



Development of Herbal Lip Balm Formulations: Natural Ingredients, Formulation Strategies, and Quality Evaluation

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Abstract

This research paper presents a comprehensive study on the formulation and evaluation of natural lip balm using organic ingredients. The increasing public awareness about hazardous synthetic ingredients in cosmetics has led to the development of effective cosmetic products using organic components. This study focuses on addressing common lip disorders such as cheilitis, dryness, cracking, and fissuring through the formulation of a natural lip balm containing beeswax, almond oil, vitamin E, beetroot powder, and lemongrass oil. The formulated product was evaluated through various parameters including organoleptic characteristics, pH measurement, skin irritation tests, spreadability, and skin sensitivity. Results demonstrate that the natural lip balm is safe, effective, and maintains healthy lip conditions without adverse effects.

Keywords: Natural lip balm, organic cosmetics, cheilitis, beeswax, almond oil, cosmeceuticals

1. INTRODUCTION

The contemporary cosmetic industry is witnessing a paradigm shift toward natural and organic formulations, driven by increasing consumer awareness of the potential health risks associated with synthetic ingredients and growing environmental consciousness. This transition is particularly significant in the development of lip care products, where safety concerns are paramount due to the high likelihood of inadvertent ingestion and the sensitive nature of labial tissue.

Cheilitis, characterized by cracking, fissuring, peeling, and dryness of the lips, represents one of the most prevalent dermatological concerns affecting individuals across diverse demographics and geographical regions. The lips' unique anatomical structure, notably the absence of sebaceous glands that typically provide natural moisturization to other skin areas, renders them particularly vulnerable to environmental stressors such as cold weather, wind exposure, and UV radiation [1]. This susceptibility necessitates consistent protection and moisturization throughout the day to maintain optimal lip health and prevent the development of chronic lip disorders.

The etiology of lip dryness and associated complications extends beyond seasonal variations, with many individuals experiencing persistent symptoms during summer months and windy conditions. These chronic manifestations underscore the inadequacy of conventional lip care approaches and highlight the need for more effective, sustained therapeutic interventions. Traditional synthetic lip balms, while providing temporary relief, often contain potentially harmful ingredients including petroleum derivatives, heavy metals, synthetic waxes, parabens, aluminum compounds, and artificial fragrances and colorants. These constituents pose significant health risks, particularly considering the inevitable ingestion that occurs during normal lip balm use, potentially leading to systemic accumulation and chronic health disorders [2].

Although natural alternatives such as ghee, honey, and vitamin E demonstrate moisturizing properties, their efficacy is typically short-lived and requires frequent reapplication in substantial quantities to achieve desired therapeutic outcomes [3]. This limitation has prompted researchers to explore more sophisticated formulation approaches that combine the safety profile of natural ingredients with enhanced therapeutic efficacy and prolonged action.

The emergence of cosmeceuticals—cosmetic products incorporating biologically active ingredients with demonstrated therapeutic properties—represents a promising avenue for addressing these challenges. These formulations offer dual functionality, providing both cosmetic enhancement and therapeutic intervention for various lip disorders through topical application. The bioactive components in cosmeceuticals exert protective effects against environmental factors while simultaneously treating existing lip pathologies through their inherent biological mechanisms [4].

The present study addresses the critical need for developing an organic lip balm formulation that minimizes adverse effects while maximizing therapeutic efficacy. This research focuses on creating a product specifically designed for the protection and treatment of lip disorders, utilizing organic ingredients that demonstrate superior safety profiles compared to their synthetic counterparts. The formulation approach emphasizes the integration of naturally derived active compounds that can provide sustained moisturization, barrier protection, and therapeutic intervention for common lip ailments.

Quality assessment of cosmetic products traditionally relies on evaluation of organoleptic properties including color, fragrance, appearance, and related physical parameters. In alignment with the organic formulation philosophy, this study incorporates non-toxic, naturally derived coloring and fragrance agents, thereby eliminating the potential risks associated with synthetic alternatives while maintaining consumer acceptability and product appeal [6].

The significance of this research extends beyond the development of a single product, contributing to the broader understanding of organic cosmeceutical formulation principles and their application in addressing common dermatological concerns. By establishing effective organic alternatives to conventional synthetic lip care products, this work supports the growing movement toward safer, more sustainable cosmetic solutions that prioritize human health and environmental stewardship.

This investigation aims to bridge the gap between traditional natural remedies and modern cosmeceutical science, developing an evidence-based organic lip balm formulation that offers superior therapeutic outcomes while maintaining the safety profile inherent to natural ingredients. The findings of this study are expected to contribute valuable insights to the field of organic cosmetic development and provide a foundation for future research in natural lip care therapeutics



Fig .1-Lip Balm

1.1 Anatomical Structure of Lips

The lips constitute a critical anatomical feature of the human oral cavity, serving multiple physiological functions including food intake, speech articulation, and tactile sensation. Structurally, lips comprise two distinct components: the upper lip (labium superioris) and lower lip (labium inferioris), which together form a flexible muscular organ capable of precise movements around the mouth opening [7,8].

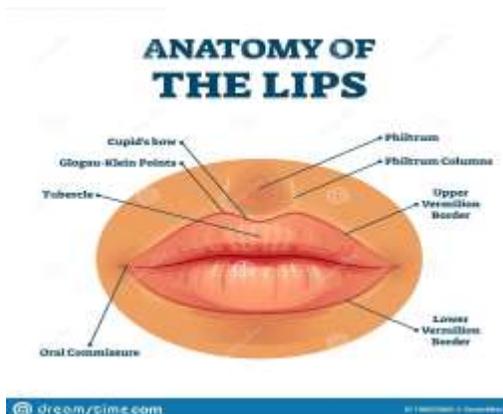


Figure 2 – Anatomy of lips

Key Anatomical Components:

- **Vermillion Zone:** The characteristic red portion of the lips, covered by specialized stratified squamous epithelium that maintains continuity with the oral mucosa
 - Figure 3 – Figure of vermillion of lips
 - Figure 3 – Figure of vermillion of lips



Figure 3- Vermillion of lips

- **Vermillion Border:** The demarcation line separating the lip vermillion from surrounding facial skin, also termed the vermilion-cutaneous junction



Figure 4 – Figure of vermilion border of lips

- **Cupid's Bow:** The distinctive curved border of the central vermillion, resembling an archer's bow when viewed frontally



CUPID

Figure 5 – Figure of cupid bow of lips

- **Oral Commissures:** The lateral corners where upper and lower lips converge, serving as the axis for lip movement [11]



Figure 6- figure of oral commissure of lips

The lips' distinctive red coloration results from their unique histological composition, containing fewer melanocytes compared to facial skin and possessing a rich vascular network that becomes visible through the thin epidermal layer [12]. This structural characteristic renders lips particularly vulnerable to environmental damage, as the lip skin consists of only 3-5 cellular layers compared to the 16-layer thickness of facial skin [13].

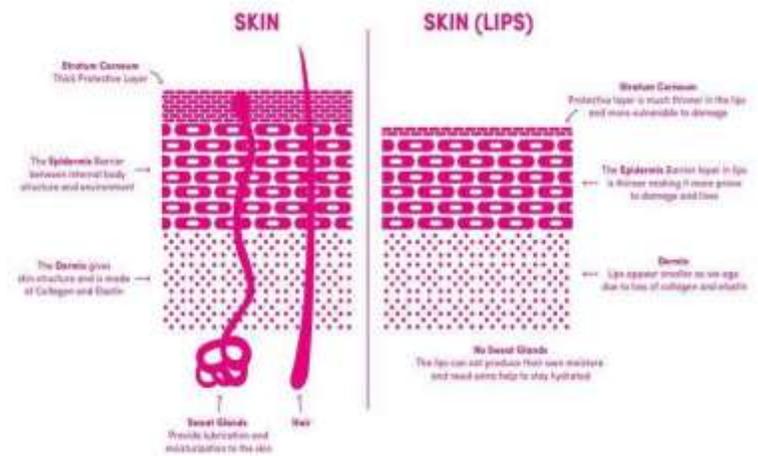


Figure 7 - layers of skin on lips

1.2 Common Lip Disorders

1.2.1 Inflammatory Conditions (Cheilitis)

Cheilitis represents the most prevalent lip disorder, characterized by inflammation that may affect the vermillion, surrounding skin, or both lips. Clinical manifestations include pain, irritation, erythema, cracking, and scaling. Etiological factors encompass allergens, contact irritants, prolonged sun exposure, and nutritional deficiencies, particularly vitamin B2 deficiency [16].



Figure 8– Figure of lips inflammation

1.2.2. Mechanical and Environmental Damage

Swelling: Commonly results from allergic reactions to foods, medications, cosmetics, or airborne irritants. Chronic cases may indicate hereditary angioedema or other systemic conditions [14].

Sun Damage: Prolonged UV exposure causes lip desiccation, hardening, and the development of erythematous patches or white filmy layers, potentially progressing to malignant transformation [15].

Figure 9 – Swelling of lips



Figure 10 – Sun Damage



1.2.3. Pigmentation Disorders

Lip discoloration manifests as color changes from normal red/pink appearance, indicating various systemic or local pathologies:

- **Cyanosis** (blue lips): Indicates poor oxygen circulation
- **Pallor** (white lips): Suggests anemia or circulatory compromise
- **Hyperpigmentation** (black lips): Results from excessive melanin deposition due to smoking, trauma, or genetic factors



Figure 11 – Figure of discolor lips

1.3 Classification of Lip Care Products

Based on therapeutic applications and environmental protection needs:

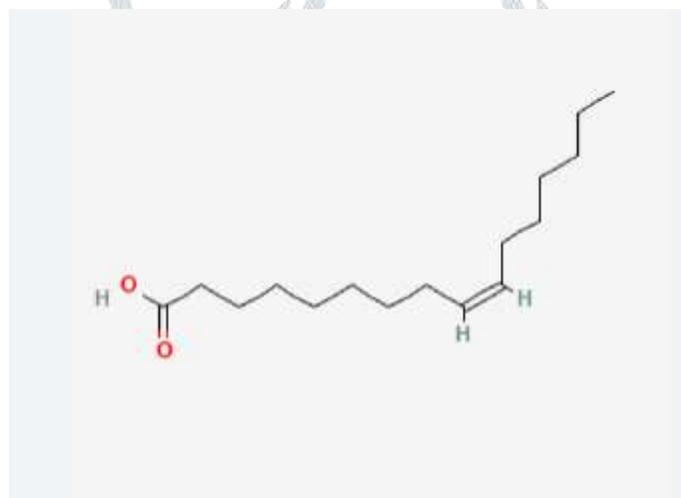
1. **UV Filter Lip Balms:** Provide photoprotection through UV absorption or scattering mechanisms
2. **Nourishing Lip Balms:** Deliver essential nutrients for lip health maintenance
3. **Moisturizing Lip Balms:** Form protective barriers to prevent transepidermal water loss
4. **Medicated Lip Balms:** Contain active pharmaceutical ingredients for therapeutic intervention
5. **Tinted Lip Balms:** Combine cosmetic enhancement with protective functions [17,18]

2. Rationale for Organic Formulations

The unique anatomical vulnerability of lips, combined with the high probability of inadvertent ingestion during normal use, necessitates the development of safer, organic alternatives to conventional synthetic lip care products. The thin epidermal structure and rich innervation of lips make them particularly susceptible to irritation from synthetic ingredients, while their essential physiological functions require gentle, effective therapeutic intervention.

3. DRUG AND EXCIPIENT PROFILE

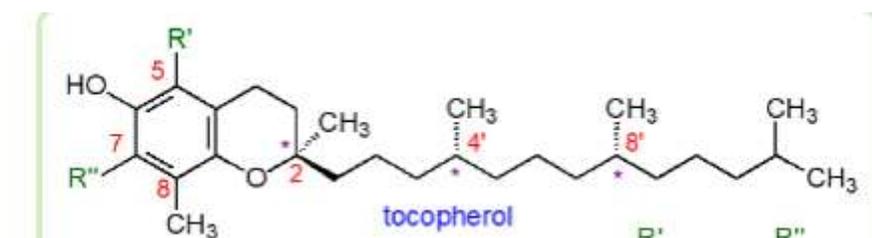
The natural lip balm formulation consists of the natural almond oil. It contains the palmitoleic acid which is used for moisturizing the lips and preventing dryness of the lip.



Structure of palmitoleic acid.

Palmitoleic acid is also called Hexadec-9-enoic acid. It is an omega-7 monounsaturated fatty acid. The molecular formula is $\text{CH}_3(\text{CH}_2)_5\text{CH}=\text{CH}(\text{CH}_2)_7\text{COOH}^{(30)}$.

Vitamin E used in the formulation for antioxidant properties. And helps to maintain the stability of the formulation. It is composed of 8 isoforms collectively called tocopherols and tocotrienols. Among its α -tocopherols is the active antioxidant [31].



Structure of tocopherol

It fights off the infection from the germs.

4. Materials and Methods

4.1 Natural Ingredients for Organic Lip Balm Formulation

The selection of natural ingredients for organic lip balm formulation is based on their therapeutic properties, safety profile, and functional characteristics. Natural ingredients are categorized into four primary groups based on their role in the formulation:

Classification of Natural Ingredients

Table 4.1: Categories of Natural Ingredients Used in Organic Lip Balm

| Base Materials | Carrier Oils | Natural Colorants | Flavoring Agents |
|------------------|----------------|-------------------|------------------|
| Cocoa butter | Coconut oil | Beetroot | Strawberry |
| Beeswax | Olive oil | Pomegranate | Lemongrass |
| Shea wax | Almond oil | Marigold | Orange |
| Avocado butter | Corn oil | Capsicum | Jasmine |
| Mango butter | Joboba oil | Turmeric | Sandalwood |
| Yellow beeswax | Tea tree oil | Watermelon | Vanilla |
| Raspberry butter | Grape seed oil | Lemon | Pineapple |

4.2 Natural Colorants and Their Sources

Natural colorants provide aesthetic appeal while contributing additional therapeutic benefits through their inherent phytochemical compositions.

Table 4.2: Natural Colorants, Sources and Associated Nutrients

| Color | Chromophore | Plant Sources | Key Nutrients |
|---------------|---------------|---|--|
| Purple-blue | Anthocyanins | Eggplant, blackberry, blueberry, purple grape | Lutein, zeaxanthin, resveratrol, Vitamin C, flavonoids |
| Green | Chlorophyll | Avocado, spinach, kale, broccoli, kiwi | Lutein, zeaxanthin, Vitamin C, calcium, folate |
| White-tan | Anthoxanthins | Cauliflower, ginger, onion, garlic | Allicin, potassium, selenium |
| Yellow-orange | Carotenoids | Papaya, carrot, orange, pumpkin | β -carotene, zeaxanthin, Vitamin C, potassium |

| | | | |
|-----|-----------------------|---|-------------------------------------|
| Red | Lycopene/Anthocyanins | Beetroot, tomato, watermelon, pomegranate | Ellagic acid, quercetin, hesperidin |
|-----|-----------------------|---|-------------------------------------|

4.3 Flavoring System

Table 4.3: Natural Flavoring Agents for Taste Masking

| Taste Profile | Recommended Natural Flavors |
|---------------|---|
| Salt | Butterscotch, maple |
| Bitter | Wild cherry, walnut, chocolate-mint, licorice |
| Sweet | Fruits, berry, vanilla |
| Acidic | Citrus |

Key Ingredients and Their Therapeutic Properties

Beeswax

Beeswax serves as the primary structural base, providing consistency and stability to the formulation. Its natural emulsifying properties facilitate homogeneous distribution of active ingredients while creating a protective barrier on lip surfaces. The antimicrobial compounds naturally present in beeswax contribute to preventing secondary bacterial infections in compromised lip tissue [22,23].



Vitamin E (α-Tocopherol)

Functions as both an antioxidant and natural conditioning agent, providing protection against oxidative stress and promoting cellular regeneration. Its anti-aging properties contribute to maintaining youthful lip texture while preventing further environmental damage. The viscous nature of vitamin E oil provides additional moisturization and reduces irritation [24,25].



Almond Oil (*Prunus dulcis*)

Rich in essential fatty acids, almond oil demonstrates excellent penetration properties, delivering deep moisturization to lip tissues. Its anti-inflammatory characteristics provide relief from sun damage and chapping, while antioxidant properties combat free radical damage and prevent premature aging [26].



Beetroot Extract (*Beta vulgaris*)

Contains natural betaine pigments (betacyanins and betaxanthins) that provide vibrant red-purple coloration. Beyond its coloring function, beetroot extract contributes antioxidant properties that enhance skin elasticity, provide UV protection, and promote healing of damaged lip tissue [27,28].

4.4 Experimental Formulation

Table 4.5: Ingredient Quantities and Functional Roles

| S.No. | Ingredient | Quantity | Functional Role |
|-------|-----------------|----------|---------------------------|
| 1 | Beetroot powder | 2.0 g | Natural colorant |
| 2 | Beeswax | 9.0 g | Base, consistency, gloss |
| 3 | Almond oil | 0.6 ml | Moisturizing agent |
| 4 | Vitamin E | 0.5 ml | Antioxidant, stabilizer |
| 5 | Lemongrass oil | q.s. | Natural fragrance |
| 6 | Glycerol | q.s. | Humectant, gloss enhancer |

Preparation Methodology

Manufacturing Process

- Ingredient Preparation:** All ingredients were weighed accurately using an analytical balance according to the predetermined formula.
- Melting Phase:** Beeswax and almond oil were combined in a glass beaker and heated in a water bath at 55-60°C until complete melting was achieved.
- Active Addition:** Vitamin E, beetroot powder, and lemongrass oil were incorporated into the melted base with vigorous mixing to ensure uniform distribution.
- Homogenization:** The mixture was stirred continuously until a homogeneous blend was obtained, ensuring no phase separation.
- Filling and Cooling:** The hot mixture was poured into sterilized containers and allowed to cool at room temperature under controlled conditions.
- Quality Control:** Each batch was labeled with manufacturing details and subjected to quality evaluation parameters [29,30].

4.5 Evaluation Parameters

Organoleptic Assessment

Physical characteristics including appearance, color, odor, texture, and homogeneity were evaluated visually and tactilely. The presence of coarse particles or phase separation was specifically monitored to ensure product quality [31].

pH Determination

The pH of the formulated lip balm was measured to assess its compatibility with lip skin. A 1g sample was dissolved in 100ml distilled water, and pH was measured using a calibrated pH meter. The pH range was maintained near neutral to prevent irritation [32].

Skin Irritation Testing

Patch testing was conducted by applying the formulated product to skin for 10 minutes, followed by observation for any adverse reactions including erythema, edema, or discomfort [33].

Spreadability Assessment

The ease of application and uniformity of spread were evaluated on glass slides at room temperature. Results were classified as:

- **Good (G):** Uniform spread, no fragmentation, perfect application
- **Intermediate (I):** Uniform spread with minimal fragmentation
- **Poor (B):** Non-uniform spread, excessive fragmentation, inappropriate application [34]

Color Effectiveness Test

The intensity and uniformity of color imparted by natural beetroot extract were evaluated by applying the product on white paper, allowing assessment of colorant efficiency and stability [30].

Skin Sensitivity Evaluation

Patch testing was performed to evaluate potential allergic reactions:

- **N:** No reaction observed
- **R:** Mild redness
- **I:** Itching, swelling, or inflammation

This comprehensive evaluation protocol ensures the safety, efficacy, and quality of the organic lip balm formulation while maintaining compliance with cosmetic product standards.

5. Results and Discussion

Evaluation of Formulated Organic Lip Balm

The developed organic lip balm formulation was subjected to comprehensive quality evaluation to assess its physical, chemical, and safety parameters. The results demonstrate successful formulation of a stable, safe, and effective organic lip care product.

Physical and Organoleptic Characteristics

The organoleptic evaluation revealed satisfactory physical properties of the formulated lip balm, indicating successful incorporation of natural ingredients while maintaining desirable cosmetic attributes.

Table 7: Organoleptic Evaluation Results

| S.No. | Parameter | Observation | Assessment |
|-------|------------|--------------|--|
| 1 | Color | Pink | Uniform, natural tint from beetroot extract |
| 2 | Appearance | Good, Smooth | Homogeneous texture without grittiness |
| 3 | Odor | Pleasant | Mild, acceptable fragrance from lemongrass oil |

The pink coloration achieved through beetroot extract demonstrates the successful incorporation of natural colorants without synthetic dyes. The smooth, homogeneous appearance indicates proper melting and mixing procedures, ensuring uniform distribution of all components. The pleasant odor profile suggests effective masking of any undesirable base material odors through natural lemongrass oil.

pH Analysis

The pH measurement of the formulated lip balm yielded a value of **7.2**, which falls within the optimal range for lip care products. This near-neutral pH indicates:

- **Skin Compatibility:** The pH closely matches the natural pH of healthy lip tissue (6.5-7.5)
- **Non-irritant Nature:** Neutral pH minimizes the risk of chemical irritation upon application
- **Stability:** pH values near neutral enhance product stability and shelf-life
- **Safety Profile:** Suitable for frequent application without causing pH-related adverse effects

The slightly alkaline nature (pH 7.2) is acceptable for lip products and falls within the safe range recommended for topical cosmetic applications.

Safety Assessment

Skin Irritation Testing

The 10-minute patch test revealed **no signs of irritation**, indicating excellent skin tolerance. This result confirms:

- Absence of immediate hypersensitivity reactions
- Good biocompatibility of the organic ingredient blend
- Suitability for application on sensitive lip tissue
- Low risk of contact dermatitis

Skin Sensitivity Evaluation

The formulated lip balm demonstrated **no adverse reactions** during sensitivity testing, classified as 'N' (**No reaction**). This finding indicates:

- Hypoallergenic properties of the natural formulation
- Absence of sensitizing compounds
- Suitability for individuals with sensitive skin
- Low risk of allergic contact dermatitis

Performance Characteristics

Spreadability Assessment

The spreadability test resulted in a '**G**' (**Good**) rating, characterized by:

- **Uniform distribution:** Consistent application without streaking
- **No fragmentation:** Maintained structural integrity during application
- **Perfect application:** Smooth gliding properties on lip surface
- **No deformation:** Retained shape and consistency at room temperature

These results indicate optimal formulation consistency, providing ease of application while maintaining product stability.

Color Effectiveness Test

The paper application test demonstrated **uniform color distribution** with **effective pigmentation**, confirming:

- Successful extraction and incorporation of beetroot pigments
- Stable color dispersion throughout the product matrix
- Consistent tinting capability
- Adequate color intensity for cosmetic appeal

Discussion

The comprehensive evaluation results validate the successful development of an organic lip balm formulation that meets essential quality parameters for cosmetic lip care products. The achievement of desirable organoleptic

properties while maintaining safety and efficacy demonstrates the viability of natural ingredients as alternatives to synthetic components.

Formulation Success Factors

1. **Natural Colorant Efficacy:** Beetroot extract provided adequate pigmentation without synthetic dyes, supporting the natural product philosophy while achieving consumer-acceptable aesthetics.
2. **pH Optimization:** The near-neutral pH (7.2) ensures skin compatibility, addressing the primary concern with organic formulations regarding pH stability.
3. **Safety Profile:** The absence of irritation and sensitivity reactions validates the selection of natural ingredients and supports the product's suitability for regular use.
4. **Physical Properties:** Good spreadability and smooth texture demonstrate that natural ingredients can achieve performance characteristics comparable to synthetic alternatives.

Clinical Implications

The results suggest that the developed organic lip balm formulation addresses the key limitations of synthetic lip care products while providing:

- Safe, non-toxic composition suitable for inadvertent ingestion
- Effective moisturization and protection through natural emollients
- Aesthetic appeal through natural colorants
- Broad applicability across different skin types

Limitations and Future Considerations

While the current evaluation demonstrates promising results, long-term stability studies and extended safety assessments would further validate the product's commercial viability. Additionally, comparative studies with synthetic alternatives could provide quantitative data on relative efficacy and consumer preference.

The successful formulation and evaluation of this organic lip balm represent a significant step toward safer, more sustainable lip care solutions that align with growing consumer demand for natural cosmetic products.

6. Conclusion

This research successfully achieved its primary objective of preparing and evaluating an organic lip balm using natural ingredients. The formulated product demonstrated excellent organoleptic characteristics with stable properties at both room temperature and refrigerated conditions. All evaluation parameters were successfully

met, including good spreadability (G-rating), appropriate melting point, optimal consistency, and near-neutral pH (7.2).

The combination of natural ingredients—beeswax, almond oil, vitamin E, beetroot extract, and lemongrass oil—proved effective in creating a safe, stable lip balm formulation. The product showed no signs of skin irritation or sensitivity reactions, confirming its hypoallergenic nature and suitability for regular use.

The comprehensive evaluation confirmed that the natural lip balm maintains a healthy lip environment while providing effective moisturization and protection. All stability tests validated the formulation's quality and safety profile, demonstrating that natural ingredients can successfully replace synthetic alternatives without compromising product performance.

In conclusion, this study proves that organic lip balm formulations using natural ingredients represent a superior, safer alternative to synthetic products, offering comparable efficacy with enhanced safety for consumers.

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