

Development and Comparative Evaluation of Natural Pigment-Enriched Polyherbal Therapeutic Lipsticks for Supportive Management of Cheilitis

Dr. Sreevidya Puvvala^{1*}; Dr. M. Sri Rekha¹; Y. Nagasurekha¹; Sk. Rizwana²; Sk. Imran²; M. Venkatesh Naik²

¹Assistant Professor, Department of Pharmaceutics,

²Hindu College of Pharmacy

^{1,2}Guntur, A.P., India

Corresponding Author: Dr. Sreevidya Puvvala*

Publication Date: 2026/07/17

Abstract: Cheilitis is an inflammatory disorder of the lips characterized by dryness, fissuring, erythema, scaling, and susceptibility to microbial infections. Conventional lip care products primarily provide cosmetic benefits and frequently contain synthetic pigments that may induce allergic reactions and irritation. The present study aimed to develop and comparatively evaluate natural pigment-enriched polyherbal therapeutic lipsticks intended for supportive management of cheilitis. Three formulations were prepared using natural pigments obtained from dragon fruit peel, beetroot, and rose petals along with neem oil, betel leaf extract, henna leaf extract, coconut oil, soy wax, vitamin E, and rose oil. Lipsticks were prepared by the fusion molding method and evaluated for organoleptic characteristics, melting point, breaking strength, spreadability, pH, homogeneity, skin irritation, stability, antioxidant activity, and antimicrobial activity. The formulations exhibited satisfactory physicochemical properties and acceptable stability. Beetroot-based formulation demonstrated the highest antioxidant activity ($84.7 \pm 1.5\%$) and antimicrobial activity against *Staphylococcus aureus* and *Candida albicans*. Dragon fruit formulation showed superior stability, whereas rose-based lipstick exhibited the highest sensory acceptability. The findings suggest that natural pigment-based polyherbal lipsticks may serve as multifunctional cosmetic products providing both aesthetic enhancement and therapeutic benefits.

Keywords: Cheilitis, Herbal Lipstick, Natural Pigments, Beetroot, Dragon Fruit Peel, Rose Petals, Antioxidant Activity, Antimicrobial Activity.

How to Cite: Dr. Sreevidya Puvvala; Dr. M. Sri Rekha; Y. Nagasurekha; Sk. Rizwana; Sk. Imran; M. Venkatesh Naik (2026) Development and Comparative Evaluation of Natural Pigment-Enriched Polyherbal Therapeutic Lipsticks for Supportive Management of Cheilitis. *International Journal of Innovative Science and Research Technology*, 11(6), 3641-3646. <https://doi.org/10.38124/ijisrt/26jun2069>

I. INTRODUCTION

The cosmetic industry has experienced a significant shift toward natural and herbal products due to increasing concerns regarding the safety of synthetic ingredients. Lipsticks are among the most commonly used cosmetic preparations worldwide. Apart from enhancing appearance, modern lip products are expected to provide hydration, protection, and therapeutic benefits.

Cheilitis is an inflammatory condition affecting the lips and may result from microbial infection, allergic reactions, environmental exposure, nutritional deficiencies, or immune-mediated disorders [1]. Clinical manifestations include dryness, cracking, pain, erythema, scaling, and ulceration. Persistent inflammation often compromises quality of life and

may predispose individuals to secondary bacterial and fungal infections [2].

Natural pigments have attracted considerable interest as alternatives to synthetic colorants. Beetroot contains betalains, particularly betanin, responsible for its intense red coloration and antioxidant properties [5]. Dragon fruit peel is a rich source of betalains and polyphenolic compounds with significant antioxidant potential [7]. Rose petals contain anthocyanins and flavonoids which impart color and provide antioxidant activity [9].

In addition to natural pigments, medicinal plants such as neem, betel leaf, and henna possess antimicrobial, anti-inflammatory, antioxidant, and wound-healing activities [10–15]. Their incorporation into lipstick formulations may provide therapeutic support for inflammatory lip conditions.

The present work was therefore undertaken to formulate and comparatively evaluate three natural pigment-enriched polyherbal lipsticks intended for supportive management of cheilitis.

II. MATERIALS AND METHODS

The present study was aimed at developing a polyherbal therapeutic lipstick for the supportive management of cheilitis using natural pigments and medicinal plant extracts. The formulation was designed to provide both cosmetic and therapeutic benefits. Natural pigments obtained from beetroot, dragon fruit peel, and rose petals were selected as coloring agents, while betel leaf extract, henna leaf extract, and neem oil were incorporated for their antimicrobial, antioxidant, anti-inflammatory, and wound-healing properties.

Soy wax was used as the structural base to impart hardness and shape retention, whereas coconut oil served as an emollient and moisturizing agent. Vitamin E was incorporated as an antioxidant to improve formulation stability and protect the oils from oxidative degradation.

➤ Extraction of Natural Pigments

• Beetroot Pigment Extraction

Fresh beetroot was washed, sliced, shade dried, and powdered. The powder was extracted with 70% ethanol for 48 h by maceration. The extract was filtered and concentrated using a rotary evaporator.

• Dragon Fruit Peel Pigment Extraction

Dragon fruit peels were washed, shade dried, powdered, and extracted using distilled water at 50°C. The extract was filtered and concentrated.

• Rose Petal Pigment Extraction

Rose petals were shade dried, powdered, and extracted using 70% ethanol. The filtrate was concentrated under reduced pressure.

➤ Extraction of Therapeutic Herbal Extracts

Betel leaves and henna leaves were separately dried, powdered, extracted using hydroalcoholic solvent, filtered, and concentrated.

Three different formulations were developed by varying the pigment source while maintaining a constant therapeutic base.

• Preparation of Polyherbal Lipsticks

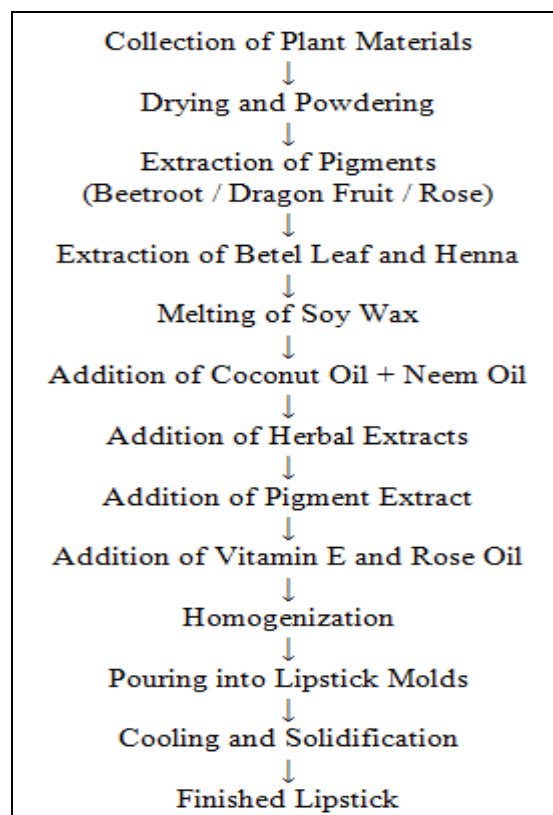


Fig 1 Flowchart for Preparation of Polyherbal Lipsticks

Table 1 Formulation Composition

Ingredient	F1	F2	F3
Soy Wax	20	20	20
Coconut Oil	48.5	48.5	48.5
Neem Oil	4	4	4
Betel Leaf Extract	8	8	8
Henna Leaf Extract	7	7	7
Dragon Fruit Extract	10	-	-
Beetroot Extract	-	10	-
Rose Extract	-	-	10
Vitamin E	2	2	2
Rose Oil	0.5	0.5	0.5

III. RESULTS AND DISCUSSION

The prepared formulations (F1–Dragon Fruit, F2–Beetroot, and F3–Rose) were evaluated for physicochemical characteristics, stability, antioxidant activity, and

antimicrobial activity to determine their suitability for therapeutic application in the supportive management of cheilitis.

➤ Organoleptic Evaluation

Table 2 Organoleptic Evaluation of Formulations

Formulation	Colour	Odor	Texture	Appearance
F1	Pinkish Purple	Pleasant	Smooth	Uniform
F2	Deep Red	Pleasant	Smooth	Uniform
F3	Soft Pink	Pleasant	Smooth	Uniform

All formulations exhibited acceptable organoleptic properties. F1 showed an attractive pinkish-purple color due to the presence of dragon fruit peel betalains. F2 exhibited a deep red color attributed to beetroot betanin pigments, whereas F3 produced a soft pink shade due to anthocyanins present in rose petals. All formulations possessed a pleasant

odor because of rose oil and demonstrated smooth texture with uniform appearance, indicating successful incorporation of pigments and herbal ingredients.

➤ *Melting Point*

Table 3 Melting Point of Formulations

Formulation	Melting Point (°C)
F1	64.2 ± 0.4
F2	63.8 ± 0.5
F3	64.5 ± 0.3

The melting points of all formulations were within the acceptable range for lipsticks (55–75°C). The presence of soy wax contributed significantly to structural stability. No significant variation was observed among formulations, indicating that the type of pigment used did not substantially

affect thermal behavior. The melting points suggest adequate resistance to softening during storage and handling.

➤ *Breaking Strength*

Table 4 Breaking Strength of Formulations

Formulation	Breaking Strength (g)
F1	162 ± 3
F2	158 ± 4
F3	165 ± 2

All formulations demonstrated satisfactory mechanical strength. F3 showed slightly higher breaking strength, possibly due to better compatibility of rose extract with the wax-oil matrix. The results indicate that the lipsticks possess

sufficient hardness to withstand routine application without breakage.

➤ *Spreadability*

Table 5 Spreadability of Formulations

Formulation	Observation
F1	Excellent
F2	Good
F3	Excellent

The presence of coconut oil provided adequate lubrication and smooth application. F1 and F3 exhibited excellent spreadability, whereas F2 showed slightly greater drag due to the higher concentration of beetroot pigments.

Overall, all formulations demonstrated satisfactory application characteristics.

➤ *Surface Anomalies*

Table 6 Surface Anomalies of Formulations

Parameter	F1	F2	F3
Cracks	Absent	Absent	Absent
Sweating	Absent	Slight	Absent
Crystal Formation	Absent	Absent	Absent
Air Bubbles	Absent	Absent	Absent

No major surface defects were observed. Slight sweating in F2 may be attributed to the hygroscopic nature of beetroot extract. The absence of cracks, crystal formation,

and air bubbles confirms good formulation stability and proper processing conditions.

➤ *pH Determination*

Table 7 pH Determination of Formulations

Formulation	pH
F1	6.3 ± 0.1
F2	6.2 ± 0.2
F3	6.4 ± 0.1

The pH values of all formulations were close to the physiological pH of the skin and lips. These values suggest that the formulations are unlikely to cause irritation and are suitable for topical application.

➤ *Homogeneity*

Table 8 Homogeneity of Formulations

Formulation	Homogeneity
F1	Uniform
F2	Uniform
F3	Uniform

All formulations showed uniform distribution of pigments and herbal extracts without visible lumps or phase separation. This indicates effective mixing during formulation development.

➤ *Skin Irritation Study*

Table 9 Skin Irritation Study of Formulations

Formulation	Irritation Response
F1	No irritation
F2	No irritation
F3	No irritation

No signs of redness, itching, burning, or swelling were observed following application. The results suggest that the formulations are dermatologically acceptable and safe for external use.

➤ *Ease of Removal*

Table 10 Ease of Removal of Formulations

Formulation	Ease of Removal
F1	Easy
F2	Moderate
F3	Easy

F1 and F3 were easily removed using cotton and coconut oil, whereas F2 required slightly greater effort due to stronger pigment retention. Adequate removability is important for user convenience and product acceptability.

➤ *Antimicrobial Activity*

Table 11 Zone of Inhibition (mm) of Formulations

Formulation	<i>Staphylococcus aureus</i>	<i>Candida albicans</i>
F1	17.2 ± 0.4	15.6 ± 0.3
F2	18.5 ± 0.5	16.4 ± 0.4
F3	15.8 ± 0.3	14.1 ± 0.2

All formulations exhibited antimicrobial activity against both test organisms. F2 showed the highest inhibition, followed by F1 and F3. The antimicrobial activity can be attributed to neem oil, betel leaf extract, and henna extract. The results indicate the potential usefulness of these

formulations in preventing secondary microbial infections associated with cheilitis.

➤ *Antioxidant Activity*

Table 12 Antioxidant Activity of Formulations

Formulation	% DPPH Inhibition
F1	78.4 ± 1.2
F2	84.7 ± 1.5
F3	72.6 ± 1.3

F2 exhibited the highest antioxidant activity due to the high concentration of betalains and phenolic compounds present in beetroot. F1 also demonstrated strong antioxidant activity because of betalains present in dragon fruit peel. F3 showed comparatively lower antioxidant activity, although it remained significant due to the presence of anthocyanins and

flavonoids. The superior antioxidant activity of F2 may help reduce oxidative stress associated with lip inflammation and tissue damage.

➤ Stability Study

Table 13 Stability Study of Formulations

Parameter	F1	F2	F3
Color Stability	Excellent	Good	Good
Odor Stability	Excellent	Excellent	Excellent
Sweating	Absent	Slight	Absent
Cracking	Absent	Absent	Absent

F1 exhibited superior stability, likely due to the higher stability of betalain pigments from dragon fruit peel. F2 showed minor color fading and slight sweating under accelerated conditions. F3 maintained acceptable stability throughout the study period. Overall, all formulations remained physically stable.

IV. SUMMARY AND CONCLUSION

The present study was undertaken to develop and evaluate natural pigment-enriched polyherbal therapeutic lipsticks intended for the supportive management of cheilitis. Three lipstick formulations were prepared using natural pigments extracted from dragon fruit peel (F1), beetroot (F2), and rose petals (F3), along with medicinal herbal ingredients such as neem oil, betel leaf extract, and henna leaf extract. Soy wax and coconut oil were utilized as natural base materials to provide desirable consistency, stability, and moisturizing properties.

The formulated lipsticks were evaluated for various physicochemical parameters including organoleptic characteristics, melting point, breaking strength, spreadability, homogeneity, pH, skin irritation, and stability. In addition, biological activities such as antioxidant and antimicrobial properties were assessed to determine their therapeutic potential. All formulations exhibited satisfactory physicochemical characteristics with smooth texture, uniform appearance, acceptable melting point, adequate mechanical strength, and good spreadability. The pH values were found to be compatible with lip tissue, and no signs of irritation were observed during skin compatibility studies.

Among the formulations, F2 containing beetroot extract demonstrated the highest antioxidant activity and antimicrobial efficacy against *Staphylococcus aureus* and *Candida albicans*. F1 containing dragon fruit peel extract showed superior physical stability throughout the storage period, while F3 containing rose petal extract exhibited excellent sensory characteristics and consumer acceptability. The enhanced biological activities observed in the formulations may be attributed to the synergistic effects of natural pigments and herbal extracts possessing antioxidant, antimicrobial, anti-inflammatory, and wound-healing properties.

In conclusion, the developed polyherbal therapeutic lipsticks successfully combined cosmetic appeal with functional therapeutic benefits. The study demonstrated that natural pigments can effectively replace synthetic colorants while providing additional health-promoting properties. Among the tested formulations, the beetroot-based lipstick (F2) emerged as the optimized formulation owing to its superior antioxidant and antimicrobial activities, making it a promising candidate for supportive management of cheilitis. The findings suggest that natural pigment-enriched polyherbal lipsticks represent a safe, eco-friendly, and multifunctional alternative to conventional lipsticks and have significant potential for further clinical evaluation and commercial development.

REFERENCES

- [1]. Lugović-Mihić L, Blagec T, Japundžić I, Skroza N. Cheilitis: A comprehensive review. *Acta Dermatovenerol Croat*. 2018;26(2):136-142.
- [2]. Neville BW, Damm DD, Allen CM, Chi AC. *Oral and Maxillofacial Pathology*. 4th ed. St. Louis: Elsevier; 2016.
- [3]. Sharma PP. *Cosmetics: Formulation, Manufacturing and Quality Control*. 5th ed. New Delhi: Vandana Publications; 2018.
- [4]. Barel AO, Paye M, Maibach HI, editors. *Handbook of Cosmetic Science and Technology*. 4th ed. Boca Raton: CRC Press; 2014.
- [5]. Cai Y, Sun M, Corke H. Antioxidant activity of betalains from plants of the Amaranthaceae. *J Agric Food Chem*. 2003;51(8):2288-2294.
- [6]. Kanner J, Harel S, Granit R. Betalains as natural antioxidants. *J Agric Food Chem*. 2001;49(11):5178-5185.
- [7]. Nurliyana R, Syed ZI, Mustapha SK, Aisyah MR, Kamarul RK. Antioxidant study of pulps and peels of dragon fruits: A comparative study. *Int Food Res J*. 2010;17(2):367-375.
- [8]. Rebecca OPS, Boyce AN, Chandran S. Pigment identification and antioxidant properties of red dragon fruit (*Hylocereus polyrhizus*). *Afr J Biotechnol*. 2010;9(10):1450-1454.
- [9]. Kähkönen MP, Hopia AI, Vuorela HJ, Rauha JP, Pihlaja K, Kujala TS, et al. Antioxidant activity of plant extracts containing phenolic compounds. *J Agric Food Chem*. 1999;47(10):3954-3962.

- [10]. Biswas K, Chattopadhyay I, Banerjee RK, Bandyopadhyay U. Biological activities and medicinal properties of neem (*Azadirachta indica*). *Curr Sci*. 2002;82(11):1336-1345.
- [11]. Subapriya R, Nagini S. Medicinal properties of neem leaves: A review. *Curr Med Chem Anticancer Agents*. 2005;5(2):149-156.
- [12]. Prabhu S, Jainu M, Devi CS. Antimicrobial activity of *Piper betle* leaf extracts against pathogenic microorganisms. *J Ethnopharmacol*. 2009;121(3):438-442.
- [13]. Arambewela LSR, Arawwawala LDAM, Ratnasooriya WD. Antidiabetic activities of aqueous and ethanolic extracts of *Piper betle* leaves. *J Ethnopharmacol*. 2005;102(2):239-245.
- [14]. Ali BH, Al-Wabel N, Blunden G. Phytochemical, pharmacological and toxicological aspects of *Lawsonia inermis* L.: A review. *Phytother Res*. 2008;22(11):1431-1437.
- [15]. Singh M, Kumar V. Wound healing activity of *Lawsonia inermis* leaf extracts. *Int J Pharm Sci Res*. 2011;2(5):1234-1238.
- [16]. Brand-Williams W, Cuvelier ME, Berset C. Use of a free radical method to evaluate antioxidant activity. *LWT Food Sci Technol*. 1995;28(1):25-30.