WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
Coden USA: WJPRAP Impact Factor 8.453
Volume 14, Issue 22, 241-256. Review Article ISSN 2277–7105

# FORMULATION AND EVALUATION OF LIP BALM CONTAINING ROSEMARY OIL AND TEA TREE OIL FOR THE TREATMENT OF ANGULAR CHEILITIS

**Dr. Mohd. Azharuddin[1]*, Mr. M. Anudeep[2], Ms. Ashwini K.[3], Ms. B. Lakshmi[4], Ms. B. Sushmitha[5], Ms. Bapuram Satvika[6]**

*[1]Assistant Professor, Department of Pharmaceutics, TVM College of Pharmacy, Ballari, Karnataka, India.

[2,3,4,5,6]Bachelor of Pharmacy Student, Department of Pharmaceutics, TVM College of Pharmacy, Ballari, Karnataka, India.

Article Received on 19 October 2025,
Article Revised on 08 Nov. 2025,
Article Published on 16 Nov. 2025,

https://doi.org/10.5281/zenodo.17615516

***Corresponding Author**

**Dr. Mohd. Azharuddin**

Assistant Professor, Department of Pharmaceutics, TVM College of Pharmacy, Ballari, Karnataka, India.

**How to cite this Article:** Dr. Mohd. Azharuddin1*, Mr. M. Anudeep2, Ms. Ashwini K.3, Ms. B. Lakshmi4, Ms. B. Sushmitha5 and Ms. Bapuram Satvika6 (2025) FORMULATION AND EVALUATION OF LIP BALM CONTAINING ROSEMARY OIL AND TEA TREE OIL FOR THE TREATMENT OF ANGULAR CHEILITIS. "World Journal of Pharmaceutical Research, 14(21), 241–256.



## ABSTRACT

Angular cheilitis is a painful inflammatory condition affecting the corners of the mouth, often characterized by cracking, redness, and discomfort. It is commonly associated with fungal or bacterial infections. In response to growing interest in natural therapies, this study explored the development of an herbal lip balm using beeswax and candelilla wax as the base, enriched with essential oils of rosemary and tea tree, both known for their antifungal, antibacterial, and anti- inflammatory properties. To verify the presence of active constituents, we employed thin-layer chromatography (TLC) and basic chemical tests. These confirmed the inclusion of 1,8-cineole from rosemary oil and terpinen-4-ol from tea tree oil—compounds recognized for their therapeutic potential. Various lip balm formulations were prepared by varying the ratios of waxes and essential oils. Each formulation was assessed for key attributes including appearance, colour, odour, pH, melting point, spreadability and washability. All formulations maintained a skin-compatible pH (approximately 5.5–6.5) and were suitable for lip care applications. Among the tested formulations, the formulation containing both beeswax and candelilla wax with rosemary oil (F5) showed optimum characteristics. The melting point close was to body

temperature, it shows even spreadability and it remained stable and homogeneous throughout the study. These favourable characteristics are attributed to the balanced wax composition and rosemary oil. Overall, the findings suggest that this rosemary-infused herbal lip balm may offer a promising topical solution for managing angular cheilitis, providing both soothing relief and antifungal protection.

**KEYWORDS**: Angular cheilitis, lip balm, rosemary oil, tea tree oil.

## INTRODUCTION

### Anatomical structure of the lips[1]

The lips are soft, flexible anatomical structures that define the anterior boundary of the oral cavity and play a crucial role in articulation, mastication, and facial expression. Structurally, they consist entirely of soft tissue, with an external covering of skin and an internal lining of oral mucosa. The upper lip (labium superioris) spans from the base of the nose to the nasolabial folds and vermilion border, while the lower lip (labium inferioris) extends from the vermilion border to the oral commissures and down to the mandible. Histologically, the lips are composed of four distinct layers arranged from superficial to deep: the epidermis, subcutaneous connective tissue, the orbicularis oris muscle, and the mucosal lining.

### *Angular cheilitis*

Angular cheilitis (AC), also known as angular cheilosis, angular stomatitis, or perleche (from the French *lecher*, meaning "to lick thoroughly"), is a clinically recognized inflammatory condition affecting the commissures of the mouth. The term "angular" specifies the anatomical site at the mouth's corners, while "cheilitis" originates from the Greek *chilos*, meaning lips, denoting inflammation of the labial tissue.[2] AC typically presents as painful, ulcerative lesions at the lip angles, often resembling aphthous ulcers. These lesions may provoke habitual lip licking, particularly among children, which exacerbates the condition. Though multifactorial in origin, AC is frequently classified under fungal infections due to its association with *Candida* species. Epidemiological data indicate that AC accounts for approximately 0.7% to 3.8% of oral mucosal lesions in adults and 0.2% to 15.1% in paediatric populations. The condition affects both male and female equally and is most prevalent among individuals aged 20 to 50 years.[3]

**Pathophysiology of angular cheilitis[4]**

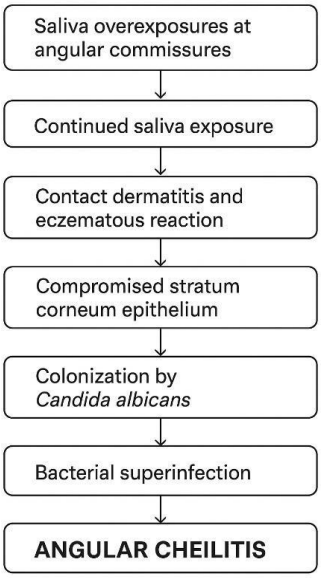


**Fig. No. 01: Pathophysiology of angular cheilitis.**

**Causes[4]**

Angular cheilitis arises from a variety of contributing factors, both local and systemic. Common causes include infections—particularly fungal (*Candida albicans*) and bacterial (*Staphylococcus aureus*)—as well as irritant reactions from habitual behaviours such as lip licking or thumb sucking. Anatomical issues like overclosure of the mouth or poorly fitting dentures can predispose individuals to this condition. Inflammatory skin disorders, including psoriasis, may also play a role. Nutritional deficiencies, especially of B-complex vitamins, iron, and zinc, are frequently implicated, and poor oral hygiene further increases susceptibility.

Clinically, angular cheilitis presents as red, inflamed patches at the labial commissures, often appearing bilaterally and symmetrically. Lesions may be triangular in shape and vary in appearance—ranging from pink and papular to eczematous or fissured. In more severe or bacterial cases, crusting, exudation, or bleeding may occur. Oral candidiasis is a common coexisting condition, characterized by white patches, erythematous zones, or leathery plaques within the oral cavity.

Patients typically report symptoms such as dryness, itching, soreness, irritation, or a mild burning sensation. Pain tends to intensify during mouth opening, and in advanced cases, eating may become uncomfortable, potentially impacting nutritional intake. Associated conditions include deficiencies in vitamins B2, B3, B6, B12, folate, iron, and zinc; denture use—especially when hygiene is poor or fit is inadequate; and systemic factors such as diabetes,

HIV, or prolonged use of proton pump inhibitors and corticosteroids, all of which can predispose to *Candida* overgrowth.

**Treatment**[5]

Management of angular cheilitis involves a tiered approach based on severity and underlying cause. Primary treatment typically includes oral and topical therapies aimed at controlling infection and inflammation. Secondary options may involve injectable medications for systemic support, while surgical intervention is reserved for refractory or anatomically complex cases. A variety of pharmaceutical formulations are available to address the condition. Oral tablets such as amoxicillin (an antibiotic) and dapsone (a sulfonamide) are used for systemic infections. Topical preparations include hydrocortisone-based lip balms (steroid), tacrolimus ointment (immunosuppressant), and creams containing potent corticosteroids like clobetasol and triamcinolone acetonide. In addition to conventional drugs, several herbal formulations have shown therapeutic potential. Oral tablets containing aloe vera, clove, and garlic offer antifungal benefits, while topical creams made with honey and coconut oil provide antimicrobial action. Herbal lip balms infused with rosemary oil and tea tree oil serve as natural antifungal agents, offering alternative or adjunctive relief in mild to moderate**.**

**Cosmetics**

Cosmetics are topical preparations intended for use on the skin, hair, and nails to enhance appearance through cleansing, beautifying, softening, or protecting. The term originates from ancient Greek, denoting bodily adornment. Modern cosmetology blends science and artistry to improve aesthetic appeal through product formulation and application techniques.[6] According to the Drug and Cosmetic Act 1940, 'cosmetic' means any article intended to be rubbed, poured, sprinkled or spared on, or introduced into, or otherwise applied to, the human body or any part thereof for cleansing, beautifying, promoting attractiveness, or altering the appearance, and includes any article intended for use as a component of cosmetic.[7]

***Lip Balm***

Lip balm is a semisolid cosmetic formulation that is primarily used to protect the delicate skin of the lips from environmental stressors such as wind, cold, heat, and sunlight. Lip balms are the essential cosmetic products that are designed to provide moisture and protection to the lips, against harsh environmental condition.[8]

A well-formulated lip balm contains ingredients with emollient and moisturizing properties, which not only enhance the smoothness and softness of the lips but also aid in repair and healing. Natural oils, waxes, and butters are frequently included in lip balm formulations, as they supply fatty acids and bioactive compounds that hydrate, nourish, and improve the barrier function of the lip skin.

Natural plant-derived compounds offer promising antifungal activity against *Candida* species. Key examples include rosemary (*Rosmarinus officinalis*), tea tree oil (*Melaleuca alternifolia*), oregano, thyme, basil, liquorice, aloe vera, cinnamon, turmeric, and black pepper, each containing bioactive ingredients such as cineole, terpinen-4-ol, carvacrol, thymol, and curcumin. These natural agents are increasingly preferred over synthetic alternatives due to their lower toxicity, better skin compatibility, and broader safety profile. In this study, an antifungal lip balm was formulated using rosemary and tea tree oils, chosen for their strong antifungal, antibacterial, and anti-inflammatory properties—providing a plant-based solution for lip infections and enhancing lip health.

## MATERIALS AND METHODOLOGY

The formulation of the herbal lip balm utilized key ingredients sourced from reliable sources.

### 1. Rosemary oil[9]

Rosemary oil is derived from the flowering tops and leaves of *Rosmarinus officinalis*, a Mediterranean shrub of the Lamiaceae family. Known for its aromatic profile, the oil contains key constituents such as 1,8-cineole, α-pinene, camphor, and β-caryophyllene. Beyond its antifungal properties, rosemary oil exhibits antioxidant, neuroprotective, and anti-cancer activities, making it a valuable ingredient in therapeutic and cosmetic formulations. The rosemary oil was obtained from TSBT International. Bangalore.


**Fig. No. 02: Rosemary oil.**

### 2. Tea tree oil[10]

Tea tree oil is a pale, volatile essential oil extracted from the leaves of *Melaleuca alternifolia*, a Myrtaceae family tree native to Australia. It has a fresh, camphor-like scent and contains active compounds like terpinen-4-ol, γ-terpinene, and α-terpinene. Known for its antifungal, antimicrobial, and anti-inflammatory properties, tea tree oil is widely used in dermatology and wound care. The tea tree oil was obtained from TSBT International. Bangalore.


**Fig. No. 03: Tea tree oil.**

### 3. Beeswax[11]

Beeswax is a purified natural wax obtained from the honeycomb of *Apis mellifera*, a bee species belonging to the Apidae family. It appears as a yellow to brownish solid with a honey-like scent and a dull, granular texture when cold. Chemically, it comprises monoesters, diesters, hydrocarbons, free acids, and various polyesters. Widely used in cosmetics as a thickening agent, emollient, and moisturizer, beeswax also serves traditional roles in wound healing and as a base for ointments and plasters. The beeswax was obtained from Loba Chemie Pvt. Ltd. Mumbai.

**Fig. No. 04: Bees wax.**

### 4. Candelilla wax[12]

Candelilla wax is a hard, yellowish-brown wax obtained from *Euphorbia antisyphilitica*, native to Mexico and the U.S., and part of the Euphorbiaceae family. It contains long-chain hydrocarbons, esters, resins, and free acids. Known for its water- insoluble, lipophilic nature, it acts as an emollient and protective barrier in cosmetics and serves as a vegan alternative to

beeswax, also used in tablet and capsule coatings. The candelilla wax was obtained from Veda oils, New Delhi.

**Fig. No. 05: Candelilla wax.**

### 5. Lemon oil[13]

Lemon oil is derived from the fruit and peel of *Citrus limon*, a member of the Rutaceae family. Rich in terpenes—primarily limonene—it also contains sesquiterpenes, aldehydes, and esters. Known for its fresh citrus aroma, lemon oil is widely used as a flavouring agent and exhibits notable antimicrobial properties.

### 6. Castor oil[14]

Castor oil is extracted from the seeds of *Ricinus communis*, a member of the Euphorbiaceae family. It is rich in triglycerides, primarily containing ricinoleic acid along with linoleic, oleic, palmitic, and stearic fatty acids. Known for its lubricating properties, castor oil is widely used as a natural laxative and in cosmetic formulations for its emollient and moisturizing effects.

### 7. Oleic acid[15]

Oleic acid, a monounsaturated omega-9 fatty acid commonly sourced from olive and other plant oils. It is widely used in pharmaceuticals and cosmetics as an excipient, texture enhancer, emulsifier, and penetration enhancer, improving drug solubility, bioavailability, and providing emollient benefits

### 8. Glyceryl monostearate[16]

Glyceryl monostearate, a naturally occurring monoglyceride derived from plant oils or animal fats, is a white, odourless, hygroscopic solid widely used in pharmaceutical, food, and cosmetic formulations. It functions primarily as an emulsifier, surfactant, and thickening agent. In topical products, it enhances stability, texture, and skin hydration, while in drug delivery it improves solubility and bioavailability of active ingredients.

## METHODOLOGY

### I. Identification test

### 1. Identification Tests for Rosemary Oil

- Organoleptic properties: Colour and odour were examined.
- TLC for 1,8-cineole: Stationary phase – $SiO_2$; Mobile phase – ethyl acetate: toluene (10:90); Detecting agent – anisaldehyde. After heating at 100–105 °C for 5–10 min, a spot with Rf value 0.72 confirmed the presence of 1,8-cineole.
- Chemical test: In the Cineole–Resorcinol test, mixing the oil with saturated resorcinol solution produced a white crystalline mass, indicating 1,8-cineole.

### 2. Identification test for Tea Tree Oil

- Organoleptic properties: Colour and odour were examined.
- TLC for terpinene-4-ol: Stationary phase – silica gel 60; Mobile phase – toluene: ethyl acetate (95:5); Detecting agent – vanillin sulphuric acid. After heating at 100–105 °C for 5–10 min, a spot with Rf value 0.65 confirmed terpinene-4-ol.
- Chemical test: Lucas test with $ZnCl_2$/HCl produced a cloudy emulsion and oily layer, confirming the presence of the secondary alcohol terpinene-4-ol.

### II. Formulation of lip balm[14]

**Table No. 01: Formulation of lip balm containing rosemary oil and tea tree oil.**

| Ingredients | Uses | Quantity (in grams) | | | | | |
|---|---|---|---|---|---|---|---|
| | | F1 | F2 | F3 | F4 | F5 | F6 |
| Rosemary oil | Anti-fungal agent | 0.5 | 0.5 | - | - | 0.5 | - |
| Tea tree oil | Anti-fungal agent | - | - | 0.5 | 0.5 | - | 0.5 |
| Bees wax | Glossiness & hardness | 2 | 2 | - | - | 1 | 1 |
| Candelilla wax | Glossiness & hardness | - | - | 2 | 2 | 1 | 1 |
| Castor oil | Moisturizing agent | 4 | 4 | 4 | 4 | 4 | 4 |
| Vitamin E | Antioxidant | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Lemon oil | Coloring agent | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Vanilla extract | Flavoring agent | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Oleic acid | Texture enhancer | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 |
| Glyceryl monostearate | Stabilizer | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| Total | | 10 | 10 | 10 | 10 | 10 | 10 |

F1- Rosemary lip balm with bees wax as base, F2-Rosemary lip balm with candelilla wax as base, F3- Tea tree lip balm with bees wax as base, F4- Tea tree lip balm with candelilla wax as base, F5- Rosemary lip balm with bees wax and candelilla wax as base, F6- Tea tree lip balm with bees wax and candelilla wax as base.

**Procedure**

The wax was accurately weighed and transferred into a heat-safe beaker. It was melted at ~70°C using a double boiler. After the base liquefied, the castor oil was added and the blend was kept warm while stirring. We incorporated the texture enhancer and emulsifier, mixed thoroughly, added vitamin E oil, and removed the mixture from heat. While warm, we added in the essential oil, flavouring agent and colouring agent and stirred to uniformity, then poured the mixture into moulds and allowed it to cool and set.

**III. Evaluation of formulated lip balm containing rosemary oil and tea tree oil**[17,18,19,20&21]

1. **Organoleptic properties:** The characteristics of lip balm such as color, texture, odor, appearance are observed and studied.

2. **Determination of presence of active ingredients**

- **Chemical test for rosemary oil(1,8-cineole):** In the Cineole–Resorcinol test, mixing the oil with saturated resorcinol solution produced a white crystalline mass, indicating 1,8-cineole.
- **Chemical test for tea tree oil(terpinene-4-ol):** Lucas test with $ZnCl_2$/HCl produced a cloudy emulsion and oily layer, confirming the presence of the secondary alcohol terpinene-4-ol.

3. **pH measurement:** The pH of lip balm was performed by using pH paper. The small amount of lip balm is applied on the pH paper and the colour is observed and compared with the pH scale.
4. **Melting point:** The lip balm is taken in a test tube and a thermometer is attached to it. The test tube is heated on a water bath. The temperature at which the lip balm starts melting is recorded.
5. **Spread ability:** The homogeneity of the lip balm was visually assessed in the formulation by applying the lip balm repeatedly to a glass slide.
6. **Washability:** This test is carried out by applying a small amount of lip balm to the region of forefinger and thumb, then left for sometimes and allowed to rinse under tap water**.**

**RESULTS AND DISCUSSION**

**I. IDENTIFICATION TEST**

**A.** Test for rosemary oil

**a.** Organoleptic properties

**Table No. 02: Organoleptic properties of rosemary oil.**

| Test | Observation |
|---|---|
| Colour | Pale yellow |
| Odour | Strong camphourous odor |

The rosemary oil is pale yellow in colour and it has characteristic odour of strong, fresh, herbaceous and woody scent with camphoraceous, balmy and misty undertones and hence it meets standard refence requirements.

**b. Chemical test for 1,8-cineole**

**Table No. 03: Identification test for rosemary oil.**

| Test | Observation | Result |
|---|---|---|
| Cineole- resorcinol test | White crystalline mass | Presence of 1,8-cineole |

The cineole–resorcinol test yielded a white crystalline mass, confirming the presence of 1,8-cineole as a key active constituent in rosemary oil.

**c. Identification test for 1,8-cineole**

Distance travelled by solute(d1) = 4.4 Distance travelled by solvent(d2) = 6.1 Rf=0.72

TLC analysis revealed an Rf value of 0.72, consistent with the standard for 1,8-cineole, further validating its presence in the sample.

**B. Test for tea tree oil**

**a. Organoleptic properties**

**Table No. 04: Organoleptic properties of tea tree oil.**

| Test | Observation |
|---|---|
| Colour | Yellow colorless liquid |
| Odour | Distinct, camphourous odor |

The tea tree oil is pale yellow in colour and it has characteristic odour of fresh, camphor- like, and woody, with a slightly medicinal, spicy, and minty undertone and hence it meets standard refence requirements.

**b. Chemical test for terpinene-4-ol**

**Table No. 05: Identification test for tea tree oil.**

| Test | Observation | Result |
|---|---|---|
| Lucas test | Distinct oily layer | Presence of terpinene-4-ol |

The Lucas test was performed on tea tree oil which produces a cloudy emulsion which then separates into a distinct oily layer. This confirms the presence of terpinene-4-ol in the oil. The results conclude that the tea tree oil consists of main active ingredient.

**c.** Identification test for 1,8-cineole: Distance travelled by solute(d1) = 4.2 Distance travelled by solvent(d2) = 6.4 Rf=0.65

TLC analysis revealed an Rf value of 0.65, consistent with the standard for terpinene-4-ol, further validating its presence in the sample.

## II. EVALUATION OF FORMULATED LIP BALM CONTAINING ROSEMARY OIL AND TEA TREE OIL

### 1. Visual appearance

**Table No. 06: Organoleptic properties of the formulations.**

| Formulations | Physical appearance | Odor | Texture |
|---|---|---|---|
| F1 | Creamy white | Pleasant | Smooth |
| F2 | Creamy white | Pleasant | Smooth |
| F3 | Pale yellow | Pleasant | Smooth |
| F4 | Pale yellow | Pleasant | Smooth |
| F5 | Light yellow | Pleasant | Smooth |
| F6 | Light yellow | Pleasant | Smooth |

The formulations F1 & F2 were creamy white, F3 & F4 were pale yellow and F5 & F6 were light yellow in color. The characteristic pleasant odor was observed and the appearance of lip balm was smooth, homogenous and showed no visible phase separation. All the organoleptic parameters of the lip balm comply to the standard reference.

### 2. Determination of presence of active ingredients

**a.** Identification test for rosemary oil

**Table No. 07: Identification test for rosemary oil.**

| Sample no. | Test | Observation | Inference |
|---|---|---|---|
| F1 | Cineole- resorcinol test | White crystalline mass | Presence of 1,8-cineole |
| F3 | | | |
| F5 | | | |

**Fig no.06: Chemical test for standard (rosemary oil)**

**Fig no.07: Chemical test for F1**

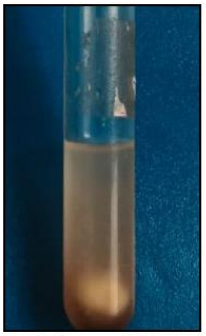

**Fig no.08: Chemical test for F3**

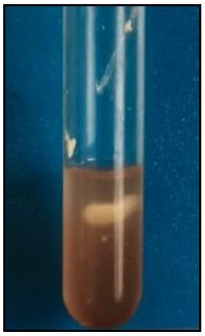

**Fig no.09: Chemical test for F5**

The formulations in which rosemary oil is the active ingredient (i.e., F1, F3, F5), cineole-resorcinol test was performed. The oily layer of liquid turns into a distinct white crystalline mass. This confirms the presence of cineole in formulation. The results conclude that the formulation contains rosemary oil as active ingredient.

**b.** Identification test for tea tree oil

**Table No. 08: Identification test for tea tree oil.**

| Sample no. | Test | Observation | Inference |
|---|---|---|---|
| F2 | Lucas test | Distinct oily layer | Presence of terpinene-4-ol |
| F4 | | | |
| F6 | | | |

**Fig no.10: Chemical test for standard (tea tree oil)**

**Fig no.11: Chemical test for F2**

**Fig no.12: Chemical test for F4**

**Fig no.13: Chemical test for F6**

The formulations in which tea tree oil is the active ingredient (i.e., F2, F4, F6), Lucas test was performed. A cloudy emulsion is produced which then separates into a distinct oily layer. This confirms the presence of terpinene-4-ol in the formulation. The results conclude that the formulation contains tea tree oil as active ingredient.

### 3. Melting point

**Table No. 09: Determination of melting point.**

| Formulation | F1 | F2 | F3 | F4 | F5 | F6 |
|---|---|---|---|---|---|---|
| Melting point | 61–63ºC | 61–63ºC | 67-69ºC | 67–69ºC | 64–66ºC | 64–66ºC |

The melting point of lip balm formulations was primarily influenced by wax type. F1 & F2 showed lower M.P range due to beeswax's softer texture. F3 & F4 showed higher M.P range, reflecting its crystalline hardness. F5 & F6 showed intermediate M.P range, showing balanced thermal behaviour.

### 4. pH determination

**Table No. 15: Determination of Ph.**

| Formulation | F1 | F2 | F3 | F4 | F5 | F6 |
|---|---|---|---|---|---|---|
| pH | 5.5 | 6.1 | 5.8 | 5.9 | 6.3 | 5.7 |

All formulations were tested using standard procedures. Due to the mildly acidic nature of rosemary oil and the near-neutral profile of tea tree oil, pH values ranged from 5.5 to 6.3. These results fall within the acceptable limits for lip care products (4.5–6.5), skin (5.4–5.9), and lips (4.5–6.0), confirming formulation suitability.

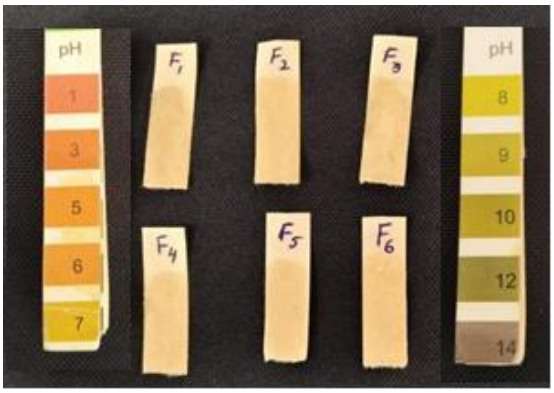


**Fig. No. 14: Determination of pH of all the formulations.**

### 5. Spreadability test

**Table No. 16: Determination of spreadability.**

| Formulations | F1 | F2 | F3 | F4 | F5 | F6 |
|---|---|---|---|---|---|---|
| Spreadability | Intermediate ++ | Intermediate ++ | Average + | Average + | Good +++ | Good +++ |

F1 & F2 showed intermediate spreadability with creamy texture and smooth glide. F3 & F4 showed average spreadability due to firmer, more brittle texture. F5 & F6 showed good spreadability with balanced softness and reduced drag.

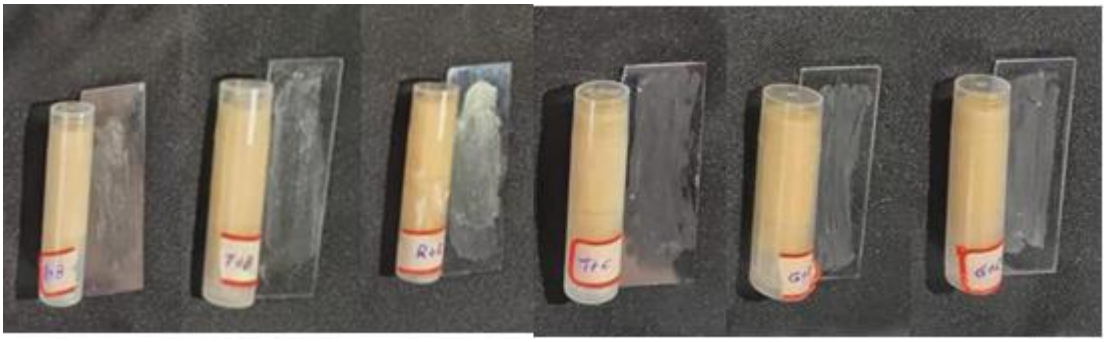

**Fig. No. 15: Spreadability test performed on slides for prepared formulations.**

**5. Washability test**

**Table No. 17: Determination of washability.**

| Formulation | Observation |
|---|---|
| F1 | Moderate |
| F2 | Moderate |
| F3 | Easy |
| F4 | Easy |
| F5 | Good |
| F6 | Good |

Washability depends on the oil–wax ratio and occlusivity of the balm. The beeswax-based formulations (F1 and F2) required slightly more effort due to higher occlusive property. The candelilla-based formulations (F3 and F4) showed easier wash-off because of harder texture and less greasy residue. The blended formulations (F5 and F6) had balanced washability, showing the most consumer-friendly removal profile.

**Fig. No. 25: Lip balm application on forearm.**

**Fig. No. 26: Washability test of lip balm.**

## CONCLUSION

This study successfully developed and evaluated herbal lip balm formulations using rosemary and tea tree oils, selected for their antifungal and anti-inflammatory properties selected along with different concentrations of beeswax and candelilla wax. The formulations were assessed for key parameters including pH, melting point, spreadability, washability, and stability. Among all batches, formulation F5—containing a balanced blend of beeswax and candelilla wax—demonstrated optimal performance across all evaluation criteria.

The findings support the use of these essential oils in lip care, offering a safe, natural, and effective alternative for managing angular cheilitis and promoting overall lip health.

## REFERENCE

1. Sharma S S, Aji A. *Labia Oris: A Realistic Platform for Drug Delivery. Int J Pharm Pharm Res.*, 2018; 13(3): 1–10.
2. Cabras M, Gambino A, Broccoletti R, Lodi G, Arduino P G. *Treatment of Angular Cheilitis: A Narrative Review and Authors' Clinical Experience*, Oral diseases., 2020; 26; 1107-1115.
3. Anitha K. P., Sukumaran A., Srinivas P. V. *Angular cheilitis- An updated overview of the etiology, diagnosis and management*. Int J Dentistry Oral science, 2021; 8(2): 1433- 1438.
4. Justin R. Federico; Brandon M. Basehore; Patrick M. Zito. *Angular cheilitis. Statpearls publishing* Angular Cheilitis - StatPearls - NCBI Bookshelf [Accessed on 23 July 2025]
5. Shazmeen I, Dehghan MH, Usman SA, Asim S. *Review on the formulations available for the treatment of cheilitis – a patent perspective*. GIS Sci J., 2024; 10: 758–66.
6. Sweta J, Haricha J, Priyanka, Shaurya K. *Unlocking the power of nature: A comprehensive review of herbal face serums*. Int J Pharm Sci., 2024; 2(4): 116-1122.
7. Prachi PU, Sanap. AS. *Formulation and development of face serum*. Int J Creat Res thoughts, 2023; 11(6): 833-845.
8. Shivani Maruti Lohar, Alia Ajim Shaikh, Vaishnavi Anil Kamble, Deepak J. Kare. *Formulation and evaluation of herbal lip balm*. Int J Adv Res Innov Ideas Educ., 2024; 10(4): 23-30.
9. de Macedo LM, Santos ÉMD, Militão L, Tundisi LL, Ataide JA, Souto EB, Mazzola PG. *Rosemary (Rosmarinus officinalis L., syn Salvia rosmarinus Spenn.) and Its Topical Applications: A Review*. Plants (Basel)., 2020; 9(5): 651.
10. Vázquez, A.; Tabanca, N. *Development of a Combined 2D-MGD TLC/HPTLC Method for*

*the Separation of Terpinen-4-ol and α-Terpineol from Tea Tree, Melaleuca alternifolia, Essential Oil*. Biomolecules., 2025; 15: 147.

11. Coppock RW. *Bee products as nutraceuticals to nutraceuticals for bees*. In: Gupta RC, Lall R, Srivastava A, editors. *Nutraceuticals.* 2nd ed. London: Academic Press; 2021; 813–33.
12. National Center for Biotechnology Information. *"PubChem Compound Summary for Candelilla wax" PubChem*; Available from: https://pubchem.ncbi.nlm.nih.gov/compound/Candelilla-wax. [Accessed 25 July, 2025]
13. Evans WC, Evans D. Volatile oils and resins. In: Evans WC, Evans D, editors. *Trease and Evans' Pharmacognosy*. 16th ed. Edinburgh: Saunders Elsevier, 2009; 263–303.
14. Alookaran J, Tripp J. *Castor Oil. In: StatPearls [Internet]*. StatPearls Publishing; Available from: https://www.ncbi.nlm.nih.gov/books/NBK551626/ [Accessed on 25 July 2025]
15. Francoeur ML, Golden GM, Potts RO. *Oleic acid: its effects on stratum corneum in relation to (trans) dermal drug delivery.* Pharm Res., 1990 Jun; 7(6): 621-627.
16. National Center for Biotechnology Information. *"PubChem Compound Summary for CID 24699, Glyceryl Monostearate" PubChem. Available from:* https://pubchem.ncbi.nlm.nih.gov/compound/Monostearin. [Accessed on 25 July, 2025].
17. Lohar SM, Shaikh AA, Kamble VA, Kare DJ. *Formulation and evaluation of herbal lip balm*. Int J Adv Res Innov Ideas Educ., 2024; 10(4): 23–30.
18. Nahata AN, Ansari NM, Nahar S, Walode SG, Chatur VM. *Formulation and evaluation of lip balm prepared using various herbal entities*. Int J Creat Res Thoughts, 2022; 10(3): d122–7.
19. Moyna P, Rossini C, Dellacassa E, Pandolfi E. *Determination of 1,8-cineol in eucalyptus essential oils by TLC-densitometry*. J AOAC Int., 1995; 78(1): 115–7.
20. Howard J Lucas. *A new test for distinguishing the primary, secondary and tertiary saturated alcohols.* Journal of the American chemical society, 1930; 52(2): 802-804.
21. Rohini A. Jadhav, Shubhangi J Jadhav, Mahesh R. Gangurde, Vijay R. Gaikwad, Charulata T. Nemade, Nayana S. Baste, *Design, Development and Evaluation of Herbal Lip Balm for Angular Cheilitis*, Adv Pharmacol Phar., 2025; 13(1): 90–96.