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Rosella (*Hibiscus sabdariffa L.*) extract lip balm: optimization of the composition of beeswax and paraffin wax as a base.

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ABSTRACT

One of the main components of lip balm is wax. The wax content in the lip balm works to improve the consistency. In this study, a lip balm was prepared to contain rosella flower extract (*Hibiscus sabdariffa L.*), which contains anthocyanin and can be used as a natural dye. This study aimed to determine the effect of the combination of beeswax and paraffin wax as a wax base on the physical properties and physical stability of lip balm containing rosella flower extract (*Hibiscus sabdariffa L.*) so that the optimum composition can be obtained. Rosella flower extract (*Hibiscus sabdariffa L.*) was prepared by maceration method using 96% ethanol. The extract was formulated in eight formulas with variations of beeswax-paraffin wax and evaluated for physical properties (organoleptic, pH, melting point) and physical stability (organoleptic, pH every week). The optimum formula was obtained using a Simplex lattice design (SLD) with the help of Design-Expert® 10.0.1 software. The results of the simplex evaluation test using the one sample t-test at a 95% confidence level indicate that beeswax has a dominant influence in influencing pH and decreasing pH with design expert coefficient values of 2.09 and 0.50. Meanwhile, paraffin wax has a dominant influence on the melting point with a design expert coefficient value of 0.89. The composition of the two waxes did not affect the shape, texture, color, and scent based on organoleptic observations. The optimum formula for combining beeswax and paraffin wax is 8.02% and 12.31% to produce a product with a pH of 3.91, a melting point of 65.51°C, and the ability to maintain the pH for four weeks.

Keywords: Beeswax, Paraffin wax, Lip balm, *Hibiscus sabdariffa L.*, Simplex Lattice Design, Physical properties.

INTRODUCTION

Indonesia is a country that is located around the equator, causing Indonesia to have a tropical climate or what can be called a hot climate. Currently, Indonesia has high temperatures cause body and facial skin to burn. However, it's not only the skin of the body and face that can get burned by the sun; the lips are also the most sensitive parts, such as lips becoming dry and cracked and even actinic cheilitis. For this reason, to deal with the condition of the lips, a lip balm cosmetic preparation is needed, which is useful for caring for the lips (Putri, 2012). Lip balm can keep the lips moist because lip balm contains main components such as waxes, fats, and oils from natural or synthetic extracts to moisturize to prevent dryness and damage to the lips (Kwunsiriwong, 2016).

This study used a lip balm containing rosella flower extract (*Hibiscus sabdariffa L.*) as a natural coloring agent. The color here plays an important role in cosmetic preparations because it can attract consumer interest and provide aesthetic value. The chemical constituents of rosella flowers that give them their color are anthocyanins. Anthocyanins are pigments in flower petals that are red to blue (Rahayu et al., 2009). In addition to giving it a red color, the function of anthocyanin is as an antioxidant. Antioxidants can play a role in protecting against cell damage due to excessive absorption of ultraviolet light. It protects the cells on the lips from changes caused by free radicals (Maryani & Kristiana, 2008). So in this study, rosella flowers were used as dyes and antioxidants. 96% ethanol solvent was used to extract compounds from rosella flower petals. The solvent makes it easy to extract polar anthocyanins. Then a 2% rosella flower extract, which contains anthocyanin, is used as a lip balm color (Nurany et al., 2018). This was confirmed by the research of (Xavier et al., 2008), which extracted rosella flower extract by maceration using 96% ethanol.

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One of the main components of lip balm is the base. The base is an important main ingredient in the manufacture of decorative cosmetics, especially lip balms. According to (Williams, 2009), a base is a complex mixture of hydrocarbons and fatty acids combined with esters. The base is used to facilitate the lip balm to stick to the lips.

One of the solid waxes used in this research is beeswax. Beeswax is pure wax formed from Apis mellifera beehives. According to (Williams, 2009), Beeswax is easy to form and stable in maintaining its shape. Regarding safety, beeswax can be used in cosmetics with a limit of 5-20% (Mercado & Krog, 1991). Apart from beeswax, another wax base was added to be combined in this study, namely paraffin wax. According to (Freund et al., 1983), paraffin wax is a wax base with a function for hardness but is still rarely used. Paraffin wax belongs to the type of alkane hydrocarbon and is safe for use in cosmetics if its use is less than 15%.

The ideal lip balm has a suitable melting point between 65 and 75ºC (Vinodkumar et al., 2019). This fairly high melting point is the basis for selecting lip balm hardness ingredients to maintain stability at room temperature. However, the formula contains oil and other semisolid or liquid ingredients with low melting points, so there is a risk of lowering the lip balm's melting point, so hardness-forming materials are needed. The melting point is the main physical property important for the stability of lip balms in all periods of use and transportation. These characteristics can vary according to the composition of the material (Bono et al., 2006). In this research, lip balm was made using a combination of beeswax and paraffin wax. Paraffin wax has a lower melting point than beeswax, which is 48 – 68ºC (Spreight, 2015), while beeswax has a fairly high melting point, which is 61 – 66ºC (Paramelt, 2014), so it needs to be combined to achieve the ideal product melting point. In the range of 65 – 75ºC. Adding the beeswax and paraffin wax bases is also expected to make lip balm products look good, which are non-sticky, easily removed, and match the pH of the lips, so they are comfortable when applied.

Furthermore, beeswax and paraffin wax are optimized using the Simplex lattice design (SLD) method because it can be used to optimize formulas for various amounts of different material compositions to produce an optimum formula (Bolton & Bon, 2003) so that it is good organoleptically, has the appropriate pH. with lips, good melting point, and stable in storage.

From the description above, it is hoped that in this study, optimization of the appropriate composition of beeswax and paraffin wax can be obtained to produce lip balm preparations that meet the response to physical properties and physical stability, namely those that are good organoleptically, have a pH that matches the lips, have a good melting point, and stable in storage.

RESEARCH METHOD

Materials

The materials used in this study were olive oil (Borges brand) originating from Spain, rosella flower extract, 96% ethanol, beeswax (Pharmaceutical), paraffin wax (Pharmaceutical), lanolin (Pharmaceutical), nipagin (Pharmaceutical), propylene glycol (Pharmaceutical), BHT (Pharmaceutical) and strawberry fragrance.

The tools used in this study were glassware (Pyrex), maceration tool, lip balm pot, analytical balance (Ohaus), stir bar, water bath (Memmert), filter paper, porcelain cup, dropper pipette, evaporator (Heidolph), melting point test equipment (Stuart Scientific), climatic chamber (Climacell), oven (Binder), pH meter (Ohaus).

Methods

Lip balm composition formulation

The lip balm composition formula is based on the research of (Elsner & Maibach, 2005), which is presented in Table 1.

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Table 1. Lip balm composition formula (Elsner & Maibach, 2005).

Formulas	Compositions
Emollient/oil	40 – 55 %
Candle	8 – 13 %
Fats/plasticizers	2 – 4 %
Dye	3 – 8 %
glossy	3 – 6 %
Active substance	0 – 2 %
Filler	4 – 15 %
Perfume	0,05 – 0,1 %
Preservative	0,5 %

Modification of the Rosella Flower Extract Lip Balm Formula

Modification of the lip balm formula based on research by (Elsner & Maibach, 2005) using the Simplex lattice design method is presented in Table 2.

Table 2. Modified Lip balm Formula based on Simplex Lattice Design

Formulas	F1	F3	F3	F4	F5	F6	F7	F8
Beeswax	8.75%	8.75%	7.63%	7.91%	8.19%	8.47%	8.19%	7.63%
Paraffin wax	11.59 %	11.59 %	12.71 %	12.43 %	12.15 %	11.87 %	12.15 %	12.71 %
Olive oil	62.11 %	62.11 %	62.11 %	62.11 %	62.11 %	62.11 %	62.11 %	62.11 %
Rosella flower extract	2%	2%	2%	2%	2%	2%	2%	2%
Lanolin	5%	5%	5%	5%	5%	5%	5%	5%
Nipagin	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Strawberry fragrance	4%	4%	4%	4%	4%	4%	4%	4%
Propylene glycol	6%	6%	6%	6%	6%	6%	6%	6%
BHT	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%

Making Rosella Flower Powder

Dried Rosella flower Simplicia (*Hibiscus sabdariffa L.*) is cut into small pieces and then grinded to form a powder (Ulfah & Wahyuningrum, 2010).

Preparation of Rosella Flower Ethanol Extract

Approximately 600 grams of rosella flower powder (*Hibiscus sabdariffa L.*) was macerated with 1800 ml of 96% ethanol extractor solution. The process of soaking the simplicial powder was carried out for three days with occasional stirring; then, the dregs were washed with sufficient solvent. Then it was filtered into a new container to obtain a liquid extract. The maceration liquid extract was concentrated using a rotary evaporator at a temperature of ± 70°C for ± 5 hours at a speed of 100 rpm. Rosella flower extract, concentrated with a rotary evaporator, is suspected to still contain ethanol. Therefore, ethanol is evaporated using a water bath to obtain a viscous extract of rosella flowers free of ethanol (Suzery et al., 2010).

Anthocyanin Qualitative Test

The extract was dissolved in distilled water and then tested qualitatively. Extracts that positively contain anthocyanins will produce a blue-green color when added to NaOH drop by drop, and the color will remain red when HCL is added and heated at 100°C (Harborne, 1996).

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Making Lipbalm

Each material is weighed according to the desired weight. Beeswax and paraffin wax are heated in a porcelain cup at 80°C above a water bath. Lanolin is heated under the same conditions and temperature in separate dishes. Furthermore, nipagin and BHT dissolved in olive oil until dissolved. After that, add the oil mixture to the lanolin and wax mixture while stirring it homogeneously. After that, adding strawberry flavoring was carried out until it was homogeneous. The mixture from the water bath is then added to rosella flower extract, dissolved with propylene glycol. After being mixed homogeneously and slightly thick, the mixture was poured into the lip balm container, then left to cool and solidify at room temperature for further testing (Barel et al., 2009).

Lip balm organoleptic test

Examination of lip balm, which includes color, shape, texture, and scent using the five senses (Gouvea, 1993).

Lip balm pH test

Determination of pH using a calibrated pH meter. The the electrodes were washed with aquadestilata, then dried with a tissue. Samples were prepared a concentration of 1%, weighing 1 g of the preparation and dispersing it in 100 mL of distilled water. Then the electrode is immersed in the solution. The tool is allowed to show the pH value until it is constant. The number indicated by the pH meter is the pH of the lip balm preparation (Rawlins, 2003). The desired pH value is 3.8 – 4.7 according to the pH of the lips (Reshmi et al., 2012).

Lip balm Melting Point Test

By melting the lip balm, observations were made on the melting point. A good lip balm preparation has a melting point of 65 – 75°C (Gouvea, 1993). The lip balm is put into a capillary tube with a diameter of one millimeter and then into a melting point device to be heated. The recorded temperature is when the sample starts to melt (Siregar, 2014).

Lip balm Physical Stability Test.

The finished lip balm preparations were evaluated for their physical stability using a climatic chamber set at 40 ± 2°C and humidity/RH 75 ± 5% which was carried out for one month and was observed every week for pH and organoleptic.

Data Analysis

The data obtained from the results of testing the physical properties of rosella flower extract lip balm in each formula were then analyzed using the Design-Expert® 10.0.1 software, the simplex lattice mixture method, to obtain the SLD equation to see the effect of beeswax and paraffin wax, as well as formulas that give optimum physical property response. After receiving the optimum formula, then verification of the results of the optimum formula for program predictions was carried out with a comparative formula for the study results using the one-sample t-test analysis with a confidence level of 95.

RESULT AND DISCUSSION

The ingredients used in each formula consist of beeswax and paraffin wax as a wax base, lanolin as a plasticizer, olive oil as an emollient, propylene glycol as a humectant, nipagin as a preservative, rosella flower extract as a colorant, BHT as an antioxidant and strawberry fragrance as a perfume.

The results of the extract specification test showed that the yield of viscous extract from rosella flowers (*Hibiscus sabdariffa L.*) w 21.43%. Furthermore, the results of the anthocyanin qualitative test using 2M NaOH and 2M HCl can be seen in Table 3. The test results indicated that anthocyanins were contained in rosella viscous extract.

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Table 3. Qualitative Test Results.

Test	Result	Color
NaOH	(+)	Green and didn't fade.
HCl	(+)	Color and didn't fade.

The properties of rosella flower extract lip balm are known by organoleptic, pH, melting point, and stability tests. From the results of the organoleptic test, it was known that all identified formulas were pink in color, solid in shape, smooth in texture, and had the scent of strawberries. The results of the organoleptic test of rosella flower extract lip balm (*Hibiscus sabdariffa L.*) are presented in Table 4. The resulting color of the lip balms in the various formulas was the same because the same amount of rosella flower extract was added, namely 2% in each formula. The amount of dye added, as much as 2% obtained from the results of the orientation of the lip balm, can give a good color. In the whole formula, a solid lip balm is obtained.

Table 4. Organoleptic Test Results for Rosella Flower Extract Lip Balm.

Formula	Color	Shape	Texture	Scent
1	Pink	Solid	Fine	Strawberry Scent
2	Pink	Solid	Fine	Strawberry Scent
3	Pink	Solid	Fine	Strawberry Scent
4	Pink	Solid	Fine	Strawberry Scent
5	Pink	Solid	Fine	Strawberry Scent
6	Pink	Solid	Fine	Strawberry Scent
7	Pink	Solid	Fine	Strawberry Scent

The colors produced in the lip balms in the various formulas are the same because the same amount of rosella flower extract is added, which is 2% in each formula. The amount of dye added, as much as 2% obtained from the results of the orientation of the lip balm, can give a good color. In the whole formula, a solid lip balm is obtained.

The rosella flower extract lip balm formula (*Hibiscus sabdariffa L.*), which contains many beeswaxes, has a dense, non-sticky shape with a smooth texture. In comparison, formulas containing more paraffin wax produce a solid lip balm but are soft. Each formula has a strawberry scent due to the addition of strawberry fragrances so that the characteristic scent of the extract and base can be covered. This organoleptic test was not included as a response to the Simplex lattice design. The results of making rosella flower extract lip balm are presented in Figure 1.

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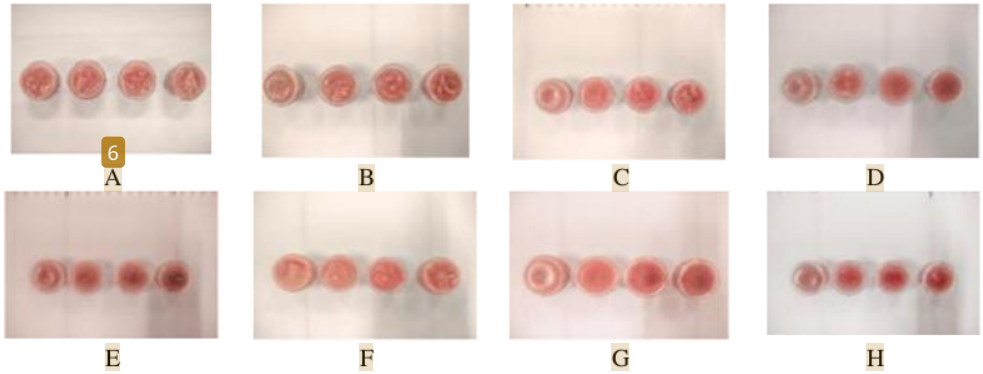

Figure 1. The results of making rosella flower extract lip balm with various compositions of Beeswax and Paraffin wax; (A) 8.75% and 11.59%; (B) 8.75% and 11.59%; (C) 7.63% and 12.71%; (D) 7.91% and 12.43%; (E) 8.19% and 12.15%; (F) 8.47% and 11.87%; (G) 8.19% and 12.15%; (H) 7.63% and 12.71%.

The results of the next physical property test, namely the pH and melting point of rosella flower extract lip balm as presented in Table 5. pH testing needs to be done because it is related to skin irritation; if the pH does not match the pH of the skin of the lips then it can increase irritation of the skin of the lips. The pH of normal lip skin is between 3.8 – 4.7 (Siregar, 2014). The test results show that the lip balm meets the pH requirements.

The melting point test of the lip balm aims to determine the resistance of the lip balm to temperature. A good lip balm has a melting point of 65 – 75°C (Gouvea, 1993). Lip balm must meet the melting point requirements at that temperature so that the lip balm does not melt at room temperature during the distribution, storage, and use process. Lip balm Rosella flower extract (*Hibiscus sabdariffa L.*) has a melting point that meets the applicable regulations. The data were analyzed using the Design-Expert® 10.0.1 software using the simplex lattice mixture method to obtain the pH and melting point profiles, as shown in Figures 2 and 3.

Table 5. Testing of pH and Melting Point of Rosella Flower Extract Lip Balm.

Formula	pH	Melting point (^{0}C)
1	4,07	65,9
2	4,05	65,8
3	4,09	65,0
4	3,94	65,4
5	3,93	65,7
6	3,95	65,6
7	4,01	65,7
8	3,99	65,1

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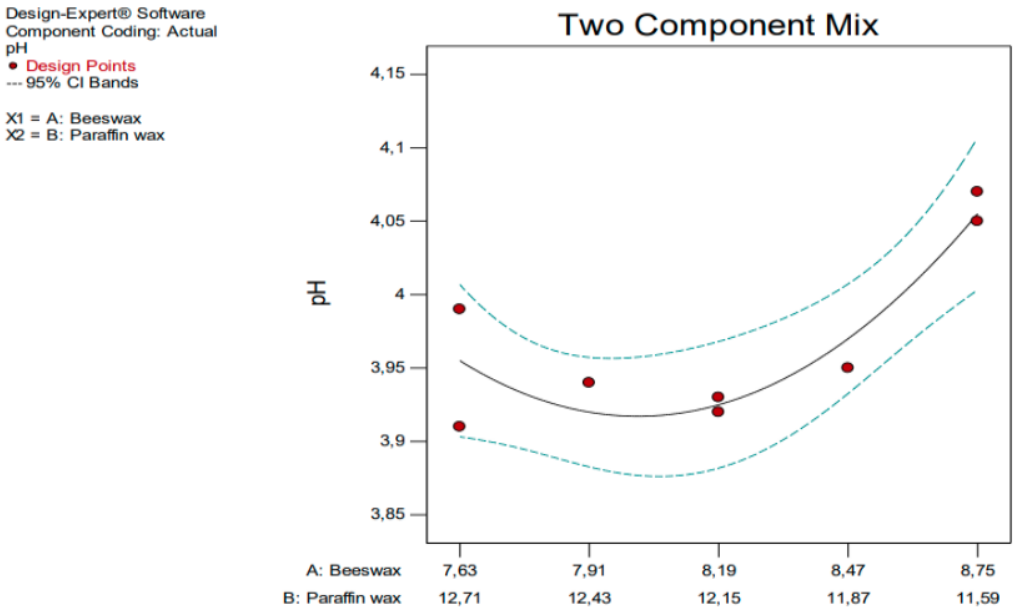

Figure 2. The pH profile of Rosella Flower Extract Lip Balm. Equation for pH test = 2,09777A + 0,99828B – 0,25510AB. (Description: A = Beeswax; B = Paraffin wax; AB = Combination of Beeswax and Paraffin wax).

The ANOVA Design Expert statistical analysis used to test the pH and melting point of rosella flower extract lip balm was a quadratic model. The quadratic model shows that the p-value > F value is less than 0.05, so the resulting model is significant, which means that the model used follows the existing data. The lack of fit value obtained is insignificant, representing that the data distribution is even.

The response profile of the pH test shows that the curved curve image opens up. The curve image shows the effect of using a combination of beeswax and paraffin wax to cause a decrease in the pH of the lip balm with a coefficient value of -0.25 (Equation 1). This is related to the pH of beeswax, which has a pH of 6.11 (Tihonov et al., 1986). lower than paraffin wax. It can be interpreted that the presence of beeswax can lower the pH of the lip balm. Beeswax (2.09) is more dominant in influencing the pH of the preparation than paraffin wax. However, in theory, the pH of paraffin wax is higher, namely 11 (Freund et al., 1983). Meanwhile, beeswax has a pH of 6.11 (Tihonov et al., 1986).

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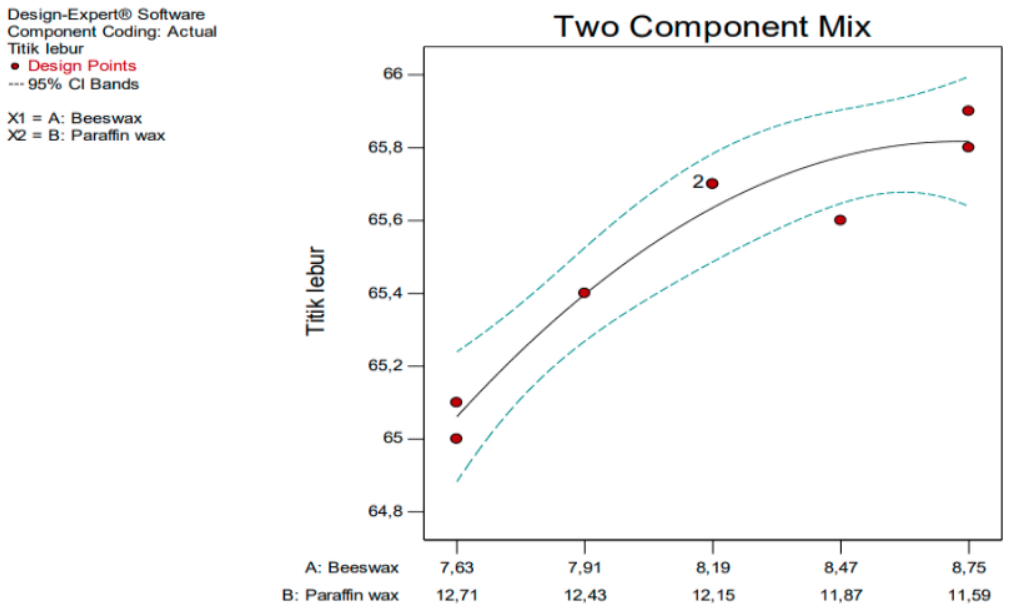

Figure 3. Melting Point Profile of Rosella Flower Extract Lip Balm. Equation for the melting point test = -0,90803A + 0,89336B + 0,62525AB.

The melting point test's response profile shows that the curved curve's image opens downward. This result represents that paraffin wax (0.89) is more dominant in influencing the melting point of the preparation than beeswax. But in theory, the melting point of beeswax is higher, namely 61 – 66°C, while paraffin wax has a melting point of 50 – 61°C (Rowe et al., 2009). This is not following the equation. The combination of the two increases the melting point of the lip balm by (0.62) due to the influence of beeswax, which has a high melting point of 61 – 66°C (Rowe et al., 2009).

In addition to organoleptic, pH, and melting point tests, lip balm stability tests are also needed to see whether there is a change in formulation and storage. The stability test carried out in this study was seen from the shift in the pH of the lip balm after one month of storage. Data collection was carried out in weeks 1, 2, 3, and 4. The results of the pH examination for the physical stability of the lip balm are presented in Table 6.

Table 6. pH Examination Results in the Stability Test.

Time (week)	Formula							
	F1	F2	F3	F4	F5	F6	F7	F8
1	4.02	3.98	3.91	3.90	3.93	3.92	3.92	3.92
2	3.97	3.97	3.90	3.89	3.92	3.91	3.90	3.90
3	3.97	3.96	3.90	3.90	3.92	3.91	3.90	3.90
4	3.96	3.94	3.88	3.89	3.92	3.90	3.89	3.90
pH decrease	0.06	0.04	0.03	0.01	0.01	0.02	0.03	0.02

In observing the stability of the pH of the lip balm, there was a decrease in pH from week to week, but the pH value of the lip balm was still in the pH range of the skin of the lips, namely 3.8 – 4.7, which means that the lip balm does not irritate the skin of the lips. The pH data is then calculated by looking at the difference in pH in the 1st week minus the pH in the 4th week. The smaller the decrease

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in pH obtained, the more stable the lip balm formula obtained. The smallest decrease in pH was produced by the formulas F4 and F5, with a decrease in pH of 0.01, which means that the formulas F4 and F5 were the most stable of the eight formulas. Then the results of the decrease in pH obtained were analyzed with the Design-Expert® 10.0.1 software using the simplex lattice mixture method. The profile of the results of the pH stability test (decreasing pH) of the lip balm is presented in Figure 4.

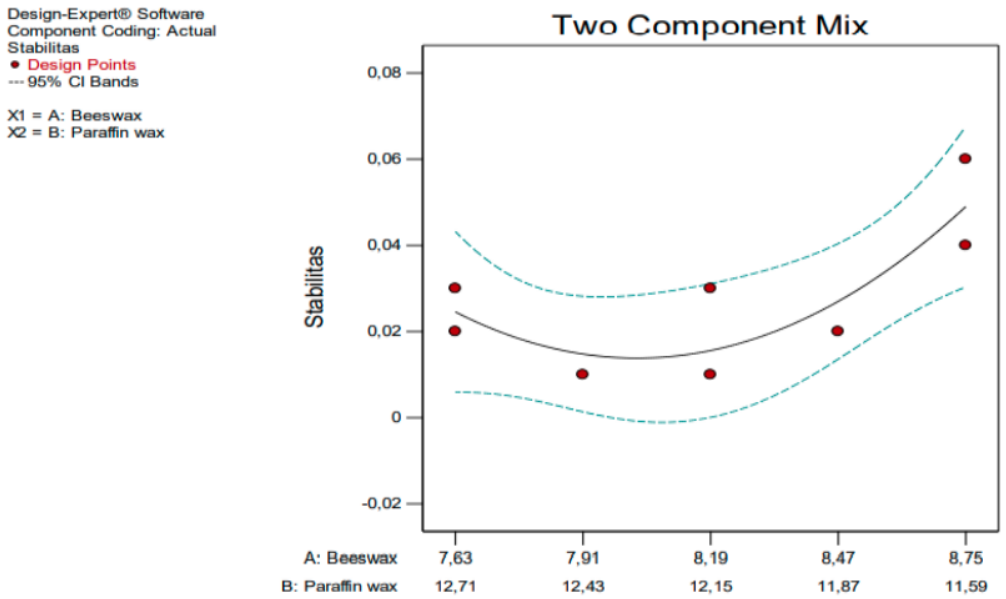

Figure 4. Profile of pH Stability Test Lip balm Rosella Flower Extract. pH stability test equation = 0.50390A + 0.21467B -0.067527AB.

The ANOVA Design Expert statistical analysis results, show that the equation has a quadratic model. The quadratic model shows that the p-value > F value is less than 0.05, so the resulting model is significant, which means that the model used follows the existing data. The insignificant lack of fit value means that the data distribution is even. Based on the response profile of the pH stability test (decreasing pH) of the lip balm, it can be seen that the curved curve image opens up. The resulting curve image illustrates that there is an effect of using a combination of beeswax and paraffin wax which causes a decrease in a decrease in the pH of the lip balm with a coefficient value of – 0.06 (Equation 3).

Based on Equation 3, it is known that individually the values of both variables show a positive value, which means that both increase the decrease in the pH of the lip balm. However, the effect of beeswax on decreasing pH is more dominant, indicated by a higher value (0.50). This is because the more beeswax is stored, the more acid value will increase (Kim & Eom, 2010). An increased acid value means that the pH of the beeswax will decrease. This causes an increase in the value of the decrease in pH.

Apart from being seen from the pH stability, it can also be seen from the organoleptic lip balm. Organoleptic observations of physical stability were carried out in a climatic chamber at 40 ± 20°C and humidity/RH 75 ± 5% for four weeks, with parameters measured including the change in color, shape, texture, and scent of lip balm. The test results showed that rosella flower extract lip balm (*Hibiscus sabdariffa L.*) during storage from week 1 to week 4 showed no change in shape, texture, and odor. The color of the lip balm changed in weeks 2, 3, and 4, which indicated a change in color from pink to

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brown. The color of the lip balm changes slowly due to the oxidation of the lip balm preparation so that the color changes. This is because not only are the anthocyanins extracted, but other substances besides the dyes are also extracted, thus increasing the yield weight of the dyes. In rosella, there are tannins which give a brown color, and chlorophyll which has a bluish-green color (Mastuti, 2013). The results of the organoleptic examination for the physical stability of the lip balm are presented in Table 7.

Table 7. Stability Organoleptic Examination Results

Observation	Lama pengamatan (minggu)	Formula							
		F1	F2	F3	F4	F5	F6	F7	F8
Color (pink)	1	-	-	-	-	-	-	-	-
	2	+	+	+	+	+	+	+	+
	3	+	+	+	+	+	+	+	+
	4	+	+	+	+	+	+	+	+
Shape (solid)	1	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	-	-	-
	4	-	-	-	-	-	-	-	-
Texture (smooth)	1	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	-	-	-
	4	-	-	-	-	-	-	-	-
Scent (strawberry)	1	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	-	-	-
	4	-	-	-	-	-	-	-	-

Description: (+) = There is a change; (-) = There is no change.

After all the physical tests have been carried out, the optimum lip balm formula is determined. The optimum formula was determined using the Simplex lattice design method using the Design-Expert® 10.0.1 software program, the simplex lattice mixture method. The results of the physical property parameter test of rosella flower extract lip balm (*Hibiscus sabdariffa L.*) in the form of pH value, melting point, and physical stability results in the form of a decrease in pH value were analyzed using the Design Expert program to produce a graph of two components of the mixture. To produce these graphs, we determine the goals in the form of in-range, minimize, and maximize what we want for each parameter, as presented in Table 7. The pH for determining the goal was chosen because the pH value in the lip balm preparations met the lip pH range between 3.8 and 4.7. The melting point for determining the target was chosen in the range because the melting point value of the lip balm preparations met the melting point range between 65 – 75°C.

In terms of physical stability (decrease in pH), the goal chosen is minimized because the smaller the value of the decrease in pH, the more stable the lip balm will be. The lowest value (lower) and the highest value (upper) are obtained from the results of the tests. Then weighting is carried out ranging from one (+) to five (+++++), which means that the higher the weighting, the more important the component or response is to be optimized. All tests were given a weighting of five (+++++) because it was considered very important so that the lip balm formed was non-irritating, had an ideal melting point, and was stable in storage. The weight value for each test of rosella flower extract lip balm (*Hibiscus sabdariffa L.*) is presented in Table 8.

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Table 8. Determination of the Optimum Formula of Lip Balm Rosella Flower Extract.

Parameter	Goal	Lower	Upper	Bobot
A: *Beeswax*	In range	7.63	8.75	-
B: *Paraffin wax*	In range	11.59	12.71	-
pH	In range	3.91	4.07	+++++
Melting point	In range	65	65.9	+++++
pH decrease	Minimize	0.01	0.06	+++++

After all, data is filled in; the Design Expert program will present a graph of two components of a mixture of beeswax and paraffin wax. The program will choose a formula with the highest desirability so that the selected optimum formula will produce good physical properties and physical stability of the lip balm. The graph of the optimum formula for rosella flower extract lip balm is presented in Figure 4.

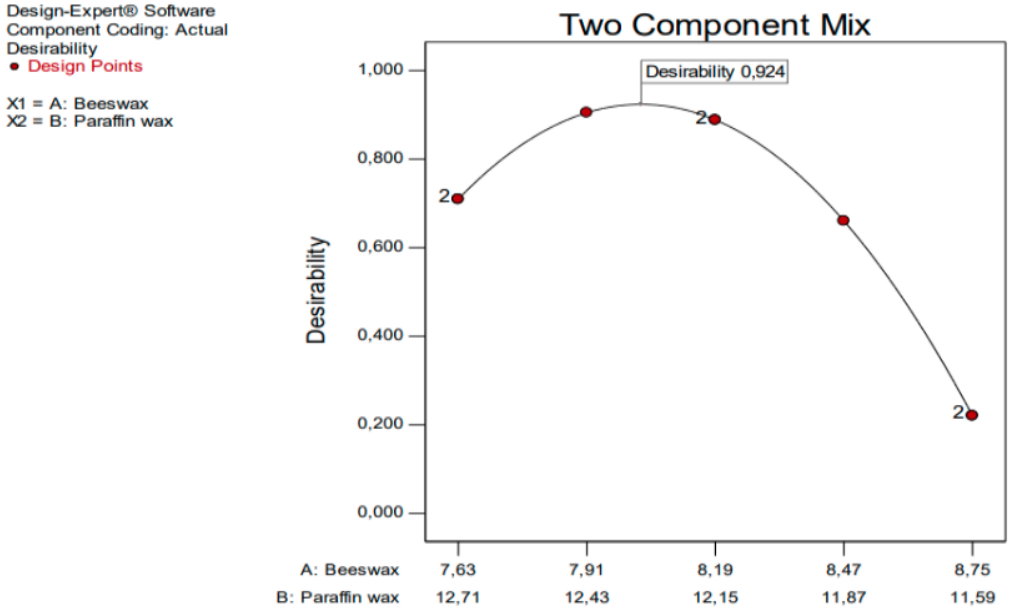

Figure 4. Graph of Optimum Formula Prediction of Rosella Flower Extract Lip Balm.

The figure shows that the optimum point of the combination of beeswax and paraffin wax is a desirability value of 0.92, with the optimum point at a concentration of 8.02% beeswax and 12.31% paraffin wax. The optimum point shows that the combination of 8.02% beeswax and 12.31% paraffin wax is predicted to produce lip balm with a pH of 3.91, a melting point of 65.51°C and a stable pH during four weeks of storage.

Verification is a step to determine whether the actual value obtains the program predictions' value. The optimum formula was verified by comparing the optimum response value of the predicted result of the Design-Expert® 10.0.1 software program simplex lattice mixture method with the experimental result value of the optimum formula using a one-sample t-test.

One sample t-test analysis is used to determine whether there is a significant difference between the predicted parameter values and the verification results. The comparison between the two groups is

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said to be significantly different if the sig value is less than 0.05, so it can be seen whether the data is valid. It is valid if the sig value obtained is greater than 0.05. The results of the one-sample t-test response of the predicted optimum formula compared to the experimental optimum formula are presented in Table 9.

Table 9. Optimum Formula Verification.

Physical Properties	Prediction Results	Experiment results	Sig (2-tailed)	Information
pH	3,917	39,267	0.387	Not significantly different
Melting point	65,510	655,667	0.231	Not significantly different

Based on the verification data presented in Table 9 shows that the pH and melting point values in Table 9 do not differ significantly between the two data presented because they have a value of (p) >0.05. The two responses data in the table are obtained from the graph of the optimum formula so that with the results showing that there is no significant difference between the predicted parameter values and the verification results, it can be concluded that the SLD equation developed is valid and can be used to develop formulas that provide pH parameters and points good melting.

CONCLUSION

Changes in the composition of the two waxes did not affect shape, texture, color, and odor based on organoleptic observations. Still, beeswax had a more dominant influence on pH, as indicated by the design expert equation coefficient value of 2.09. Paraffin wax has a more dominant influence on the melting point, as indicated by the design expert equation coefficient value of 0.89. Beeswax has a more dominant influence in affecting the decrease in pH, as indicated by the design expert equation coefficient value of 0.50. However, on the organoleptic color of the lip balm, rosella flower extract (*Hibiscus sabdariffa L.*) is less stable in storage. The lip balm with the best characteristics in terms of physical properties and stability is owned by a formula with 8.02% beeswax and 12.31% paraffin wax which produces a product with a pH of 3.91, so it does not irritate the skin, a melting point of 65.51°C and can maintain pH for four weeks.

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