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Phytocosmetic Formulation of Beetroot-Enriched Lipstick Cum Lip Balm with Enhanced Antioxidant and Moisturizing Properties

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Abstract: *The growing demand for safe, eco-friendly, and plant-based cosmetic products has encouraged the development of herbal alternatives to synthetic lip care formulations. The present study focuses on the phytocosmetic formulation and evaluation of a beetroot-enriched lipstick cum lip balm with enhanced antioxidant and moisturizing properties. Beetroot (Beta vulgaris) was selected as the primary natural colorant due to its rich betalain pigment content and beneficial bioactive constituents possessing antioxidant potential. The formulation was prepared using natural waxes, oils, and herbal ingredients to provide colour, hydration, nourishment, and protection to the lips while minimizing the adverse effects commonly associated with synthetic lip cosmetics.*

The prepared herbal formulation was evaluated for various physicochemical and functional parameters including colour, texture, pH, spreadability, softening point, stability, skin compatibility, antioxidant activity, and moisturizing efficacy. The results indicated that the formulation exhibited satisfactory organoleptic characteristics, good stability, smooth application, and acceptable moisturizing performance. The incorporation of beetroot extract enhanced the product's natural coloration and antioxidant properties, making it a promising alternative to conventional synthetic lipsticks and lip balms.

The study highlights the potential of herbal phytoconstituents for developing multifunctional lip cosmetics with improved safety, therapeutic value, and consumer acceptability. The formulated product may serve as a sustainable and effective herbal cosmeceutical for modern lip care applications..

Keywords: Phytocosmetics, Herbal Lipstick, Lip Balm, Beetroot, Beta vulgaris, Natural Colorant, Antioxidant Activity, Moisturizing Property, Herbal Cosmetics, Cosmeceuticals

I. INTRODUCTION

Cosmeceuticals represent a rapidly expanding segment of the cosmetic and personal care industry, combining aesthetic enhancement with therapeutic benefits. The term “cosmeceutical” was first introduced by Albert Kligman in 1984 to describe products that function as cosmetics while exhibiting pharmaceutical-like biological activity (Pandey et al., 2023). In recent years, growing consumer awareness regarding product safety, sustainability, and the adverse effects of synthetic chemicals has accelerated the demand for herbal and plant-based cosmetic formulations. Herbal cosmeceuticals are primarily formulated with naturally derived ingredients such as plant extracts, essential oils, natural pigments, waxes, and antioxidants, which provide both cosmetic and protective functions.

Among cosmetic products, lip care formulations hold a significant place due to their frequent, direct application to the sensitive lip surface. Lipsticks and lip balms are widely used not only for beautification but also for hydration,

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nourishment, and protection against environmental damage. Modern consumers increasingly prefer herbal lip products because they are perceived as safer, biodegradable, and free from harmful synthetic additives.

The lips possess a thin epithelial layer and limited sebaceous gland activity, making them highly susceptible to dryness, cracking, oxidative stress, and environmental damage. Consequently, lip care products should ideally provide moisturization, protection, and aesthetic enhancement simultaneously. Natural lip care products enriched with botanical oils, waxes, and pigments offer multifunctional benefits, including hydration, antioxidant activity, and reduced potential for irritation.

Natural ingredients such as beeswax, cocoa butter, castor oil, coconut oil, and plant-derived pigments have gained prominence in herbal lipstick formulations for their emollient and protective properties. Herbal formulations also improve consumer acceptability due to their lower toxicity and compatibility with sensitive skin. Furthermore, botanical ingredients often contain bioactive compounds such as phenolics, flavonoids, carotenoids, and betalains that contribute antioxidant and anti-inflammatory activities beneficial for lip health.

Despite their widespread use, synthetic lipsticks and lip balms have raised concerns regarding long-term safety due to the presence of heavy metals, artificial dyes, preservatives, and petroleum-derived ingredients. Lip products are particularly important from a toxicological perspective because a portion of the applied product may be inadvertently ingested during routine use (Piccinini et al., 2019).

Several studies have reported the presence of trace metals, including lead, cadmium, chromium, nickel, and arsenic, in commercial lipstick formulations. The U.S. Food and Drug Administration (FDA) has acknowledged that heavy metals may occur in cosmetic products as impurities originating from raw materials or manufacturing processes (FDA, 2024a). Although present in trace amounts, prolonged exposure to these contaminants has generated significant public health concerns. Lead exposure, in particular, has been associated with neurotoxicity and systemic health risks (FDA, 2024b).

Synthetic preservatives and fragrances may also contribute to allergic reactions, irritation, dryness, and barrier impairment in susceptible individuals. These concerns have encouraged researchers and cosmetic manufacturers to explore safer herbal alternatives utilizing natural colorants and bioactive plant constituents.

Beetroot (*Beta vulgaris* L.) has emerged as a promising natural ingredient in cosmetic formulations due to its intense red-violet pigmentation and rich phytochemical profile. The characteristic colour of beetroot is mainly attributed to betalain pigments, particularly betacyanins and betaxanthins, which exhibit strong antioxidant properties. Beetroot also contains phenolic compounds, carotenoids, vitamin C, nitrates, and various bioactive constituents that contribute therapeutic benefits.

The antioxidant activity of beetroot plays an important role in neutralizing oxidative stress and protecting biological tissues from free radical damage. Due to these properties, beetroot extract has been investigated in several herbal cosmetic and lip care formulations as a natural alternative to synthetic dyes. In addition to providing attractive coloration, beetroot-derived pigments contribute moisturizing and protective effects that enhance the functional value of lip products.

The use of natural pigments from beetroot aligns with current trends emphasizing sustainability, eco-friendly cosmetic production, and reduced dependence on synthetic additives. Herbal lip formulations incorporating beetroot may therefore offer improved safety, therapeutic value, and consumer preference compared to conventional synthetic products.

Although numerous herbal lipstick formulations have been reported in previous studies, many commercially available products still rely heavily on synthetic colorants, preservatives, and petroleum-based ingredients. Existing research has primarily focused on basic formulation and colour evaluation, while comparatively limited attention has been given to the combined antioxidant and moisturizing potential of multifunctional herbal lipstick cum lip balm formulations.

Moreover, there remains a need for phytocosmetic formulations that integrate natural pigments with therapeutic botanical ingredients to improve lip health while maintaining acceptable physicochemical stability and cosmetic performance. Beetroot-enriched herbal formulations offer a promising approach to addressing these limitations by incorporating natural antioxidants and moisturizing agents.

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The present study aims to formulate and evaluate a beetroot-enriched herbal lipstick cum lip balm with enhanced antioxidant and moisturizing properties using natural ingredients. The objectives of the study include preparing a stable herbal formulation, evaluating physicochemical parameters, assessing antioxidant activity, and determining moisturizing and cosmetic performance characteristics. The study also seeks to promote the development of safer and sustainable alternatives to synthetic lip cosmetics.

II. LITERATURE REVIEW

2.1 Herbal Lipstick and Lip Balm Formulations

The increasing awareness regarding the harmful effects of synthetic cosmetic ingredients has significantly contributed to the development of herbal lip care formulations. Herbal lipsticks and lip balms are formulated with natural waxes, oils, pigments, and plant extracts that provide both aesthetic and therapeutic benefits. These formulations are considered safer alternatives because they minimize exposure to synthetic dyes, preservatives, and heavy metals commonly found in conventional cosmetics.

Chaudhari et al. (2018) reviewed the formulation and evaluation of herbal lipsticks prepared from natural colouring pigments and highlighted the importance of plant-derived ingredients in reducing adverse reactions associated with synthetic colourants. The authors emphasized the growing consumer preference for herbal cosmetics due to their safety, nourishing properties, and environmental compatibility. Similarly, Anilkumar et al. (2021) discussed the increasing global demand for herbal lipsticks and described the role of natural colour extracts, oils, and waxes in improving product safety and lip compatibility.

Konda et al. (2023) further reported that herbal lipstick formulations provide both cosmetic enhancement and soothing effects while minimizing irritation caused by synthetic chemicals. The study highlighted the significance of natural ingredients such as beetroot, rose petals, and plant oils in the development of safer lip care products. In another study, Tiwari et al. (2023) formulated herbal lipstick using beetroot and rose petal extracts and evaluated important quality parameters including pH, melting point, and smoothness. The results demonstrated acceptable cosmetic characteristics and consumer suitability.

2.2 Natural Pigments Used in Lip Cosmetics

Natural pigments have attracted substantial attention in cosmetic science due to growing concerns about the toxicity and environmental impact of synthetic dyes. Plant-derived pigments such as anthocyanins, carotenoids, chlorophylls, and betalains are increasingly used in herbal cosmetic formulations due to their colouring ability and biological activity. Beetroot (*Beta vulgaris*) is one of the most widely investigated natural sources of red-violet pigment for cosmetic applications. The characteristic colour of beetroot is primarily attributed to betalains, especially betacyanins and betaxanthins, which also exhibit antioxidant properties (Georgiev et al., 2010). Swetha Kruthika et al. (2014) formulated natural lipstick using pigments extracted from *Beta vulgaris* taproot and reported satisfactory colour stability and product performance. Similarly, Chaudhari et al. (2019) developed herbal lipstick formulations containing beetroot-derived betanin pigment and observed that the optimized formulation exhibited desirable physicochemical characteristics.

Natural pigments from other botanical sources have also been investigated for cosmetic use. Lusiana Dian Anjarsari et al. (2020) studied the incorporation of super red dragon fruit extract in herbal lipstick and demonstrated significant antioxidant and antibacterial properties. Likewise, Setyawaty et al. (2020) utilized purple-fleshed sweet potato extract rich in anthocyanins as a natural lipstick dye and concluded that the pigment possessed potential cosmetic applicability, although stabilization measures were necessary to improve colour retention.

2.3 Therapeutic and Antioxidant Potential of Beetroot

Beetroot has gained scientific attention because of its rich phytochemical composition and associated health-promoting properties. The root contains betalains, phenolic compounds, carotenoids, vitamin C, nitrates, and flavonoids that contribute significant antioxidant and anti-inflammatory activities (Clifford et al., 2015). These bioactive compounds play an important role in neutralizing free radicals and reducing oxidative stress.

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The antioxidant potential of beetroot makes it highly suitable for incorporation into phytocosmetic formulations aimed at protecting the delicate lip tissue from environmental damage. Georgiev et al. (2010) reported that betalains exhibit strong radical-scavenging activity and may provide protective biological effects against oxidative injury. In addition to antioxidant activity, beetroot extracts have demonstrated antimicrobial, anti-inflammatory, and protective properties beneficial for skin and mucosal applications.

Recent studies have also explored the therapeutic use of botanical ingredients in lip care products. Shirish Nagansurkar et al. (2024) formulated a beetroot-based lip balm using organic ingredients and highlighted its moisturizing and antioxidant potential. The authors concluded that natural formulations may help reduce the risks associated with heavy metals and synthetic preservatives commonly present in conventional lip products.

2.4 Recent Advances in Phytocosmetic Lip Care Products

Modern phytocosmetic research focuses on combining cosmetic performance with therapeutic efficacy using plant-derived bioactive compounds. Advances in herbal cosmetic science have led to the development of multifunctional formulations possessing moisturizing, antioxidant, antimicrobial, anti-aging, and photoprotective properties.

Ganesan et al. (2016) discussed the application of phytocompound-based nanocosmeceuticals in skincare and beauty therapy. The study highlighted the role of nano-delivery systems in improving the stability, penetration, and sustained release of bioactive plant constituents in cosmetic products. Although nanotechnology-based approaches are still emerging in herbal lip care products, they represent a promising direction for future phytocosmetic research.

The role of botanical antioxidants in cosmetic dermatology has also gained increasing importance. Damayanti et al. (2023) investigated the dermatological applications of saffron and reported antioxidant, anti-inflammatory, photoprotective, and moisturizing effects relevant to cosmetic formulations. Similarly, natural oils, waxes, and plant pigments continue to be explored for their multifunctional properties in herbal lipsticks and lip balms.

Despite significant progress in herbal cosmetic development, there remains a need for stable and multifunctional formulations that effectively combine natural colouration with therapeutic benefits. The present study therefore focuses on the formulation and evaluation of a beetroot-enriched herbal lipstick cum lip balm possessing antioxidant and moisturizing properties while minimizing dependence on synthetic cosmetic ingredients.

III. MATERIALS AND METHODS

3.1 Materials and Chemicals Used

The materials used for the formulation of the beetroot-enriched herbal lipstick cum lip balm were selected based on their natural origin, safety, moisturizing potential, and compatibility with herbal cosmetic preparations. Beetroot (*Beta vulgaris*) was used as the primary natural colouring agent due to its betalain pigment content and antioxidant properties. Natural waxes and oils were incorporated to provide structural stability, smooth texture, moisturization, and emollient effects.

Table 1. Materials Used in the Formulation

S. No.	Ingredient	Category/Function
1	Beetroot extract (*Beta vulgaris*)	Natural colouring agent, antioxidant
2	Beeswax	Hardening agent, emollient
3	Carnauba wax	Gloss enhancer, stiffening agent
4	Coconut oil	Moisturizer, emollient
5	Castor oil	Glossing agent, blending agent
6	Cocoa butter	Nourishing and moisturizing agent
7	Vitamin E	Antioxidant
8	Rose essence/Vanilla essence	Flavouring agent
9	Olive oil	Softening and moisturizing agent

All ingredients used in the formulation were of cosmetic or pharmaceutical grade.

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3.2 Collection and Preparation of Beetroot Extract

Fresh beetroot roots (*Beta vulgaris*) were procured from a local market and thoroughly washed with distilled water to remove dirt and impurities. The outer peel was removed, and the roots were cut into small pieces. The beetroot pieces were dried under shade and then crushed using a grinder to obtain coarse material.

The extraction of the natural pigment was carried out using an aqueous or hydroalcoholic extraction method. The crushed beetroot material was soaked in solvent and subjected to filtration using muslin cloth followed by Whatman filter paper. The filtrate obtained was concentrated under controlled temperature conditions to preserve the betalain pigments and antioxidant constituents.

Table 2. Phytoconstituents Present in Beetroot Extract

Phytoconstituent	Functional Importance
Betalains	Natural pigmentation, antioxidant activity
Phenolic compounds	Free radical scavenging activity
Vitamin C	Antioxidant and protective effect
Carotenoids	Protective and nourishing properties
Flavonoids	Anti-inflammatory and antioxidant activity

3.3 Formulation of Herbal Lipstick Cum Lip Balm

The herbal lipstick cum lip balm was formulated using natural waxes, oils, and beetroot extract in suitable proportions to achieve desired colour, texture, spreadability, and moisturizing performance. The formulation aimed to provide aesthetic enhancement along with therapeutic lip protection.

Table 3. Composition of Herbal Lipstick Cum Lip Balm

Ingredient	Function
Beetroot extract	Natural colourant
Beeswax	Structural base and hardness
Carnauba wax	Stability and glossy finish
Castor oil	Smooth application and gloss
Coconut oil	Moisturizing effect
Cocoa butter	Nourishment and emollient action
Olive oil	Softening agent
Vitamin E	Antioxidant protection
Flavouring agent	Improved sensory characteristics

3.4 Preparation Procedure

The herbal lipstick cum lip balm was prepared by the fusion method. Initially, waxes including beeswax and carnauba wax were melted together using a water bath under controlled temperature conditions. After complete melting, oils such as coconut oil, castor oil, olive oil, and cocoa butter were added gradually with continuous stirring to obtain a uniform mixture.

The concentrated beetroot extract was then incorporated slowly into the molten base with constant mixing to ensure uniform colour distribution. Vitamin E and flavouring agents were added during the final stage of preparation. The homogeneous mixture was poured into lipstick moulds or lip balm containers and allowed to cool at room temperature until solidification occurred.

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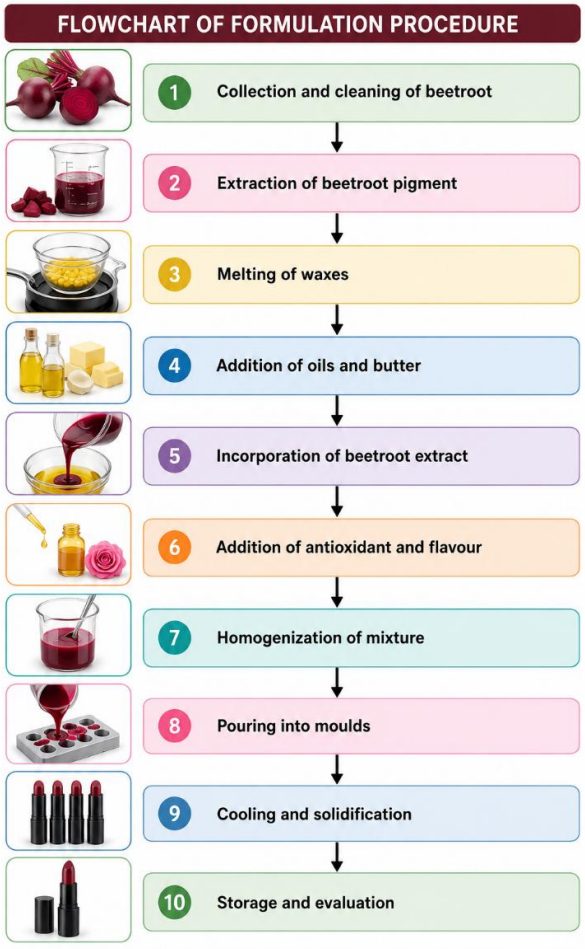

Figure 1. Flowchart of Formulation Procedure

3.5 Evaluation Parameters

The prepared formulation was evaluated for various physicochemical and functional parameters to determine product quality, stability, safety, and performance.

Table 4. Evaluation Parameters of Herbal Lipstick Cum Lip Balm

Parameter	Purpose of Evaluation
Colour and appearance	Visual acceptability
Texture and smoothness	Ease of application
pH determination	Skin compatibility
Spreadability	Uniform application
Softening/Melting point	Stability at different temperatures
Skin irritation test	Safety assessment
Stability study	Product consistency during storage
Antioxidant activity	Functional therapeutic property
Moisturizing property	Hydration efficiency

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3.5.1 Organoleptic Evaluation

The formulation was visually examined for colour, odour, texture, gloss, and overall appearance. Smoothness and ease of application were assessed manually.

3.5.2 pH Determination

The pH of the formulation was determined using a digital pH meter after dispersing a small quantity of the product in distilled water. The pH was maintained within a range suitable for lip application.

3.5.3 Melting Point/Softening Point

The softening point of the formulation was evaluated to determine thermal stability and suitability under normal storage conditions.

3.5.4 Spreadability Test

Spreadability was evaluated by applying the formulation on a glass surface or skin area to determine smoothness, uniformity, and ease of application.

3.5.5 Stability Study

The prepared product was stored under different temperature conditions to assess changes in colour, texture, odour, and consistency over a specified period.

Table 5. Stability Study Parameters

Storage Condition	Observation Parameters
Room temperature	Colour, odour, texture
Refrigerated condition	Hardness and consistency
Elevated temperature	Melting and stability

3.5.6 Skin Irritation Test

The formulation was applied on a small area of skin to observe any signs of irritation, redness, itching, or hypersensitivity reactions.

3.5.7 Antioxidant Activity Assessment

The antioxidant potential of the beetroot-enriched formulation was assessed based on the known free radical scavenging activity of betalain pigments and associated phytoconstituents.

3.5.8 Moisturizing Property Evaluation

The moisturizing efficacy of the formulation was evaluated based on smoothness, hydration retention, and prevention of lip dryness after application. Natural oils and butter present in the formulation contributed to emollient and protective effects.

IV. RESULTS

4.1 Physical Evaluation Results

The prepared beetroot-enriched herbal lipstick cum lip balm was evaluated for its organoleptic and physicochemical characteristics. The formulation exhibited a smooth texture, uniform colour distribution, pleasant odour, and glossy appearance. The natural beetroot pigment imparted an attractive reddish tint suitable for cosmetic application. The product demonstrated satisfactory spreadability and ease of application without grittiness or surface irregularities.

Table 6. Organoleptic Evaluation of Herbal Lipstick Cum Lip Balm

Evaluation Parameter	Observation
Colour	Reddish pink to deep red
Appearance	Smooth and glossy
Odour	Pleasant and acceptable
Texture	Soft and uniform
Surface defects	Absent
Spreadability	Good
Washability	Easy to remove

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Consistency	Homogeneous

The prepared formulation remained stable and aesthetically acceptable throughout the evaluation period. No sweating, crystal formation, or bleeding of colour was observed.

4.2 Stability Analysis

The stability study was conducted under different storage conditions to evaluate the physical integrity and consistency of the formulation. The herbal lipstick cum lip balm maintained acceptable stability at room temperature and refrigerated conditions. Minor softening was observed under elevated temperature conditions; however, the formulation retained acceptable structural integrity without phase separation.

Table 7. Stability Study Observations

Storage Condition	Colour Stability	Texture	Odour	Overall Stability
Room temperature	Stable	Smooth	Unchanged	Good
Refrigerated condition	Stable	Slightly firm	Unchanged	Good
Elevated temperature	Slight softening observed	Acceptable	Unchanged	Moderate to good

The presence of natural waxes such as beeswax and carnauba wax contributed significantly to the thermal stability and structural strength of the product.

4.3 Antioxidant Activity Results

The antioxidant potential of the formulation was primarily attributed to beetroot-derived betalains and the presence of vitamin E. The formulation demonstrated satisfactory antioxidant characteristics based on the known free radical scavenging properties of the incorporated phytoconstituents.

Table 8. Functional Ingredients Contributing to Antioxidant Activity

Ingredient	Major Bioactive Components	Functional Role
Beetroot extract	Betalains, phenolics	Antioxidant activity
Vitamin E	Tocopherols	Prevention of oxidative degradation
Coconut oil	Medium-chain fatty acids	Protective effect
Olive oil	Polyphenols	Antioxidant support

The antioxidant-rich composition of the formulation may help protect the delicate lip tissue from oxidative stress and environmental damage.

4.4 Moisturizing Efficacy Results

The moisturizing performance of the herbal lipstick cum lip balm was found to be satisfactory due to the incorporation of natural oils and butters. The formulation provided smooth application and reduced lip dryness after application. Emollient ingredients such as coconut oil, cocoa butter, olive oil, and castor oil contributed to improved hydration and softness.

Table 9. Moisturizing and Functional Properties of Formulation Ingredients

Ingredient	Functional Property
Coconut oil	Moisturizing and softening
Cocoa butter	Nourishing and protective
Castor oil	Gloss enhancement and lubrication
Olive oil	Hydration and emollient effect
Beeswax	Moisture retention barrier

The formulation formed a protective layer on the lips, helping to reduce moisture loss and improve smoothness.

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4.5 Comparative Evaluation with Synthetic Products

The prepared herbal formulation was compared qualitatively with conventional synthetic lip products based on safety, ingredient profile, and functional properties. The herbal lipstick cum lip balm demonstrated advantages in terms of natural composition, reduced risk of irritation, and presence of antioxidant phytoconstituents.

Table 10. Comparative Evaluation of Herbal and Synthetic Lip Products

Parameter	Herbal Formulation	Synthetic Products
Colour source	Natural beetroot pigment	Synthetic dyes
Moisturizing agents	Natural oils and waxes	Mineral oils and synthetic emollients
Antioxidant potential	Present	Limited
Heavy metal risk	Lower	Possible contamination risk
Skin compatibility	Better suitability for sensitive lips	Possible irritation/allergic reactions
Environmental impact	Eco-friendly and biodegradable	Relatively less sustainable

The results suggest that the formulated herbal lipstick cum lip balm possesses desirable cosmetic and functional characteristics while offering improved safety and phytocosmetic benefits compared to conventional synthetic lip products.

V. DISCUSSION

5.1 Interpretation of Physicochemical Properties

The present study successfully formulated a beetroot-enriched herbal lipstick cum lip balm using natural waxes, oils, and plant-derived pigments. The prepared formulation exhibited satisfactory physicochemical characteristics including smooth texture, glossy appearance, acceptable consistency, and good spreadability. These findings indicate that the selected combination of natural ingredients was effective in producing a stable and cosmetically acceptable phytocosmetic formulation.

The structural stability and smooth application of the product can be attributed to the presence of beeswax and carnauba wax, which are commonly used as natural stiffening and consistency-enhancing agents in herbal cosmetic preparations. Similar observations were reported by Chaudhari et al. (2019), who formulated herbal lipstick using beetroot pigment and observed desirable organoleptic and stability characteristics. The acceptable spreadability and homogeneous consistency observed in the present study are important quality parameters that influence consumer acceptability and product performance.

The formulation also maintained satisfactory stability under different storage conditions with no significant phase separation, colour bleeding, or development of surface defects. These findings support the suitability of natural waxes and oils for the development of stable herbal lip care products.

5.2 Effectiveness of Beetroot as Natural Colorant

Beetroot (*Beta vulgaris*) served as an effective natural colouring agent in the prepared formulation by imparting an attractive reddish hue. The pigmentation properties of beetroot are primarily associated with betalains, especially betacyanins, which possess both colouring and antioxidant potential. The incorporation of beetroot extract provided natural coloration without the use of synthetic dyes that may produce adverse health effects.

The findings of the present study are consistent with previous investigations conducted by Swetha Kruthika et al. (2014), who reported that beetroot pigments could be successfully utilized in natural lipstick formulations with acceptable cosmetic characteristics. Similarly, Georgiev et al. (2010) demonstrated that betalain-rich beetroot extracts possess strong antioxidant activity in addition to their colouring ability.

Natural pigments are increasingly preferred in cosmetic formulations because of growing concerns regarding the toxicity of artificial colourants and heavy metal contamination in synthetic cosmetics. The utilization of beetroot extract therefore contributes not only to cosmetic appeal but also to the development of safer and environmentally sustainable phytocosmetic products.

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5.3 Antioxidant and Moisturizing Potential

The antioxidant potential of the formulated product is primarily associated with the presence of beetroot phytoconstituents and vitamin E. Beetroot contains betalains, phenolic compounds, flavonoids, and vitamin C, all of which contribute significant free radical scavenging activity (Clifford et al., 2015). Antioxidants play an important role in protecting delicate lip tissues against oxidative stress induced by environmental pollutants, ultraviolet radiation, and dehydration.

In addition to antioxidant activity, the formulation demonstrated satisfactory moisturizing properties due to the incorporation of coconut oil, olive oil, cocoa butter, and castor oil. These ingredients are recognized for their emollient and protective functions, which help maintain lip hydration and reduce dryness or cracking. The combination of moisturizing and antioxidant properties enhances the multifunctional nature of the formulation and supports its application as both a cosmetic and protective lip care product.

Recent phytocosmetic studies have similarly emphasized the therapeutic potential of herbal ingredients in cosmetic formulations. Damayanti et al. (2023) reported that botanical antioxidants possess significant moisturizing, protective, and anti-inflammatory properties beneficial in cosmetic dermatology. The present formulation therefore aligns with current trends focusing on multifunctional herbal cosmetics with therapeutic benefits.

5.4 Advantages of Herbal Formulation over Synthetic Products

The formulated herbal lipstick cum lip balm demonstrated several advantages compared to conventional synthetic lip products. Herbal formulations generally contain fewer synthetic additives, preservatives, and artificial colourants, thereby reducing the risk of irritation, hypersensitivity, and long-term toxicological concerns. The use of naturally derived ingredients also improves biocompatibility and consumer preference toward eco-friendly cosmetic products.

Several studies have reported the presence of trace heavy metals such as lead, cadmium, chromium, and nickel in commercial lipsticks (Piccinini et al., 2019). Although these contaminants may occur in small quantities, continuous exposure through repeated application has raised safety concerns among consumers and regulatory agencies. The present herbal formulation attempts to minimize such risks through the utilization of plant-derived colourants and naturally sourced ingredients.

Furthermore, the biodegradable and sustainable nature of herbal cosmetic ingredients contributes positively toward environmental protection and green cosmetic development. The present study therefore supports the growing shift from synthetic cosmetics toward safer phytocosmetic alternatives.

5.5 Limitations of the Study

Although the present study demonstrated promising results, certain limitations remain. The evaluation was primarily focused on physicochemical properties, antioxidant potential, and moisturizing characteristics. Advanced analytical investigations such as quantitative antioxidant assays, microbial stability testing, long-term accelerated stability studies, and dermatological safety assessments were beyond the scope of the present work.

Additionally, natural pigments may exhibit sensitivity toward environmental factors such as light, temperature, and pH, which could affect long-term colour stability. Further studies involving formulation optimization, preservative systems, and advanced delivery approaches may help improve product stability and shelf life.

Despite these limitations, the study successfully highlights the potential of beetroot-enriched herbal formulations as safer and multifunctional alternatives to synthetic lip cosmetics.

VI. CONCLUSION

The present study successfully formulated and evaluated a beetroot-enriched herbal lipstick cum lip balm using natural ingredients possessing cosmetic as well as therapeutic benefits. The formulation demonstrated satisfactory physicochemical characteristics including smooth texture, acceptable consistency, good spreadability, attractive natural

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coloration, and desirable moisturizing performance. The incorporation of beetroot (*Beta vulgaris*) extract provided a natural red pigment along with antioxidant properties that contributed to the functional value of the formulation.

The use of natural waxes, oils, and botanical ingredients helped improve product safety, hydration, and lip protection while reducing dependence on synthetic colourants and chemically derived additives commonly associated with conventional lip cosmetics. The formulation also exhibited acceptable stability under different storage conditions without significant deterioration in colour, texture, or appearance.

The findings of the study support the growing importance of phytocosmetic formulations as safer and eco-friendly alternatives to synthetic cosmetic products. The antioxidant and moisturizing properties of the prepared herbal lipstick cum lip balm indicate its potential utility in modern lip care applications. Overall, the study demonstrates that beetroot-based herbal formulations can serve as promising multifunctional cosmetic products with improved consumer acceptability, therapeutic value, and sustainability.

Future Perspectives

The growing demand for herbal and sustainable cosmetic products provides significant opportunities for further advancement in phytocosmetic lip care formulations. Future research may focus on improving the long-term stability of natural pigments such as betalains through the use of advanced stabilization techniques and optimized formulation strategies. The incorporation of natural preservatives and encapsulation technologies may further enhance product shelf life and colour retention.

Additional investigations involving quantitative antioxidant analysis, microbial stability studies, dermatological testing, and consumer acceptability assessments may provide stronger scientific validation for commercial applications. Future studies may also explore the incorporation of additional herbal bioactive compounds possessing antimicrobial, anti-inflammatory, UV-protective, and wound-healing properties to enhance the multifunctional performance of the formulation.

Advances in nanotechnology and herbal nanocosmeceuticals may further improve the delivery and stability of plant-derived bioactive compounds in lip care products. Moreover, increasing awareness regarding green cosmetics and environmentally sustainable manufacturing practices is expected to encourage wider adoption of herbal lipstick and lip balm formulations in the cosmetic industry.

The present study therefore provides a foundation for future development of innovative, safe, and therapeutically effective phytocosmetic lip care products based on natural ingredients.

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