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A comprehensive review on potential of natural ingredients in formulation of herbal lipsticks

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Abstract

Natural ingredients are the main components of herbal lipsticks, which are cosmetic products that offer color, texture, and protection to the lips. These products are becoming more popular among consumers who want to avoid synthetic lipsticks that may have harmful chemicals and cause negative effects such as allergy, dermatitis, skin discoloration, and lip dryness. This review article provides a detailed overview of the natural ingredients used in herbal lipsticks, including beeswax, castor oil, coconut oil, olive oil, rose oil, *etc*., and natural colorants from plants, fruits, and spices. It also covers the aspects of formulation, evaluation, and quality control of herbal lipsticks, as well as the benefits and challenges of using natural ingredients in cosmetics. The review suggests that herbal lipsticks have a great potential to satisfy the increasing demand for natural and organic cosmetics. Still, they need more research and development to enhance their stability, performance, and consumer acceptance.

1. Introduction

The Greek term 'kosmetikos' means 'technique of dress and ornament'. Cosmetics are made up of a blend of chemical substances that come from either synthetic or naturally occurring sources. In the United States, cosmetics fall under the regulatory purview of the Food and Drug Administration (FDA). According to the FDA's definition, cosmetics are products designed for application to the human body with the purpose of cleansing, enhancing beauty, promoting attractiveness, or modifying appearance without exerting any impact on the body's structure or functions (Watts, 2010). The FDA specifically excludes pure soap from this category, although this wide definition covers any substance meant to be used as an ingredient in a cosmetic product. In modern times, cosmetics encompass a wide range of products, including makeup, skincare items, hair care products, perfumes, and more (Figure 1). Herbal cosmetics are beauty and skincare products that utilize natural ingredients derived from plants, herbs, and botanical sources. Herbal cosmetics are often perceived as a gentler option for individuals with sensitive skin or those seeking a more holistic approach to beauty. As consumers become more conscious of the products they use, herbal cosmetics continue to carve a niche for themselves in the market (Mesko *et al*., 2020; Vaidya *et al*., 2023).

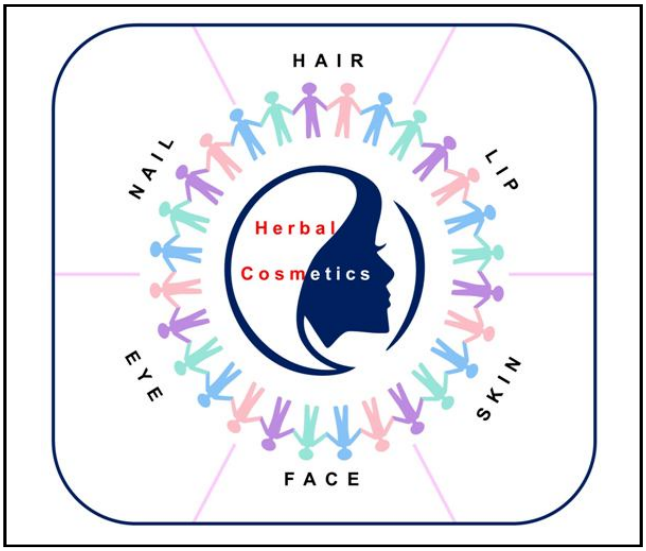

Figure 1: Types of herbal cosmetic formulations.

Lipstick is one of the most popular and widely used cosmetic products among women of all ages and cultures. Lipstick not only enhances the appearance and attractiveness of the lips but also provides protection and nourishment for the lips. However, most of the commercially available lipsticks are made from synthetic ingredients, such as petroleum-derived chemicals, synthetic dyes, fragrances, preservatives, and additives, which may have adverse effects on the health and safety of the users and the environment. Some of these ingredients are carcinogenic, endocrine-disrupting, or bioaccumulative, meaning that they may cause cancer, hormonal imbalance, or environmental damage (Rasheed *et al.*, 2020; Mawazi *et al.*, 2022). Moreover, some users may experience allergic reactions,

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irritation, or infection due to the use of synthetic lipsticks (Sunil *et al.*, 2013). Therefore, there is a growing demand and interest in natural, organic, or herbal lipsticks, which are made from natural ingredients, such as plant extracts, oils, waxes, pigments, and minerals. Herbal lipsticks are considered to be safer, eco-friendly, and more beneficial for the lips, as they do not contain any toxic or harmful ingredients. Herbal lipsticks provide nourishment and hydration to the lips, as they contain natural oils, waxes, and butter that moisturize and soften the lips (Ghongade *et al.*, 2021). However, herbal lipsticks also face some challenges and limitations, such as higher cost, lower availability, shorter shelf-life, less variety, and lower effectiveness compared to synthetic lipsticks (Chaudhari *et al.*, 2018; Malvandi and Sancholi, 2018; Harshad and Wankhade, 2019). Such a review would provide valuable information and insights for the researchers, manufacturers, and consumers of herbal lipsticks, and would also identify the gaps and opportunities for future research and development of herbal lipsticks.

2. Objectives and scope

The main objective of this review is to provide a comprehensive and systematic overview of the literature on herbal lipsticks, focusing on the following aspects:

- The various natural ingredients that are used in the formulation of herbal lipsticks, such as plant extracts, oils, waxes, pigments, and minerals, and their properties and benefits for the lips, such as moisturizing, healing, coloring, antioxidants, anti-inflammatory, *etc*.
- The different methods and techniques that are used in the preparation and evaluation of herbal lipsticks and the various parameters and methods of evaluation, such as color, texture, pH, melting point, breaking point, surface anomalies, ageing, perfume stability, *etc*.
- The comparison and contrast of the advantages and disadvantages of herbal lipsticks with synthetic lipsticks, such as safety, efficacy, quality, cost, availability, consumer preference, *etc*., and the challenges and limitations of herbal lipsticks, such as stability, shelf-life, standardization, regulation, *etc*. The literature search and selection were conducted using relevant keywords, titles, authors, or other criteria, and the articles were screened and assessed for their quality and relevance. The data extraction and synthesis were performed using a narrative approach, and the results were presented and discussed logically and coherently.

3. Herbal lipstick versus synthetic lipstick: A comparison

Herbal lipstick and synthetic lipstick are two types of lipstick that differ in their ingredients, benefits, and drawbacks. Herbal lipstick is made from natural ingredients that nourish, protect, and beautify the lips, while synthetic lipstick is made from artificial ingredients that provide a wide range of colors, finishes, and effects to the lips. However, herbal lipstick is more expensive, less available, and less effective than synthetic lipstick, while synthetic lipstick may cause dryness, irritation, and toxicity to the lips and the environment (Pavani *et al.*, 2019). Therefore, the choice of lipstick depends on the preferences, needs, and values of the individual. Some users may prefer herbal lipstick for its safety, eco-friendliness, and natural ingredients. On the other hand, synthetic lipstick is favoured by many for its affordability, accessibility, and effectiveness (Yang *et al.*, 2011). Yet, it is recommended that users always read the labels, ingredients, and reviews of the lipstick before buying or using it, and avoid any lipstick that contains harmful or questionable ingredients. Users should also take good care of their lips by applying lip balm, exfoliating, and hydrating them regularly, regardless of the type of lipstick they use.

3.1 Definition and ingredients

Herbal lipstick is a type of lipstick that is made from natural ingredients, such as plant extracts, oils, waxes, pigments, and minerals. It is also known as natural, organic, or eco-friendly lipstick. Whereas, synthetic lipstick is a type of lipstick that is made from artificial ingredients, such as petroleum-derived chemicals, synthetic dyes, fragrances, preservatives, and additives. Synthetic lipstick may also contain some natural ingredients, such as beeswax, lanolin, or carmine, but they are not the main components. Synthetic lipstick is also known as conventional, regular, or traditional lipstick (Gediya *et al.,* 2011).

3.1.1 Benefits and drawbacks

Herbal lipstick has several benefits for the lips and the health of the user. Some of the benefits are:

- Herbal lipstick provides nourishment and hydration to the lips, as it contains natural oils, waxes, and butter that moisturize and soften the lips.
- Herbal lipstick protects the lips from environmental damage, such as sun exposure, wind, and pollution, as it contains natural antioxidants, anti-inflammatory, and healing agents that prevent and repair lip damage.
- Herbal lipstick enhances the natural beauty of the lips, as it contains natural pigments and minerals that give an aesthetic and natural color to the lips, without clogging the pores or drying the lips.
- Herbal lipstick is safe and eco-friendly, as it does not contain any toxic or harmful ingredients that may cause allergic reactions, irritation, or health problems. Herbal lipstick is also biodegradable and cruelty-free, as it does not harm animals or the environment (Azwanida *et al.,* 2015).

However, herbal lipstick also has some drawbacks that may limit its use and popularity. The drawbacks are:

- Herbal lipstick is more expensive than synthetic lipstick, as it requires more time, effort, and resources to produce and package.
- Herbal lipstick also has a shorter shelf-life, as it does not contain any preservatives or stabilizers that extend its durability.
- Herbal lipstick is less available than synthetic lipstick, as it is not widely distributed or marketed.
- Herbal lipstick may also have less variety and consistency, as it depends on the availability and quality of the natural ingredients.
- Herbal lipstick is less effective than synthetic lipstick, as it may not provide the same level of coverage, intensity, or longevity as synthetic lipstick.
- Herbal lipstick may also fade or smudge more easily, as it is not resistant to heat, moisture, or friction (Harshad and Wankhade, 2019; Poomanee *et al.*, 2021).

Similarly, synthetic lipsticks also have several benefits and drawbacks for the lips. The benefits are:

- Synthetic lipstick provides a wide range of colors, finishes, and effects to the lips, as it contains synthetic dyes and additives that create a diverse and vibrant palette of lipstick shades and styles.
- Synthetic lipstick provides a long-lasting and flawless performance to the lips, as it contains synthetic ingredients that make the lipstick more stable, durable, and resistant to external factors, such as heat, moisture, or friction.
- Synthetic lipstick is more affordable and accessible than herbal lipstick, as it is cheaper and easier to produce and package. Synthetic lipstick also has a longer shelf-life, as it contains preservatives and stabilizers that prevent it from spoiling or deteriorating (Niederer *et al.*, 2016; Westfall and Giusti, 2017).

Drawbacks that may affect the health and the environment which are described as:

- Synthetic lipstick may cause dryness and damage to the lips, as it contains petroleum-derived ingredients that strip the natural oils and moisture from the lips, leaving them cracked and chapped.
- Synthetic lipstick may cause irritation and infection to the lips, as it contains artificial colors, fragrances, and preservatives that may trigger allergic reactions, inflammation, or bacterial growth on the lips.
- Synthetic lipstick may cause toxicity and pollution, as it contains harmful ingredients that may be ingested, absorbed, or released into the environment. Some of these ingredients are carcinogenic, endocrine-disrupting, or bioaccumulative, meaning that they may cause cancer, hormonal imbalance, or environmental damage (Choi and Lee, 2015).

4. Herbal ingredients and their benefits

Cosmetic products, especially lipsticks, have witnessed a paradigm shift with an increasing emphasis on natural, plant-derived ingredients. Herbal lipsticks, characterized by formulations rich in botanical extracts, have gained popularity for their dual role in enhancing aesthetics while potentially offering skincare benefits (Lodyga-Chruscinska *et al.*, 2018; Sivakumar *et al.*, 2022). Many herbal ingredients are discussed here, highlighting their diverse properties and the advantages they bring to the formulation of herbal lipsticks. Figure 2 illustrates the different herbal ingredients.

4.1 Base

Wax is a solid substance that is obtained from various natural sources, such as beeswax, carnauba wax, candelilla wax, *etc*. Wax has a high melting point and a low viscosity, which makes it suitable for forming the base and structure of the lipstick. Wax also helps to hold the other ingredients together, and provides a smooth and even application of the lipstick. Shea Butter (*Vitellaria paradoxa*) is rich in fatty acids and vitamins, providing excellent moisturization and nourishment to dry or chapped lips (Akihisa *et al.,* 2010; Maktabi *et al.,* 2021).

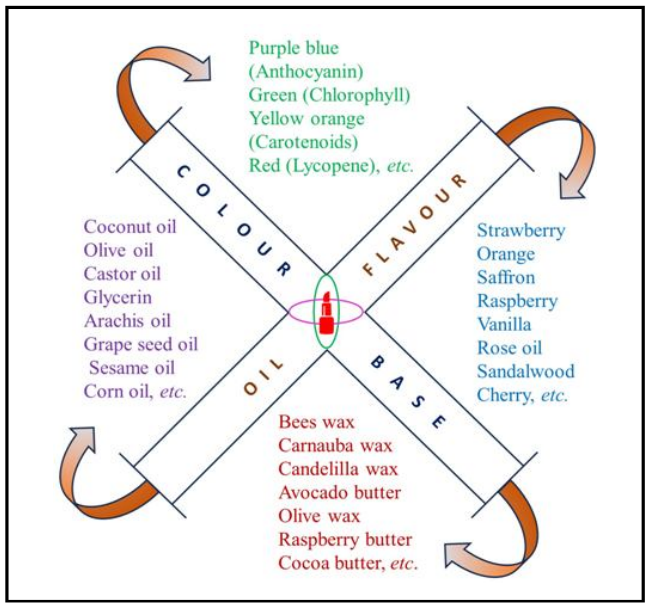

Figure 2: Different herbal ingredients for lipstick formulations.

4.2 Oils

Castor oil is a vegetable oil that is extracted from the seeds of the castor plant. Castor oil has emollient, anti-inflammatory, and antibacterial properties that moisturize, soothe, and heal the lips. Castor oil also forms a protective barrier on the lips that prevents water loss and environmental damage (Mawazi *et al.,* 2021; Muley *et al.,* 2009). Coconut oil is a plant-based oil that is obtained from the kernel of the coconut. Coconut oil has moisturizing, antioxidant, anti-inflammatory, and antimicrobial properties that hydrate, protect, and repair the lips. Coconut oil also enhances the barrier function of the lips, which helps to prevent dryness and chapping (Lin *et al.,* 2017). Lemon oil is an essential oil that is derived from the peel of the lemon fruit. Lemon oil has astringent, bleaching, and exfoliating properties that cleanse, lighten, and smooth the lips. Lemon oil also stimulates blood circulation and collagen synthesis, which improves the texture and appearance of the lips (Rao and McClements, 2012; Komane *et al.,* 2016).

4.3 Coloring agents

Beetroot juice is a natural source of betalains, which are pigments that give a reddish-purple color to the lips (Temgire *et al.,* 2023). Beetroot juice also contains antioxidants, vitamins, and minerals that nourish and protect the lips from oxidative stress and inflammation (Kumorkiewicz-Jamro *et al.,* 2021; Ahrari *et al.,* 2023).

4.4 Flavoring agents

Honey is a sweet substance produced by bees from the nectar of flowers. Honey has humectant, antioxidant, anti-inflammatory, and antibacterial properties that attract and retain moisture, prevent and treat infections, and heal wounds and cracks on the lips. Honey also gives a natural shine and softness to the lips. Orange essence is a liquid extract that is obtained from the peel of the orange fruit. Orange essence has a refreshing citrus scent and flavour that enhances the sensory appeal of the lipstick. Orange essence also contains vitamin C and flavonoids, which are antioxidants that protect the lips from free radical damage and ageing. Vanilla essence is a liquid

extract that is derived from the pods of the vanilla plant. Vanilla essence has a sweet and pleasant aroma and taste that adds flavour and fragrance to the lipstick. Vanilla essence also has antioxidant and anti-inflammatory properties that reduce oxidative stress and inflammation on the lips (Chaiyana *et al.,* 2021).

Others, such as *Aloe vera* (*Aloe barbadensis*), are known for their moisturizing properties. Aloe helps soothe and hydrate the lips. It also contains antioxidants that may contribute to overall lip health (Sanchez *et al.,* 2020). Chamomile *(Matricaria recutita)* has anti-inflammatory properties, making it suitable for soothing sensitive lips. It can also contribute to the overall calming effect of the lipstick (Srivastava *et al.,* 2010). Lavender (*Lavandula angustifolia*) oil has antimicrobial and antioxidant properties, contributing to the preservation of the lipstick and providing potential benefits for the lips (Cavanagh *et al.,* 2002). Lastly, Coconut Oil (*Cocos nucifera*) is known for its moisturizing properties. It helps soften and condition the lips, preventing dryness and flakiness (Evangelista *et al.,* 2014).

5. Manufacturing methods of herbal lipstick

The manufacturing process of lipstick involves several steps described as (Figure 3):

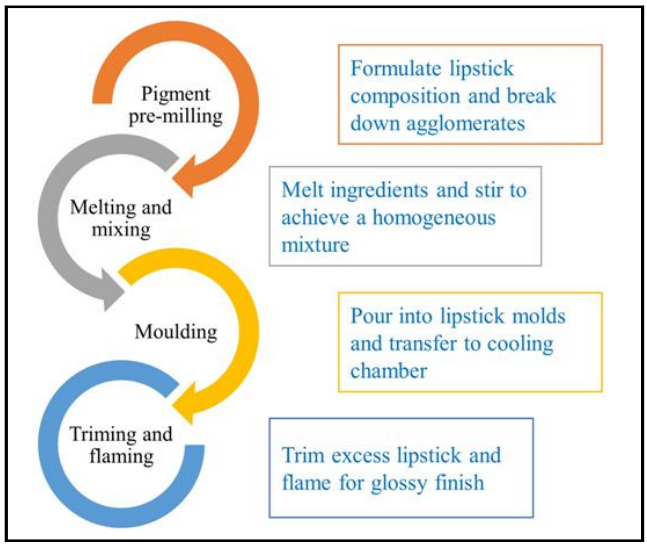

Figure 3: Illustration of different steps in the formulation of lipstick.

5.1 Pigment pre-milling

The process begins with formulating the lipstick composition. This involves combining various ingredients such as waxes (*e.g.,* beeswax, carnauba wax), oils (*e.g.,* castor oil, lanolin), pigments, emollients, and additional components like preservatives or fragrances. To give the lipstick a uniform, smooth, and even colour, the agglomerates in the powder are broken down (Esposito and Kirilov, 2021).

5.2 Melting and mixing

The ingredients are then melted together in a mixing vessel The temperature and duration of melting are critical to achieve a homogeneous mixture. As waxes are solid, they are need to be melted first before mixing. The oil and melted mass are stirred to ensure uniform distribution of pigments and other components (Rapp and Vergnes, 2023).

5.3 Moulding

Once the mixture is homogenized, it is poured into lipstick moulds made of either metal or plastic. The moulds are typically bullet-shaped and can vary in size and design. The moulds are then transferred to a cooling chamber to allow the lipstick to solidify, and then it is removed from the mould with slight pressure.

5.4 Trimming and flaming

After cooling, excess lipstick may extend beyond the mould. This excess is trimmed to achieve the desired bullet shape. The last stage involves flaming the lipstick, which is usually held and twisted for a maximum of one second before removing it to prevent it from melting and losing its form and giving it a glossy finish. The lipstick is then put into the containers (Mishra and Dwivedi, 2012).

6. Characterization of herbal lipstick

6.1 Color and texture

It is essential to consider both color and texture. Assessing color involves examining factors like pigmentation, hue variability, color stability, and natural appearance to ensure vibrant, diverse, and long-lasting shades that complement natural lip tones. Meanwhile, texture evaluation encompasses smoothness, moisturization, weight, buildability, longevity, and transfer resistance. A quality herbal lipstick should glide on smoothly, provide hydration without feeling heavy, maintain its integrity over time, and resist transferring onto objects. By thoroughly assessing these parameters, consumers can make informed choices based on their desired aesthetic and comfort preferences, ensuring a satisfying lipstick experience (Kamairudin *et al.,* 2014).

6.2 Melting point

The melting point is a critical parameter in evaluating the quality and performance of herbal lipsticks. It refers to the temperature at which the lipstick transitions from a solid to a liquid state. A suitable melting point ensures that the lipstick maintains its structural integrity during storage and application, preventing it from melting or deforming under normal environmental conditions. Typically, herbal lipsticks are formulated to have a melting point slightly above room temperature to withstand warm climates and avoid melting when carried in handbags or pockets. However, the melting point should also be low enough to allow for smooth application and comfortable wear on the lips without feeling overly stiff or waxy. The capillary tube technique is used to determine the melting point. Slide the glass capillary tubes open on both ends. A suitable amount of lipstick should be introduced into a capillary tube that is about 10 mm high. The tubes should then be left to stand for the required period and temperature. A melting point is thought to be the temperature at which a substance flows down a capillary tube (Kamairudin *et al.,* 2014). Manufacturers achieve the desired melting point by carefully selecting and balancing the ratio of natural waxes, oils, and butter in the formulation. Additionally, the melting point can impact the lipstick's stability, shelf-life, and resistance to temperature fluctuations during transportation and storage. Therefore, a thorough evaluation of the melting point ensures that herbal lipsticks maintain their quality, consistency, and performance throughout their lifespan, providing consumers with a satisfying and reliable cosmetic experience.

6.3 Breaking point

The breaking point of herbal lipstick is a critical parameter that reflects its structural integrity and resilience to mechanical stress. The purpose of this test is to determine the maximum amount of stress that lipstick can bear before breaking. It refers to the point at which the lipstick breaks or fractures under applied force, such as pressure or bending. A suitable breaking point ensures that the lipstick remains intact during normal usage, preventing it from snapping or crumbling during application or storage. This test provides lipstick with strength. The prepared herbal lipstick is positioned one inch from the edge of the support and held horizontally in a socket. The weight is increased by a specified amount (10 g) progressively at intervals of 30 sec, and the breaking point is determined by calculating the weight at which it breaks (Maier *et al.,* 2003). Factors influencing the breaking point include the composition of natural waxes, oils, and butter, as well as the presence of reinforcing agents or thickeners in the formula.

6.4 Determination of spreadability

Spreadability influences the ease and uniformity of application of herbal lipsticks. This describes the lipstick's ability to spread over the lips, ensuring smooth coverage without any unevenness or patchiness. The spreadability of lipstick is influenced by various factors, including its texture, viscosity, and formulation ingredients. A well-balanced combination of natural oils, butter, and emollients enhances the spreadability, allowing the lipstick to glide effortlessly over the lips for a seamless finish. To determine spreadability, testers may apply the lipstick to the lips and assess factors such as ease of application, even distribution of color, and adherence to lip contours. Additionally, spreadability impacts the overall user experience, affecting factors such as comfort, precision, and the ability to achieve desired lip looks. For determination, the lipstick is applied to the glass slide several times to evaluate the consistency of the protective layer's composition and to see if the stick broke, fractured, or distorted while being applied.

6.5 Softening point

The Ring and Ball technique was used to test the softening point of lipstick. A prepared herbal lipstick was placed into a ring or support orifice to provide support. A sharp knife was used to cut away the excess material above and below the opening, leaving lipstick tablets inside the ring. This was kept in a 60°C refrigerator for around 10 min. A heated plate with a magnetic stirrer is used to hold a beaker filled with 500 ml of room-temperature water. The lipstick tablet was carefully positioned above a steel ball. After that, the bar was placed into the beaker until it was submerged in it. Using a thermometer, gently stir and heat. The softening point of lipstick was determined by measuring the temperature at which the steel balls and lipstick mass dropped to the bottom of the beaker (Panda *et al.,* 2018).

6.6 Rancidity

Rancidity assessment involves monitoring the lipstick over time for any signs of spoilage, such as unpleasant odors or changes in color and texture, which may indicate the presence of rancid oils or fats. The breakdown of fats, oils, and other lipids by oxidation or hydrolysis is known as rancidification. It causes the product to taste awful, have an unpleasant smell, get sticky, and occasionally change colour. The peroxide number of the substance can be used to test for rancidity (Panda *et al.,* 2018; Swati *et al.,* 2013). Regular inspection and sensory evaluation of lipstick samples allows for the detection of these undesirable changes, ensuring that the product maintains its quality throughout its shelf-life (Manjusha *et al.,* 2023).

6.7 Microbiological test

Microbiological testing is crucial to ensuring that the lipstick is free from harmful microorganisms, with analyses conducted to determine the total bacterial count and the presence of yeast and moulds. Microbial growth can be caused by contaminated raw materials, mould, storage kettles, or lipstick containers. To conduct the test, a known mass of the sample is placed on two culture mediums that have been carefully chosen to support the growth of bacteria and fungi. The samples are then incubated for a predetermined amount of time to allow for the production of visible colonies that can be counted (Swati *et al.,* 2013; Manjusha *et al.,* 2023).

6.8 Surface anomalies

Surface anomalies should also be carefully examined, looking for any irregularities such as air bubbles, cracks, or uneven texture, which can affect the aesthetic appeal and usability of the product. This is examined through surface imperfections, including crystal development, fungal and mould contamination, wrinkle formation, and the exudation of liquid and solid fatty substances. By visually inspecting lipstick samples under controlled lighting conditions, quality control personnel can assess the surface quality and integrity of the product. A smooth and uniform surface indicates a well-formulated lipstick that is free from defects, ensuring a pleasing appearance and effortless application. (Panda *et al.,* 2018; Swati *et al.,* 2013).

6.9 Perfume stability

Perfume stability is another important factor, with the lipstick's scent monitored for changes in intensity or aroma profile over time. Perfume stability testing is essential for evaluating the long-term fragrance integrity of herbal lipsticks. This test involves monitoring the scent of the lipstick over time to assess its stability and consistency. Changes in fragrance intensity, aroma profile, or overall scent quality may indicate degradation of the perfume components, compromising the product's olfactory appeal. By subjecting lipstick samples to varying environmental conditions, such as temperature and humidity fluctuations, manufacturers can simulate practical storage conditions and predict how the fragrance will evolve. The 30 days of testing are used to record the fragrance of the produced herbal lipsticks. Another way to test the durability of a perfume is to keep it in an oven at 40°C and periodically compare the perfume with new lipstick (Swati *et al.,* 2013).

6.10 Skin irritation test

Finally, conducting a skin irritation test is essential to assess the product's safety for use on the skin, ensuring it does not cause any adverse reactions such as redness, itching, or inflammation. Using lipstick, apply it to the skin for approximately ten minutes, then examine the results of skin irritation. Prioritizing skin safety not only enhances consumer confidence in the product but also reflects a commitment to quality and integrity in cosmetic formulation.

7. Defects in lipsticks

Defects in lipid-based formulations pose significant challenges for manufacturers, impacting product quality, performance, and consumer satisfaction. By understanding the underlying causes and mechanisms of these defects, one can implement targeted strategies to prevent their occurrence and ensure the production of high-quality lipid-based products. The following defects may be observed in the lipstick and also illustrated in Figure 4.

7.1 Formulation-related problems

7.1.1 Sweating

Sweating refers to a phenomenon where small, moisture-like droplets or beads appear on the surface of the lipstick. Sweating in lipstick occurs when there is an excessive separation of oils or waxes from the lipstick base, resulting in visible droplets or beads of oil on the surface. This defect is often caused by inadequate emulsification of ingredients or improper temperature control during manufacturing. This can also occur under certain conditions, such as high temperatures or humidity. Sweating not only compromises the aesthetic appeal of the lipstick but also affects its texture and application, leading to an uneven and greasy finish. The sweating of lipstick is primarily attributed to the separation of its components, with the oil or liquid components rising to the surface and forming visible droplets (Yadav *et al.,* 2011). Manufacturers can address this issue by optimizing the formulation to achieve better emulsification and stability of ingredients, as well as ensuring proper cooling and solidification processes during production.

7.1.2 Bleeding

Bleeding, also known as feathering or smudging, refers to the migration of lipstick color beyond the lip contour, resulting in blurred edges and a messy appearance. It also refers to an issue where the color or pigment of the lipstick spreads from the waxy bases, creating an undefined or smudged presence. This problem is commonly observed in lipsticks with high oil content or insufficient binding agents to hold the pigment in place. Factors such as humidity, temperature, and lip movement can exacerbate bleeding. To prevent this defect, formulators may adjust the ratio of oils and waxes in the formulation to improve adhesion and reduce migration. Additionally, incorporating lip liner or using primer can create a barrier to minimize bleeding and enhance the longevity of the lipstick. (Gfeller *et al.,* 2019).

7.1.3 Streaking

Streaking occurs when the application of lipstick results in uneven and streaky coverage, with visible lines or patches of color on the lips. This defect is often attributed to formulation issues such as inconsistent pigment dispersion, insufficient emollients, or improper blending of ingredients. Inadequate mixing or processing during manufacturing can also contribute to streaking. To address this problem, manufacturers may refine the formulation to ensure uniform dispersion of pigments and enhance the smoothness and spreadability of the lipstick. Optimizing processing parameters such as mixing time and temperature can also help achieve a more homogeneous texture and finish (Shivanand *et al.,* 2010).

7.2 Moulding-related problems

7.2.1 Laddering

Laddering refers to the formation of vertical lines or ridges on the surface of the lipstick, resembling the rungs of a ladder. This defect occurs during the moulding process and is often attributed to inadequate cooling or improper release from the mould. Factors such as temperature fluctuations or insufficient mould lubrication can exacerbate laddering. To prevent this issue, manufacturers should ensure proper mould design and maintenance, as well as optimize cooling parameters to facilitate smooth and uniform solidification of the lipstick. Additionally, employing release agents or surface treatments can aid in the easy removal of lipstick from the mould, minimizing the risk of laddering (Gfeller *et al.,* 2019).

7.2.2 Cratering

Cratering, a common defect in lipstick manufacturing, manifests as small bowl-shaped depressions or pits on the surface of the lipstick, diminishing its visual appeal and potentially impacting texture and application. These depressions can range in size from barely noticeable to quite large and can be scattered randomly or clustered together. Cratering commonly arises from formulation or processing problems, like air entrapment during mixing or incomplete mould filling, and can also be triggered by ingredient conflicts or elevated processing temperatures. Prevention and remediation strategies include optimizing formulation to minimize air entrapment, improving mixing techniques to reduce bubbles, controlling processing conditions, ensuring complete mould filling, and implementing rigorous quality control measures (Shivanand *et al.,* 2010).

7.2.3 Deformation

Deformation defect in lipstick refer to the distortion or alteration of the lipstick shape, resulting in irregular or misshapen products. This defect can occur during moulding, handling, or storage, and may be caused by factors such as inadequate cooling, improper demoulding, or physical stress during transportation. Deformation compromises the aesthetic appeal and usability of the lipstick, leading to dissatisfaction among consumers. To address this issue, manufacturers should optimize processing parameters to ensure proper solidification and structural integrity of the lipstick. Implementing measures such as controlled cooling, gentle demoulding techniques, and adequate packaging can help prevent deformation and maintain product quality. It is most noticeable in a softer formula and can be caused by a variety of factors, such as high oil content, improper storage and physical damage (Rafferty *et al.,* 2018).

7.2.4 Mushy failure

Mushy failure occurs when the lipstick fails to achieve the desired consistency and texture, resulting in a soft, mushy, or gel-like appearance and feel. This defect is often associated with formulation issues such as excessive oil content, insufficient binding agents, or improper cooling and solidification processes. This defect is not specific to any particular formula or shade, and it can be caused by various factors such as high oil content, crystallisation of waxes, the presence of air bubbles, or improper use of waxes and oils. Factors such as high ambient temperatures or prolonged storage can exacerbate mushy failure (Rafferty *et al.,* 2018). To remedy this problem, manufacturers may adjust the formulation to achieve a better balance

of ingredients and improve the viscosity and texture of the lipstick. Additionally, optimizing cooling and solidification parameters can help ensure the proper setting and firmness of the product, reducing the risk of mushy failure during production and storage.

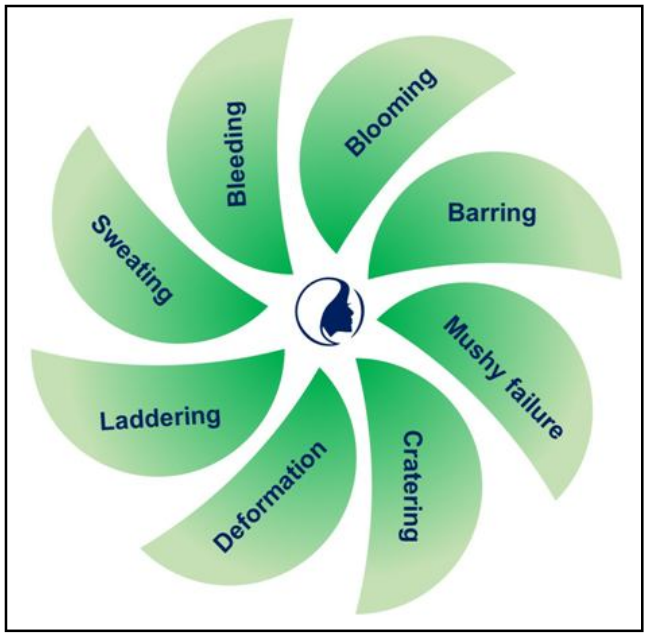

Figure 4: Defects observed in the lipstick formulations.

8. Quality control of lipstick

The Food and Drug Administration (FDA) has strict guidelines since the product must comply with their standards. Since lipstick is the only cosmetic that is consumed, strict guidelines are placed on both the production process and the contents. Lipstick is combined and processed in a sterile setting to ensure that there is no contamination. Testing is done on material that arrives to make sure it satisfies the necessary specifications. For the duration that the product is manufactured, samples from each batch are kept and kept at room temperature (Mahanthesh *et al.,* 2020).

The heat and rupture tests are two specific testing for lipstick. During the 24-hour heat test, the lipstick is kept in an extended position in a holder and heated to 130°F (540°C) continuously. The lipstick should not be warped or sagging. When doing the Rupture test, the lipstick is inserted into two holders and held outward (Yap and Aminah, 2011). Up until the lipstick bursts, weight is applied to the holder on the lipstick portion every 30 sec. The manufacturer's standards are then compared to the pressure needed to rupture the lipstick. Each producer establishes its own parameters for these testing because there are no industry standards for them. Colour control of lipstick is critical, the shades of lipstick can be controlled numerically with the use of colorimetric equipment. In order to precisely match the remaining lipsticks, this equipment provides a numerical readout of the shade when combined (Maier *et al.,* 2003).

9. Discussion and concluding remarks

The literature review on herbal lipstick covers the facts such as, the historical development of lipsticks from natural and artificial sources, the natural ingredients that make up herbal lipsticks, their effects on the lips, such as hydration, protection, coloration, and antiageing. It delves into the incorporation of various natural elements like beetroot juice, castor oil, coconut oil, honey, lemon oil, orange essence, shikakai powder, vanilla essence, and wax, elucidating their properties such as moisturizing, healing, coloring, antioxidant, and anti-inflammatory effects on the lips (Mulukuri *et al.,2021*). The review also explores diverse methods and techniques employed in the preparation and evaluation of herbal lipsticks, encompassing considerations like base selection, additives, preservatives, and packaging, along with evaluating parameters such as color, texture, pH, melting point, breaking point, surface anomalies, ageing, and perfume stability. Furthermore, it undertakes a comprehensive comparison of the advantages and disadvantages of herbal lipsticks in contrast to synthetic counterparts, encompassing safety, efficacy, quality, cost, availability, and consumer preferences, while addressing challenges and limitations such as stability, shelf-life, standardization, and regulatory aspects in the realm of herbal lipstick formulations.

The key findings underscore the multiple benefits of herbal lipsticks for both lip health and the well-being of users, such as nourishment, protection, and aesthetic enhancement. Notably, they are also eco-friendly and safe, as they avoid toxic or harmful ingredients that may cause health issues or allergies. However, herbal lipsticks also have some disadvantages that may affect their use and popularity, such as higher cost, lower availability, shorter shelf-life, less variety, and lower effectiveness than synthetic lipsticks. They also encounter some challenges and limitations, such as stability, shelf-life, standardization, regulation, *etc*. The review also suggests that herbal lipsticks are an emerging and promising area of research and development, as there is an increasing demand and interest in natural, organic, or herbal cosmetics, and there is a need to investigate the various aspects of their formulation, evaluation, and comparison with synthetic lipsticks. The review also recommends some directions for future research and development of herbal lipsticks, such as finding new natural ingredients that have beneficial and unique properties for the lips, such as moisturizing, healing, coloring, antioxidant, anti-inflammatory, *etc*. Improving and optimizing the formulations and techniques of herbal lipsticks, such as the choice of base, additives, preservatives, packaging, *etc.*, to enhance their quality, performance, and stability, and overcome their drawbacks and challenges. Additionally, comprehensive evaluations and comparing the safety, efficacy, and quality of herbal lipsticks with synthetic lipsticks, using various parameters and methods, alongside clinical trials and consumer surveys, to measure the pros and cons of herbal lipsticks, and to determine the consumer preference and satisfaction. Finally, the suggestion to diversify applications and uses, exploring different shades, styles, and effects to meet varied user needs and occasions, aims to carve out new markets and segments, such as vegan, organic, or halal lipsticks.

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Conflict of interest

The authors declare no conflicts of interest relevant to this article.

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