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FORMULATION AND ANTIOXIDANT ACTIVITY EMULGEL SENGGANI LEAF (*Melastoma malabathricum* L.) WATER FRACTIONS WITH VARIATIONS OF GELLING AGENT USING DPPH METHOD

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ABSTRACT

The senggani plant is reported to have antioxidant activity owing to its flavonoid content, which is a free radical scavenger. The water fraction of senggani leaves needs to be prepared for use, one of which is the emulgel. An important additional ingredient in emulgels is the gelling agent, and the most commonly used is carbopol 940. This study aimed to determine the formulation of emulgel preparations with the most stable variation in carbopol 940 and to test the antioxidant activity of water fraction emulgel preparations from senggani leaves (*Melastoma malabatricum* L.). The preparations were made by varying the concentrations of Carbopol 940 to 0.5% (F1), 1.25% (F2), and 2% (F3). Physical stability evaluations included organoleptic, homogeneity, pH, spreadability, adhesive power, viscosity, and antioxidant tests for 28 days. The results of the research showed that the emulgel that tested the physical stability of emulgel preparations with each concentration produced the best emulgel, F3 with an emulgel concentration of 2%, with a pH of 5.32-5.19, spreadability of 4.47-5.53 cm, adhesive power of 31. 21 -25.64 seconds, and viscosity of 47520-34853 cP. The IC50 value of the emulgel preparation is 17870.83-14851.28 ppm, with statistical test results of sig. (p-value) > 0.05, which means that storage has no effect on the emulgel preparation. The conclusion of this research is the best concentration of Carbopol as gelling agent of emulgel is 2% with the antioxidant activity is very weak

Keywords: emulgel; senggani leaf water fraction; carbopol 940; IC_{50}

INTRODUCTION

Free radicals are molecules that exhibit high reactivity owing to the presence of unpaired electrons in their outer orbitals, rendering them unstable (Pai *et al*.,2014). The human skin is considered to be the most vulnerable part of the body to the deleterious effects of free radicals. These reactive species can cause a range of adverse outcomes, including premature aging, hyperpigmentation, and skin cancer, which can be attributed to exposure to ultraviolet (UV) radiation, a prominent source of free radicals. According to a survey in Indonesia, 57% of women begin to show signs of aging at the age of 25, whereas these signs are normally visible at around the age of 30. The most common premature aging sign is dull skin, affecting 53.30% of participants (Aizah, 2016). As such, effective protection against free radical attacks necessitates the deployment of antioxidant compounds, which neutralize, reduce, and impede the formation of new free radicals within the body. (Sari, 2016). Senggani (*Melastoma malabatricum*) is rich in flavonoids. The Senggani plant has been

empirically believed by the community to be used to treat various diseases. This plant is efficacious as a fever reducer (antipyretic), pain reliever (analgesic), diuretic, and for vaginal discharge (leukorrhea). It has also been reported that the senggani plant can provide such benefits owing to the presence of flavonoids such as kaempferol, hyperin, quercetin, and quercitrin, which are all effective free radical scavengers (Roswita *et al*., 2019). The research conducted on senggani leaves has revealed that the ethanol extract to water residue from senggani leaves has demonstrated a significant IC_{50} value of 6.8 ppm, and 9.3 ppm (Apridamayanti *et al*., 2022).

The application of antioxidants found in the water fraction of Senggani leaves on facial skin is more effective when formulated in the form of topical cosmetic preparations that are easy to use and provide a comfortable feeling to the skin. One such preparation is the emulgel (Pakhare *et al*., 2017). Emulgel is a type of emulsion that can be transformed into a gel through the addition of a gelling agent. The advantages of emulgels include their soft and pliable consistency, refreshing and cooling sensation, ease of application, and excellent drug release properties. Its unique formulation offers several benefits to users, making it a desirable option for a variety of applications (Rahmania *et al*., 2020). Gelling agents used in pharmaceutical and cosmetic preparations must meet several criteria, including being inert, safe, and non-reactive with other ingredients. Carbopol 940 was used as a gelling agent. Carbopol 940 was chosen because it can produce a clear gel preparation and is a good thickening agent because it has a high viscosity with a large viscosity range, namely 40,000-60,000 cP (Thomas *et al*., 2023). Carbopol has a pH range of 2-3 with and can be used as a gelling agent of 0.5-2% (Sheskey, *et al*., 2017).

Measurement of the antioxidant activity of the emulgel preparations was performed using the DPPH method. The DPPH method is commonly used to provide information on the reactivity of a tested compound with a stable radical. The DPPH method was chosen because it is easy to use with a high level of sensitivity and can be used to quickly analyze small samples using a UV-Vis spectrophotometer (Sukweenadhi *et al*., 2020). Based on the explanation above, research was carried out to determine the effect of carbopol 940 concentration with a variation of 0.5%, 1.25%, and 2% as a gelling agent on the antioxidant activity of emulgel preparations using the DPPH method.

RESEARCH METHODS

Equipment and Materials

The tools used in this research are adhesive test equipment, centrifuge, pH meter (Hanna® HI-98103), Uv-Vis spectrophotometer (Shimadzu® type 2450), sonicator viscometer (Brookfield®), micropipette (DLAB™), analytical balance (Ohauss®), mortar, ruler, turtle spoon, stirring rod, glass preparation, spatula, vial, separating funnel, and glassware (Pyrex®, IwakiCTE33).

The materials used in this study are methanol pro analyze (PT. Nusa Kimia), distilled water (Dwicentra, Indonesia), Carbopol 940 (Kimia Jaya Labora), Triethanolamine, senggani leaf water fraction, DPPH (2,2-diphenyl-1-picrylhydrazyl) (Sigma Aldrich), n-hexane, methyl paraben, liquid paraffin, propylene glycol, span 80, TEA, and tween 80.

Research Procedure

1. Plant Determination

Senggani leaves (*Melastoma malabathricum* L.) were examined to ensure the identity of the plant. The leaf part was determined by the Biology Study Program Biology Study Program, Faculty of Mathematics and Natural Sciences, Tanjungpura University, Pontianak, West Kalimantan.

2. Preparation of Senggani Leaf Fraction

The simplicia leaves were macerated with 80% ethanol in a vessel until completely submerged. Remaceration was carried out for 3 × 24 hours with stirring, after which it was

continued by filtration using a Buchner funnel. The maserate obtained was evaporated using a rotary evaporator until an ethanol extract was formed, which was then evaporated in a water bath until a thick extract was obtained. Fractionation was then continued using a separating funnel with solvent levels of nonpolar, semipolar, and polar solvents (Apridamayanti, Sari and Pratiwi, 2022). The fractionation results used polar fractions with water solvent, which were then evaporated until the desired fraction was obtained.

3. Preparation of Senggani Leaf Water Fraction Emulgel

The emulgel formula used in this study refers to research conducted by (Puspitasari *et al,* 2023) with modifications. Making emulgel is carried out according to the formula composition listed in **Table I.**

Table I. Formulation of Senggani Leaf Water Fraction Emulgel Preparation

Component	Formula		
	I	II	III
Senggani Leaf Water Fraction	2,5%	2,5%	2,5%
Carbopol 940	0,5%	1,25%	2%
Paraffin Cair	5%	5%	5%
Span 80	1,5%	1,5%	1,5%
Tween 80	15%	15%	15%
Metil Paraben	0,2%	0,2%	0,2%
Propilenglikol	5%	5%	5%
Propil Paraben	0,03%	0,03%	0,03%
TEA	qs	qs	qs
Aquadest	add 100	add 100	add 100

It begins by making the gel base first, and then developing Carbopol at concentrations of 0.5%, 1.25%, and 2% in hot water until maximum clarity is achieved. Carbopol, as is known, has a pH of 2-3, so TEA needs to be added as a pH increase until the pH of carbopol reaches the appropriate pH, namely, 5. After making the gel base, proceed with making an emulsion consisting of two phases, namely, the oil phase and water phase, was formed. The oil phase consisted of Span 80 liquid paraffin, which was then heated at 70 °C until it became homogeneous (Auliasari, 2016). The water phase consisted of a mixture of Tween 80, methylparaben, propylene glycol, propylparaben, and distilled water, which was heated at 70 °C until homogeneous. Then, the oil phase was added to the water phase while stirring using a hand mixer at the maximum speed for 10 minutes. The emulsion was then mixed with gel, and the water fraction of the senggani leaves, which was dissolved in distilled water, was added. The mixture was homogenized using a hand mixer at maximum stirring speed until homogeneous (Priani *et al.*, 2021). The emulgel formulas used are shown in the following table.

4. Evaluation of Senggani Leaf Extract Emulgel Preparation

Organoleptical and Homogenity

The organoleptic test was carried out by visually observing the physical appearance of the emulgel preparation, while homogeneity test was carried out by smearing the emulgel preparation on a glass slide, then placing another glass preparation on top of it, and observing the presence of coarse particles in the preparation (Priani *et al.*, 2021). Organoleptic stability testing was carried out on days 0, 7, 14, and 28 at room temperature.

pH

A pH test was carried out to determine the acidity level of the preparation so that the preparation did not cause irritation to the skin. The emulgel preparation was tested for pH

using a pH meter by dipping the pH meter into the preparation. The pH values were recorded on the pH meter screen. A pH test was also carried out to determine if the pH of the emulgel preparation met the requirements according to SNI 16-3499-1996. The pH of the skin is 4.5-6.5 (Ratnapuri Fitriana, 2019). pH stability testing was carried out on days 0, 7, 14, and 28.

Spreadability

This test was carried out by weighing 0.5 g of the emulgel placed on a flat glass, and another glass was placed on top and left for 1 minute. Subsequently, 150 g of load was added and left for 1 minute and the constant diameter was measured. The same treatment was performed with a load of 200 g. Good spreading power is between 4-7 cm (Chandra and Rahmah, 2022). Spreadability stability testing was carried out starting on days 0, 7, 14, and up to 28.

Stickiness

A total of 0.25 grams of the emulgel preparation is smeared on a glass object of a predetermined area. The object glass was then placed at a weight of 1000 g for 5 minutes. The object glass was installed on the test equipment, a load was released, and the time until the two object glasses were released was recorded. The requirement for adhesion to topical preparations is not less than 4 seconds (Priani *et al*., 2021). Adhesion stability testing was carried out starting on days 0, 7, 14, and up to 28.

Viscosity

Emulgel viscosity testing was performed by weighing 100 g in a beaker and then determining the viscosity using a Brookfield spindle 7 viscometer at a speed of 50 rpm (Wulandari *et al*., 2023). Viscosity stability testing was carried out starting on days 0, 7, 14, and up to 28.

5. Antioxidant Activity Testing (IC_{50})

Preparation of DPPH Solution and Maximum Wavelength Screening of DPPH Solution

DPPH was prepared at a concentration of 1000 ppm as a stock solution. The treatment began with 25 mg being weighed and then dissolved in methanol in a 250 mL volumetric flask. Then 40ppm DPPH was prepared by pipetting 4 ml of the stock solution and dissolving it in 100 ml of methanol. DPPH 40ppm is then put to the cuvette. Visible light in the 400–600 nm range was used for light absorption.

Preparation of Serum Test Solution

The emulgel with the best formulation was weighed to as much as 4 mg of the emulgel sample, then each was dissolved in 500 ml of methanol and sonicated to obtain a homogeneous solution. The sample solution was then extracted with n-hexane until two layers were formed. The bottom layer (methanol) was removed from the solution to obtain an extracted sample solution, which was then placed in a vial and labeled as the mother solution.

Measurement of Antioxidant Activity (IC_{50})

A 500,000 ppm emulgel stock solution was prepared and then divided into several concentration series: 5,000, 10,000, 30,000, 50,000, and 70,000 ppm. Each concentration series was dissolved in a 5 mL p.a. ethanol volumetric flask. From each concentration, 2 mL was pipetted into a vial and mixed with DPPH solution at a ratio of 2:3. The vials were then incubated in a dark room for 30 minutes (Ratnapuri, Haitami and Fitriana, 2019).

Calculation of Inhibition Percentage

Percent inhibition is the ability of a material to inhibit free radical activity which is related to the sample concentration. The percentage of DPPH radical inhibition of each sample solution was calculated using the following formula (Ratnapuri, Haitami and Fitriana, 2019):

$$\%\text{inhibition} = \frac{DPPH\ Absorbance - Sample\ Absorbance}{DPPH\ Absorbance} \times 100\%$$

RESULTS AND DISCUSSION

Preparation of Senggani Leaf Extract

Extraction is the process of separating the chemical content of a mixture using a particular solvent. The maceration method was chosen as the extraction method because it contains active compounds that are resistant to heating. The principle of the maceration method is to soak the simplisia powder in a suitable solvent for several days at room temperature and protected from light. Extraction occurs when the solvent enters the plant cell through the cell wall. Maceration was carried out using 80% ethanol solvent for 3x24 hours with periodic stirring and replacement of ethanol every 1 × 24 hours. Then, the obtained maserat was concentrated with a rotary evaporator and oven at 70°C until the extract was thickened. The thick extract was then fractionated. Fractionation is a technique for separating and grouping the chemical contents of extracts based on polarity. The fractionation used was liquid-liquid fractionation. Liquid-liquid fractionation is a fractionation process carried out using solvents that do not mix with each other based on their polar properties (Herdiana and Aji, 2020). In the fractionation process with different solvents based on the level of polarity, 2 layers are formed, where the solvent with the higher density is at the bottom and the solvent with the lower density is in the top layer. The purpose of these 2 layers of solvent is to ensure that the chemical content contained in the sample can be selectively attracted by the solvent used (Luntungan, Wewengkang and Rumondor, 2021). Fractionation is carried out in stages using a separating funnel with solvents that have different levels of polarity, namely non-polar, semipolar and polar solvents (Apridamayanti, Sari and Pratiwi, 2022). The thick extract obtained was dissolved in ethanol:water, then added to a nonpolar solvent, which was then shaken and allowed to stand until there were two separate layers, and the remainder of the ethanol:water partition was dissolved with semipolar. This liquid-liquid fractionation process was repeated with each solvent until a water residue was found. In this research, the fractionation results that will be used for further research are the water residue which has a thick texture and a dark brownish yellow color.The results of the extraction of senggani leaves (*Melastoma malabathricum* L.) can be seen in **Figure 1**.

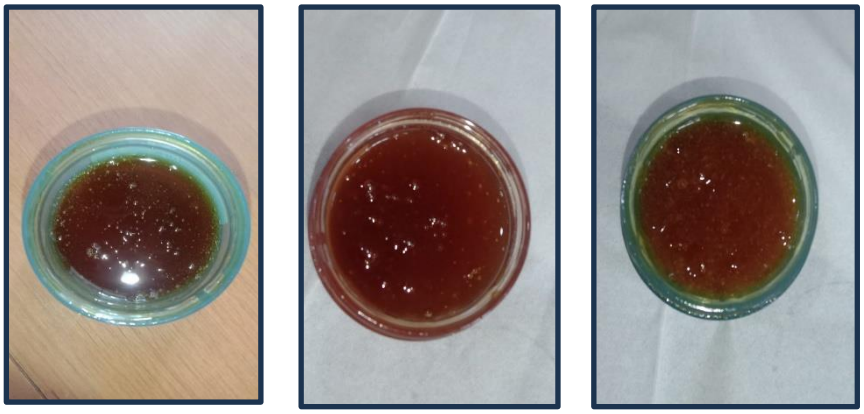
Figure 1. Water Fraction of Senggani Leaf

Formulation of Senggani Extract Serum.

The stages of making an emulgel generally consist of three stages: making the gel base, making the emulsion, and mixing the gel base and emulsion (Patel, Aundhia and Seth, 2016). The gel base was prepared by developing Carbopol 940 at concentrations of 0.5, 1.25, and 2% in hot water until maximum clarity was achieved. The choice of concentration variation was based on research by Tsabitah *et al.* (2020), who explained that the amount of carbomer used determines the viscosity of the gel preparation to be made; the more carbomer added, the viscosity will increase, while decreasing the amount of carbomer will reduce the viscosity. Dispersed Carbopol 940 has a pH of 2-3, so it is necessary to add TEA as a pH

adjustment until the pH of Carbopol 940 reaches the appropriate pH, namely 5. The addition of TEA as a pH adjustment is necessary because when carbopol is at pH 2-3, the viscosity of carbopol 940 itself is reduced, so it is necessary to add TEA as a pH adjustment to neutralize the pH of carbopol 940 to 5, which can also increase the viscosity of carbopol 940 (Rahayu, Fudholi and Fitria, 2016).

The subsequent manufacturing process involves the creation of an emulsion. Emulsions are known to consist of two phases: oil and water. This oil phase can be useful as a drug carrier agent, which can also influence viscosity and permeability (Milutinov *et al.*, 2023). The oil phase consisted of liquid paraffin and span 80, which was then heated to a temperature of 70^{o}C while stirring until homogeneous. Then, a water phase consisting of distilled water, methylparaben, and propylparaben, which had been dissolved in propylene glycol and Tween 80, was heated at a temperature of 70 °C until homogeneous. The choice of emulsifying agent used to enhance emulsification during the preparation process and to ensure the physical stability of the emulsion during its shelf life is based on its ability to emulsify, toxicity, and method of administration (Milutinov *et al.*, 2023). The oil phase was then dispersed into the water phase. Stir using a hand mixer for 10 minutes until an emulsion forms. The next manufacturing process is to make an emulgel. Emulgel is made by mixing the emulsion into a mortar-containing gel followed by stirring until it becomes strong. Mixing the emulsion and gel is important for making an emulgel; therefore, vigorous and constant stirring must be performed. The optimal mixing speed and duration will produce an emulgel that is homogeneous and meets the requirements for a good topical preparation (Pakhare *et al.*, 2017). After the emulsion and gel were well mixed, a homogeneous and thick emulsion was formed.



(a) **(b)** **(c)**

Figure 2. Senggani Leaf Water Fraction Emulgel Preparation (a) FI; (b) FII; (c) FIII

Serum Evaluation of Senggani Extract

Organoleptic Evaluation

Organoleptic tests were carried out directly through the smell, shape, and color of the emulgel preparation using the five senses. The organoleptic test results of the three formulas showed a distinctive odor from the fraction with a slight oil aroma from the emulsion oil phase used, a semi-solid (emulgel) consistency, and a yellowish brown color obtained from the water fraction of senggani leaves. The homogeneity test aims to determine the distribution of particles in the emulgel preparation based on the presence or absence of separated particles. Preparation must be homogeneous and evenly distributed to avoid irritation when applied to the skin surface (Ratnapuri Haitami and Fitriana, 2019). The results obtained by the three formulations showed good homogeneity until the 28th day,

indicated by the absence of grains and lumps on the slide. This showed that the preparation had a homogeneous composition, indicating that the ingredients used were completely mixed (Chandra and Rahmah, 2022). The results are presented in **Table II.**

Table II. Organoleptic Test Results Data for Emulgel Preparations

Formula	Day-				
	0	7	14	21	28
F1 (0,5%)	Typical Thick Brown-yellow	Typical Thick Brown-yellow	Typical Moderate Brown-yellow	Typical Moderate Brown-yellow	Typical Light yellow
F2 (1,25%)	Typical Thick Brown-yellow	Typical Thick Brown-yellow	Typical Thick Brown-yellow	Typical Moderate Brown-yellow	Typical Moderate Brown-yellow
F3 (2%)	Typical Thick Brown-yellow	Typical Thick Brown-yellow	Typical Thick Brown-yellow	Typical Thick Brown-yellow	Typical Thick Brown-yellow

Evaluation of pH

A pH test was carried out to determine the compatibility between the pH of the topical preparation and the pH of the skin, which affects the skin's acceptance of the preparation. Topical preparations should have the same pH as the pH, namely 4.5-6.5. A pH value of less than 4 can cause irritation to the skin, and if the pH is greater than 7, the skin will dry out and lose moisture (Najih *et al.*, 2021). The results of the pH test are shown in **Table III**, which shows that the emulgel preparations that met the pH range were F2 and F3. The F1 preparation showed a decrease in pH values below the specified range from day 14 (4.25 ± 0.12) to day 28 (4.09 ± 0.04). It can be concluded that the pH levels of F2 and F3 are the most stable and within the desired range. In comparison, F1 had a significant difference in pH levels, which indicates that changes in the concentration of carbopol 940 have an impact on the pH levels of the emulgel preparation. Carbopol 940 is an acidic base gel, and when added to water, it maintains acidic pH levels. Therefore, an increase in the carbomer concentration leads to a decrease in the pH of the emulgel preparation. The decrease in pH levels can be attributed to factors such as temperature, instability of active substances, and the presence of CO_2 in the air, which reacts with the water phase, resulting in acidic pH levels.

Table III. pH test results for Emulgel preparations

Formulation	Average ± %CV Day-				
	0	7	14	21	28
F1 (0.5%)	4.80±0.03	4.69±0.00	4.25±0.03	4.15±0.01	4.09±0.01
F2 (1.25%)	4.95±0.02	4.91±0.03	4.90±0.01	4.87±0.01	4.74±0.03
F3 (2%)	5.32±0.03	5.26±0.03	5.22±0.02	5.21±0.02	5.19±0.02

In the statistical test of the pH of the preparation, it was found that all formulas met the normality test specification values with (F1) value (p-value 0.12 > 0.05), (F2) (p-value 0.871 > 0.05), (F3) (p-value 0.168 > 0.05), while in the homogeneity test, the sig results were not normal (p-value 0.000 < 0.05). Then proceed with the non-parametric test, namely

Kruskal Wallis, the Asymp Sig results were obtained (p-value 0.000 < 0.05) which can be concluded that there is a difference between the formulas.

Evaluation of Spreadability

The spreadability test aims to determine the quality of the preparation, which can spread rapidly on the skin. The good spreading power for topical preparations is approximately 4-7 cm. The higher the spreading power, the easier it is to prepare and distribute evenly on the skin (Niazi, 2004). Even though it is not significantly different, it can still be observed that the smaller the concentration of carbopol 940, the greater the spreadability of the preparation, which indicates that variations in the concentration of carbopol 940 have an effect on the spreadability of the preparation, because the higher the concentration of carbopol 940, the smaller the spreadability. This is because increasing the concentration causes the matrix formed in the emulgel preparation to become denser and the consistency of the emulgel preparation to become thicker (Mursal *et al*., 2019).

Table IV. Spreadability Test Results

Formulation	Average (Cm) ± %CV Day-				
	0	7	14	21	28
F1 (0.5%)	4.53 ± 0.11	5.23 ± 0.09	5.50 ± 0.07	6.17 ± 0.05	6.67 ± 0.02
F2 (1.25%)	4.47 ± 0.03	4.80 ± 0.02	5.17 ± 0.03	5.87 ± 0.03	6.5 ± 0.03
F3 (2%)	4.47 ± 0.03	4.67 ± 0.03	4.90 ± 0.05	5.27 ± 0.09	5.53 ± 0.10

In the statistical test of the dispersion power of the preparation, it was found that all formulas met the normality test specification values with a value of (F1) (p-value 0.663 > 0.05), (F2) (p-value 0.344 > 0.05), (F3) (p-value 0.119>0.05) and homogeneity test and one-way ANOVA test. The results of the One Way Anova analysis for Normality results obtained a Sig value. in all spreading power test formulas because the Sig value is >0.05. In the Homogeneity test, looking at the results, Sig results were obtained (p-value 0.92 > 0.05) which can be concluded that the data is homogeneous. In the ANOVA analysis, looking at the Sig results (p-value 0.52 > 0.05), it can be concluded that the spreadability test of this preparation is not significantly different between the formulas.

Evaluation of Stickiness

The stickiness test is conducted to determine how long it takes for the emulgel to stick to the skin. The longer the preparation sticks to the skin, the more effective the resulting pharmacological effect will be. Therefore, it is necessary to have good adhesion time for topical preparations, which should not be less than 4 seconds. The hypothesis H0 of the three formulations is accepted with the best adhesion for F3 and F2 because they have a stable pH and are in the range compared to F1. There are significant differences between the formulas, and variations in carbomer concentration affect the adhesion of the emulgel preparation. The higher the carbomer concentration, the more viscous the preparation will be, resulting in longer adhesion time. The results show that increasing the gelling agent concentration in each formula results in longer adhesion time. This is because carbomer forms colloids with the addition of hot water, which makes the substance absorb water and become thick and sticky. Therefore, it can be concluded that increasing the concentration of carbomer increases the colloids formed, thereby increasing its adhesive power (Mursal *et al*., 2019).

Table V. Adhesion Test Results

Formulation	Average ± %CV (Second) Day-				
	0	7	14	21	28
F1 (0.5%)	28.73±0.06	25.69±0.07	14.61±0.08	4.76±0.09	3.74±0.12
F2 (1.25%)	23.37±0.05	19.74±0.04	17.30±0.13	12.17±0.02	7.06±0.10
F3 (2%)	31.21±0.12	30.07±0.10	28.64±0.06	27.59±0.03	25.64±0.05

In the statistical test of the adhesive strength of the preparation, it was found that all formulas met the normality test specification values with (F1) value (p-value 0.14>0.05); (F2) (p-value 0.290>0.05); (F3) (p-value 0.189 > 0.05), while in the homogeneity test the sig results were not homogeneous because (p-value 0.000 < 0.05). Then proceed with the non-parametric test, namely Kruskal Wallis, the Asymp Sig results were obtained (p-value 0.000 < 0.05) which can be concluded that there are differences in the data between the formulas.

Evaluation of Viscosity

Viscosity is the resistance of a liquid to flow. An emulgel's viscosity is increased by the presence of a gelling agent. The requirement for good viscosity is 2000- 50000 (Nasional, 1996). The results of the viscosity test can be seen in **Table VI** which shows that the emulgel preparation that meets the viscosity range is F3. The F1 and F2 preparations showed a decrease in the viscosity value of F1 below the specified range from the 21st day (1466.67 ± 302.88) to the 28th day (640 ± 160) while in F2 there was a decrease in viscosity to outside the required range on the 2nd day. 28 (1920 ± 654.83). Based on these results, it was found that there were significant differences between the formulas, so that variations in carbomer concentration affected the viscosity of the emulgel preparation, because the higher the carbomer concentration, the viscosity of the preparation would increase because the carbomer could expand when dispersed in water to form a colloid (Mursal *et al*.,, 2019). The results show that the viscosity of each formula has decreased. A decrease in viscosity can occur due to changes in the surrounding environmental temperature and the length of storage time, because the longer the storage time, the longer the preparation is affected by the environment, for example air, so that the viscosity of the preparation decreases.

Table VI. Viscosity Test Results

Formulation	Average ± %CV (Second) Day-				
	0	7	14	21	28
F1 (0.5%)	30720 ± 0,21	2783 ± 0,14	2240 ± 0,04	1467 ± 0,21	640 ± 0,25
F2 (1.25%)	20293 ± 0,01	17573 ± 0,06	10586 ± 0,04	3840 ± 0,06	1920 ± 0,34
F3 (2%)	47520 ± 0,02	44800 ± 0,03	41120 ± 0,05	39227 ± 0,08	34853 ± 0,08

In the statistical test for the viscosity of the preparation, it was found that only formula 2 and formula 3 met the normality test specification values with a value of (F1) (p-value 0.02 < 0.05); (F2) (p-value 0.025>0.05); (F3) (p-value 0.720>0.05), while in the homogeneity test the sig results were not homogeneous because (p<0.05). Then proceed with the non-parametric test, namely Kruskal Wallis, the Asymp Sig results were obtained (p-value 0.000 <0.05) which can be concluded that the data is different. The results of this viscosity test are related to the value of the adhesion test, because the higher the viscosity value, the longer the preparation will adhere to the skin. The longer a preparation adheres to

the skin, the longer the absorption in the skin so that the resulting effect will be more in accordance with what is desired (Kindangen *et al.*, 2018)

Antioxidant Activity Testing (IC_{50})

The study aimed to determine the antioxidant activity of the emulgel water fraction of senggani leaves using the DPPH method, a widely used technique for determining free radical capture owing to its simplicity, high sensitivity, and ability to analyze numerous samples in a short time using only UV-Vis spectrophotometry. The study began by identifying the maximum wavelength of the DPPH compound to determine the wavelength that could produce the highest absorption. The maximum wavelength that was found in this research was in the range of 515-516nm. Based on several formulations that had been tested, the study selected formula 3 for testing the water fraction emulgel preparation of senggani leaves. Formula 3 was the most stable formula, out of all the preparations that had been tested for 28 days, and was chosen for the study. Additionally, the study tested the stability of the antioxidant activity of the emulgel preparation from the water fraction of senggani leaves every week for 28 days, using the same storage and testing methods as the physical stability test of the emulgel preparation. The process of extracting the sample solution was carried out using the liquid-liquid extraction method with n-hexane. This method is commonly preferred for extracting hydrophobic lipid molecules and involves the use of a polar solvent such as methanol as the basic solvent (Saini *et al.*, 2021). The test results of the IC_{50} value of all formulas can be seen in **Table VII**. The results of emulgel measurements, which have been reacted with DPPH, are typically obtained using a Uv-Vis instrument and are represented in the form of absorbance. The occurrence of a color change to yellow indicates the reaction has taken place. The DPPH working principle involves the bonding of a hydrogen atom present in the antioxidant compound with the free electrons found in the radical compound. This chemical reaction causes the free radical compound to change from diphenylpicrylhydrazine to the compound diphenylpicrylhydrazine. The purple DPPH solution is introduced to an electron donor, leading to the occurrence of DPPH and fading of the purple color until it becomes yellow. The concentration of the test solution determines the decrease in DPPH activity. A higher concentration of the test solution leads to more DPPH pairing with hydrogen atoms. However, this activity is relatively weak compared to the antioxidant activity of senggani leaf extract. It is necessary to increase the concentration of the extract in the serum formulation to increase the antioxidant activity

Table VII. Antioxidant Activity Test Results for Senggani Leaf Emulgel Preparations

Formula	Day	Average	%CV	Average ± %CV
F3	0	16141,10	0,13	16141.10 ± 0.13
	7	17514,50	0,09	17514,50 ± 0,09
	14	17870,83	0,05	17870,83 ± 0,05
	21	13878,00	0,12	13878,00 ± 0,12
	28	14851,28	0,10	14851,28 ± 0,10

These results are in accordance with research conducted by Sawiji, *et al* (2022) which showed that the results of the body butter preparations made were in the weak antioxidant category. Another study conducted by Istiqomah, *et al* (2021) also explained that the decrease in antioxidant activity could be due to natural ingredient extracts having low stability because they contain various compounds and can influence each other so that their activity can decrease during storage. Apart from that, excipients in the preparation can also influence the results of the activity of the preparation. Because excipients can inhibit the

release of active substances from diffusing, so not all of the extract contained in them comes into contact with the DPPH solution. This very weak antioxidant result may also occur because the liquid-liquid extraction process was not carried out optimally, so that the active compounds from the water fraction of senggani leaves were attracted and separated into the n-hexane solution.

CONCLUSION

This study concludes that Carbopol 940 variation significantly affects the physical characteristics of senggani leaf water fraction emulgel preparations, with a carbopol concentration of 2% (F3) as the most stable formulation. The antioxidant activity of the emulgel (F3) is very weak with an IC50 value of 13878 ppm> 200 ppm.

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