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Formulation And Evaluation Of Lip Balm Preparation From Watermelon Seed Extract (*Citrullus lanatus*) As Lip Moisturizer

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ABSTRAK

Penelitian ini bertujuan untuk memformulasikan dan mengevaluasi sediaan lip balm yang mengandung ekstrak biji semangka (*Citrullus lanatus*) sebagai agen pelembap bibir alami yang aman dan efektif, seiring meningkatnya kebutuhan akan kosmetik berbahan dasar tanaman. Ekstrak diperoleh melalui metode maserasi, kemudian dibuat empat formula lip balm dengan konsentrasi ekstrak sebesar 0%, 3%, 6%, dan 9%. Evaluasi sediaan meliputi uji karakteristik fisik, uji iritasi, uji hedonik, serta uji stabilitas selama penyimpanan 10 minggu. Hasil penelitian menunjukkan bahwa seluruh formula bersifat stabil, memiliki nilai pH dan titik lebur yang sesuai, serta tidak menimbulkan iritasi. Peningkatan konsentrasi ekstrak secara signifikan meningkatkan daya sebar dan efektivitas pelembap, dengan formula 9% menjadi yang paling disukai oleh panelis. Dengan demikian, ekstrak biji semangka berpotensi sebagai bahan aktif alami yang aman dan efektif untuk sediaan perawatan bibir.

Kata kunci: *Citrullus lanatus*, *lip balm, ekstrak biji semangka, pelembap alami, evaluasi formulasi.*

ABSTRACT

This study aimed to formulate and evaluate a lip balm preparation containing watermelon seed extract (*Citrullus lanatus*) as a safe and effective natural lip moisturizer, in response to the increasing demand for plant-based cosmetic products. The extract was obtained using the maceration method, and four lip balm formulations were prepared with extract concentrations of 0%, 3%, 6%, and 9%. The preparations were evaluated through physical characterization tests, irritation assessment, hedonic evaluation, and stability testing over a 10-week storage period. The results indicated that all formulations were stable, exhibited acceptable pH values and melting points, and did not cause irritation. Increasing extract concentration significantly improved spreadability and moisturizing performance, with the 9% formulation receiving the highest preference among panelists. These findings suggest that watermelon seed extract has strong potential as a natural and safe active ingredient for lip care formulations.

***Keywords*:** *Citrullus lanatus*, lip balm, watermelon seed extract, natural moisturizer, formulation evaluation.

1. INTRODUCTION

Cosmetics, particularly lip care products, have become an essential necessity because the skin on the lips is highly vulnerable to environmental factors such[1] as extreme temperatures and UV exposure, which may cause dryness and chapping[2]. Although many

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commercial products still contain synthetic[3] ingredients, such as petroleum jelly, which may potentially lead to adverse effects, there is an increasing trend toward the use of natural-based cosmetic ingredients[4].

Previous research has shown the potential of watermelon fruit and rind extracts as moisturizers and UV protectors[3]. However, exploration of watermelon seeds for similar applications is still limited. Empirically, watermelon seeds have long been used in traditional medicine[5], and phytochemical studies show the presence of beneficial compounds such as flavonoids and essential fatty acids (especially linoleic acid)[6], which has natural emollient properties and potentially helps maintain lip moisture[5]. Therefore, this study aims to fill this gap by formulating a lip balm preparation using watermelon seed extract as the main active ingredient and testing its effectiveness as a lip moisturizer.

2. RESEARCH METHOD

Time and Place of Research

This research was conducted from March to April 2025 at the Laboratory of the Faculty of Mathematics and Natural Sciences, Indonesian Christian University Tomohon.

Materials and Instruments

The instruments used in this research included an analytical balance, blender, spatula, porcelain dish, measuring cylinder, water bath, digital pH meter, microscope slide, beakers, filter paper, glass jars, and a rotary evaporator.

The materials consisted of watermelon seed extract, n-hexane, cera alba, lanolin, methylparaben, glycerin, olive oil, and rabbits used as experimental subjects for the irritation test.

Type of research

This research employed an experimental laboratory approach aimed at formulating, preparing, and evaluating lip balm preparations containing watermelon seed extract[7].

Research procedure

1. Preparation of Watermelon Seed Extract
   Fresh watermelon seeds were obtained from a plantation in Matani Village, South Minahasa. A total of 705 g of seeds were washed and oven-dried at 60°C for 60 minutes[7] until the weight decreased to 455 g. The dried seeds were then ground into powder[8]. Extraction was carried out using the maceration method by soaking 455 g of seed powder in 1 L of n-hexane for 3 × 24 hours. The resulting macerate was filtered and concentrated using a rotary evaporator at 40°C until a thick extract was obtained[2].
2. Formulation of Lip Balm Preparations
   Four lip balm formulations were prepared: a control formulation without extract (F0) and three formulations containing watermelon seed extract at concentrations of 3% (F1), 6% (F2), and 9% (F3). All formulations used the same base composition, consisting of 10% cera alba, 10% lanolin, 0.03% methylparaben, 5% glycerin, and olive oil added up to 10 g.
   The preparations were produced using the melting method. Cera alba and lanolin were melted at 62–65°C, followed by the addition of methylparaben, glycerin, and olive oil with continuous stirring until a homogeneous mixture was formed8. Watermelon seed extract was then incorporated into each formula, poured into molds, and allowed to solidify at room temperature[4].

Table 1. Formula LipBalm

Material	Formula (amount %)				Description
	F0	F1	F2	F3	
(1)	(2)	(3)	(4)	(5)	(6)
Watermelon seed extract	-	3	6	9	Active substance
Cera alba	10	10	10	10	Candle
Lanolin	10	10	10	10	Fat
Metil paraben	0,03	0,03	0,03	0,03	Preservative
Gliserin	5	5	5	5	Humectant
Olive oil	Ad 10	Ad 10	Ad 10	Ad 10	Oil phase

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3. Evaluation of Lip Balm Preparations
   The lip balm formulations prepared in this research were evaluated through the following tests:
   Organoleptic Test: Visual observation of changes in color, odor, and texture during one week of storage[9].
   Homogeneity Test: Examination of the preparation between two glass plates to detect coarse particles[2].
   pH Test: Measurement using a digital pH meter; preparations were considered acceptable if the pH ranged from 4.5 to 7[10].
   Spreadability Test: Determination of spread diameter using the glass plate method[11].
   Melting Point Test: Assessment of melting point at 50°C[12].
   Irritation Test: Conducted on rabbits using the patch test method, with erythema and edema observed for 72 hours[13].
   Hedonic Test: Preference evaluation by 30 panelists regarding aroma, texture, ease of application, and moisturizing effect[14].
4. Stability Test
   Stability testing in this research was carried out over a period of 10 weeks by monitoring organoleptic characteristics, pH, and homogeneity of the formulations[7].

Data Analysis

Quantitative data obtained in this research from melting point, spreadability, and hedonic tests were analyzed using Analysis of Variance (ANOVA) with SPSS software to determine significant differences among formulations. Qualitative data from organoleptic evaluation, homogeneity, pH, and irritation tests were presented descriptively in tabular form.

3. RESULTS AND DISCUSSION

Production of Watermelon Seed Extract

The extraction of watermelon seeds obtained from the Empat Bersaudara plantation in Matani Village, South Minahasa, produced a thick extract with an orange to reddish-yellow appearance. The extraction yielded 20 g of concentrated extract from 455 g of dried seed powder. The procedure began with oven-drying at 60°C to reduce the moisture content of the seeds, followed by maceration using n-hexane as the solvent. This method was selected because n-hexane effectively extracts lipid components, including linoleic acid and other essential fatty acids, which function as natural emollients. The resulting extract was subsequently incorporated as the active ingredient into lip balm formulations at concentrations of 3% (F1), 6% (F2), and 9% (F3), while the formulation without extract served as the negative control (F0).

Evaluation Results of LipBalm Preparation

1. Organleptic test
   Organoleptic observations conducted over one week of storage demonstrated that all lip balm formulations exhibited good physical stability. The control formulation (F0) appeared cloudy white with a mild beeswax aroma. In contrast, formulations containing watermelon seed extract (F1, F2, and F3) showed colors ranging from pale yellow to bright yellow and possessed a characteristic nutty odor derived from the extract. All formulations maintained a semi-solid consistency, which is considered suitable for lip application. The gradual increase in color intensity with higher extract concentrations indicates that watermelon seed extract contributes to the pigmentation of the preparation[15].

Table 2. Organoleptic Test Results

Formula	Color	Smell	Texture
(1)	(2)	(3)	(4)
F0	Murky white	A little beeswax	Semi solid
F1	Pale yellow	A little nutty	Semi solid
F2	Pale yellow	A little nutty	Semi solid
F3	Bright yellow	A little nutty	Semi solid

2. Homogeneity Test
   The homogeneity test confirmed that all formulations (F0–F3) exhibited a uniform distribution of ingredients. No coarse particles or granules were observed when the preparations were spread between two glass plates. This result indicates that the melting and mixing process successfully produced homogeneous lip balm preparations. The stability of the formulations may be attributed to the wax–oil phase formed by cera alba and olive oil, supported by lanolin, which acts as an emulsifying agent[12].

Tablel 3. Homogeneity Test Sesults

Formula	Homogeneous	Non-homogeneous
(1)	(2)	(3)
F0	√	-
F1	√	-
F2	√	-
F3	√	-

3. Melting Point Test
   The melting point evaluation demonstrated that all formulations complied with the Indonesian National Standard (SNI 16-4399, 1996), which specifies an acceptable melting point range of 50–70°C. The average melting point increased with higher extract concentrations, recorded as 50°C (F0), 51°C (F1), 52°C (F2), and 55°C (F3). This finding suggests that watermelon seed extract influences the structural properties of the preparation, enhancing its resistance to heat[10]. Statistical analysis using ANOVA (p-value < 0.001 and F-value = 289.000) demonstrated a significant difference in melting points between formulas. This confirms that the extract concentration substantially affects the thermal stability of the product, which plays an important role in maintaining the shape and consistency of lip balm at room temperature[16].

Table 4. Melting Point Test Result

Formula	Replication	Temperature
(1)	(2)	(3)
F0	1	*50°C*
	2	*50°C*
F1	1	*51°C*
	2	*51,1°C*
F2	1	*52°C*
	2	*52,3°C*
F3	1	*55°C*
	2	*55,2°C*

4. Spreadability Test
   Spreadability is an essential parameter that determines the ease of product application. In this research, all lip balm formulations demonstrated adequate spreadability, with diameters ranging from 3.25 cm to 4.50 cm. These values fall within the optimal spreadability range of 3–5 cm. ANOVA results indicated a statistically significant difference in spreadability among formulations (p-value = 0.022; F = 10.692), suggesting that the concentration of watermelon seed extract influences the spreading capacity of the preparation[16].

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Table 5. Dispersal Test Results

Formula	Replication	Spread power (cm)
(1)	(2)	(3)
F0	1	3,2
	2	3,3
F1	1	3,4
	2	4
F2	1	3,6
	2	4,4
F3	1	3,5
	2	4,5

5. pH Test
   The pH test results indicate that all formulas have pH values that are safe and comfortable for lip skin, ranging from 6.50 to 6.86. These values are within the physiological pH range of lip skin (4.5–7.0), which aims to ensure that the lip balm preparations in this study will not cause irritation. The decrease in pH occurs with the addition of the extract, but it remains safe and stable[10].

Table 6. pH Test Results

Formula	Homogeneous
(1)	(2)
F0	*6,86*
F1	*6.68*
F2	*6,50*
F3	*6,59*

6. Hedonic Test
   A hedonic evaluation involving 30 panelists revealed variations in preference among the formulations, particularly regarding moisturizing performance and ease of application.
   The formulation containing 9% watermelon seed extract (F3) was the most favored, receiving the highest preference scores for moisture (70%) and ease of application (81.43%).
   ANOVA results confirmed significant differences among formulations, indicating that higher extract concentrations enhance product performance due to the presence of emollient fatty acids[17].

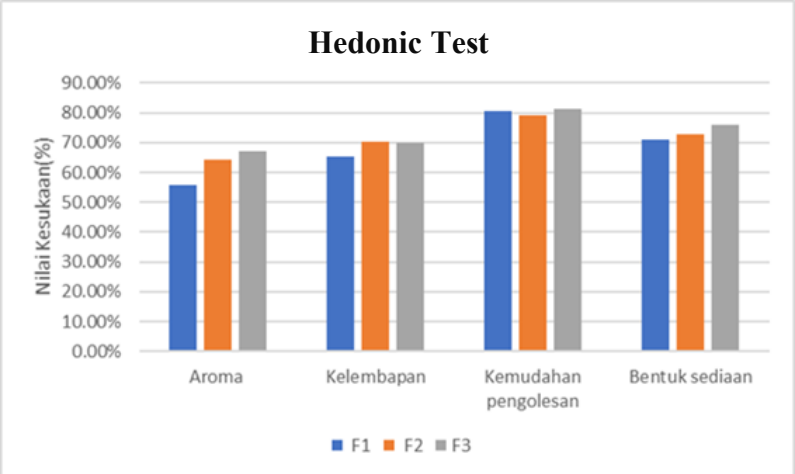

Figure 1. Hedonic Test Results

Table 7. Results of the Repeated Measures ANOVA Test

Parameter	*Mauchyl's Test (p)*	*E(df1, df2)*	*p-value*	*Partial Eta Squared*	description
humidityari	0,694	F(2,58) = 9,256	< 0,001	0,242	There is a significant difference between the formulas. Formula 1 differs significantly from formulas 2 and 3.
Aroma	0,192	F(2,58) = 0,335	< 0,717	0,011	There is no significant difference between formulas in terms of aroma
Dosage form	0,060	F(2,58) = 0,921	< 0,404	0,031	There is no significant difference between the formulas. The effect of the formula is very small.
Ease of application	0,253	F(2,58) = 9,667	< 0,001	0,250	There are significant differences between the formulas. The effect is medium to large.

7. Iritation test
   Irritation test results showed that all formulas, including those containing watermelon seed extract, did not cause erythema (redness) or edema (swelling). This proves that the formulation is safe and does not cause skin irritation. This safety is supported by the natural emollient content in the extract, which effectively maintains moisture without side effects[12].

Table 8. Irritation Test Results

Formula	Reaction	
	Errythema	*Edema*
(1)	(2)	(3)
F0	non-irritating	non-irritating
F1	non-irritating	non-irritating
F2	non-irritating	non-irritating
F3	non-irritating	non-irritating

Lip Balm Stability Evaluation

The stability evaluation of the lip balm preparation was carried out over 10 weeks, showing very good results, as all formulas maintained their organoleptic characteristics and homogeneity without any significant changes in color, rancid odor, or phase separation.

pH re-testing after 10 weeks showed good pH stability, with all formulas remaining within a safe range for lip skin. Although F1 and F2 had a slight increase in pH, their values are still acceptable for lip balm products. This stability indicates strong formulation integrity.

Table 9. LipBalm Stability Evaluation Results

Test parameter	Formula	1 week	10 week
Organoleptic	F0	Semi-solid with a cloudy white color, this preparation has the characteristic aroma of beeswax.	Its semi-solid consistency has a pale yellow to bright yellow color with a stable aroma, resembling beeswax.
	F1, F2, F3	Having a semi-solid texture, this substance is pale yellow to bright yellow in color with a	ranging from pale yellow to bright yellow, with a semi-solid texture and a slightly

		slightly nutty aroma.	nutty aroma.
homogeneity	F0, F1, F2, F3	homogeneous	Homogeneous
pH	F0, F1, F2, F3	6.50 - 6.86	F1(7.28), F2(7.42), F3(6.86).

4. CONCLUSION

Based on the research conducted, watermelon seed extract (*Citrullus lanatus*) was successfully formulated into a lip balm preparation that met the required physical evaluation standards, including organoleptic stability, homogeneity, appropriate pH, melting point, and satisfactory spreadability. All formulations were proven to be safe, as no signs of erythema or edema were observed during the irritation test, indicating that the preparations were non-irritating. Statistical analysis demonstrated that increasing the concentration of watermelon seed extract significantly enhanced the moisturizing effect and ease of application of the lip balm. Among all formulations, formula F3 containing 9% extract was the most preferred by panelists, particularly in terms of moisture improvement and user comfort. Meanwhile, the extract concentration did not significantly influence the aroma or the physical form of the preparation. Overall, this research concludes that watermelon seed extract has strong potential as an active natural ingredient for producing lip balm products that are safe, stable, effective, and well-accepted by consumers, with the optimal performance observed at a concentration of 9%.

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