A Review of Herbal and Medicated Lipsticks: The General Cons and The Metal Contamination

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Abstract:

Medicated lipsticks use active medicinal compounds in lipstick formulations to combine therapeutic advantages with cosmetic benefits such as hydrating, mending, and shielding the lips against infections, dryness, and chapping. A shed of light on the materials used, such as waxes, oils, and pigments.

Also, this review provided an overview of previous research that clarified the usage of various constituents in lipstick and the production methods. A focus on herbal and medicate lipsticks such as lipstick formulations of antifungal agents (e.g. ketoconazole), antiviral (e.g. acyclovir), sunscreens, vitamin D3, and moisturizers like vitamin E and lanolin. Lipstick's effectiveness can be investigated through many studies, such as melting point, softening point, breaking point, thixotropy, the force of application, separability, pH meter, skin irritation, and stability. Additionally, metal contaminants are due to ingredients impurities and attention to the use of advanced analytical instruments to analyse the presence of lead and other metals in lipstick formulation based on their considerable impact on consumer health.

Keywords: Herbal, medicated lipstick, acyclovir, lanolin, metal contamination

مراجعة لأحمر الشفاه العشبي والعلاجي: السلبيات العامة والتلوث المعدني

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الخلاصة:
يستخدم أحمر الشفاه الطبي مركبات طبية نشطة في تركيبات أحمر الشفاه للجمع بين المزايا العلاجية والفوائد التجميلية مثل ترطيب الشفاه وإصلاحها وحمايتها من الالتهابات والجفاف والتشقق. تسليط الضوء على المواد المستخدمة كالشموع والزيوت والأصباغ. كما قدمت هذه المراجعة نظرة عامة على الأبحاث السابقة التي أوضحت استخدام المكونات المختلفة في أحمر الشفاه وطرق الإنتاج. التركيز على أحمر الشفاه العشبي والطبي مثل تركيبات أحمر الشفاه التي تحتوي على عوامل مضادة للفطريات (مثل الكيتوكونازول)، ومضادات الفيروسات (مثل الأسيكلوفير)، وواقيات الشمس، وفيتامين د3، والمرطبات مثل فيتامين هـ واللانولين. يمكن التحقق من فعالية أحمر الشفاه من خلال العديد من الدراسات، مثل نقطة الانصهار، ونقطة التليين، ونقطة الانهيار، والتغير المتغير، وقوة التطبيق، وقابلية الانفصال، ومقياس الرقم الهيدروجيني، وتهيج الجلد، والثبات. بالإضافة إلى ذلك، ترجع الملوثات المعدنية إلى شوائب المكونات، والاهتمام باستخدام أدوات تحليلية متقدمة لتحليل وجود الرصاص والمعادن الأخرى في تركيبات أحمر الشفاه بناءً على تأثيرها الكبير على صحة المستهلك.
الكلمات المفتاحية: عشبي، أحمر الشفاه العلاجي، الأسيكلوفير، اللانولين، التلوث المعدني

Introduction

One of the most popular cosmetic items is lipstick, known for its social and psychological effects, and its ease of application can be advantageous for medical purposes. As a history of this product, humans used lipsticks around 500 years ago, and it was originally found in the Middle Ages as a rough solid piece. In 1869, lipstick, which was initially sold in France for cosmetic purposes, was composed of beeswax and animal fat [1]. Various flower and herb extracts have been employed in cosmetic manufacturing for cosmetic and protective purposes, believing the natural ingredients in cosmetics repair and nourish the human body instead of producing damage [2]. In 1915, lipstick became available in metal tubes with a cylindrical shape to ease handling. Lipsticks are now considered an essential item for many people [3]. Various substances derived from chemical, natural, or combination sources are found in lipsticks to offer natural and synthetic lipstick components [4]. In 1984, Albert Kligman used the term "cosmeceuticals" to describe substances having both medicinal and cosmetic uses [5]. This led to present-day lip care products combining the cosmetic appearance with additional therapeutic benefits, and medicated lipsticks with active medical substances appeared on the market, primarily presenting protection against bacterial infections, as, indeed, the main objective of lipsticks is to hydrate and emolliently protect the lips from drying out and cracking [6]. Successively, many lipstick formulations began to consist of ingredients either for systemic or local treatment. To illustrate, Allantoin nowadays is a common ingredient in lip balms and lipsticks because of its anti-irritating, keratolytic, abrasive, astringent, healing, moisturising, soothing, and non-toxic characteristics. This helps treat a variety of conditions, including impetigo, eczema, psoriasis, burns, scalds, acne, and skin eruptions. It worked well at concentrations as low as 0.1–2% w/w as many formulators mixed it with honey and cow ghee as natural excipients instead of lipstick's traditional synthetic carriers. It was found Cow ghee a good alternative to castor oil after various tests, while honey aids in the healing process and encourages the renewal of tissue[7]. Further, Curcumin and acyclovir are active components that were included in lipstick formulations in cases of lip diseases [8-10].

Moreover, salicylic acid was formulated in lipsticks as a keratolytic agent that showed a moderate antibacterial effect. The concentration of salicylic acid that can be used safely ranges from 0.0008% to 3% [11]. Vitamin E and lemon juice were included for the antioxidant action, and vanilla essence is usually utilized as a preservative. Many non-pharmaceutical excepients, such as beeswax, are used in most lipstick formulations, which adds shine and hardness [12, 13].

One of the biggest problems in lipstick formulations is the presence of lead as a natural contaminant. Furthermore, metals frequently present in cosmetics as contaminants or intended additions, such as nickel and copper, and the presence of colouring components can cause allergic responses in certain people [14].

In this article, we reviewed the lipstick's main dosage forms and ingredients of lipstick formulations for cosmetics, focusing on medicated lipsticks and the preparation method. For its importance, we included in this review the metal chemical presence in lipstick formulation and its impact on both the product and customer health.

Lipsticks main classification

Lipsticks could be defined or addressed as balms, gloss and rouges, depending on the purpose of use with the content, and they were clarified as following:

- Lip balms, often called lip soothes or lip conditioners, are necessary cosmetics intended to protect, hydrate, and nourish the sensitive lip region. These formulas, which resemble wax, serve as a barrier to protect the lips from elements that might lead to dryness, chapping, and irritation, including wind, sun exposure, and freezing temperatures. Lip balms are usually formulated using a carefully measured combination of emollients, oils, butter, and waxes [15].

- Lip glosses are a unique class of lip care products that are intended to give the lips a glossy, shimmering appearance. Lip glosses are designed to improve the look and visual appeal of the lips, frequently adding subtle colour and shine, in contrast to lip balms, which are primarily focused on protection and nutrition. To get the right texture, colour, and shine, lip glosses are usually formulated using a combination of oils, waxes, pigments, and other chemicals. Castor, jojoba, and mineral oils are a few examples of oils that add to the glossy finish and give lips a smooth, non-greasy sensations [16].

-Typically, a mixture of waxes, oils, pigments, and additives is used to manufacture lip rouges (lipstick) to provide accurate colour, texture, and touch. Beeswax, carnauba wax, and ozokerite are some waxes that give lipstick structure, consistency, and adhesion. Mineral oil, castor oil, and lanolin oil are some of oils that provide emolliency and enhance the formulation's adhesion and spreadability on the lips. Although lip rouges are primarily utilised for their aesthetic appeal, they can also have other advantages, including anti-ageing and UV protection. Specific formulas include antioxidants and broad-spectrum sunscreen ingredients to shield the vulnerable lip region from damaging UV rays and free radical damage, maintaining the lip's general health and youthful appearance. It is important to remember that certain people may be allergic to or sensitive to specific lip rouge's chemicals, such as scent compounds or certain pigments [15].

Translabial drug-delivery system (TLDDS)

When taken orally, a medication may experience pre-systemic metabolism, enzymatic breakdown, and variable extent of drug absorption. These processes can alter the drug's concentration in the body and reduce its bioavailability. Lip's mucosa can get over these issues, known as the translabial or transmucosal route, and the route via which drugs of lip's formulations are absorbed [17]. At the moment, the translabial route of drug administration has great promise for treating several systemic and local illnesses. Numerous researchers have studied the delivery of drugs, the TLDDS, through the lips and have offered promising solutions with specific formulations for a range of diseases [8, 18, 19]. Figure 1 shows a comparison between normal skin and lip skin.

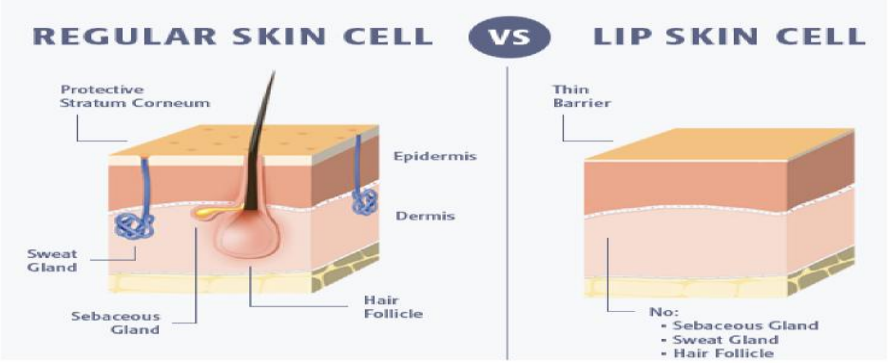

Figure 1 Comparison between normal skin and lip skin cell [20].

Advantage of TLDDS

In addition to the several advantages of TLDDS, such as preventing lips from drying out and cracking, reducing lip swelling, preventing sores, being simple to use, and removing the dosage form from the application site [21], the TLDDS validates the ability to distribute medications to the mouth cavity in a localised, systemic, and site-specific manner allows for prolonged action. The administration method provides easy access to treat a specific illness or a range of lip conditions [22].

Limitations of TLDDS

TLDDS cannot be used to give medications that have an unpleasant taste or odour or are local irritants that cause instability in the labial mucosa. Hence, these administration methods are inappropriate for medications or excipients that may result in specific local side effects, such as irritation, or local arrhythmia. For distribution via this method, drug candidates should have a short half-life of two to eight hours. One of the key difficulties with this route of administration is the tiny surface area of the application location that restricts the dosage administered. Among the physiological restraints are the lip's peptidase and esterase enzymes, which might lead to presystemic metabolism. Peptides thus cannot be administered in this manner [21, 23].

Mechanism of TLDDS

Drug molecules can easily pass through lip skin via two pathways: paracellular/intercellular transport, which allows drug molecules to enter through the junction between lip skin epithelial cells, and transcellular/intracellular transport, which explains how drug molecules pass through lip skin's epithelial cells. There are no hair follicles or sweat ducts, i.e. the appendage route in the vermillion zone of the labial mucosa, which is the typically distinct line separating the lip from the surrounding normal skin. It shows how the epidermis changes from having a lot of keratin on the outside to having less on the inside [22]. Figure 2 shows the permeation of drug through lips.

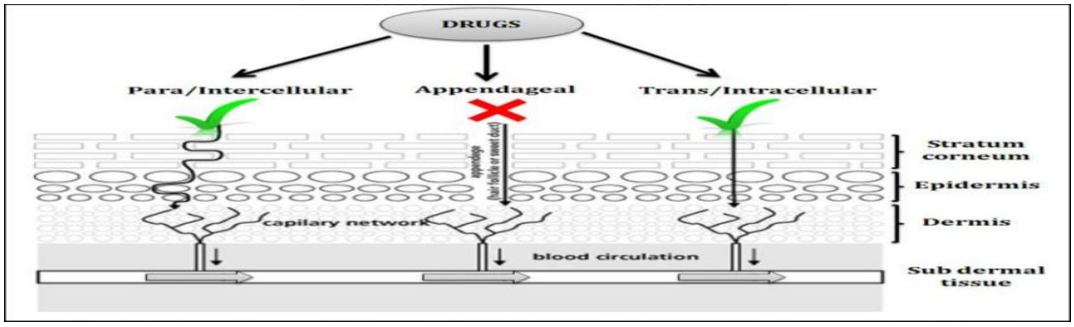

Figure 2 shows the drug permeation mechanism through lips [24].

Preparation of lipsticks

The most recommended method is the moulding technique, as the components needed to prepare lipstick were divided into three phases according to McIntosh *et al.*: phase A, phase B, and phase C. Phase A consisted of waxes, whilst phase B included colours and other oils, ending with phase C contained preservatives, chemical ingredients, drugs, and other additives. After elevating phase, A content temperature to 80 °C, then phase B all components were added to phase A. After removing the phase A and B combination from the heat, phase C was added, followed by mixing, and the resultant liquid was poured into the lipstick moulds [25]. With slight modification, Esposito *et al.* created organogel-based lipstick using the previous sequence of described procedure [19]. In a water bath, the waxes are typically melted in decreasing order of melting point to generate the wax phase (phase A). The melting points of waxes and the water bath temperature used in the lipstick preparation should be based on the highest melting point of any wax component [26].

Herbal lipstick

Plant extracts such as oils, waxes, pigments, and minerals are some examples of natural materials used for developing herbal lipstick. Another name for it is eco-friendly, natural, or organic lipstick [27]. Herbal lipstick contains natural oils, waxes, and butter for lip softening and moisturising, giving them nourishment and moisture. Further, the presence of natural antioxidants [28, 29] , anti-inflammatory, and therapeutic agents in herbal lipstick protects the lips from environmental harm caused by wind, sun, and pollution. Also, herbal lipstick does not block pores or dry out the lips; hence, it improves the natural appeal of the lips. Herb lipstick also could contain natural pigments and minerals that give the lips a beautiful, natural colour. Herbal lipstick is safe and environmentally friendly and is considered free of dangerous or poisonous elements that might irritate skin, trigger allergic responses, or create other health issues [30]. Figure 3 shows the components utilized for the formulation of herbal lip balm from natural ingredients. Table 1 summarises some research on herbal lipstick that may be utilised by consumers to help render it safer and more advantageous.

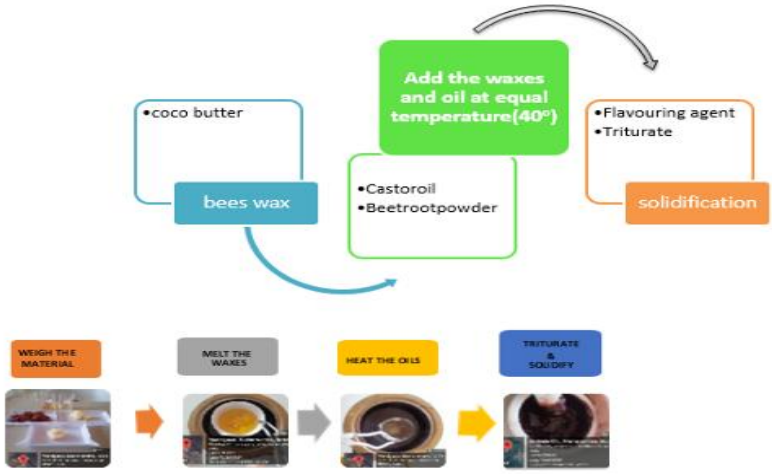

Figure 3 Components Involved in the Production of Natural Lip Balm [31].

Table 1 provides a summary of studies on herbal lipstick

Concept	Anticipated Results	Reference
formulation and evaluation of lipstick contain herbal ingredient	It was determined that this herbal lipstick formulation offers a more beneficial alternative for customers with insignificant adverse effects.	[9]
formulation and evaluation of herbal lipstick from color pigment from bixa orellana	Owing to the numerous negative effects of the synthetic preparations now on the market, the current effort to create a herbal lipstick that has few to no side effects and can be widely utilised in our communities.	[32]
formulation and evaluation of herbal lipstick	Herbal lipstick has gained popularity among consumers. Herbal medicine is a rapidly expanding field for curing various illnesses, and users of herbal medication want to remain in control of their health.	[33]
formulation and evaluation of herbal lipsticks from carrot (daucus carota l) extract	Develop and evaluate herbal lipsticks using carrot (Daucus carota L) standardized carotenoid extract with different castor oil bases. may be utilised as a natural pigment, and the beta-carotene itself has the ability to function as an A precursor.	[34]
Formulation and Evaluation of Herbal Lipstick using Lycopene Extracted from Solanum lycopersicum L	Using lycopene as a colouring ingredient, the objective is to create and assess herbal lipstick as well as other natural components including lemon juice, bees wax, carnuba wax, white soft paraffin, castor oil, and strawberry essence.	[35]
Antibacterial properties of crude aqueous Hylocereus polyrhizus peel extracts in lipstick against gram positive and negative bacteria	The main objective of this experiment is to ascertain if lipstick made with H. polyrhizus extracts as a colourant has antibacterial qualities.	[36]

Disadvantages of herbal lipstick

Compared with non-herbal lipsticks, the production and packaging of herbal lipstick take more time and energy, and the materials used in their formulations are more expensive. The lack of stabilizing substances and preservatives keeps herbal lipsticks lasting with a shorter shelf life. Also, the records indicated that herbal lipsticks are less accessible than non-herbal lipsticks due to their limited availability and marketing [37].

Furthermore, the other reason for limited availability is that herbal lipsticks depend on the quality and availability of the stock's natural components. Herbal lipstick is

usually described as not resistant to heat, sweat, or contact, making their disappearance more quickly [38].

lipstick component and their advantages

A significant change has occurred in the cosmetics industry, with a growing focus on natural, plant-derived ingredients, particularly lipsticks. Herbal lipsticks, distinguished by formulations rich in plant extracts, have become effectively liked for their ability to improve appearance and perhaps provide healthcare advantages [39]. The following section presents the materials used in herbal lipstick formulation.

1- Waxes

Wax is a solid substance derived from a variety of natural sources, including candelilla, carnauba, and beeswax. With the low viscosity of waxes and high melting point, wax is an excellent material for forming the structure and basis of lipsticks. Wax ensures a smooth and uniform application of the lipstick and aids in holding the other components together. Generally, waxes are rich in fatty acids and vitamins and shea butter (Vitellaria paradoxa) is an excellent moisturiser and nutrient for dry or chapped lips [40].

2- Oils

Herbal oil, such as castor oil, is derived from the seeds of the castor plant. Lips are moisturized, soothed, and healed by castor oil's emollient, anti-inflammatory, and antibacterial properties. Additionally, castor oil provides a barrier protecting lips from environmental harm and water loss [4, 41]. Another essential oil is coconut oil, which is produced from coconut kernel. The hydrating, anti-inflammatory, antibacterial, and antioxidant potentials of coconut oil help to heal and preserve lips. Additionally, coconut oil improves the lip's ability to serve as a barrier, reducing the likelihood of chapping and dryness [42]. Further to castor and coconut oils, lemon oil is one of the necessary ingredients in the herbal lipstick extracted from the lemon fruit peel. Lemon oil provides brightening, smoothing, and cleansing properties due to its stringent nature, whitening, and exfoliating characteristics [43, 44].

3- Flavouring components

The flavouring agents in herbal lipsticks are also natural, and honey is one of the flavours as the nectar of flowers aids in generating honey, the sweet substance. Not only the honey's flavouring property is vital in lipstick, but also its antibacterial, anti-inflammatory, antioxidant, and humectant properties which help to heal lip cracks and sores. Also, it prevents and cures infections with the additional ability of honey to hold moisture. Honey also leaves lips with a natural glow and flexibility. Orange essence is also used to flavour lipsticks, mainly found as a liquid extract made from the peel of orange fruit. Orange essence improves the lipstick's sensory appeal with its fresh citrus smell and fragrance. This extract contains antioxidants, vitamin C and flavonoids that protect the lips from ageing and oxidative stress damage.

The other most widely used flavouring liquid extract, vanilla essence, is made from the vanilla plant's pods. The sweet, pleasant scent and taste of vanilla essence enhance the flavour and smell of the lipstick. Additionally, vanilla essence's anti-inflammatory and antioxidant qualities reduce inflammation and oxidative stress on the lips [45].

The antibacterial and antioxidant qualities of lavender (Lavandula angustifolia) oil help to keep lipstick fresh and may even improve the lips [46]. Lastly, (Cocos nucifera), or coconut oil, is renowned for its moisturizing qualities. It keeps the lips hydrated and flexible, avoiding flakiness and dryness [47].

Medicated lipsticks

Lipsticks contain active medicinal ingredients, defined as medicated lipsticks that help in different approaches to treating

diseases. A study was performed to enhance the acyclovir permeability through the labial mucosa to treat recurrent herpes labialis; it found 20% to 40% of individuals are infected with herpes simplex virus type 1 infection, which often results in a moderate, painful burning around the mouth. Typically, this recurrence is due to a primary infection that happens in childhood. Furthermore, factors including tiredness, stress, and exposure to extreme temperatures might cause recurrence of this disease [48].

In addition, the medicated lip rouge included acyclovir encapsulated in a niosomes vesicle for treating herpes labialis. Acyclovir as a chemical structure shown in Figure 4 is poorly bioavailable since it is a class III medication under the Biopharmaceutical Classification System (BCS) with minimal skin permeability [49]. Niosomes of acyclovir were created using the film hydration approach and added to three distinct lip formulations, lipstick, lip balm, and lip rouge, to increase cutaneous bioavailability [8]. A hydrophobic alkyl chain of lipids in niosomes impacted the acyclovir's encapsulation ability. The niosomes made from longer alkyl chains (surfactants span 60 and 80) had a better entrapment efficiency than niosomes vesicles made from shorter alkyl chain surfactants. Furthermore, the *in vitro* drug release rate also depended on the surfactant chain length, as the longer the chain length, the lower the drug-release rate [50].

Porcine snout membrane *ex vivo* permeability tests demonstrated 2.39 times better penetration than the commercially available cream formulation. Despite being a cosmetic procedure, medicated lip rouge can potentially improve therapeutic efficacy in treating recurrent herpes labialis and encourage patient acceptability.

Earlier research formulated a lipstick of the antifungal drug ketoconazole with tween 80 as a surfactant, PEG 400 as a cosurfactant and isopropyl myristate oil with waxes (beeswax and carnauba wax) and cow ghee as a penetration enhancer. The study's primary objective was self-emulsifying ketoconazole in a lipstick delivery system. The selected lipstick formulation was tested for stability at three distinct temperatures: room temperature, 40 °C, and 45 °C, which showed no instability. Lastly, compared to a ketoconazole solution, the microbiological test of the ketoconazole self-emulsified lipsticks demonstrated anti-fungal activity. Consequently, it was concluded that the lipsticks loaded with self-emulsifying systems could be appropriate for improving drug distribution and enhancing the medication's therapeutic potential in candidiasis [51].

Furthermore, recent research has developed a sustainable Lipstick with Vitamin D3 supplementation, as the selected vitamin D3 concentrations may provide people with the daily recommended intake of vitamin D3. The results suggest that a combination of berry wax, candelilla wax, and carnauba wax could be an efficient formulation for developing lipstick to enhance penetration of vitamin D3. Olive oil was the main lipid component, and enhanced further by combining it with jojoba, castor, cocoa, sunflower, and shea butter. The *in vitro* release of vitamin D3 presented direct concentration dependency [52].

A different study concerned the development of medicated lip formulations using repaglinide, an antidiabetic medication used to treat Type 2 diabetes mellitus, to make medicated lip strips for translabial or transmucosal delivery aided in limiting first-pass metabolism. These strips used zea mays, which are part of the Poaceae family. The zea mays seeds are comprised of vitamins, Lucine, lycine, fat, protein, sugars, carbs, and dietary fibres. Also, the zea seeds have several medical applications, including diuretic and kidney stone prevention [53]. The zea mays strip containing repaglinide showed non-irritant bio-adhesivity, and the capacity to form a drug delivery system as this was

investigated by the *in vivo* testing in rabbits, which produced a Cmax of 25 ng/ml at a tmax of 12 h and an AUC0-24 h of 430.29 ng h/ml [54].

In a previous study to sustain the release of rosiglitazone maleate, another antidiabetic medication, was delivered by TLDDS as lip strips that showed low moisture content and strong bio-adhesivity, which elongated the shelf life and lessened their brittleness after being stored. The *in vivo* study in rabbits revealed the following pharmacokinetic parameters: AUC0-24 h was 336.55 ng/ml, and the Cmax 23.084 ng/ml at a tmax of 12 h, verifying rosiglitazone systemic distribution through the labial route [55]. Table 2 lists the recent research of the incorporation of active pharmaceutical ingredients to formulate medicated lipstick.

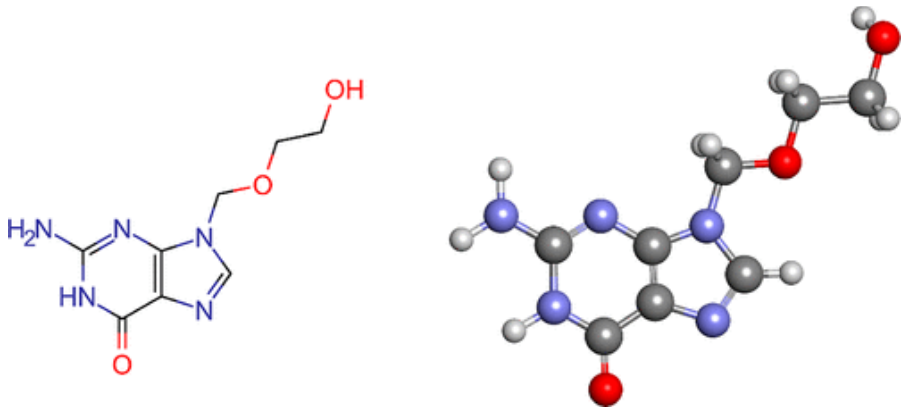

Figure 4 chemical structure of ACV drug [56].

Table 2 illustrate summery on medicated lipstick

Active pharmaceutical ingredient	Aim	Reference
allantoin	The purpose of this study was to develop therapeutic lipsticks using honey and cow ghee as natural excipients in place of traditional synthetic lipstick formulas.	[7]
acyclovir	The study's objective was to develop, assess, and enhance a medicated lip rouge formulation that contains acyclovir enclosed in a unique vesicular carrier called a niosome, in order to enhance the formulation's ability to penetrate membranes. In addition to improving patient compliance, the Lip Rouge cosmetic formulation can be used to treat herpes labialis.	[8]
	The principal objective is to produce a solid, self-emulsifying drug delivery system with ketoconazole that	

ketoconazole	improves solubility by utilising the right oil, co-surfactants, and surfactants. The Ketoconazole medication formulation with medicated stick is intended to improve lip appearance and treat fungal infections on the lips.	[18]
Vitamin D3	examines the appropriateness of seven candidate formulations for developing of a commercial lipstick model that is green and contains vitamin D3.	[52]
Salicylic acid	salicylic acid and natural colouring agent combined to create therapeutic lipsticks. Salicylic acid is a treatment for inflamed, bleeding, hyperpigmented, cracked, and chapped lips because it has moderate antiseptic qualities and functions as a keratolytic agent.	[57]

Characterization of medicated lipsticks

Establishing uniform standards for lipstick is crucial. However, the solubility test, pH parameter, skin irritation test, scent stability, force of application, stability, melting point, breaking point, thixotropy character, and lead limit test were among the tests used to assess the preparation of lipsticks [26]. Additionally, the Food and Drug Administration (FDA) established the production of lipsticks by enforcing restrictions on the detection levels of colour additives and lead [4].

1- Melting point

Determining the melting point is essential for defining the boundaries of safe storage.Sunil *et al*. employed the capillary tube method to ascertain the created lipstick's melting point using digital melting point equipment. The capillary filling method determines the temperature at which the lipsticks melt thoroughly [58]. More research utilised a similar methodology [9, 13, 59]. Bhagwat *et al*.and Azwanida *et al*. also applied the melting point test [35, 59].

2- Softening point

This test is intended to ascertain lipstick's resistance to the variety of environments it might face in the customer's bag or any area in the house. Bhagwat *et al.* used the ring and ball approach by putting the lipstick in a ring and refrigerating it at 6 ℃ for ten minutes. After lipstick's solidified in its stick shape, the ring and ball assembly were submerged in water and reached 45 °C, then the temperature should climb at a rate of 1 °C each minute. The temperature at which the ball passes through the lipstick sample is recorded as the softening point. Better stability for lipstick was indicated by a higher softening point [35, 60, 61].

3- Breaking point

One crucial factor in determining a lipstick's physical characteristics is its hardness or strength. The lipstick was inserted horizontally into a socket 12 inches

from a support edge. The weight of 10 g was gradually increased at intervals of 30 seconds as the breaking was a sign of the breaking point [62]. To ascertain the breaking point differently, cocoa wax lipstick was evaluated by a texture analyzer for the breaking point test. This instrument is operated depending on the distance of the hemispherical edge blade that is pointed to the lipstick at a trigger force of 10 g. The instrument finished and recorded this test when the lipstick was shattering. According to the study, better texture is associated with higher breaking point test values [63].

4-Thixotropy test

The consistency of a base's viscosity may be evaluated using the thixotropy test. Finding lipstick with a suitable texture is crucial since it may make it easier for customers to apply. Using a penetrometer, the procedure involved inserting a needle under a 50-g load for five seconds at 25 °C. The depth of penetration showed the thixotropic character. The lipstick's thixotropy varied from 9 to 10.5 [18, 64]. Figure 6 show the thixotropy test.

Figure 6 illustrate thixotropy test.

5- Force of application

A force of application test determines the force necessary for lipstick application on the lips. Panda *et al.* explained the procedure, starting with a coarse brown paper piece placed on a shadowgraph balance to conduct the test as shown in Figure 7. The lipstick was then applied with pressure at a 45-degree angle, covering an area of one square inch until completely covered since a readout indicated the force of application. There is no clear guidance on utilising this test as a standard reference or a range of pressure values [13].

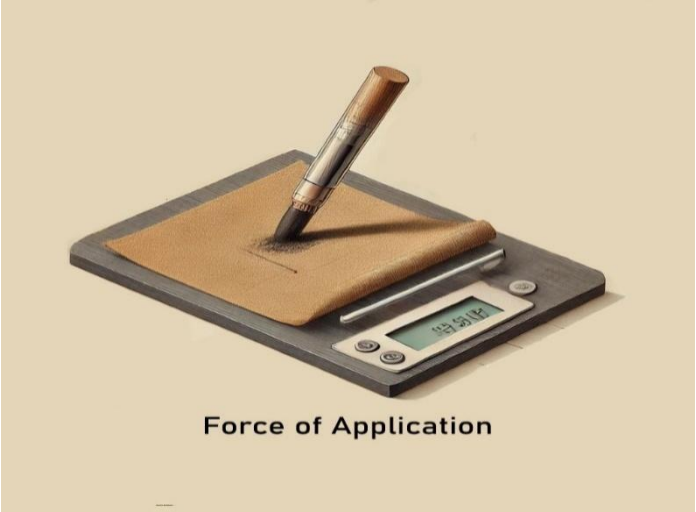

Figure 7 shows the force of application test.

6-Spreadability test

The capability of lipstick consistency to spread across a surface is assessed using a spreadability test [65]. In two earlier studies, this test was carried out by applying lipstick to a paper or glass slide for at least three centimetres as shown in Figure 8. The built spread layer of the lipstick was visually examined for smoothness and consistency [66, 67] and can be assessed using the following standards E, I and U, as each one explained:

Excellent layer (E): No fragments, even lipstick application across a smooth, homogeneous surface without distortion.

Intermediate layer (I): Few pieces, even application, little lipstick distortion.

Unsatisfactory (U): Lots of pieces, uneven application, and severe lipstick deformation.

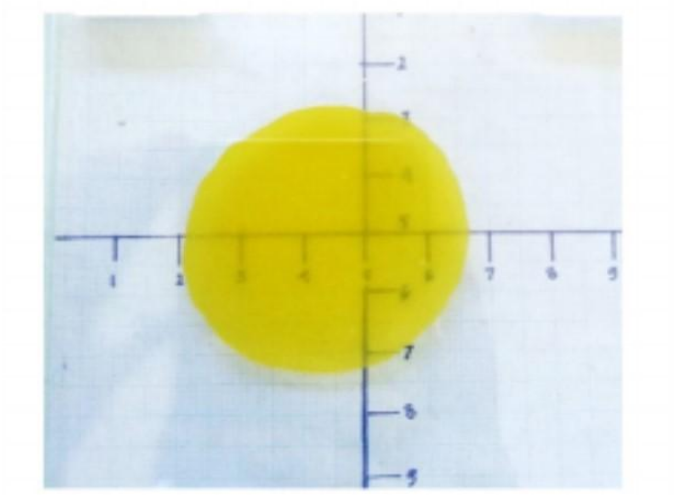

Figure 8 shows the spreadability test [68].

7- pH parameter

The allowed limits of the products to be applied on the lips safely are defined by the pH stability profile and the safe pH range for lipsticks. The solubility of components is influenced by pH level, which might change a product's physical and microbiological stability. A high pH can harm the skin's protective layer [69]. The pH of prepared lipsticks was measured using a potentiometric approach and a pH meter device, and a pH of 4 to 7 was

required for lipstick to be safe to apply on lips [32, 70, 71].

8- Skin irritation

Some research tested lipsticks for skin irritation using human models, such as Panda et al., which employed individuals in their study. The procedure initially started with covering the lip with the prepared lipstick. For ten minutes, all sensations, including itching, irritation, and redness, were noted [13, 32]. It was also proposed that the lipstick skin irritation test be conducted using a mouse model as the test run for each mouse had a slight chloroform anaesthesia for the test groups before having around 10 mg of lipstick samples applied to the dorsal area of their left ears [72].

9- Stability test

A stability evaluation during storage must be carried out to determine the requirements for product storage and establish acceptable limits for product and package expiration dates [26]. Many physical appearances, such as colour, smell, pH, and appearance, should be assessed depending on the visual inspection technique. Other properties of lipsticks were also evaluated, including bleeding (the separation of coloured liquids from the waxy base that causes uneven colour distribution) and crystallisation on the lipstick's surface [26, 73]. A lipstick's stability test starts 48 hours after formulation. A 350 g of lipstick samples were stored at room temperature (24.0 ± 3.0 ℃) for 48 hours to conduct accelerated stability investigations. The study was done using several temperatures for one hour: 4 ℃ in the refrigerator, 24.0 ± 3.0 ℃ in the room, and 40.0 ± 2.0 ℃ in the high temperature. Then, the lipstick evaluations were followed on days 3, 7, 15, 30, and 60 [35, 59, 73].

Analysis of lipstick's heavy metal concentration and its implications on health

The researchers considered the contaminants in lipsticks to represent an issue in the lipstick industry and formulation; hence, attention was paid to continuous observation.

Trace levels of heavy metals present in components of nature (rocks, water, and soil) can be detected in raw materials utilized in cosmetics production. The harmful elements, including lead (Pb) and nickel (Ni) are among the metallic contaminants that might adversely impact consumer health. In addition to these harmful trace metals, cosmetics may also include elements such as iron (Fe), copper (Cu), and zinc (Zn), which are required but toxic in high concentrations. Heavy metal contamination of preparations can arise during manufacture or from improper purification of natural raw materials used as components [74]. Lead poisoning in lipsticks and colouring products is one of the primary issues. Nickel and copper are two of the metals that might trigger irritation in people using cosmetics. Heavy metals accumulate within the body due to prolonged exposure, which raises the risk of several health issues [75, 76].

There are several available techniques for analyzing Pb in lipstick. Okamoto *et al.* utilized atomic absorption spectrometry to measure Pb using the conventional addition technique [77].

Besecker *et al.* reported a straightforward microwave-assisted acid extraction method for Pb determination using inductively coupled plasma–optical emission spectrometry. The limits of lead and nickel in oral and non-cutaneous absorption were set at 20 mg/kg for lead and 200 mg/kg for nickel by the Scientific Committee on Consumer Safety (SCCS). Since skin absorption is lower than oral absorption, these levels may be considered safer in cosmetics. If agreed to, the SCCS-determined limits could protect consumers

from systemic toxicity; still, there is another issue about local responses that demonstrate an allergy or irritation, making the metals under consideration vary based on the matrix in which they exist [14].

According to earlier research, lipsticks and lip glosses were tested for lead (Pb), aluminium (Al), copper (Cu), chromium (Cr), nickel (Ni), and titanium (Ti). Potential daily intakes were estimated, and the results were compared to current health guidelines.

According to the FDA-recommended guideline, Pb was detected in many samples at values greater than 0.1 ppm, whilst the cobalt showed the lowest average concentration (0.28 ±0.31 ppm, mean±SD) as the product's metal concentrations differed significantly from one another [78]. Figure 9 illustrate the origin of contaminants and trace elements

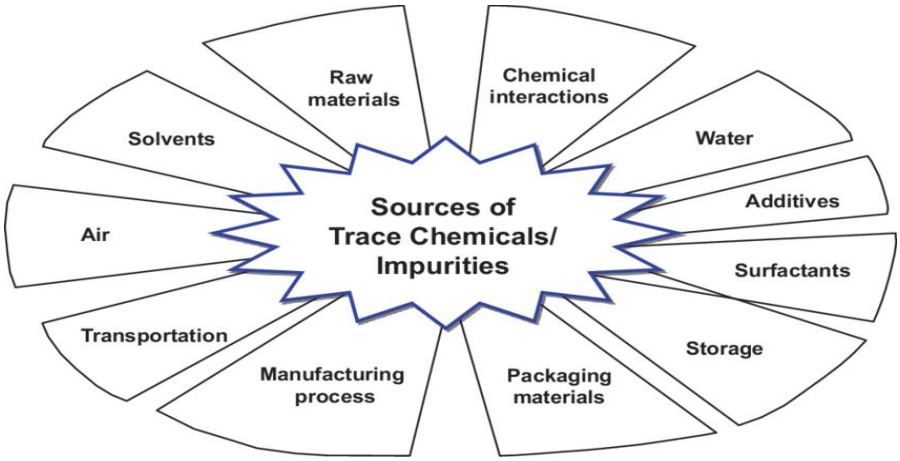

Figure 9 source of harmful substances and trace elements [79].

Regulation Requirements

Ensuring the safety of cosmetics without causing harm to customer's health is the main objective of regulations regarding cosmetics across all countries, as shown below [80]:

1- ASEAN Countries

The most current cosmetics law, known as the ASEAN Cosmetic Directive (ACD) [81], its implementation has been controlled, evaluated, and managed by the ASEAN Cosmetic Committee (ACC), which also comprises the ASEAN Cosmetic Association and ASEAN National Cosmetic Regulatory Authority (ACA). The ACD aims to eliminate technical barriers to the cosmetic industry while maintaining public health and safety standards for the people of ASEAN through harmonising technical specifications [82].

2- In European Union

In the European Union, Directive 76/768/EEC main objectives govern cosmetics by encouraging consumer product safety and facilitating European Union commerce in cosmetics. This law, which was first passed in 1976, specifies that, when applied under regular or predictable conditions, cosmetics must not be harmful to human health. Subsequently, Regulation (EC) No. 1223/2009 laid the basis for uniform cosmetovigilance standards and cosmetics management [83].

3- United States of America USA

The Food and Drug Administration defines cosmetics as items intended to be rubbed, poured, sprinkled, sprayed on, introduced into, or otherwise applied to the human body for washing, beautifying, enhancing visual appeal, or improving an appearance.

The two most significant regulations limiting cosmetics sold in the US are the Fair Packaging and Labelling Act (FPLA) and the Federal Food, Drug, and Cosmetic Act (FDCA). Under the FDCA, it is illegal to sell adulterated or mislabeled cosmetics over the borders of states [84]. Product composition problems are classified as misbranding when they include items that are misleadingly labelled or packaged, as violations resulting from contamination, manufacturing, packing, shipping, and handling are referred to as adulteration [82].

Conclusion

Herbal and medicinal lipsticks are significant developments in the cosmetics industry that satisfy aesthetic improvement needs and therapeutic efficacy. Plant oils, waxes, and extracts are examples of natural components included in herbal lipsticks, which respond to the rising customer demand for natural, non-toxic products. These formulas provide additional advantages, including antioxidant protection, hydration, and the ability to lessen environmental damage to the lips and their cosmetic uses.

In contrast, medicated lipsticks treat specific lip disorders, including inflammation, dryness, and herpes simplex skin conditions. The extensive analysis of researchers on lead and heavy metal contamination in lipstick formulation highlights serious health issues since different investigations have found elements, including lead, chromium, nickel, and others.

The development of more effective formulations, non-toxic options, and advanced and standardised testing procedures are critically required to monitor metal contamination. To minimise the possible health hazards caused by toxic metals in cosmetics, regulators, producers, and researchers must collaborate to establish an approach that ensures consumer's health and safety.

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