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Formulation and antioxidant activity test of sea kale cream (Ipomoea pescaprae) with DPPH (1.1-diphenyl-2-picrylhydrazyl) method

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ABSTRACT

Sea kale (Ipomoea pescaprae) is one of the Indonesian medicinal plants used by the community to treat inflammation, diuretic disorders, and pain in gonorrhea. Sea kale can also be used as a source of natural antioxidants that can counteract free radicals. Sea kale contains secondary metabolites such as alkaloids, flavonoids, tannins and saponins. This study aims to determine the antioxidant activity of cream preparations containing sea kale leaf extract against DPPH(1.1-diphenyl-2-picrylhydrazyl) and to find out what concentration of sea kale leaf extract cream has the highest activity as an antioxidant. Sea kale (Ipomoea pescaprae) was extracted by maceration method using methanol solvent and then preparations were made in cream form using various extract concentrations, namely 5%, 7.5% and 10%. Furthermore, evaluation of cream preparations was carried out, namely organoleptic test, homogeneity test, spreadability test, pH test, viscosity test and cream type test. Determination of antioxidant activity was carried out using the DPPH method and vitamin C as a comparison by calculating the IC50 value. IC50 results obtained in formula I with 5% extract of 237.63 ppm (Medium), formula II with 7.5% extract of 91.83 ppm (Strong) and formula III with 10% extract of 7.32 ppm (Very strong). Meanwhile, the positive control for vitamin C had an IC50 value of 5.33 ppm (very strong). Formula III is the best formula that has very strong antioxidant activity.

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INTRODUCTION

The Sea kale (Ipomoea pes-caprae) is a coastal plant that has gained attention due to its potential medicinal properties and high antioxidant content (Baliyan et al., 2022; Nilam et al., 2018). Antioxidants play a crucial role in protecting the body against oxidative stress, which has been linked to various diseases such as cancer, cardiovascular disorders, and aging-related conditions.

The formulation of sea kale cream provides an innovative approach to harness the antioxidant benefits of this plant for skincare applications (Baliyan et al., 2022)

The objective of this study is to formulate a sea kale cream and evaluate its antioxidant activity using the 1,1-diphenyl-2-picrylhydrazyl (DPPH) method (Safutra & Zuriat, 2018). The DPPH assay is a widely used technique for assessing the antioxidant capacity of natural compounds (Sharma & Bhat, 2009). It measures the ability of antioxidants to scavenge and neutralize the stable DPPH free radical by donating hydrogen atoms or electrons, resulting in a color change that can be quantified spectrophotometrically (Safutra & Zuriat, 2018)

The formulation of sea kale cream involves the careful selection of appropriate excipients, emulsifiers, and stabilizers to ensure stability, consistency, and skin compatibility (Baliyan et al., 2022). Various factors such as pH, viscosity, and sensory attributes need to be considered during the formulation process to create an effective and user-friendly product (Purwanti et al., 2022).

The evaluation of the antioxidant activity of sea kale cream will be conducted using the DPPH method, which provides valuable insights into its potential as a topical antioxidant. The DPPH assay allows for the determination of the percentage inhibition of the DPPH radical by the sea kale cream, indicating its ability to scavenge free radicals and exhibit antioxidant activity (Sharma & Bhat, 2009). A higher percentage inhibition corresponds to a stronger antioxidant effect (Badarinath et al., 2010).

The urgency of this research is to contribute development of natural antioxidant-based skincare products by exploring the formulation and antioxidant activity of sea kale cream. The findings of this study will not only enhance our understanding of the antioxidant potential of sea kale but also provide insights into the formulation of antioxidant-rich creams for promoting skin health.

The implication of this research is the discovery of antioxidant activity from the sea kale plant in the form of a cream preparation which has never been formulated in a dosage form before, so that later this pharmaceutical preparation can be continued to the next test stage and production stage if this preparation is as expected.

RESEARCH METHOD

Preparation Of Sea Kale Leaf Extract

Sea kale (Ipomoea pescaprae) as much as 5000 grams which has been cut into small pieces then macerated with 10 L of methanol in a glass jar until the sample is submerged. Every 24 hours the filtrate was filtered and the residue was macerated again with methanol. Extraction was carried out for 3 days. Furthermore, the macerate is separated from the dregs again, the process is repeated twice, then the macerate results are combined and the solvent is evaporated using a rotary evaporator to obtain sea kale leaf extract (Diani et al., 2015). The yield obtained is calculated by the following equation:

$$\% \text{ Yield} = \frac{Extract\ weight}{Sample\ Initial\ weight} x100\% \quad (1)$$

(Hainil et al., 2020)

Making of Sea Kale Leaf Extract Cream

Weigh 5 grams of thick extract, then put it in a mortar and then grind it. Add 100 grams of vanishing cream base material little by little while grinding until homogeneous so that a concentration of 5% is obtained. Cream is also made at a concentration of 7.5% and 10%.

Evaluation of Cream Preparations

Organoleptic Test

Observe the shape, color, and smell of the cream. This is done to find out whether the cream made matches the color and smell of the extract used (Hainil et al., 2020).

Homogeneity Test

Take a little cream, then smeared on the object glass. Evenly spread the cream on the glass object. Then it is seen that the cream is homogeneous by seeing whether or not there are grains in the cream (Hainil et al., 2020).

PH Test

pH measurement was carried out using a pH meter. The trick is to weigh 1 gram of cream and dissolve it with 10 ml of distilled water. Then, use a pH-meter that has a sensor and reads the pH on the monitor. The pH of the preparations that meet the skin pH criteria is around 4.5 – 6.5 (Alfath, 2012).

Spreadability Test

Weigh 0.5 grams of cream, then place the cream in the middle of a petri dish which is in an inverted position, put another load of petri dish on top of the cream then let it stand for 1 minute and calculate the diameter. Then add 150 grams of weight and then measure the diameter again. Good cream spread between 5-7 cm (Eliska et al., 2016).

Cream Type Test

A number of cream preparations are placed on a glass object, then add 1 drop of methylene blue, stir with a stirring rod. If methylene blue is spread evenly, it means that the type of cream produced is oil in water (M/A), whereas if blue spots appear, the cream produced is water in oil (A/M) type (Hainil et al., 2020).

Cream Viscosity

Viscosity measurements were carried out using a Brookfield viscometer by installing spindle no. 4 on the tool then dipped into the preparation to a certain extent and set the speed of 12 rpm. Each measurement is read by the scale when the red needle has stabilized. The viscosity value is obtained from the multiplication of the dial reading with a specific correction factor for each spindle speed. The ideal cream viscosity value is more than 5000 cps (Naiu & Yusuf, 2018)

Antioxidant Cream Testing

Preparation of DPPH reagent (2,2-Diphenyl-1-1Pickrylhydrazyl)

Weigh 1.97 mg of DPPH, dissolve it with methanol up to 50 ml in a volumetric flask then shake until homogeneous to obtain a solution with a concentration of 100 ppm then store in a dark place (Pratiwi et al., 2016).

Preparation of Vitamin C Comparison Solution

A 100 ppm stock solution was prepared by weighing 1 mg of vitamin C and then dissolving it in 10 ml of methanol. Series were made in several concentrations, namely 2 ppm, 4 ppm, 6 ppm, 8 ppm and 10 ppm (Sharma & Bhat, 2009)

Antioxidant Activity Testing of Cream Against DPPH

Approximately 50 mg of cream was weighed and then dissolved with methanol in a 50 ml volumetric flask and mother liquor was obtained with a concentration of 1000 ppm. Then several series of concentrations of 50, 100, 150, 200 and 250 ppm were made (Elya et al., 2013)

IC50 Determination Using the DPPH Method

Cream and vitamin C of various concentrations are taken 2 ml. Added 2 ml of DPPH, then vortexed and incubated for 30 minutes at room temperature. Measure the absorbance at a wavelength of 400-800 nm. DPPH absorption was carried out as a blank, namely 2 ml of DPPH plus 2 ml of methanol at the same wavelength. After obtaining the absorbance value, calculate the % inhibition using the formula: (Marghitas et al., 2009).

$$\% \text{ inhibition} = \frac{Abs.Kontrol - Abs.Sampel}{Abs.Kontrol} x100\% \quad (2)$$

(Handayany et al., 2018).

RESULTS AND DISCUSSIONS

Fromas much as 5000 grams, obtained a thick extract of 123.74 grams so that a percent yield of 2.47 was obtained.

$$\%\text{Rendaman extract} = \frac{\text{Initial Weight Extract}}{\text{Weight Extract obtained}} \text{X100\%} \quad (3)$$

$$\%\text{Rendaman extract} = \frac{123{,}74 \text{ gram}}{5000 \text{ gram}}\text{X100\%} \quad (4)$$

$$= 2.47\ \%$$

Evaluation of Cream Preparations

Organoleptic Test

The organoleptic test was observed visually by observing changes in shape, smell, and color in the cream preparations that had been made. Organoleptic testing aims to determine the organoleptic preparation which includes color and aroma according to the extract used. The organoleptic observations showed that the four formulas had a semisolid dosage form in the form of cream and had a distinctive lemon odor due to the addition of oleum citri to the formula to improve the aroma of the sea kale extract cream and produced a white color for the negative control cream, a brownish green color at a concentration of 5% (FI), brownish green color at a concentration of 7.5% (FII), and blackish green at a concentration of 10% (FIII). This proves that the more concentration of the extract added, the darker the green color of the cream will be.

Table 1. Organoleptic test results for cream preparations

Formulas	Color	Form	Smell
Cream Base	White	Semisolid / Cream	Lemon special
5%	Brownish green	Semisolid / Cream	Lemon special
7.5%	Brownish green	Semisolid / Cream	Lemon special
10%	Blackish green	Semisolid / Cream	Lemon special

Homogeneity Test

Based on the homogeneity test results of the sea kale leaf extract cream, it shows that the four cream formulas have a homogeneous composition and there are no coarse grains when the preparations are smeared on glass objects. This is in accordance with the requirements for homogeneity of the cream, namely the cream is said to be homogeneous if there is an even color equation and no particles are found in the cream. This homogeneity test aims to see and know the mixing of the cream preparation ingredients. The active substance properties of the sea kale herbal extract are mixed with the M/A base so that no clumping and phase separation occurs.

Table 2. Cream preparation homogeneity test results

Formulas	Results
Cream Base	Homogeneous (No coarse grains)
5 %	Homogeneous (No coarse grains)
7.5 %	Homogeneous (No coarse grains)
10 %	Homogeneous (No coarse grains)

pH test

The pH test on cream preparations is carried out to see the acidity level of the preparations to ensure the preparations do not cause irritation to the skin. The results of the pH test on the herbal extract cream, namely the negative control cream, was 6.45, while the 5% extract

concentration cream had a pH value of 5.71, the 7.5% cream concentration, which was 5.80 and 10%, had a pH value of 5.99. A pH value that is too low can cause irritation, while a pH value that is too high can cause scaly skin. The pH of the cream preparations that affects the requirements is 4.5 – 8. This shows that the pH value of the cream preparations is still in the range that is allowed for use on the skin.

Table 3. Cream preparation pH test results

Formulas	Results	Condition
Cream Base	6.45	
5 %	5.71	3.5-8
7.5 %	5.80	
10 %	5.99	

Spreadability Test

Spreadability test aims to determine the area of the preparation that can be spread and evenly distributed when used. Good spreading power is having a diameter of 5 - 7 cm. the greater the spreadability given, the ability of the active substance to spread and contact with the skin is wider. From the results of the spreadability test on each sea kale herb extract cream preparation, the negative control cream obtained a spreadability value of 5.19 cm. At a concentration of 5%, a scattering value of 5.78 cm was obtained. At a concentration of 7.5%, a scattering value of 6.02 cm was obtained. At a concentration of 10%, a scattering value of 6.16 cm was obtained. The results of the spreadability of the sea kale herb extract cream showed that the four formulas had good spreadability. Negative control cream has a greater spreadability value than Formula I, II, and III.

Table 4. Results of spreadability test of cream preparations

Formulas	Results	Condition
Cream Base	5.19cm	
5 %	5.78cm	5-7 cm
7.5 %	6.02cm	
10 %	6.16cm	

Viscosity Test

Viscosity test was carried out aiming to determine the consistency of the thickness of a cream preparation. The higher the viscosity value of a preparation, the denser the cream preparation will be. The viscosity value will be inversely proportional to the spreadability value where the higher the viscosity value of a preparation, the lower the spreadability value of the preparation. Viscosity test was carried out with a Brookfield viscometer using spindle number 4 and speed of 12 rpm. The Brookfield viscometer was chosen because it is very easy and simple to use, only uses a small sample but the measurement results are quite accurate and do not require a long time. The results obtained were 5% concentration (27,000 cps), 7.5% concentration (29,500 cps) and 10% concentration (33,500 cps). The results of this study showed that cream preparations with an extract concentration of 10% had a higher viscosity value than other preparations. The viscosity value that has been obtained meets the requirements where the viscosity range of the cream according to SNI 16-4399-1996 is 2,000-50,000 cps.

Table 5. Cream preparation viscosity test results

Formulas	Results	Time	Condition
Cream Base	26,000 cps	60 sec	2000-50000 cps
5 %	27,000 cps	60 sec	2000-50000 cps
7.5 %	29,500 cps	60 sec	2000-50000 cps
10%	33,500 cps	60 sec	2000-50000 cps

Cream Type Test

Cream type testing was carried out to determine the emulsion type of the cream preparation that had been made. If methylene blue is spread evenly, it means that the type of cream produced is oil in water (O/W), whereas if blue spots appear, the cream produced is water in oil (A/M). The results obtained show that all cream formulations are M/A cream type which is characterized by the even distribution of methylene blue in the cream without any spots forming. The reason for choosing this type of oil-in-water (M/A) cream is because it is easier to spread evenly on the surface of the skin, is not sticky and is easily removed when washed with water compared to the water-in-oil (A/M) cream type.

Table 6. Cream dosage type test results

Formulas	Results	Cream Type
Cream Base	Methylene blue is spread evenly	M/A
5 %	Methylene blue is spread evenly	M/A
7.5 %	Methylene blue is spread evenly	M/A
15 %	Methylene blue is spread evenly	M/A

Antioxidant Activity Testing

Antioxidant activity test of sea kale (Ipomoea pescaprae) leaf extract cream was carried out by the DPPH method using a UV-Vis spectrophotometer (Rajakumar & Abdul Rahuman, 2011) .This method is based on the ability of antioxidants to neutralize free radicals (Pruchniak et al., 2016) (Prieto et al., 1999).

The free radical used is DPPH (1,1-diphenyl-2-picrylhidrazyl) (Kumar et al., 2015) (Brand-Williams et al., 1995) This test aims to determine the absorbance of the remaining DPPH after adding antioxidant compounds (Jayaprakasha et al., 2003)

The DPPH method was chosen because it is simple, does not require a lot of reagents, can be done quickly and only requires a UV-Vis spectrophotometer (P, 2004) (Re et al., 1999). In addition, DPPH has a high level of sensitivity, can analyze a large number of samples in a short period of time, and can be used for small or small samples (Re et al., 1999) (Koleva et al., 2002). The maximum DPPH wavelength obtained for measuring the antioxidant activity of meniran herb extract was 521 nm, using a UV-Vis spectrophotometer (Prieto et al., 1999) (P, 2004).

The parameter used to show antioxidant activity is Inhibition concentration (IC50)) (Mensor, 2001) . IC50 value is a value that indicates the concentration of antioxidants that can inhibit 50% of free radical activity (Benzie & Strain, 1996) (Panche et al., 2016). Chemically, antioxidant compounds are electron-giving compounds (electron donors) (Prior et al., 2005) (Pruchniak et al., 2016).Antioxidants work by donating an electron to compounds that are oxidants so that the activity of these oxidant compounds can be inhibited (Pruchniak et al., 2016) (Rajakumar & Abdul Rahuman, 2011). Antioxidant compounds that react with DPPH radicals cause reduced absorption of DPPH, which is indicated by a change in the color of the DPPH free radicals from purple to pale yellow (Re et al., 1999) (Prieto et al., 1999). This also occurred in testing the antioxidant activity of the meniran herb extract cream, where the color of the DPPH solution changed from dark purple to pale purple (P, 2004) (Mohamad et al., 2019). Meanwhile, in the Vitamin C comparison solution, the color of the DPPH solution changed from purple to pale yellow 2004) (Jayaprakasha et al., 2003).

Based on the results obtained in the observation of the antioxidant activity test, the negative control cream preparation had an IC50 value of 857.21 ppm (inactive or very weak), FI with an extract concentration of 5% had an IC50 of 237.63 ppm (moderate), FII with an extract concentration 7.5% has an IC50 of 91.83 ppm (strong) and FIII with an extract concentration of 10%

has an IC50 of 5.33 ppm (very strong). This is in accordance with the opinion that the higher the concentration, the greater the antioxidant activity and which is indicated by the lower the absorbance.

Table 7. Antioxidant test results for creams of various concentrations

Formulation	Regression Equation	IC50 (ppm)
Vitamin C (Positive Control)	y = 6.3793x + 16.01 R^2 = 0.9887	5,33
F0 (Negative Control)	y = 0.0558x + 2.1675 R^2 = 0.9847	857,21
FI (5%)	y = 0.2026x + 1.8555 R^2 = 0.9729	237.63
FII (7.5%)	y = 0.243x + 27.685 R^2 = 0.965	91.83
FIII (10%)	y = 0.1727x + 48.736 R^2 = 0.9906	7,32

CONCLUSION

Sea kale leaf extract can be formulated into an antioxidant cream and sea kale leaf extract cream (Ipomoea pescaprae) has antioxidant activity against DPPH with very strong antioxidant activity. The implication of this research is the discovery of antioxidant activity from the sea kale plant in the form of a cream preparation which has never been formulated in a dosage form before, so that later this pharmaceutical preparation can be continued to the next test stage and production stage if this preparation is as expected. The limitation in this research is that further tests need to be carried out so that this preparation can really be produced on an industrial scale and of course can be sold to the public after obtaining a GMP certificate.

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