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Herbal Lip Balm Containing Beetroot and Aloe Vera: A Review of Formulation and Evaluation

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Abstract: *Dry, chapped lips are a frequent complaint, and lip balm is a simple wax-based product that coats the lips with a protective layer and limits moisture loss. Because many commercial balms rely on synthetic colours, fragrances, preservatives and petroleum-derived bases, herbal substitutes are receiving growing attention. This review focuses on lip balms made with beetroot (Beta vulgaris), a source of red colour and antioxidant betalains, and aloe vera (Aloe barbadensis Miller), valued for its moisturising and soothing action. It outlines the composition of lip balms, the preparation techniques with emphasis on fusion followed by moulding, the processing of beetroot extract and aloe vera powder, a representative formula with increasing beetroot levels alongside a herb-free control base, and the evaluation tests: appearance, pH, melting point, breaking point, spreadability, DPPH antioxidant activity, skin irritation and stability at 4, 25 and 40 °C. Eight published studies are examined. Their reported melting points lie between 50 and 73 °C, and they indicate that heat softens the balm whereas cold storage leads to fat bloom. To the authors' knowledge, no study has combined beetroot and aloe vera in a single anhydrous base, and this gap is highlighted.*

Keywords: Lip balm, Herbal, Beetroot, Aloe vera, Fusion method, Evaluation, Stability.

I. INTRODUCTION

Herbal cosmetics and cosmeceuticals use plant-derived materials for their colour, fragrance, moisturising, antioxidant and protective qualities. Their appeal lies in the ready availability and low cost of botanicals, which are also generally regarded as gentler than synthetic additives. In lip care, natural pigments, plant extracts and vegetable oils are increasingly replacing synthetic dyes, fragrances and mineral-oil bases.[1,2,3]

Lip skin is thin and contains very few sebaceous glands, so moisture escapes quickly and the lips readily turn dry, cracked and chapped, especially in dry, windy or sunny conditions. A lip balm is a waxy semi-solid preparation applied to the lips to leave a protective film that limits water loss and softens the skin. It therefore serves both as a cosmetic and as a simple supportive product for dry or chapped lips.[4,5]

Herbal Ingredients Commonly Studied

Beetroot (Beta vulgaris) and aloe vera (Aloe barbadensis Miller) are two herbal ingredients that have been investigated for lip care. Beetroot contributes a natural red colour together with antioxidant activity, whereas aloe vera gel provides a moisturising and soothing effect.[2,3,6]

Table: Profile of Beetroot and Aloe Vera[2,3,6]

Attribute	Beetroot	Aloe vera
Botanical source	*Beta vulgaris* L., root	*Aloe barbadensis* Miller, leaf gel
Family	Amaranthaceae	Asphodelaceae
Part used	Root	Inner leaf gel (mucilaginous pulp)
Main constituents	Betalains (betacyanins such as betanin; betaxanthins), plus phenolic compounds and flavonoids	Polysaccharides such as acemannan, with vitamins, amino acids, enzymes and minerals

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Attribute	Beetroot	Aloe vera
Role in lip balm	Provides natural red colour and antioxidant action	Provides moisturising and soothing action
Points to note	The pigment is affected by heat, light and pH, so it is added once the base has cooled	The water-rich gel does not mix with a wax base, so dried gel powder is used, and the yellow latex (aloin) is washed off

Herbal Lip Balm as a Dosage Form

A lip balm is an anhydrous, waxy, semi-solid product composed of waxes, which provide structure and set the melting point; butters and oils, which add softness, gloss and spreadability; and active, colouring, flavouring and antioxidant components.[5,7] An acceptable balm is smooth and uniform, glides on with light pressure, melts at lip temperature but stays solid in warm weather, is firm enough to resist breaking during use, has a pleasant taste and smell, and does not irritate.[1,4,5]

Table: Typical Composition of a Lip Balm[5,7]

Component	Typical amount	Examples
Waxes	15 – 30% w/w	Beeswax, carnauba wax, candelilla wax
Butters	10 – 25% w/w	Cocoa butter, shea butter
Liquid oils	30 – 50% w/w	Castor oil, coconut oil, sweet almond oil
Herbal active / colour	1 – 10% w/w	Herbal powders, extracts, natural pigments
Humectant	2 – 5% w/w	Glycerin
Antioxidant	0.05 – 1% w/w	Vitamin E, butylated hydroxytoluene
Flavour	0.5 – 1% w/w	Peppermint, orange or vanilla flavour

Several methods can be used to prepare lip balms, as listed below. In laboratory work the fusion method followed by moulding is used most often, because it requires only simple equipment and no solvent in the base.[1,4]

Table: Methods of Preparing Lip Balms[1,4,7]

Method	Principle	Remarks
Fusion (melt and mix)	Waxes, butters and oils are melted together and the remaining ingredients are blended in	The most straightforward method, well suited to laboratory scale
Hot moulding	The molten mass is poured into stick moulds or tubes and left to solidify on cooling	Produces sticks of uniform shape
Cold addition of heat-sensitive ingredients	Heat-sensitive herbs and flavours are mixed in after the base has cooled to about 45 to 50 °C	Preserves pigments and volatile oils
Roller milling and plodding	Pigments are milled into the base and the mass is then extruded into sticks	Industrial method requiring specialised equipment

Advantages and Limitations

Table: Advantages and Limitations of Herbal Lip Balm[1,2,4]

Advantages	Limitations
Leaves an occlusive protective film that limits moisture loss and softens dry or chapped lips	Oils and butters can turn rancid during storage, so an antioxidant is required
Portable and easy to apply without water	Affected by heat (softening and sweating) and by cold (white fat bloom)

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Advantages	Limitations
Natural colour and antioxidant benefits from the herbal ingredients	Natural pigments may fade or change shade with light, heat and pH
Inexpensive and easy to make on a small scale with common equipment	Botanical ingredients or beeswax may provoke allergy in sensitive individuals
No synthetic dyes or fragrances, hence a lower risk of irritation	Quality and colour can differ with the source and extraction of the herbal material

Applications

Prevention and relief of dry or chapped lips caused by weather, wind or sun exposure.
Natural lip tint or colour as an alternative to synthetic lipsticks.
Carrier for herbal actives with moisturising, soothing or antioxidant properties.[1,3,6]
Everyday lip care for both children and adults.

Conventional and Herbal Lip Balms

Many commercial lip balms contain synthetic dyes, fragrances and preservatives that can irritate sensitive lips. Their petroleum-derived bases, such as petrolatum and mineral oil, are not biodegradable and act only as an occlusive barrier without adding any herbal benefit. The two types are compared in the table below.

Table: Comparison of Conventional and Herbal Lip Balms

Feature	Conventional lip balm	Herbal lip balm
Colour	Synthetic dyes	Natural pigments such as beetroot
Base	Often petrolatum or mineral oil	Waxes, butters and plant oils
Added benefit	Mainly an occlusive effect	Moisturising and antioxidant effects from the herbs
Safety	Synthetic additives may cause irritation	Usually mild, though allergy to botanicals can occur
Consistency	Consistent from batch to batch	May vary with source and method of extraction
Stability	Good, supported by synthetic preservatives	Requires an antioxidant and stability testing

II. LITERATURE REVIEW

The studies below describe the formulation and evaluation of lip balms and lip tints prepared with natural ingredients.

Organic and Herbal Lip Balms

In the work of Fernandes et al., an organic lip balm was made with about 95% certified organic material (cocoa butter, carnauba wax, palm butter and sweet almond oil), the balance being soy lecithin, benzoic acid and vitamin E. Over 90 days, samples held at room temperature, at 40 °C and under refrigeration were checked for colour, odour, appearance, spreadability and melting point. Melting point (about 72.9 ± 1.7 °C) and odour were unchanged throughout. Room-temperature and refrigerated samples retained good spreadability but showed fat bloom, while the 40 °C samples became softer and darker.[4]

Jadhav et al. made an organic lip balm from natural materials, including ghee and honey, and examined its organoleptic characters, melting point, spreadability and pH. Stability was followed for 30 days at room temperature, under refrigeration and in an oven. The balm remained uniform at room temperature and in the refrigerator, with a mean melting point of 69 °C and a mean pH of 7.2; storage in the oven was not recommended.[8]

Reddy developed eight lip balm batches (F1 to F8) on a beeswax base, using shea and cocoa butters as emollients, coconut and almond oils as moisturisers, glycerin, orange oil as flavour and turmeric as colourant. The batches were

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tested for pH, skin irritation, perfume stability, spreadability, melting point and breaking point. Values of 6.2 to 6.5 for pH, 60 to 66 °C for melting point and 28 to 32 g for breaking point were recorded, and F8 was chosen as the optimum batch.[5]

Visht et al. replaced synthetic dyes in herbal lip balms with natural pigments obtained from Opuntia fruit, Curcuma longa, Nyctanthes arbor-tristis flowers, Centaurea orientalis flowers and carotene. Ten batches were made by the fusion method and checked for pH, melting and softening points, texture, ageing stability, perfume retention and skin irritation. Every batch showed smooth texture, no surface defects, stable ageing behaviour and good perfume retention, and none caused skin irritation.[1]

Lip Balms with Beetroot, Okra and Aloe Vera

Yulyana et al. incorporated ethanolic okra fruit extract at 1, 3 and 5% into lip balms and assessed organoleptic properties, homogeneity, pH, melting point, spreadability, stability over 28 days at room temperature and DPPH antioxidant activity. The extract alone gave an IC50 of 10.06 µg/mL, while the finished balms were less active (IC50 30.23 to 46.35 µg/mL). The pH and melting point conformed to the SNI standard.[9]

Hadi et al. prepared an ethanolic extract of beetroot (Beta vulgaris L.), tested it for flavonoids, saponins, tannins and alkaloids, and incorporated it into lip balms at 0, 5, 10 and 15%. The balms were semi-solid with a cacao aroma and were homogeneous; their red colour intensified as the extract level rose, the pH was about 9 and adhesion exceeded 4 seconds. Spreadability, however, did not reach the minimum standard, and the panel favoured the 10% formulation.[2]

Bansod et al. described a herbal lip tint built on glycerin, vitamin E and beeswax, with strawberry and beetroot powders as colourants, together with castor oil, tea tree oil and coconut oil. Evaluation included texture, spreadability, melting point, hydration, effect on chapped lips, user satisfaction and stability under varied conditions.[3]

Yanti et al. prepared lip balms containing aloe vera gel and examined their physical stability and sensory quality. The products had a stable semi-solid texture, uniform colour and aroma, even mixing, a skin-compatible pH and a melting point of 50 °C, and the panelists' hedonic scores were acceptable.[6]

Table: Summary of the Lip Balm Studies Reviewed[1,2,3,4,5,6,8,9]

Herbal / special ingredient	Study	Base / system	Main points examined
Cocoa butter, carnauba wax, almond oil	Fernandes 2013	Organic lip balm	Stability at three temperatures
Ghee and honey	Jadhav 2019	Organic lip balm	Melting point, pH, stability
Turmeric	Reddy 2024	Beeswax with butters and oils	pH, melting and breaking point, irritation
Herbal pigments	Visht 2024	Wax base, fusion method	Texture, stability, irritation
Okra extract	Yulyana 2024	Lip balm	pH, melting point, DPPH, stability
Beetroot extract	Hadi 2025	Lip balm	Spreadability, pH, adhesion, preference
Beetroot and strawberry powders	Bansod 2025	Lip tint	Spreadability, melting point, stability
Aloe vera gel	Yanti 2025	Lip balm	Stability and sensory quality

Observations from the Literature

Three observations emerge from these studies. First, reported melting points of 50 to 73 °C and breaking points of about 28 to 32 g indicate the range generally considered acceptable for lip balms.[4,5,6,8,9] Second, storage at 40 °C softened and darkened the balms and cold storage caused fat bloom, so stability should be assessed at more than one

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temperature.[4,8] Third, the beetroot balm showed spreadability below the standard minimum,[2] indicating that the wax and oil proportions need adjustment.

Gap in the Literature

The studies above examined beetroot, aloe vera, okra, turmeric and other pigments individually, using different bases and different tests. To the authors' knowledge, none combined beetroot (colour and antioxidant) with aloe vera (moisturising) in a single anhydrous base, compared graded beetroot levels against a control base, and assessed antioxidant activity, skin irritation and stability at three temperatures within the same study.

Formulation of Herbal Lip Balm

Materials Used

Table: Materials Commonly Used for a Herbal Lip Balm[1,5,7]

No.	Material	Role / use
1	Beetroot (Beta vulgaris) root	Natural colourant and antioxidant
2	Aloe vera (Aloe barbadensis) leaf gel	Moisturising and soothing agent
3	Beeswax	Wax that provides structure
4	Carnauba wax	Hard wax that raises melting point and gloss
5	Cocoa butter	Emollient that adds firmness
6	Coconut oil; sweet almond oil	Emollient oils that aid spreadability
7	Castor oil	Vehicle that adds gloss and disperses the herbal powders
8	Glycerin	Humectant
9	Vitamin E (tocopherol); butylated hydroxytoluene	Antioxidants
10	Peppermint oil / flavour	Flavour and fragrance

Preparation of Beetroot Extract and Aloe Vera Powder

Fresh beetroot and aloe vera leaves are collected from a dependable source, authenticated by a botanist and cleaned of extraneous matter. Beetroot is washed, sliced, dried in a hot air oven at 40 to 50 °C, powdered and passed through sieve no. 80. The powder is macerated in 70% ethanol (1 part to 10 parts) for 24 to 48 hours with intermittent shaking, filtered, concentrated on a water bath at not more than 50 °C and dried. For aloe vera, the leaves are washed to remove the yellow latex, the gel is scraped out, dried at 45 to 50 °C and powdered. The percentage yield is calculated, and both materials are stored in airtight containers protected from light.[2,6]

Preparation of the Lip Balm

The lip balms are prepared by fusion followed by moulding. Waxes and butter are melted at 70 to 75 °C and the oils are mixed in. After the mass has cooled to about 50 °C, the herbal powders dispersed in castor oil are added along with glycerin, vitamin E, BHT and flavour. The mixture is stirred, poured into moulds and allowed to set by cooling.[1,4] A representative 100 g batch formula, with beetroot at three levels and a herb-free control base, is given below; the quantities are indicative and are adjusted after preliminary trials.

Table: Typical Formulation of Herbal Lip Balm (% w/w)[5,7]

Ingredient	F1	F2	F3	F4	Function
Beetroot extract / powder	2	5	8	–	Colour, antioxidant
Aloe vera powder	2	2	2	–	Moisturising
Beeswax	18	18	18	18	Wax
Carnauba wax	3	3	3	3	Hard wax

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Ingredient	F1	F2	F3	F4	Function
Cocoa butter	15	15	15	15	Emollient
Coconut oil	15	15	15	15	Emollient oil
Sweet almond oil	15	15	15	15	Emollient oil
Glycerin	3	3	3	3	Humectant
Vitamin E	0.5	0.5	0.5	0.5	Antioxidant
BHT	0.05	0.05	0.05	0.05	Antioxidant
Peppermint oil	0.5	0.5	0.5	0.5	Flavour
Castor oil	q.s. to 100	q.s. to 100	q.s. to 100	q.s. to 100	Vehicle

F4 is the control batch, which contains the base alone.

Characterisation of Herbal Materials

Table: Characterisation and Pre-formulation Studies of the Herbal Materials[7]

Study	Method
Organoleptic properties	Colour, odour, taste and appearance observed by eye
Solubility	Solubility in water, ethanol, castor oil and coconut oil
pH	pH of a 1% w/v dispersion read on a calibrated pH meter
Loss on drying	Sample heated at 105 °C until constant weight is reached
Phytochemical tests	Betalains by sodium hydroxide test; flavonoids by Shinoda test; phenols by ferric chloride test; saponins by foam test; carbohydrates by Molisch's test
Compatibility	FTIR spectra of the herbal materials, the base and their mixtures
Preliminary trials	Wax-to-oil ratio varied to obtain suitable firmness and spreadability

Evaluation of Lip Balm

Lip balms are assessed for physical quality, safety and stability. The usual tests and their methods are listed below.[1,4,5,9]

Table: Evaluation Parameters of Lip Balm[1,4,5,9]

Parameter	Method
Appearance and surface anomalies	Colour, odour, texture, homogeneity, cracks, bloom and sweating checked by visual inspection
pH	1 g of balm is melted and dispersed in 10 mL warm distilled water, cooled, and the pH is measured
Melting point	Sample filled in a capillary tube and heated gradually in a melting point apparatus; the temperature at which it melts completely is recorded
Breaking point	Stick held horizontally at a set length while weight is added in increments until it snaps
Spreadability and force of application	Stick drawn across a surface under a fixed load, noting time and distance; the weight needed to leave a uniform mark is also recorded
Antioxidant activity (DPPH)	Balm extract is mixed with methanolic DPPH solution, kept in the dark for 30 min and read at 517 nm, with ascorbic acid as the standard
Skin irritation test	Patch test on healthy volunteers after ethics approval and informed consent; erythema and oedema are scored at 24 and 48 h
Stability study	Balms are stored at 4 ± 2, 25 ± 3 and 40 ± 2 °C for 30 days, and appearance, melting point, pH and spreadability are examined at 0, 15 and 30 days

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Calculations

Table: Formulae Used in the Evaluation

Parameter	Formula
Percentage yield	(Weight of dried extract or powder / weight of starting material) × 100
Loss on drying (%)	[(Initial weight − final weight) / initial weight] × 100
Spreadability	(M × L) / T, where M = weight applied, L = distance spread and T = time taken
Breaking point	Weight (g) at which the stick breaks
% DPPH scavenging	[(Ac − As) / Ac] × 100, where Ac = absorbance of control and As = absorbance of sample

Stability Studies

Stability is checked at 4, 25 and 40 °C because the literature reports softening and darkening at high temperature and fat bloom in the cold.[4,8] Testing conditions follow the guideline of the International Council for Harmonisation.[10] All results are taken in triplicate and expressed as mean ± standard deviation, and one-way ANOVA with $p < 0.05$ is considered significant.

III. CONCLUSION

Dry and chapped lips are a common problem, and many commercial lip balms contain synthetic dyes, fragrances and petroleum-derived bases. The reviewed studies indicate that balms made from waxes, butters and oils with natural pigments and herbal extracts can offer an attractive colour, a melting point of about 50 to 73 °C, good spreadability and acceptable stability, without reported skin irritation. Beetroot provides natural colour and antioxidant activity and aloe vera a moisturising effect; however, to the authors' knowledge, no report combines the two in one base while evaluating antioxidant activity, irritation and stability at three temperatures together.

Most of the reviewed work is laboratory based and includes no clinical studies, so the healing effect on chapped lips remains unconfirmed. Future work could explore other herbs, sun protection, shade optimisation and clinical comparison with marketed products.

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