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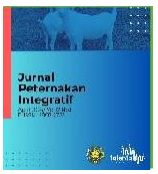

Organoleptic and Total Plate Count (TPC) Tests of Lanolin Lipstick Made from Sheep Wool with the Addition of Red Dragon Fruit (*Hylocereus polyrhizus*) Peel Extract

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ABSTRACT

The peel of red dragon fruit possesses potential as a source of natural colorant rich, which provides a bright and stable red color for an environmentally friendly alternative compared to synthetic dyes. This study aims to analyze the organoleptic quality and Total Plate Count (TPC) and irritation test of lipstick formulations utilizing lanolin from sheep wool and the addition of red dragon fruit peel extract (*Hylocereus polyrhizus*). The study's background is the potential of lanolin as a moisturizing base for lipstick and red dragon fruit peel extract as a natural coloring alternative to synthetic dyes. Lipstick was formulated with varying concentrations of red dragon fruit peel extract (0%, 20%, 40%, and 60%) to observe the effect on product quality. The research includes organoleptic tests (color, aroma, texture, preference) and TPC tests to analyze the number of microorganisms in the lipstick also irritation test. The results showed that the addition of red dragon fruit peel extract significantly influenced the organoleptic properties and microbial safety of the lipstick. The formulation with 60% extract (P3) exhibited the most appealing color, a pleasant aroma preferred by panelists, and favorable texture. Furthermore, the TPC test indicated that the P3 formulation had the lowest microbial count, suggesting better microbiological safety. The irritation test also confirmed that the 60% extract addition caused no signs of irritation.The treatment with the addition of 60% red dragon fruit peel extract (P3) showed the best results.

Keywords: Lipstick, Lanolin, Red Dragon Fruit Peel, Organoleptic

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1. Introduction

Lipstick is a widely used cosmetic product applied on a daily basis. Beyond its aesthetic function, lipstick use also contributes to enhancing an individual's self-confidence [1]. Lipstick is a complex formulation consisting of color pigments evenly dispersed in a wax base. This wax base, which is generally a mixture of various types of waxes such as lanolin, beeswax, carnauba wax, and candelilla wax, provides texture and form to the lipstick [2].

Lanolin, also known as adeps lanae, is a natural oily substance extracted from sheep's wool. It contains approximately 25% water [3]. Lanolin often referred to as wool wax, is a natural emollient that is

highly effective in moisturizing and softening the skin. Its molecular structure enables the formation of a protective layer on the skin, which effectively prevents dehydration and helps retain moisture [4]. Sheep's wool, which is often considered a byproduct of livestock farming in Indonesia, has frequently been overlooked and ends up as waste. A lack of knowledge regarding wool processing techniques and the limited market demand for wool-based products are the main causes for the large-scale disposal of this wool waste [5]. This has led to a lack of public awareness about wool's significant potential, especially its natural fat content known as lanolin [6]. These properties render lanolin a highly valuable raw material in the cosmetics industry. Leveraging lanolin allows for the development of various cosmetic products, including moisturizers, soaps, and lipsticks [7].

The application of color to lipstick is an important aspect. The sources of lipstick colorants can be divided into two main groups: artificial (synthetic) colorants and those from natural sources [8]. Dragon fruit peel waste holds great potential that is currently underutilized. Its high antioxidant content makes it valuable for combating free radicals in the body. Extracting dragon fruit peel can open opportunities to produce various natural food and cosmetic products that are beneficial to health [9]. The peel of red dragon fruit (*Hylocereus polyrhizus)* contains a high concentration of color pigments, resulting in a deep red hue. This natural pigment presents a potential alternative to synthetic colorants. Methanolic extraction of red dragon fruit peel has revealed the presence of phenolic compounds and betacyanins. Therefore, dragon fruit peel is highly suitable for use as a pigment in cosmetics, particularly in lipstick formulation [10]. This study aims to utilize that potential by developing a natural lipstick formulation based on dragon fruit peel, offering a healthier and more environmentally friendly alternative to synthetic lipsticks [11]. Many people are still unaware that lanolin, a by-product of livestock farming, can be used as a primary ingredient in modern lipstick production. In addition, dragon fruit peel serves as a strong natural pigment, making it a valuable coloring agent in lipstick formulations [12].

Several studies have been conducted on the use of lanolin in cosmetics, particularly in lipstick formulations with the addition of roselle flower [7]. However, no research has yet been carried out on the formulation of lipstick using lanolin combined with dragon fruit peel extract. Based on this background, the researcher aims to explore the development of a lipstick product using lanolin and dragon fruit peel extract.

2. Method

This research will be conducted at the Animal Production Laboratory, Faculty of Agriculture, Universitas Sumatera Utara; the Biochemistry Laboratory, Faculty of Mathematics and Natural Sciences; and the Cosmetology Laboratory, Faculty of Pharmacy, Universitas Sumatera Utara, from January 2025 to April 2025.

2.1. Materials

The materials required for the formulation of this lipstick include wool to be extracted (lanolin), beeswax, macerated dragon fruit peel, 70% ethanol, cetyl alcohol, oleum rosae, and methylparaben.

2.2. Tools

This research utilized equipment such as a spatula, stirrer, sieve, pan, thermometer, laboratory glassware (Pyrex), analytical balance (Ohaus), rotary evaporator, dish, water bath (Memmert), dropper, electric stove, lipstick mold (roll-up type), and freezer. Tools used for physical testing included a brush and patch, while the organoleptic test involved 30 panelists to evaluate color, aroma, and texture, along with the use of Plate Count Agar (PCA) as the testing medium.

2.3. Study design

The design used in this study was a completely randomized design (CRD) with 4 treatments and 3 replicates. The treatments to be used are:

P0: (Control) marinade without using draon fruit peel extract
P1: Using 20% addition of dragon fruit peel extract
P2: Using 40% addition of dragon fruit peel extract
P3: Using 60% addition of dragon fruit peel extract

Table 1. Lanolin Lipstick Formulation with the Addition of Dragon Fruit Peel Extract (*Hylocereus Polyrhizus*)

Materials	Formulation (Weight)			
	P0 (g)	P1(g)	P2(g)	P3(g)
Lanolin	6,40	6,40	6,40	6,40
Beeswax	2,60	2,60	2,60	2,60
Dragon Fruit Peel Extract	**0,00**	**1,28**	**2,56**	3,84
Oleum Rosae	0,02	0,02	0,02	0,02
Paraben	0,40	0,40	0,40	0,40

* The weight of dragon fruit peel extract is based on the weight of lanolin with the addition of dragon fruit peel concentration. P0: 0%, P1: 20%, P2: 40%, and P3: 60% [7].

2.3 Research Parameters

2.3.1 Total Plate Count (TPC) Test

To examine the microbiological content of lanolin, a Total Plate Count (TPC) test can be performed on the 2nd and 7th days after storage at room temperature (37°C). One gram of lipstick is dissolved in physiological saline (NaCl) and then diluted through four serial dilutions. The diluted solution is mixed with Plate Count Agar (PCA) in a petri dish. The petri dish is then incubated for 24 hours at room temperature to allow bacterial growth. Subsequently, the number of bacterial colonies that grow is counted to determine the cleanliness level of the lipstick [7].

2.3.2 *Organoleptic*

Color

Color is the first parameter that determines panelists' acceptance of a product

Table 2. Organoleptic test of color

Specifications	Value
Color	
Brown	5
Light brown	4
Cream with brown tint	3
Cream	2
White	1

Texture

Texture is one of the determining factors of the quality of a lipstick product that needs to be considered.

Table 3. Organoleptic test of texture

Specifications	Value
Texture	
Very fine and smooth	5
Smooth	4
Moderately smooth	3

Rough	2
Very rough	1

Aroma
Aroma is one of the determining factors in whether a product is accepted or not, where scent can be used as an indicator of damage to the product if the scent in the product is no longer normal.

Table 4. Organoleptic test of aroma

Specifications Aroma	Value
No detectable smell of dragon fruit peel	4
Slightly perceptible smell of dragon fruit peel	3
Moderately perceptible smell of dragon fruit peel	2
Clearly perceptible smell of dragon fuit peel	1

2.3.3 Irritation Test

Irritation testing is essential in the formulation of lipsticks prior to commercialization. This test can be conducted by applying a small amount of the lipstick preparation onto the inner forearm of the panelists. A total of six panelists are required for this test. The forearm is chosen as the application site because it is both accessible and easy to observe. Additionally, the area is sufficient in size to allow comparison between different treatments. Therefore, the forearm is considered a suitable site for initial irritation screening.

Each treatment area on the forearm will be marked for distinction, and the skin's reaction to the lipstick will be observed at intervals of 15 minutes, 60 minutes, 180 minutes, and 300 minutes. Signs of irritation are indicated by sensations such as itching or stinging, which will be recorded accordingly [13] [14].

3. Result and discussion

3.1. Total Plate Count (TPC)

The results of the research showed that the addition of dragon fruit peel extract to the manufacture of lanolin lipstick had a significally different effect in the total bacterial plate number during the 7-day storage period. The results of the ALT analysis can be seen in Table 5.

Table 5. Total palte count of lanolin lipstick during storage

Days	Total Plate Count (log CFU g^{-1})			
	P0	P1	P2	P3
2	$4,97\pm 0,01^{cd}$	$4,79 \pm 0,06^{bcd}$	$4,69\pm0,18^{abc}$	$4,38 \pm 0,09^{a}$
7	$5,15 \pm 0,01^{d}$	$4,98 \pm 0,19^{cd}$	$4,78 \pm 0,21^{bc}$	$4,55 \pm 0,05^{ab}$

*Numbers in the same row indicate a significant difference (P<0,05). P0: 0%, P1: 20%, P2: 40%, P3: 60%

Microbial contamination testing on lanolin-based lipstick formulated with dragon fruit peel extract showed varying results across treatments (P0–P3) on day 2. The total plate count (TPC) varied significantly, with P3 (60% extract) showing the lowest microbial load (4.38 ± 0.09 log CFU g^{-1}), indicating the strongest antimicrobial effect. In contrast, P0 (control) had the highest count (5.15 ± 0.01 log CFU g^{-1}) with high variability. Increasing extract concentrations from 20% (P1: 4.79) to 40% (P2: 4.69) gradually reduced microbial growth, further supporting the extract's antimicrobial potential. Statistically significant differences (indicated by different superscript letters in the table) highlight the extract's effectiveness in inhibiting microbial growth early in storage. These findings suggest that dragon fruit peel extract, particularly at 60%, may serve as a natural antimicrobial agent in lipstick formulations, offering promising potential as an alternative preservative in cosmetics.

On day 7, Total Plate Count (TPC) analysis revealed statistically significant differences in microbial counts among treatments (P0–P3) ($P<0.05$). The control group (P0) exhibited the highest microbial load (5.15 log CFU g^{-1}), indicating continued microbial growth in the absence of inhibitory agents. The 20% extract treatment (P1) showed an increased count of 4.98 log CFU g^{-1}, though still lower than the control. A further reduction was observed in the 40% extract group (P2), with a TPC of 4.78 log CFU g^{-1}, suggesting enhanced antimicrobial activity. The 60% extract group (P3) consistently showed the lowest microbial count (4.55 log CFU g^{-1}), significantly different from P0 and P1.

These differences, marked by distinct superscript letters, confirm that the 60% dragon fruit peel extract maintained the strongest antimicrobial effect over the 7-day storage period. While all groups experienced microbial growth, higher extract concentrations more effectively suppressed this increase. These results further support the potential of dragon fruit peel extract as a natural antimicrobial agent in lipstick formulations, contributing to improved microbiological stability during storage.

3.2. Organoleptic

Organoleptic tests assess the color, aroma, and texture of lanolin-based lipstick with dragon fruit peel extract to evaluate its sensory quality. Hedonic tests measure panelists' preference and perceived quality of each parameter. The results of the hedonic and hedonic quality tests are presented in Table 6.

Table 6. Organoleptic Test Results of Lanolin Lipstick with Dragon Fruit Peel Extract Addition

Evaluation	Treatment			
	P0	P1	P2	P3
Hedonic				
Color	2.66 ± 0.80	2,63 ± 1,15	2,73 ± 0,86	2,9 ± 1,12
Texture	2.93 ± 0.94	2,9 ± 0,71	3,3 ± 0,95	3,26± 0,94
Aroma	3.06 ± 1.04	2,86 ± 1,00	3,2 ± 0,88	3,1 ± 0,92
Hedonic quality				
Color	1.8 ± 0.61 ^{c}	3.4 ± 7.2 ^{a}	4.23 ± 0.50 ^{b}	5 ± 0^{ab}
Texture	2.90 ± 0.88 ^{a}	2.86 ± 0.81 ^{a}	2.76 ± 0.97 ^{a}	2.53 ± 0.86 ^{a}
Aroma	2.13 ± 0.89 ^{a}	3.03 ± 1.06	3.33 ± 0.92 ^{a}	3.83 ± 0.98 ^{a}

*Values in the same row followed by different lowercase letters indicate a significant difference ($P<0.05$). The treatments were as follows: P0 with 0%, P1 with 20%, P2 with 40%, and P3 with 60% dragon fruit peel extract. The hedonic scale used was: (1) strongly dislike, (2) dislike, (3) slightly like, (4) like, and (5) strongly like. The hedonic quality scale for color was: (1) white, (2) cream, (3) brownish cream, (4) light brown, and (5) brown; for texture: (1) very smooth, (2) smooth, (3) slightly smooth, (4) rough, and (5) very rough; and for aroma: (1) strong lanolin scent, (2) lanolin scent, (3) slightly lanolin scent, (4) slightly dragon fruit peel extract scent, and (5) dragon fruit peel extract scent.

3.2.1. Color

Color is an important factor in lipstick selection, thus color parameters must be tested to ensure optimal shade. Hedonic tests showed no significant difference (P>0.05), with panelists' liking scores ranging from 2.66 to 2.9, indicating dislike. The dragon fruit peel extract has a dark brown color due to heating processes. Adding the extract alters the lipstick color from cream to dark brown, with intensity increasing alongside extract concentration. These findings align with previous studies indicating that anthocyanin pigments in dragon fruit peel provide natural coloration, although final color is affected by heating and interactions with other ingredients.

3.2.2. Texture

The hedonic test scores for lipstick texture with 0%, 20%, 40%, and 60% dragon fruit peel extract ranged from 2.93 to 3.3, indicating panelists' responses between "slightly like" and "dislike," with no significant differences (P>0.05). This suggests that extract addition did not affect panelists' preference for texture. However, hedonic quality scores ranged from 2.53 to 2.9, indicating a "smooth" texture, showing that the extract influenced texture characteristics. Texture was also affected by base ingredients such as beeswax and lanolin. Beeswax helps create a homogeneous and stable structure due to its oil retention and binding properties. Lanolin at an optimal concentration of 17% contributes to a smooth lipstick texture.

3.2.3. Aroma

The average hedonic test for lipstick aroma showed no significant difference among treatments (P>0.05), with scores ranging from 2.86 to 3.2, indicating "dislike" to "slightly like." However, aroma quality scores did show a significant difference (P<0.05), ranging from 2.13 to 3.83, suggesting variation in aroma intensity—from no lanolin scent to a noticeable dragon fruit peel extract scent. These findings are consistent with previous research stating that the distinct aroma of the extract can mask the base lanolin odor, improving overall aroma acceptance. Nonetheless, panelist preference remained moderate, likely due to the extract's strong natural aroma.

3.3. Irritation test

These results align with [15], who reported that red dragon fruit peel extract caused no skin irritation during short-term cosmetic application. [6] also noted that lanolin is generally safe and acts as an emollient, except for individuals with lanolin allergies. The extract's bioactive compounds—anthocyanins, flavonoids, and vitamin C—may provide antioxidant and soothing effects, reducing irritation risk. Based on BPOM standards (2015), the irritation tests met cosmetic safety criteria, with no moderate or severe reactions observed across all formulations. Thus, lanolin-based lipstick with up to 60% extract is considered safe and suitable for use. However, further testing, such as in vitro assays, is necessary to support product readiness for commercialization. The results of the irritation analysis of the lipstick formulation will be presented in Table 7.

Table 7. Irritation Test Results

Lipstick Formulation	**Observation time (minutes)**			
	15	**60**	**180**	**300**
P0	-	-	-	-
P1	-	-	-	-
P2	-	-	-	-
P3	-	-	-	-

*Notes:
– : No visible signs of irritation
+ : Mild irritation
++ : Moderate irritation
+++ : Severe irritation

4. Conclusion

4.1 Conclusion

1. The addition of 60% red dragon fruit peel extract resulted in lipstick with attractive color, pleasant aroma, good texture, and the lowest microbial count.

2. The addition of 60% red dragon fruit peel extract formulation caused no irritation, indicating it is safe and suitable for use.

4.2 Recommendations

.Further studies are recommended to optimize the lipstick formulation, including exploring different extract concentrations and other ingredients. In addition, stability and clinical testing are necessary to ensure the product's safety and effectiveness for long-term use.

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