUATION OF ANTIFUNGAL HERBAL HAIR GEL

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ABSTRACT

The study primarily focuses on the formulation and evaluation of herbal hair gel using extracts of neem and mint leaves. The preparation involves making a stable gel base using the gelling agent and water phase, ensuring proper consistency and homogeneity. The neem leaf extract, which contains flavonoids known for their antifungal activity, is extracted through maceration and incorporated into the gel base. The mint leaf extract contains menthol, which has a cooling and soothing effect; it is extracted by the enfleurage method. The gel base was prepared using carbopol 940. Carbopol functions as a gelling agent. Other components include triethanolamine as a pH adjuster and glycerine and polyethylene glycol as humectants. Antifungal action is a feature of the herbal hair gel. The gel formulations were prepared in three varying concentrations to determine the optimal formula for hair care. The F2 was found to be the best result.

KEYWORDS: Hair gel, Neem, Mint, Carbopol, Antifungal.

INTRODUCTION

The term "cosmetics" describes goods that are used to improve, beautify, encourage attractiveness, or change how the face, skin, hair, or nails look. They can be used for protection, hygiene, and aesthetics, among other things. The cosmetics sector is broad and varied, providing skincare, makeup, haircare, and fragrance items.[1] Hair gel is a style product that gives hair luster, manageability, and moisture retention. Natural hair gels provide a soft grip, boost shine, and improve hair texture without seriously harming the scalp or hair. In addition to preserving and hydrating hair, herbal hair gels also encourage growth, reduce frizz, and make hair smoother and simpler to untangle.[2]

Azadirachta indica, also known as neem leaves, is a member of the Meliaceae family.[3] It is indigenous to Bangladesh, India, and Pakistan and grows in tropical and subtropical climates.[4] Azadirachtin, nimbin, salanin, nimbolicin, quercetin, β-sitosterol, gallic acid, catechin, meliacin, and gedunin are important components. These substances are primarily divided into two categories: non-isoprenoids, which include flavonoids, polyphenols, proteins, and other vital biomolecules, and isoprenoids, which include terpenoids and limonoids.[5] It has numerous established therapeutic uses, including antibacterial, antiulcer, anti-inflammatory, and antimalarial qualities.

Fig. 1: Neem leaves.

Mint leaves, or *Mentha piperita*, are native to Europe and the Middle East and belong to the Lamiaceae family. Their main components include flavonoids (luteolin, apigenin, acacetin, diosmin, salvigenin, and thymonin), polyphenols (caffeic acid, caftaric acid, cinnamic acid, ferulic acid, and oleanolic acid), flavanols (catechin and epicatechin), and coumarins (esculetin and scopoletin).

The majority of the essential oils in the leaves are made up of menthol, menthone, isomenthone, menthyl acetate, pulegone, carvone, linalool, linalyl acetate, and derivatives of piperitenone. Its antibacterial, anti-inflammatory, antidandruff, calming, and cooling properties are just a few of its many therapeutic uses.[6]

Fig. 2: Mint leaves.

Advantages

- Gels can efficiently deliver medication through the skin.
- Gels provide the most effective cutaneous and percutaneous drug delivery.
- They are non-invasive and patients comply with them.
- They are applied to the skin for a long-term, progressive absorption.[2]

Disadvantages

• Some individuals may experience allergic reactions or skin irritation from the gel.
• Skin enzymes may break down or deactivate certain medications
• Some medications do not penetrate the skin well, even when in gel form.
• It is challenging for large-molecule drugs to pass through the skin.[7]

MATERIALS AND METHODS

Collection and authentication of plant materials

The neem and mint leaves were collected from Perumbavoor and identified as *Azadirachta indica* and *Mentha piperita* by Dr. Shintu P.V, HOD of the Department of Botany at Sree Sankara College Kalady, Kerala.

Chemicals used: Carbopol, Polyethylene glycol, Glycerine, Triethanolamine.

Preparation of plant extract

Neem leaves: After shade-drying, 25 g of powdered neem leaves were placed in a maceration vessel. Then, 250 milliliters of ethanol were added, and the mixture was macerated for 72 hours. The vessel was kept out of direct sunlight and sealed. After filtering, the ethanolic extract was evaporated.[8]

Mint leaves: Sixty grams of dried mint leaves were crushed using a mortar and pestle. The crushed leaves were combined with 70 mL of light-flavored olive oil in a 500 mL beaker. The mixture was gently heated to enhance absorption of the essential oil. After covering the beaker with aluminum foil, it was shaken until the mixture was evenly blended. It was allowed to stand at room temperature for a full day for proper absorption. To extract the essential oil, 140 mL of ethanol was added to separate the light-flavored olive oil from the plant residue. The ethanol was then evaporated by decanting the extract and placing it in a water bath at 80°C.[9]

Formulation of herbal hair gel

Three different herbal hair gel formulations were prepared using a simple gel formulation method with carbopol as the gel base. The gel contained glycerin, polyethylene glycol (PEG), carbopol 934, and triethanolamine. Two grams of carbopol 934 and the measured quantity of extracts were mixed in 80 mL of distilled water while stirring continuously for 1 hour. Then, 3 mL of glycerin was added while stirring. Mixing continued until a transparent gel formed. Finally, the ethanolic extracts of neem and mint leaves were added to the gel base with thorough stirring.

Table 1: Ingredients formula for preparing hair gel.

Sl no	Composition	F1	F2	F3	Category and use
1	Neem extract	1.0ml	1.0ml	1.0ml	Plant extract Anti-fungal
2	Mint extract	0.5ml	0.5ml	0.5ml	Plant extract Cooling and soothing
3	Carbopol 940	1.0g	2.0g	3.0g	Gelling agent
4	Polyethylene glycol	0.5ml	0.5ml	0.5ml	Humectant
5	Glycerine	3ml	3ml	3ml	Humectant
6	Triethanolamine	1.5ml	1.5ml	1.5ml	pH adjuster
7	Distilled water	80ml	80ml	80ml	Co solvent

Evaluation of herbal hair gel

The following parameters were used to evaluate the developed herbal hair gel.

Physical Appearance

To assess the characteristics of the gel formulation, including phase separation, color and odor changes, and rheological properties.

Color: Evaluate the hair gel's color by placing each formulation against a white background.
Smoothness: Rub a small amount of the gel between our fingers to check its smooth texture.

Homogeneity
We tested the gel for homogeneity by visually inspecting it after it was set in the container. Then looked for a uniform appearance and checked for any aggregates or clumps.

pH
To determine the gel's pH using a digital pH meter. Immerse the probe in the gel and recorded the pH value.

Washability
Apply the hair gel formulation to the skin and evaluated how easily it washed off with water.

Spreadability
Place a weighed amount of gel between two glass slides and applied a 500 g weight for 5 minutes. After removing the weight, we measured the diameter of the spread gel at different points. We calculated spreadability using the formula:
$S = M \times L / T$
where S is spreadability, M is the applied weight, L is the diameter of the spread circle (cm), and T is the time (seconds).

Antifungal Activity
The antifungal qualities against *Candida albicans* were evaluated using the agar well diffusion technique. The microorganism's sensitivity to the chemical under test is shown by the size of the inhibitory zone. A 23 mm inhibitory zone was detected for the hair gel containing *Azadirachta indica* and *Mentha piperita*, suggesting antifungal activity against *Candida albicans.* These findings imply that the formulation can successfully prevent dandruff brought on by Candida fungus, even at high concentrations.

Stability Study
Stability testing gives information to determine storage conditions, shelf life, and retest intervals, as well as how a formulation's quality changes under various environmental circumstances, such as temperature, humidity, and light. The formulation in this investigation was kept at room temperature (25–30°C) for 30 days, during which time any changes in its physical characteristics and assessment criteria were tracked.[10]

RESULT AND DISCUSSION

Table 2: Results of evaluation tests.

Formulation number	Color	Homogeneity	pH	Spreadability (gem/sec)
F1	Greenish	Good	5.9	8.4
F2	Greenish	Good	6.1	6.3
F3	Greenish	Good	6.4	4

Anti-fungal activity

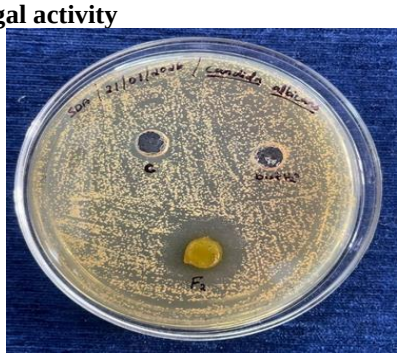

Fig. 3: Antifungal activity of F2 concentration of herbal hair gel.

Table 2: Antifungal activity of herabal hair gel.

Antifungal Activity against *Candida albicans*	
Sample (100 µl)	**Zone of Inhibition in Diameter (mm)**
Solvent	11 mm
F2	23mm

Stability study
The formulated hair gels were placed in room temperature show significant change in color and pH.

The color of the formulated herbal hair gel was greenish. The homogeneity of the formulated gels was found to be good. The pH range from 4.7 to 5.1 corresponding to the pH of hair. The spreadability of the formulated gels ranges from 33-38mm. The antifungal activity of herbal hair gel show good results of zone of inhibition against *Candia albicans* was F2. The F2 formulation was found to be the best formulation.

CONCLUSION

Azadirachta indica and *Mentha piperita* were utilized in this research to create a herbal hair gel. Carbopol 940 was employed as a polymer along with additional components, and the evaluation yielded positive outcomes. It can be concluded that the herbal hair gel formulated with *Mentha piperita* and *Azadirachta indica* exhibits potent antifungal characteristics. The formulation is both safe and effective for hair care as it demonstrates antifungal activity against *Candida albicans* species.

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