Enrichment of skin lotion with antioxidant from *Rhizophora mucronata* fruit extract

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Abstract: *Rhizophora mucronata* is one of mangrove species that are located in coastal plates and the growth is affected by the tides of the sea. This type of mangrove population is concentrated in the areas of Papua, Kalimantan, Sulawesi, and Sumatra. Mangrove population in Indonesia reaches 75% of the entire mangrove population of Southeast Asia, or about 27% of total world mangrove population. This fruit source of bioactive components like tannin, flavonoid, saponin, phenol and hydroquinone. Those bioactive components as antioxidant for skin lotion product. The purpose of this research was to know the effect of addition of different concentration of *R. mucronata* extract to the characteristics and to know the best concentration on the addition of *R. mucronata* extract. Materials used *R. mucronata* fruit which is taken from Kaliprau Village, Ulujami Regency Pemalang and made powder finely. Research method used is Completely Random Design (RAL), each 3 times repetition with non-parametric data analysis using Kruskal-Wallis and analysis of parametric data using ANOVA and HSD test. The results of preliminary study showed *R. mucronata* fruit extract containing flavonoid 65.63 ppm; phenol 4.333 ppm; saponin 9.41%; alkaloid 21.11% and positive steroids. The IC_{50} extract was 135.69 ppm. The results of the addition of the extract concentration of 0, 3, 5 and 7% showed that the skin lotion with *R. mucronata* 5% extract had the best hedonic result 4.66-5.25; viscosity 3.615 cp; pH 8.08; 100% emulsion stability, Sun Protection Factor value 10.87% and percent inhibition 79 % and the results have been in accordance with Indonesian National Standard SNI 16-4399-1996.

1. Introduction

Skin is the outer part of the body which serves to protect the body from all threats from outside such as free radical. In the human body it can be formed by normal cell metabolism, malnourished, improper diet, cigarette smoke, ultraviolet light, and polluted environments. This kind of free radical that can be source of problems in human skin such as cancer. This is necessary for an antidote, namely antioxidants As a protector, the skin needs nutrients, with the presence of Natural Moisturizing Factor (NMF). It is known that skin can protect itself from various threatening factors by Skin lotion is a moisturizer that function to maintain moisture in the skin layer and smoothness, but most of commercial skin lotions do not contain enough antioxidants to ward off free radicals on the skin. Sunscreen is a substance that contains skin protection against sunlight so that UV light does not enter the skin, by absorbing the radiation energy of the sun that hits the skin, so that it does not directly affect the skin. The use of cosmetics containing antioxidant compounds can prevent premature aging due to free radicals.

*Rhizophora mucronata* is one type of mangrove species that are spread out the coastal areas of Indonesia. Although the mangrove population in Indonesia is about 75% from the entire mangrove population in Southeast Asia or about 27% of the total mangrove population in the world, this coastal plant has not been optimally utilized. A number of studies have reported that mangrove fruit can be source of various bioactive components such as tannin, flavonoid, saponin, phenol and hydroquinone. One type of fruit that contains high antioxidants from mangrove plants is black mangrove (*R. mucronata*) because it has active components such as flavonoids, saponins, phenols, hydroquinone and alkaloids [1]. The bioactive component can serve as an antioxidant to counteract free radicals. Flavonoids are the most important phenol compounds, and have a broad spectrum of chemical and...
biological activities including free radical scavenger activity. Owing to the need of antioxidant for the healthy skin, the enrichment of skin lotion by *R. mucronata* seems to be essential.

The increasing need for cosmetics from natural ingredients provides opportunities for mangroves as one of the ingredients in making cosmetics. The use of natural ingredients in other cosmetics has not been able to counteract free radicals. The purpose of this study was to determine the effect of the addition of *R. mucronata* extract concentration on the physical and chemical characteristics of skin lotion; The best concentration in lotions enrichment with *R. mucronata* extract.

### 2. Research Methods

#### 2.1 Sample Extraction

Sample extraction method were followed the previous study [2]. A total of 50 g *R. mucronata* fruit powder were dissolved in 250 ml 95% ethanol. Maceration was done for 24 hours at room temperature. The maceration results were then filtered using fine filter paper (Whatman No.42). Extraction was done using a rotary vacuum evaporator at 40°C. The extraction results are weighed and stored in a closed bottle.

#### 2.2 Phytochemical Screening Test

The determination of Phytochemical screening was conducted according to earlier research [3]. The 5 ml of 10% acetic acid in ethanol was added, 1 ml of filtrate was strained, 2 ml of AlCl₃5% solution was added and aquadest with a 420nm spectrophotometer was read; Phenol test was followed the previous study [4], i.e. 5 grams of sample in 100 ml of distilled water, 1 ml of filtrate was added 0.5 ml follin cio-calteu and 1 ml o saturated Na₂CO₃, read using spectrophotometer 730nm, Saponin and Alkaloid Compounds test were followed the previous study [4]; Steroid and Triterpenoid test was followed the previous study [5], i.e. the extract was dissolved in 0.5 ml of chloroform plus 0.5 ml of anhydrous acetic acid. plus 2 ml of concentrated H₂SO₄. Brownish or violet rings indicate the presence of a triterpenoid, if bluish green is formed indicating steroids.

#### 2.3 IC₅₀ Extract Test

IC₅₀ Extract Test was carried out based on the earlier study [6]. Samples of crude extracts from mangroves were dissolved in methanol with a concentration of 31.25; 62.5; 125; 250 and 500 ppm. DPPH solution with a concentration of 125 μM was taken as much as 100 μL and added with 100 μL of extract, then put into the prepared microplate. The solution mixture was homogenized and incubated at 37°C for 30 minutes. The resulting uptake was measured using Biochrom ™ EZ Read 800 Microplate Spectrophotometer at a wavelength of 517 nm. A compound can be said to have antioxidant activity if the compound is able to donate its hydrogen atom which is marked by a purple to yellow color change. IC₅₀ value stated the amount of sample solution concentration needed to reduce DPPH free radicals of 50%.

#### 2.4 Hedonic Test [2]

Hedonic Test was followed the previous research [2]. Skin lotion making *R.mucronata* extract also refered to earlier research [7] with modifications.

| Table 1. Skin lotion formula *R.mucronata* extract in 100 ml |
|-----------------|--------|--------|--------|--------|
| Materials       | 0%     | 3%     | 5%     | 7%     |
| Stearic Acid    | 5      | 5      | 5      | 5      |
| Cethyl Alcohol  | 1      | 1      | 1      | 1      |
| Propyl paraben  | 0.05   | 0.05   | 0.05   | 0.05   |
| Glycerin        | 5      | 5      | 5      | 5      |
| TEA (Trietanolamine) | 2   | 2      | 2      | 2      |
| Methyl paraben  | 0.1    | 0.1    | 0.1    | 0.1    |
| *R.mucronata* Extract | 0  | 3      | 5      | 7      |
| Aquades         | 86.85  | 83.85  | 81.85  | 79.85  |
The hedonic test was carried out on products with 30 panelists. This test was conducted to determine the level of panelists preference for the products produced. The hedonic test used is a test of the preference for appearance, color, viscosity, homogeneity, dampness, stickiness on a scale of 1-7 where the value of 1 states very dislike, 2 states dislike, 3 states somewhat dislike, 4 states normal, 5 stated that they liked it a bit, 6 stated likes and 7 said they really liked it.

2.5 pH Test
The acidity or pH test was carried out using a pH meter which had previously been calibrated using a buffer solution of 4.01 and 6.86 [8]. Measurement is done directly by dipping the pH eye into the sample until the pH value shown on the pH meter screen is stable.

2.6 Viscosity Test
The viscosity of the sample was measured using the Ostwald viscometer [9]. A sample of 2 grams of sample that has been dissolved in 100 ml of water is inserted into the viscometer then the viscosity is measured. Ostwald viscosimeter works based on the time interval needed by a certain amount of solution to flow through the capillary tube by force caused by the weight of the solution itself. A solution with a certain volume is measured the flow velocity from the 'A' to the 'B' along the h or the height of the top line to the bottom line of the capillary pipe. The sample viscosity value is expressed in centipoises (cP). The sample viscosity is calculated using the formula:

\[
\text{Viscosity} = \frac{\text{sample density} \times \text{sample time}}{\text{density of water} \times \text{water time}}
\]

2.7 Emulsion Stability
Emulsion Stability test was carried out based on the previous study [10]. A sample of 5 grams is put in a container and weighed. The containers and ingredients are put in an oven at 45°C for 1 hour. Observations are made on the possibility of separation of water from the emulsion. When separation occurs, the emulsion is said to be unstable and its stability level is calculated based on the percentage of the phase separated from the overall emulsion. Furthermore, the observation of physical and chemical changes from skin lotions such as cracking, color changes or odors was carried out to support the results of the emulsion stability test results.

\[
\text{SE (\%)} = \frac{100\% - \text{the weight of the phase-separating x100}}{\text{total weight of emulsion material (gr)}}
\]

2.8 Sun Protection Factor (SPF) Test
The results showed that the highest SPF values were found in Skin lotions with a concentration of R.mucronata fruit extract 7% which was 11.16%. The higher the extract concentration, the higher the SPF value. This is because R.mucronata fruit extract acts as a sunscreen in skin lotion preparations.

Sun Protection Factor (SPF) Test were conducted based on previous research [11] Weighted samples of 10 grams were then put into a 100 ml volumetric flask and diluted with methanol. The solution is ultrasonicated for 5 minutes and then filtered with filter paper. The filtrate solution was then pipette as much as 5 ml, put into a 50 ml volumetric flask then diluted with methanol. The solution obtained was measured by UV-Vis spectrophotometer at a wavelength of 290-400 nm using methanol as blank. Absorption values are recorded at intervals of 5 nm from wavelengths of 290-320 nm.

2.9 Antioxidant activity test
A thick extract of R.mucronata as much as 0.2 mg was weighed and dissolved in 1 ml of ethanol then homogeneous. DPPH solution with a concentration of 20 ppm which added 3 ml into a test tube containing extracts and ethanol. The solution mixture was homogenized and incubated at 37°C for 30 minutes. The resulting uptake was measured using a Shimadzu Spectrophotometer UV-vis at a wavelength of 517 nm. A compound can be said to have antioxidant activity if the compound is able to donate its hydrogen atom which is marked with a purple color change to yellow. Blanks are
made using a mixture of ethanol and dpph. Percent inhibition values can be calculated using the formula:

\[
\text{% inhibition} = \frac{\text{abs Blank} - \text{abs sample} \times 100\%}{\text{abs blank}}
\]  

(3)

2.10 Irritation test

The irritation test was conducted on 16 volunteers, with each test material consisting of 3-5 volunteers. The method used is a 4-hour patch test. First, the right arm of the upper part of the volunteer is cleaned and the test material is affixed for 4 hours. 40 minutes later the observation area is applied whether there is redness, edema, itching. This method was followed earlier study [1].

3. Results and Discussion

3.1. Quantitative and qualitative phytochemical test

The results of the quantitative and qualitative phytochemical test of *R. mucronata* Extract is presented in Table 2.

| Item               | Concentration   |
|--------------------|-----------------|
| Alkaloids (ppm)    | 21.11±0.77      |
| Flavonoids (ppm)   | 65.63±0.84      |
| Phenols (ppm)      | 4,333±0.74      |
| Saponins (ppm)     | 9.41±0.66       |
| Steroids           | +               |
| Triterpenoids      | -               |
| IC50* (ppm)        | 135.69          |

*inhibitor concentration of extract that can reduce 50% of Free Radical

Our present data showed that *R. mucronata* contained alkaloid 21.11 ppm, this result showed that the presence of N groups in the alkaloid structure causes alkaloid compounds to have the potential as antioxidants. The alkaloid in mangrove fruit extract is thought to have strong antioxidant properties. Almost all parts of the plant *Rhizophora* *sp.* contains alkaloid compounds. Alkaloids are toxic to microbes, thus effectively killing bacteria and viruses that can maintain the shelf life of skin lotions. Flavonoid testing produces positive values with a yield of 65.630 ppm. Flavonoids have the ability as antioxidants because they are able to transfer electrons to free radical compounds and can form complexes that are stable. Flavonoids are capable of capturing superoxide anions, oxygen singlets, hydroxyl radicals, and peroxy lipid radicals. Flavonoid results are compared with quercetin. Quercetin is the largest compound of the flavonol group, quercetin, and its glycosides are in the amount of about 60-75% of flavonoids. Quercetin is believed to protect the body from several types of degenerative diseases by preventing the occurrence of fat peroxidation [12].

The total phenol test results on *R. mucronata* fruit extract was 4,333 ppm which showed that the fruit extract contained high phenol compounds, in earlier research [2], the total phenol test of mangroves was 37.90 ppm, compared to other fruits. also high. According to previous studies [13][14], there is a relationship between total phenol and antioxidant activity where if in a substance has a high concentration of phenol compounds, the antioxidant activity in the material is also high. Phenolic compounds play a role in reducing sensitive redox signals to inhibit DNA damage. The presence of hydroxyl groups in the aromatic ring causes this compound to be very sensitive to enzyme oxidation [12].

Saponin content in *R. mucronata* fruit samples was 9.41%. The properties possessed by saponins include having a bitter taste, forming a stable foam in a water solution. Judging from the taste of the fruit, *R. mucronata* has a bitter taste. However, there are only a few saponins in the fruit due to the
drying process which reduces the saponin content. *R.mucronata* fruit which has polar and non-polar groups contains little saponin so that when it is shaken with water it does not form micelles. In the micelle structure, the polar group faces out while the non-polar group faces inward, this is what looks like foam.

Phytochemical testing results produced a positive value for the presence of alkaloids in *R.mucronata* fruit extract, which amounted to 21.11%. Alkaloids are a class of secondary compounds which are alkaline, contain one or more hydrogen atoms. Alkaloid tests are carried out using sedimentation reagents to separate the alkaloid types. The formation of the white precipitate after the addition of ammonia indicates the presence of alkaloids in the extract. The presence of N groups in the alkaloid structure causes alkaloid compounds to have the potential as antioxidants.

Phytochemical testing results revealed that *R.mucronata* extract was positive for steroid compounds. This result is proven by changing the brick red color from being bluish green. This is in accordance with the phytochemical test in previous study [15] that *Rhizophora mucronata* is positive for a steroid and negative compounds in the triterpenoid test. In general, steroid structures have cyclic structures and have hydroxyl and carbonyl groups. The presence of these groups causes the steroid to experience cyclization and oxidation easily in the final synthesis. Oxidation is related to the activity of free radicals that cause oxidation, as well as terpenoid derivatives namely alfa-carotene and cryptoxanthin which are very easily oxidized. In general, steroid compounds are widely found in plants and come from the same compound, namely isoprene molecules.

**IC₅₀ antioxidant test extract of *R.mucronata***

The results of the measurement of antioxidant activity showed IC₅₀ values of *R.mucronata* extract at 135.69 ppm and an inhibition percentage of 95% at a concentration of 250 ppm.

![Figure 1. Regression curve of *R.mucronata* fruit extract](image)

The IC₅₀ test results showed that the higher the concentration of coarse mangrove extract added, the higher the percentage of inhibition produced. The percentage of inhibition is produced by a solution containing a concentration of 250 ppm. The lowest inhibition percentage was produced by a solution containing the smallest crude extract concentration, namely a solution with a concentration of 31.25 ppm. The percentage inhibition of crude extracts on free radical activity increases with increasing extract concentration [16]. One type of fruit that contains high antioxidants from mangrove plants is black mangroves (*Rhizophora mucronata*). Based on research on the bark of *Rhizophora mucronata* plant extracted with methanol solvent produced an IC₅₀ value of 193.82 ppm [17]. The high antioxidant activity in the extract is related to the number of active compounds that can be contained in extracts that have been tested through phytochemical tests. The bioactive compounds contained in the extract include alkaloids, phenols, flavonoids, saponins, and steroids. These compounds have antioxidant activity.

**3.2 Antioxidant test**
The highest antioxidant was *R. mucronata* concentration of 7% which was significantly different from the percentage of skin lotion inhibition with *R. mucronata* 0% and 3%.

**Figure 2.** Results of Antioxidant skin lotion measurements (superscript with different letters shows significantly different and the same letter shows not significantly different (p <0.05)

The results showed that the higher the concentration of *R. mucronata* used the higher the antioxidant value. The results of the extract concentration value are directly proportional to the inhibition value. The higher the concentration, the higher the inhibition value, this indicates that the greater the concentration, the more antioxidant content in the extract which can reduce the activity of free radicals is marked by the decay of purple from DPPH [18]. Skin lotion with *R. mucronata* had a high percentage of inhibition in DPPH test because *R. mucronata* extract had a high enough free radical scavenging ability shown in addition to extract 7% inhibition percent value reached 90.49%.

### 3.3 Sun protection factor (SPF) test of skin lotion

The results showed that the highest SPF values were found in Skin lotions with a concentration of *R. mucronata* fruit extract 7% which was 11.16%. The higher the extract concentration, the higher the SPF value. This is because *R. mucronata* fruit extract acts as a sunscreen in skin lotion preparations. The SPF is a quantitative measurement of the effectiveness of sunscreen formulations. To be effective in preventing sunburn and other skin damage, sunscreen products should have a wide range of absorbances between 290 and 400 nm. Sunscreens obtained have SPF values was ranging from 6.0 to 11.16.

**Figure 3.** The SPF skin lotion measurement results

Values (means ±SD) with different superscript letter shows significant different (P <0.05)
From the figure 3, we can see the SPF values found at concentrations of 0, 3, 5 and 7% with SPF values in the low to moderate category. The effectiveness of sunscreen cream preparations is based on the determination of the Sun Protection Factor (SPF) value which describes as the ability of the sunscreen to protect the skin from erythema [2]. This SPF product is intended to protect against UVB light and is not intended to fight UVA and UVC rays.

3.4. Irritation test of skin lotion
The results of irritation tests on all four skin lotion concentrations with the addition of *R.mucronata* extract showed negative results on the three assessment parameters, which was evidenced by the absence of irritating effects on the skin of 25 panelists such as redness, edema (swelling) and itching. Treatment by using natural ingredients for the skin surface must receive attention due to the presence of usage and the high risk of disease. Skin irritation is one of the most common effects on the skin caused by various factors carried by cosmetics such as chemical composition, a frequency of usage time, exposure to toxic materials and much more.

*R.mucronata* which is added to skin lotion products is a natural ingredient that has the potential to cause irritation to the skin so that the skin irritation test is very necessary to determine the level of safety of the material to be used on the skin. Plant extracts are also used as cosmetic ingredients and other formulations such as deodorizers, dyes, anti-irritants, and anti-aging. Products from nature can cause allergies and irritation to the skin [19]. Plant active ingredients which contain antioxidant compounds, phenols, flavonoids, and high polyphenols have been proven to be able to fight UV rays and oxidative effects that can be protective for the skin. But an important point that must be overcome is that active ingredients from nature can cause problems such as allergies and irritation to the skin.

3.5. Hedonic test of skin lotion

**Appearance**
Panelists’ favorite score on the appearance of skin lotions ranged from 4.56 to 5.6 which means that the panelists gave an assessment between normal and somewhat like. The highest appearance value is shown at a concentration of 0% which is 5.60 ± 1.04. This can be caused by the effect of the color change of the lotion added to the extract.

![Figure 4](image)

**Figure 4.** The average score of panelists’ preference for skin lotion appearance
Values (means ±SD) with different superscript letter shows significant different \( P < 0.05 \)

The higher the concentration of the extract, the color of the skin lotion will be thicker, which affects the level of panelist preference. Appearance is a very basic parameter in hedonic testing because it influences consumer acceptance as an initial assessment of a product.

**Color**
Panelists’ preference for skin lotion color ranged from 4.76 to 5.6, which means that the panelists gave an assessment between normal and somewhat like. The concentration of *R.mucronata* influences the
level of panelists' preference for skin lotion color. This is presumably because the concentration of \textit{R. mucronata} added to the skin lotion formulation causes differences in skin lotion color.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure5.png}
\caption{Average value of panelists' preference for skin lotion color}
\end{figure}

The color formed in the product is influenced by the color of the constituent material [10]. The color of \textit{R. mucronata} used in concentrated chocolate and with a high amount of concentration influences the level of panelists' preference for color parameters. The higher the concentration of the extract added, the more intense the skin lotion color.

\textit{Homogeneity}

The results of the Kruskal-Wallis test (\(\alpha = 0.05\)) showed that the concentration of \textit{R. mucronata} affected the level of panelists' preference for skin lotion homogeneity. This is because the addition of \textit{R. mucronata} on skin lotions with high concentrations influences homogeneity.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure6.png}
\caption{The average value of panelists preference for skin lotion homogeneity}
\end{figure}

The highest level of panelist preference was in skin lotion formulations 7\% which was 5.16 ± 0.94. This shows that the higher the extract concentration, the more homogeneous emulsion mixture. The process of making and mixing the oil and water phases is done in making the skin lotion the same so that the resulting homogeneity is not significantly different. The homogeneity of the emulsion system is influenced by the technique or method of mixing carried out, as well as the tools used in the emulsion manufacturing process [20].
Viscosity

The results of the sensory viscosity test showed that the highest level of panelist preference was in the formulation of skin lotions 0% and 5%, which were equal to 5.00 ± 0.91 and 5.00 ± 1.04. This shows that the addition of extract does not affect panelists' preference for skin lotion viscosity.

![Figure 7. Average values of panelists' preference for skin lotion viscosity](image)

Values (means ±SD) with different superscript letter shows significant different ($P < 0.05$)

The thickener used in skin lotions such as cetyl alcohol with the same concentration causes the thickness of the skin lotion to one another is not significantly different. Skin lotion viscosity on the Mann-Whitney test showed that all concentrations of extract addition were not significantly different from the panelist's viscosity assessment.

Moist

The results of the sensory moist test showed that the highest level of panelist preference was in skin lotion formulations 7% which was 5.08 ± 1.07. This shows that the addition of extracts affects panelists' preference for the impression of moist skin lotion. The higher the concentration of *R.mucronata* extracts added, the better the moist impression is generated.

![Figure 8. Average value of panelists' preference for skin lotion moist](image)

Values (means ±SD) with different superscript letter shows significant different ($P < 0.05$)

The addition of *R.mucronata* in skin lotion can add moisture to the skin. Moisture impression of skin lotion on the Mann-Whitney test showed that all concentrations of extract addition were not significantly different from the panelist's assessment of moist impression.

Stickiness
Stickiness is one of the parameters considered in the selection of skin lotions because the stickiness feels related to comfort after use. Panelists' preference for skin lotion stickiness ranged between 4.84-5.0, which means that the panelists gave a rating between rather like and like. The concentration of *R. mucronata* did not affect panelists' preference for skin lotion stickiness.

The highest level of panelist preference on sticky taste parameters is the skin lotion formulation with a concentration of 0%. This is presumably due to the addition of *R. mucronata* in the formulation followed by reduced water concentration which causes skin lotion products to become more sticky as the concentration of extract increases.

### 3.6 pH Test of Skin Lotion

The results showed that the highest pH value of skin lotion with a concentration of *R. mucronata* was 7% which was significantly different from the pH of skin lotion 0% and 3%. An increase in the concentration of *R. mucronata* added to the skin lotion formulation causes the pH value to increase. This is because *R. mucronata* is alkaline which causes the pH of *R. mucronata* fruit extract to be high which will then affect the pH value of the product. If a cosmetic product has a very high or very low pH value it will cause irritated skin.

**Figure 10.** Measurement of pH skin lotion

Values (means ±SD) with different superscript letter shows significant different (*P < 0.05)*
produce a higher pH, while at a concentration of 0% pH only 7.21. This shows that the lotion preparations made without *R. mucronata* are slightly alkaline and will become more alkaline when *R. mucronata* extract concentration is increased.

### 3.7 Viscosity test of skin lotion

The viscosity of skin lotions ranged between 2136-5825 cP. The results showed that the highest viscosity was *R. mucronata* concentration of 7% which was significantly different from the percentage of severe shrinkage of skin lotion with *R. mucronata* 0, 3, and 5%. The results showed that the higher the concentration of *R. mucronata* used the higher the viscosity.

![Figure 11. Skin lotion viscosity measurements.](image)

Values (means ±SD) with different superscript letter shows significant different (*P* < 0.05)

Skin lotion with *R. mucronata* has high stability and humidity so that viscosity tends to be high. Changes in viscosity can be influenced by several things such as dispersing phase, dispersing medium, emulgator, other additives, or the environment. Increased viscosity can be caused also because of a lump in the preparation. The decrease in viscosity can occur due to changes in temperature, high temperatures will cause smaller viscosity.

### 3.8 Emulsion Stability Test of Skin Lotion

The results of the emulsion stability test at all four concentrations of skin lotion showed that lotions had good physical stability, as evidenced by the absence of physical or chemical changes after being given high temperature and low-temperature treatments. The stability of the emulsion on the skin lotion is influenced by mechanical factors, temperature, and the process of emulsion formation. The emulsion was droplet shaped and its size is affected by the stirring rate during the emulsification process. The smaller and uniform the droplet shape, the more stable the emulsion will be [22].

### 4. Conclusion

The enrichment of *R. mucronata* extract as a natural antioxidant for skin lotion characteristics significantly affected the antioxidant activity, pH, viscosity, emulsion stability, and sensory on appearance, color, viscosity, but not significantly different to sensory parameters on homogeneity, moisture, stickiness, and irritation. Skin lotion formulation with the best *R. mucronata* extract concentration at a concentration of 5% with the value of panelists' preference between normal to mildly like 4.660 <μ <5.245 with pH 8.08; viscosity 3,615 cP and antioxidant activity of 79.11%.

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