BIO-LIP CARE

Engineering an Anti-bacterial Hydrating and Healing lip oil using Jamaica and Pomegranate extracts

Background Research on Lip Oils: What are the expectations of them?

Lip oils are moisturizing products made with natural oils that hydrate and nourish the lips. They help keep lips soft, smooth, and prevent dryness or chapping.

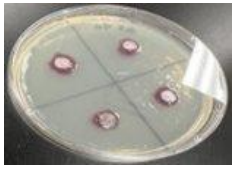
Specific Questions

1. How do Jamaica flower extract and Pomegranate extract influence the moisturizing and healing properties of a bio-lip oil?

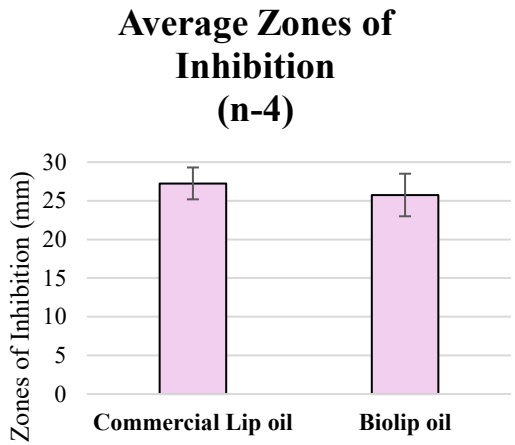
2. What are the potential anti-microbial or anti-inflammatory effects of Jamaica and Pomegranate components in lip care

Methodology

1. Preparation of Bio-Lip oil
2. Formulation of Bio-lip oil
3. Creation of Bio-Lip oil
4. Testing anti-microbial effects



Results



The bio-lip oil resulted into being a similar result as a commercial lip oil but with the difference of my bio-lip oil providing its natural synthetic effects making my lip oil a natural anti-microbial, moisturizing and inclusive product.

Discussion & Conclusion

- The Bio-Lip oil demonstrated enhanced antimicrobial properties, reducing both *S.epidermidis* and *C. albicans* colony counts compared to the commercial lip oil.
- The tint maintained a visible and natural-looking hue across different skin tones, showing good adaptability and potential for inclusive cosmetic use.

In conclusion, the Bio-Lip oil demonstrated consistent coloration, versatility across diverse skin tones, and enhanced antimicrobial properties, establishing its potential as a versatile, multifunctional lip tint.

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Chemistry

All photos & graphs were taken/created by the students unless otherwise noted

Addressing Limitations in Lip Product Safety and Inclusivity through Natural, Bio-Based Formulations

THE COSMETIC INDUSTRY

- The global beauty industry surpassed $500 billion in revenue by 2014, showing rapid expansion driven by consumer interest in diverse beauty products.
- In the early 2000s, synthetic chemicals like parabens and phthalates gained popularity in lip products but faced increasing scrutiny over potential health risks.
- The 2000s saw the rise of long-wearing and moisturizing lip glosses, shifting consumer preferences toward more functional and comfortable formulations.
- Between 2000 and 2010, demand for natural and organic beauty products grew significantly, with the market expanding by over 20% annually in some regions.

https://www.gloskinbeauty.com/products/lip-gloss?srsltid=AfmBOoqotWVZx6UQneJVVqhEuvA10xtnoGl8oHpDGC_UjQLODYBJ6_Dp

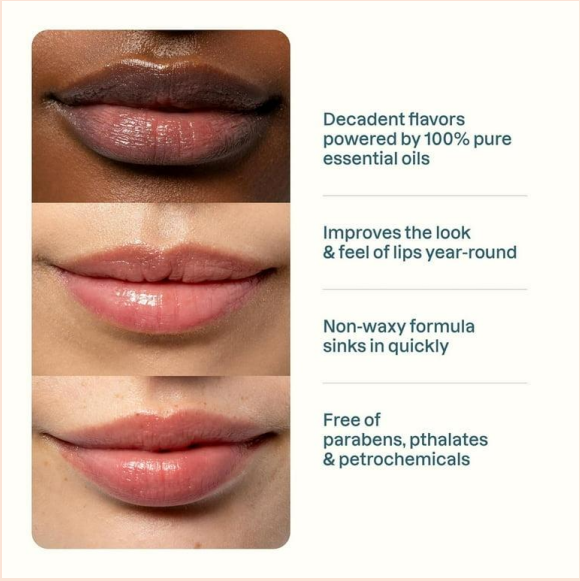
MY MOTIVATION

My motivation stems from the need to address the limitations of conventional lip products that offer superficial color without supporting true lip health; I aim to create a natural, personalized bio-lip oil that heals, nourishes, and adapts to individual chemistry for lasting results.

Background Research on Lip Oils: What are the expectations of them?

What exactly are lip oils and how do they benefit people's lips?

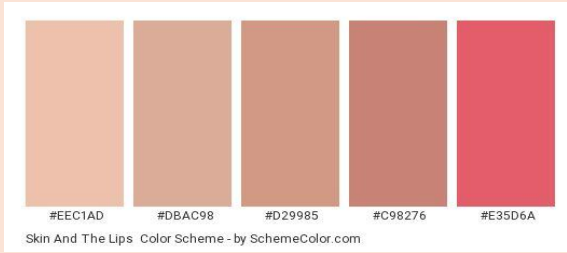
Lip oils are moisturizing products made with natural oils that hydrate and nourish the lips. They help keep lips soft, smooth, and prevent dryness or chapping.



https://www.walmart.com/ip/Cliganic-USDA-Organic-Lip-Balm-Set-6-Flavors-100-Natural-Moisturizer-for-Cracked-Dry-Lips/374218295

Inclusivity on lip oils and how they don't reach to costumers liking

As more new lip creations come out to the market, companies advertise their lip products talking about how improved their product is and how it provides benefits to consumers. This may be beneficial to some people, but not all are satisfied and still feel the need to ask for a lip product that will meet their needs as their current lip product had not reached their needs and expectations.



https://ch.pinterest.com/pin/skin-and-the-lips-color-scheme-brown--653584964662022778/

CORE ELEMENTS OF BIO-LIP CARE

NAME OF ACTIVE COMPONENTS	EFFECT OF ACTIVE COMPONENTS
JAMAICA FLOWER EXTRACTS	It provides antioxidant benefits such as the Vitamin C and Anthocyanin needed to make the lip oil pH dependent and supports lip health with its anti-inflammatory and smoothing properties
POMEGRANATE EXTRACTS	The natural acidity of pomegranate supports the anti-microbial in the Bio-Lip oil, promotes collagen production, as well as hydration & nourishment
HIBISCUS FLOWER POWDER	It has pH-sensitive colorant that provides visual cues and aesthetic appeal. Also contributes to nutritional and soothing qualities making it a multifunctional ingredient that is eco-friendly and sustainable

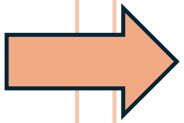
Statement Of Problem, Hypothesis, & Variables

General Problem

There is a need for natural, eco-friendly lip care products that are hydrating, and suitable for all. This research will develop a bio-lip oil with Jamaica and pomegranate to address this gap by providing a sustainable, nourishing, and inclusive solution.

INDEPENDENT VARIABLE

Jamaica
& Pomegranate



INDEPENDENT VARIABLE

PH balances &
Coloration

CONSTANT VARIABLE

Type of bacteria
concentration of extracts
pH measurement method

My Hypothesis

If I use Jamaica and Pomegranate as main components to make a bio-lip oil, then it will make a successful anti-microbial, moisturizing and hydrating lip-oil because Jamaica contains the anthocyanin needed to make the lip-oil pH depended including the rich content of vitamins and minerals, as pomegranate includes rich antioxidants plus its natural coloration and helps in hydration as well as promotes healing making this this lip-oil eco-friendly and beneficial.

Specific Questions

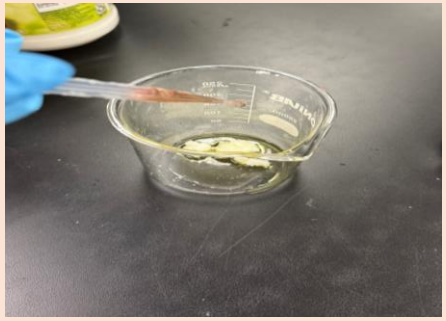
1. How do Jamaica flower extract and Pomegranate extract influence the moisturizing and healing properties of a bio-lip oil?
2. What are the potential anti-microbial or anti-inflammatory effects of Jamaica and Pomegranate components in lip care

METHODS & PROCEDURES

1

Infused coconut oil with jamaica flower to extract the natural pigment from the dried flowers. Place the solution in a warm bath for 6 hours

2

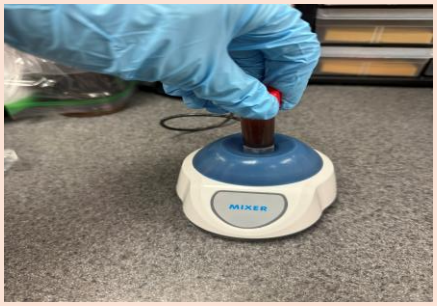


Blend 1 tbsp jojoba oil and 1 tbsp coconut oil with 1 tsp pomegranate seed oil to form the nourishing base

3

Stir in ½ tsp vitamin E oil to enhance nourishment and extend shelf life.

4



Mix thoroughly until botanical compounds and color are evenly dispersed

5

Funnel the finished blend into roll-on applicators and securely cap them

6

Label the containers and store in a cool, dry place for final product.

METHODS & PROCEDURES

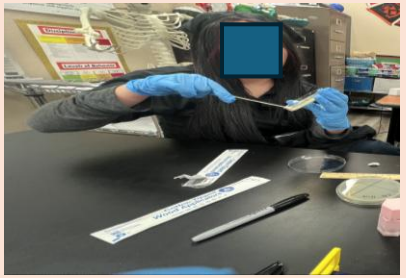
1

Preparation of microbial dilution following the 0.5 McFarland Standard

2

Divide the petri dish in four quadrants

3

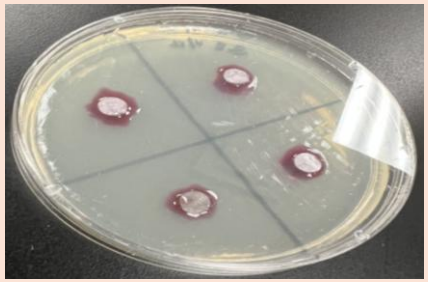


Spread the microbial dilution using a sterile cotton swab into the petri dish

4

Soak the sterile paper discs into the bio-blush

5



Place the soaked paper discs into each of the quadrant

6

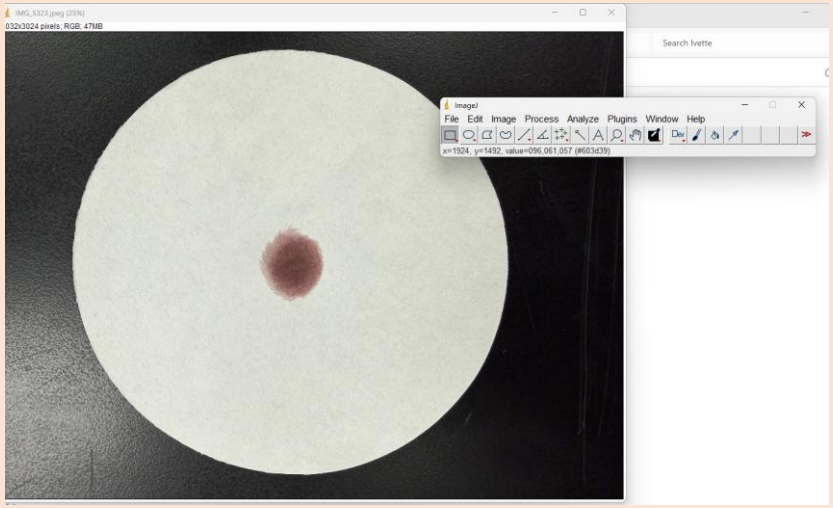
Place the samples inside a digital incubator set at 37 degrees Celsius for 24 hours

Bio-Lip Tint in Different Skin Tones

The Bio-Lip tint produced a visible and consistent reddish coloration across different skin tones. The formulation maintained a natural-looking hue without appearing too faint or overly saturated, demonstrating its suitability for diverse skin types.

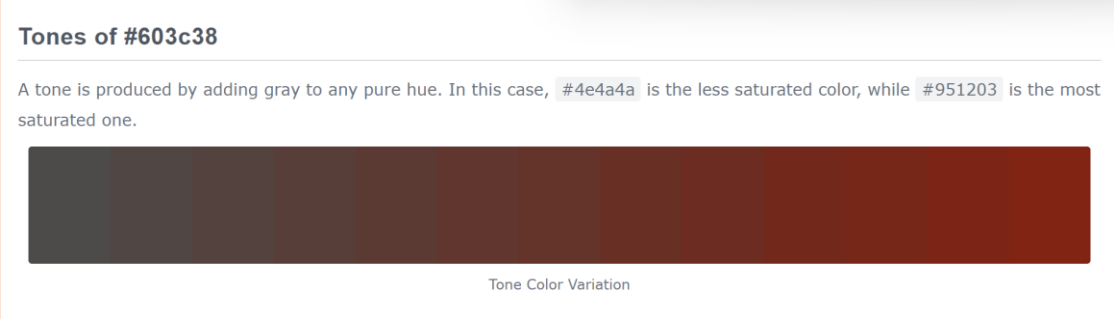
RESULTS- Color Identification

To identify the color, I used ImageJ program to detect the RGB composition of the bio-lip oil.



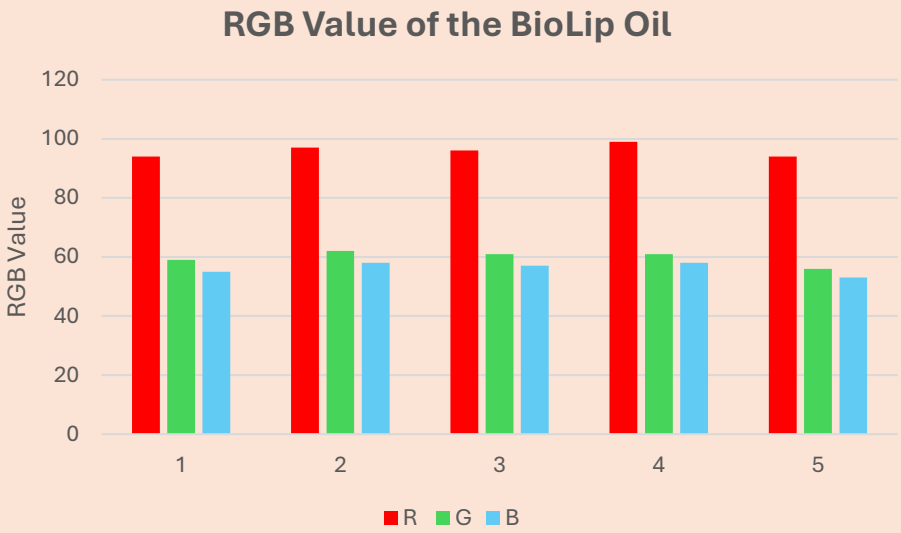
After identifying the RBG value, I uploaded the data to Colorhexa.com to identify the color.

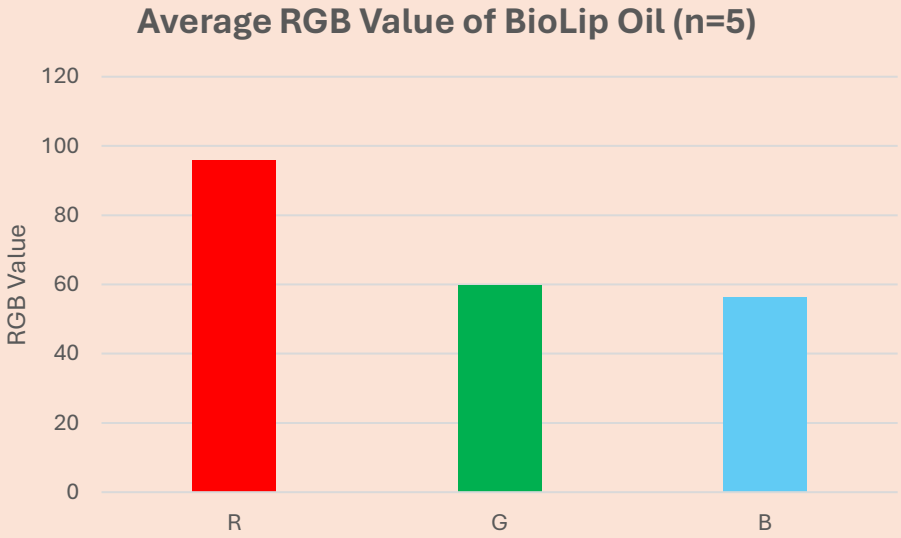
Hex number: #603c38



Based on the result, the bio-lip oil produced a very dark red coloration. Above are the different tone variations of the color.

RESULTS- RGB Composition





The RGB analysis shows that the red channel is consistently higher than the green and blue channels across all five trials. This indicates that the Bio-Lip oil has a stable reddish color profile. The small variation between trials also confirms good color consistency and reproducibility. Because the red tones dominate and remain uniform, the formulation is well-suited for lip tint coloration, where stable and natural red hues are desired.

RESULTS- Color Consistency

To check the color consistency of the bio-lip oil, I converted the RGB values to L*a*b* values using an online converter. Afterwards, I calculated the delta E values using this formula:

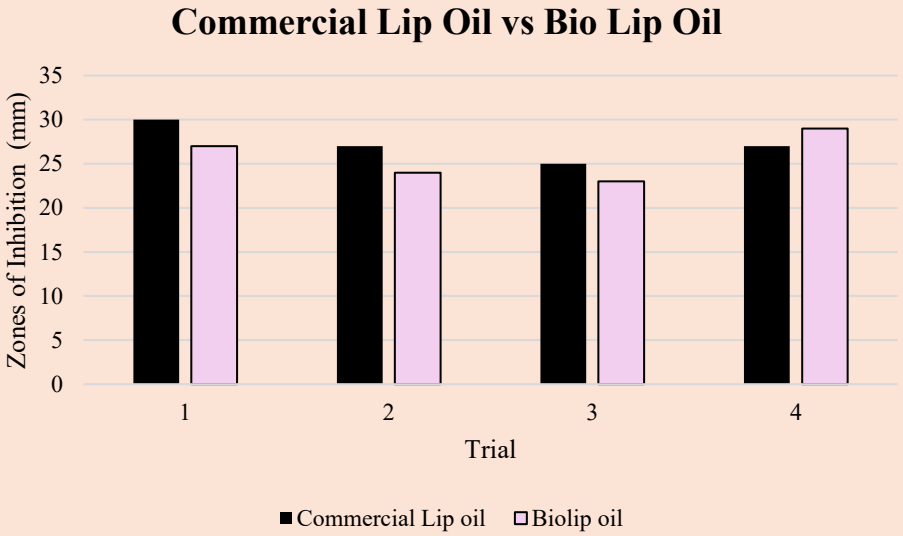
$$\Delta E = \sqrt{(L_2 - L_1)^2 + (a_2 - a_1)^2 + (b_2 - b_1)^2}$$

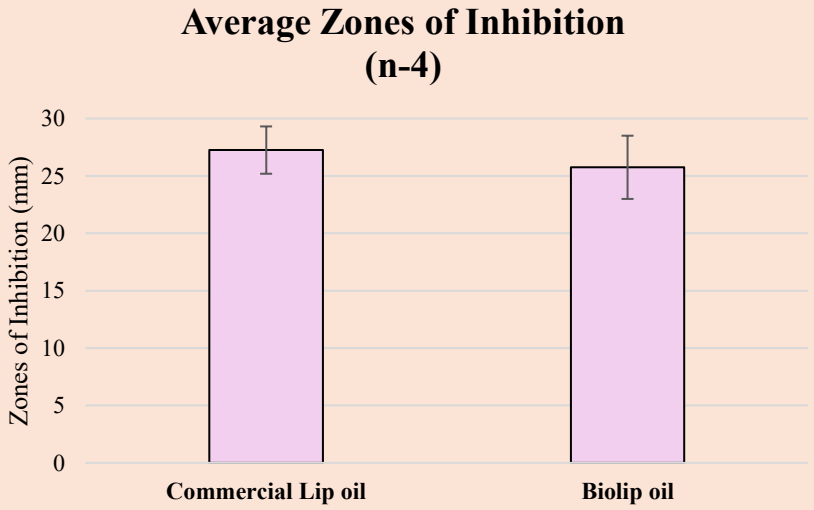
- **L*** = lightness
- **a*** = green to red
- **b*** = blue to yellow

	S1	S2	S3	S4	S5
S1	0	1.29	0.86	1.89	1.82
S2	1.29	0	0.43	1.51	2.75
S3	0.86	0.43	0	1.53	2.4
S4	1.89	1.51	1.53	0	2.15
S5	1.82	2.75	2.4	2.15	0

The ΔE heatmap shows the color differences between all five samples. Most ΔE values are below 2, indicating very small and barely perceptible differences, which confirms strong color consistency across the formulations. Although Sample 5 shows slightly higher differences, all values remain within an acceptable range, making the formulation suitable for lip tint coloration.

RESULTS- Antimicrobial Test





T-test Result:
p= 0.297

The zones of inhibition for the BioLip oil against Staphylococcus epidermidis were comparable to those of the commercial lip oil across all four trials. Although the commercial product showed slightly larger average inhibition zones, the t-test result ($p = 0.297$) indicates that the difference between the two formulations was not statistically significant. This suggests that the BioLip oil provides antimicrobial activity similar to the commercial lip oil against S. epidermidis.

Discussion

- The Bio-Lip formulation produced a stable reddish color profile, with the red channel consistently higher than the green and blue channels across all trials.
- Delta E analysis showed that most color differences were below 2, indicating strong color consistency and reproducibility suitable for cosmetic applications.
- The tint maintained a visible and natural-looking hue across different skin tones, showing good adaptability and potential for inclusive cosmetic use.
- The BioLip oil showed antimicrobial activity against *Staphylococcus epidermidis* comparable to the commercial lip oil, with no statistically significant difference between the two formulations ($p = 0.297$).

Conclusion

The Bio-Lip oil showed consistent color, adaptability across skin tones, and improved antimicrobial activity, demonstrating its potential as a multifunctional lip tint.

Future Plans

- Perform long-term stability and oxidation testing.
- Conduct quantitative antimicrobial assays with more microbial strains.
- Optimize pigment concentration for improved color performance.
- Evaluate safety, pH, and skin compatibility.

References

Cosmetic Industry Background Sources

Source: Statista - Beauty & Personal Care Market

Source: Environmental Working Group - Lipstick & Lip Gloss

Source: Vogue - Evolution of Lip Products

Source: Organic Monitor - Organic Personal Care Market