Formulation of Lipstick with Natural Colourants

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***Abstract*—The formulation and development of lipstick using natural colourants is an emerging trend in cosmetic science, driven by increasing consumer demand for safer, eco-friendly alternatives to synthetic dyes and pigments. This study focuses on the preparation of lipsticks incorporating plant-based colourants, such as beetroot, papaya, annatto, hibiscus, grapes, butterfly pea and dragon fruit, as well as other natural ingredients like beeswax, shea butter, and essential oils, to create a high-quality, sustainable product. The objectives were to evaluate the stability, texture, and colour performance of the natural colourants in the lipstick matrix, ensuring the product meets aesthetic, sensory, and safety standards. Lipstick formulations were developed through careful selection and optimization of ingredients to achieve desirable properties, such as smooth application, long-lasting wear, and vibrant pigmentation. The study further investigates the impact of natural colourants on the physicochemical properties of the lipstick, including melting point, spreadability, and moisture retention. Results indicate that natural colourants can successfully be incorporated into lipstick formulations without compromising product performance, providing an environmentally friendly and skin-safe alternative to synthetic cosmetic products. This research contributes to the growing interest in natural cosmetics by presenting an effective method for the development of lipsticks with natural colourants, paving the way for healthier, eco-conscious beauty solutions.**

***Index Terms*—Beta vulgaris, Bixa orellana, Carica posoposa, Natural colorants**

I. INTRODUCTION

Lipstick is essentially a dispersion of colouring material in a base made of an appropriate mixture of oils, fats, and waxes with appropriate fragrances and flavours that are molded into sticks to give lips an appealing glossy appearance. Lipsticks offer moisturizing look that highlights the lips and repulses their effects.

Lipsticks typically contain a variety of ingredients, including mineral derivatives (Vaseline oil, white petroleumatum), vegetable oils (castor oil, almond oil), pigments, and waxes. These ingredients are not only used for cosmetic purposes but can also function as bioactive agents in harsh weather conditions, such as UV protection. One of the most popular cosmetic items is lipstick. Wearing lipstick can have therapeutic, psychological, and social advantages. Lipsticks improve a person's appearance and appeal by colouring their lips and shielding them from the outside world. Nonetheless, modern lip care products prioritize both aesthetics and, ideally, additional therapeutic benefits for customers' lips. This caused medicated lipsticks with active therapeutic substances to appear on the market. Because the composition contains an active medical substance, the medicated lipsticks may offer protection against bacterial infections. This feature complements lipsticks' natural ability to hydrate and emolliently protect the lips from chapping and cracking. A common component of many women's fashion trends, lipstick is frequently connected to sexuality.

Fig.1: Lipstick

II. NATURAL COLOURANTS

Natural colorants, sometimes referred to as natural dyes or pigments, are compounds that are used to give things color that come from natural sources such plants, animals, and minerals. Humans have been using these colorants for thousands of years; they existed before the synthetic dyes that gained popularity during the 1800s and 1900s. Interest in natural colorants has increased as a result of rising worries about the effects of synthetic chemicals on the environment as well as the safety and health risks connected to some synthetic dyes. As safer, more environmentally friendly substitutes, they are being utilized more and more in sectors including food, cosmetics, textiles, and even pharmaceuticals.

Due to a variety of problems with synthetic dyes, many people choose to utilize natural colorants in cosmetics. More natural colorants are being utilized in cosmetics these days. Natural colouring agents are derived from biological sources and are typically environmentally benign. Natural colours can be made from bacteria, plants, and other biological sources. Most natural colorants come from environmentally friendly sources. Natural colorants are made from plant materials such as stems, bark, leaves, fruits, flowers, and seeds, among others.

Henna, teak, annatto, paprika, carrots, red cabbage, turmeric, and other natural sources of color are all examples. Natural colouring solutions have several advantages, such as being less harmful to the environment, having no negative side effects, not being carcinogenic, and

pollutants, as well as enhanced health advantages including vitamin A levels and anti-cancer capabilities.

Many secondary metabolites, or phytochemicals, are produced by plants. These phytochemicals are not necessary for the plant's growth and development. The phytochemicals possess therapeutic qualities that encourage their application in the pharmaceutical sector. Additionally, phytochemicals have a variety of appealing hues and tastes, which makes them popular in the food and cosmetics industries. The stem, bark, leaves, and flowers are among the plant sections that create the pigments. A small percentage of the 2,00,000 chemicals that plants make are thought to be colourful compounds. Anthocyanins, carotenoids, betalains, flavones, chlorophylls, lycopene, and others are major types of plant pigments.

a) Beetroot

- SYNONYM: *Beta vulgaris rubra, Beet.*
- BIOLOGICAL SOURCE: Beetroot is a member of the *Beta vulgaris*, *Chenopodiaceae* family.
- CHEMICAL CONSTITUENTS**:** Betalains, Inorganic nitrates**,** Polyphenols**,** Flavonoids**,** Saponins**,** Minerals**,** Oxalic acid.
- COLOURING MATTER: Betalains (colour red-violet betacyanins and yellow betaxanthins).
- USES: Make lips hydrated, tinted, provide even tone to lips, improve skin elasticity.

Fig.2: Beta vulgaris

b) Papaya

- SYNONYM: *Carica posoposa, Carica carica, and Carica peltate.*
- BIOLOGICAL SOURCE: Papain is the dried and purified latex of the green fruits and leaves of *Carica papaya L*. belonging to the family *Caricaceae.*
- CHEMICAL CONSTITUENTS: Vitamins, Minerals, Organic acids, Phytochemicals, Papain Prunasin, Fatty acids and Sucrose.
- COLOURING MATTER: The colour of papaya fruit flesh is determined largely by the presence of carotenoid pigments.
- USES: Moisturize, nourish and protect lips.

Fig.3: Carica posoposa

c) Grapes

- SYNONYM*: Berry, Vine Fruit.*

- BIOLOGICAL SOURCE: Grape is the flowering plant genus *Vitis vinifera* in the botanical family *Vitaceae.*
- CHEMICAL CONSTITUENTS: Phenolic acids, Flavonoids, Anthocyanins, Stilbenes, and Lipids.
- COLOURING MATTER: Anthocyanins (purple colour).
- USES: Improve blood circulation in lips, antioxidant, anti-inflammatory.

Fig.4: Vitis vinifera

d) Dragon fruit

- SYNONYM: *Acanthocereus tetragonus. Pitahaya/Pitaya.*
- BIOLOGICAL SOURCE:Dragon Fruit is a climbing vine cactus species *Selenicereus undatus* of the family *Cactaceae.*
- CHEMICAL CONSTITUENTS: Betacyanin, Lycopene, Vitamins (vitamin C mainly), Dietary fiber, Flavonoids, Amino acids, Phenolic acids, Sugars and Organic acids.
- COLOURING MATTER: Betacyanins (pink colour).
- USES: Lip moisturizer, overcome dry skin, lip scrub, skin balance.

Fig.5: Selenicereus undatus

e) Hibiscus

- SYNONYM: *Jamaica sorrel, red sorrel, roselle, rozelle, sorrel.*
- BIOLOGICAL SOURCE: Hibiscus is a flowering plant of *Hibiscus rosa sinensis belongs* to the

Malvaceae family, also known as the mallow family.

- CHEMICAL CONSTITUENTS: Organic acids (citric acid, hibiscus acid, malic acid, hydroxycitric acid, and tartaric acids), Anthocyanins, Flavonoids**,** Tannins**,** Terpenoids, Vitamins, Alkaloids**,** Amino acids, Lipids, Sesquiterpene**,** Quinones**,** Naphthalene groups**.**
- COLOURING MATTER: Anthocyanins (colour from white to pink, red, blue, orange, peach, yellow or purple).
- USES: Moisturizing, colorant, anti-inflammatory, antimicrobial.

Fig.6: Rosa sinensis

f) Butterfly pea

- SYNONYM: *Asian pigeonwings, Blue pea, Darwin pea.*
- BIOLOGICAL SOURCE: Butterfly pea is a perennial herbaceous plant of *Clitoria ternatea* from the

Fabaceae family.

- CHEMICAL CONSTITUENTS: Flavonol glycosides, Anthocyanins, Flavones, Flavonols, Phenolic acids, and Cyclotides.
- COLOURING MATTER: Anthocyanins (red, orange, blue, purple, and pink colours).
- USES:Reduce redness,irritation, moisturizing and rejuvenating.

Fig.7: Clitoria ternatea

g) Annatto

- SYNONYM: *Bixa orellana.*
- BIOLOGICAL SOURCE: Annatto is a yellow-orange-red carotenoid derived from the seeds of annatto tree belonging to the family *Bixaceae.*
- CHEMICAL CONSTITUENTS: Bixin, Norbixin, carotenoids, apocarotenoids, sterols, aliphatic compounds, monoterpenes and sesquiterpenes, triterpenoids.
- COLOURING MATTERS: Bixin (yellow to orange), Orellin (orange-red).
- USES: antioxidants, colouring agent, skin protection, skin conditioning, anti-aging.

Fig.8: Bixa orellana

II. OBJECTIVES

- To prepare natural lipstick from beetroot, papaya, annatto, dragon fruit, hibiscus, grapes and butterfly pea.
- Evaluation of organoleptic properties and physicochemical properties.
- Comparison of the formulations based on the evaluation.

III MATERIALS

Table 1: List of ingred ients and their source

Ingredients	Sources
Cocoa Butter	Suvidhinath Laboratories, Baroda
Bees Wax	Suvidhinath Laboratories, Baroda
Coconut Oil	Pavizham group Ltd. Co. Ernakulam
Natural colourants • Beetroot • Papaya ripe fruit • Annatto seeds	Local Market, Varikoli Local Market, Kakkanad Native, Kolenchery
Vitamin E	Evion 400mg
Propyl Paraben	Oxford Laboratory, Thane
Vanillin	Suvidhinam Baroda

Equipment	Manufacturer
Microwave oven	ROTEK Insruments Keaa
Weighing Balance	INFRA DIGI, Chennai
Refrigerator	Samsung, New Delhi
Thermometer	LABWORLD, India
Lipstick Mould	INCO, India

Table 2: List of equipments

IV. METHODOLOGY

Table 1: List of ingred ients and their source s

A. Preparation of Colourant from Beetroot

Freshly harvested beetroot was purchased from local market in Ernakulam. The fruits were washed thoroughly in running tap water to remove any impurities and the thick layers were peeled from the fruits manually. Crushed beetroot grind without using water. Filter the extract using muslin cloth. After the filtration extract is mixed with ethanol.

B. Preparation of Colourant from Papaya

Freshly harvested papaya was purchased from local market in Ernakulam. The fruits were washed thoroughly in running tap water to remove any impurities and the thick layers were peeled from the fruits manually. The fruit is cut into thin slices. Then

dry the slices in microwave oven, until it loses the water content. Crush the dried slices by using mortar and pestle. After crushing, the powder is mixed with ethanol.

C. Preparation of Colourant from Annatto

Annatto was purchased from local market in Ernakulam. The seeds of annatto were crushed by using mortar and pestle. Then the powder is mixed with coconut oil.

INGREDIENTS	QUANTITY [gm]					
	F1	F2	F3	F4	F5	F6
Cocoa Butter	1	1	1	1	1	1
Bees Wax	2	2	2	1	1	1
Coconut Oil	1.5	1.5	1.5	1.5	1.5	1.5
Natural Colourants						
• Beetroot	0.75	-	-	0.75	-	-
• Papaya	-	0.75	-	-	0.75	-
• Annatto	-	-	0.75	-	-	0.75
Vitamin E	2 drops	2 drops	2 drops	2 drops	2 drops	2 drops
Propyl Paraben	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
Vanillin	0.1	0.1	0.1	0.1	0.1	0.1
Petroleum jelly	-	-	-	1	1	1

Table 3: Form ulatio n codes & Ingre dient

Lipstick

- Weighed all ingredients separately.
- Transferred all ingredients into a China dish.
- The above mixture was heated to 70° Celsius.
- Then the mixture was removed from water bath and allowed them to cool.
- The extracted pigment was mixed with the above mixture and stirred vigorously.
- Then the mixture is poured into previously lubricated and ice cooled mould.

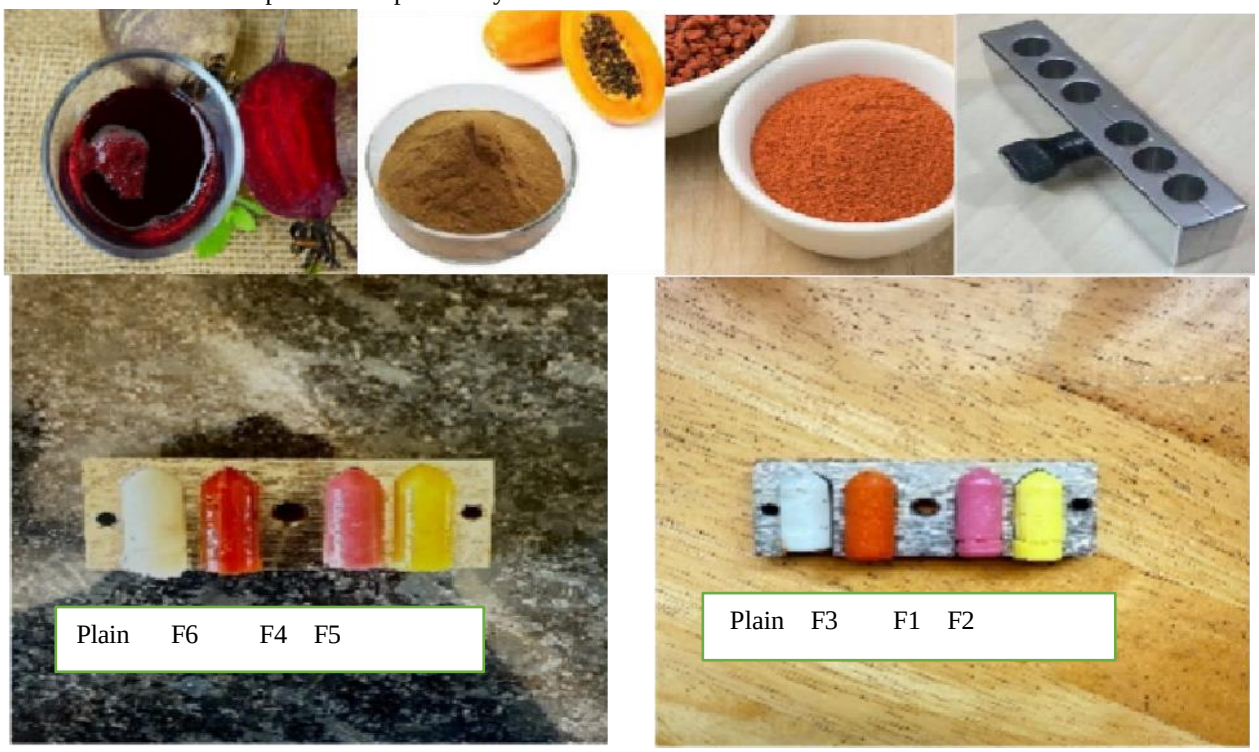

Fig.9: Preparation of lipsticks

V. RESULT AND DISCUSSION

Evaluation of Lipstick

A) Organoleptic character:

The observations made during organoleptic evaluations, viz; colour, odour, visual appearance, and texture were found as specified in the table below. The freshly powdered and dried colourants gave characteristic odour, but that odour was overpowered by vanillin in all formulations.

Table 4: Results for the evaluation of Organoleptic characters

Organoleptic Characters	F1	F2	F3	F4	F5	F6
Colour	Dark pink	Citrus yellow	Vivid orange	Fabric pink	Summer yellow	Scarlet red
Odour	Vanillin	Vanillin	Vanillin	Vanillin	Vanillin	Vanillin
Texture	Smooth	Smooth	Smooth	Smooth	Smooth	Smooth

B) Solubility test:

The formulated lipsticks were tested for solubility in ethanol and water and the observed results are tabulated as in below mentioned table. Formulations F1, F2 and F3 were soluble in ethanol whereas F4, F5 and F6 were found to be partially. All the formulations were found to be insoluble in water.

Table 5: Solubility determination results

C) Melting point:

Solvent	F1	F2	F3	F4	F5	F6
Ethanol	Soluble	Soluble	Soluble	Partially soluble	Partially soluble	Partially soluble
Water	Insoluble	Insoluble	Insoluble	Insoluble	Insoluble	Insoluble

The melting point of all formulations were found to be in the range of 50 – 54 °C. Formulations F1, F2 and F3 showed higher melting point compared to F4, F5 and F6.

Table 6: Results for melting point determination

Formulations	F1	F2	F3	F4	F5	F6
Melting point	53 ℃	54 ℃	53 ℃	50 ℃	51 ℃	50 ° C

D) Skin irritation test:

The prepared herbal lipstick formulations were studied for the skin irritation test. None of the formulations were found to be showing any skin irritation.

E) Determination of pH:

The pH of the prepared formulations were determined by using digital pH meter. Formulation F2 showed the highest pH which was found to be 6.43 and least pH was shown by F6.

Table 7: Results for pH determination

Formulations	F1	F2	F3	F4	F5	F6
pH	6.16	6.36	6.43	5.92	5.60	4.24

F) Perfume stability:

Perfume stability was carried out for all the formulations and the results are tabulated as below. F2 and F5 showed maximum perfume stability compared to other four formulations.

Table 8: Perfumed stability test results

Formulations	F1	F2	F3	F4	F5	F6
Perfume stability	+	+++	+	+	+++	+

G) Surface abnormalities:

Surface abnormalities studied by observing surface defects such as formation of crystals on surface, contamination by molds, fungi etc. Formation of wrinkles, exudation of liquid substances and of solid fatty substances are also checked. Results for the test is as shown in the table 10.

Table 9: Surface abnormality test results

Formulations	F1	F2	F3	F4	F5	F6
Surface Abnormalities	Mild defect	Mild defect	Mild defect	No defect	No defect	No defect

H) Texture and spreadability:

The spreadability of the prepared formulations performed on filter paper is as shown in the figure. The first three formulations F1, F2 and F3 were found to be hard and brittle and were also difficult to spread. The formulations F4, F5 and F6 were smooth and easily spreadable.

Fig.17: Spreadability of all six formulations on filter paper

VI. CONCLUSION

The cosmetics industry is embracing the development of lipsticks using natural colourants, a promising approach to replace synthetic dyes. These natural colourants, derived from plant- based sources like fruits, vegetables, and flowers, offer a wide range of vibrant shades and potential antioxidant, anti-inflammatory, and moisturizing properties. However, the industry faces challenges such as pigment stability, light and heat sensitivity, and achieving desired colour intensity. To address these, advancements in extraction methods, pigment stability enhancement, and sustainable sources are needed. Understanding the safety profiles of natural ingredients, including dermatological testing, is crucial for sensitive skin areas. The growing interest in ethical sourcing, sustainable packaging, and clean beauty solutions positions natural colourants as a significant trend in the future of cosmetics. Regulatory compliance and transparency in labelling are essential for building consumer trust and ensuring product safety.

The study involves the formulation and evaluation of lipsticks with natural colourants. The colourants were chosen based on the availability, feasibility of formulation. Out of the seven chosen colourants only three provided lipsticks with desired characteristics. Therefore, six formulations were prepared using the selected colourants and evaluated further. The evaluation of lipstick involves various tests to determine its organoleptic character, solubility, melting point, skin irritation test, pH, and surface abnormalities. The formulated lipstick was tested for colour, odour, visual appearance, and texture. The odour was determined by adding vanillin to the extract. The lipstick's colour ranged from dark pink to vivid orange, with a smooth texture. The solubility test was conducted on the lipstick, with results showing it was partially soluble in ethanol and partially soluble in water. The melting point was determined using the capillary tube method, which

involved cooling the sample in a capillary tube and then being tied to a thermometer. The temperature at which the sample completely melted within the tube was considered as the melting point. It was found to be between 50 to 54°C. The skin irritation test was conducted on the lipstick formulations, and results showed no irritation. The pH of the prepared lipstick was determined using a pH meter, with results ranging from 6.16 to 4.24. Perfume stability was also assessed by storing the lipstick at 40°C and periodically comparing it with fresh lipstick. Surface abnormalities were observed, including crystal formation, contamination by molds and fungi, wrinkle formation, and exudation of liquid substances and solid fatty substances. Surface abnormalities were classified as mild, medium, or no defect. Formulations F1, F2 and F3 showed mild defects and F4, F5 and F6 doesn't showed any defects. First three formulations were more brittle, hard and were less easily applicable compared to other three formulations. F4, F5 and F6 were also found to be more evenly spreadable. On comparison the formulations containing petroleum jelly were found to have some desirable features as lipstick. Out of the three colourants, the lipstick containing annatto was brighter more catchable.

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