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Formulation and stability testing of physical properties of sunscreen from Dragon's Blood Resin (*Daemonorops draco* (Willd) Blume)

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Abstract

Background. Excessive exposure to UV-A and UV-B rays can damage the skin, causing wrinkles, dark spots, and an increased risk of skin cancer. As a tropical country, Indonesia has high sun intensity, so additional protection such as sunscreen is needed. Dragon's blood resin (Daemonorops draco), a flagship commodity from Jambi Province, is rich in flavonoids, polyphenols, and triterpenoids, which have the potential to act as natural antioxidants to protect the skin from damage caused by free radicals. This research aims to develop a sunscreen based on jernang resin through tests of physical properties, stability, and Sun Protection Factor (SPF), utilizing the advantages of natural antioxidants that can maintain skin health and prevent damage from UV exposure.
Method. This research was conducted through several stages, namely the Characteristics of Jernang Resin, Phytochemical Screening of Jernang Resin, Sunscreen Formula Preparation, physical evaluation, antioxidant testing, and SPF testing. The evaluation of the cream formulation included organoleptic tests, homogeneity, stability, pH, adhesion, spreadability, and viscosity.
Results. The results of the antioxidant test for the cream showed IC50 values of F1 (0.1%) at 95.729 µg/mL, F2 (0.2%) at 87.498 µg/mL, and F3 (0.3%) at 70.683 µg/mL. Meanwhile, the antioxidant test of Jernang resin showed an IC50 value of 39.158 µg/mL. Based on the SPF formula test results, F3 has the highest moisture percentage at 2.543. Furthermore, the most stable cream is F3, excelling in 6 out of 7 tests.
Conclusion. The best sunscreen formula with dragon's blood resin is formula 3, with an IC50 of 70.683 ppm, reflecting high antioxidant effectiveness. However, with an SPF of 2.543, which provides minimal protection, sunscreen formula 3 is more suitable as an antioxidant cream rather than a sunscreen cream. This cream is safe to use and effectively protects the skin from free radicals.

Keywords: Sun exposure, dragon's blood resin, sunscreen, antioxidants, SPF.

INTRODUCTION

Exposure to sunlight is electromagnetic radiation consisting of three wavelengths: ultraviolet (UV), visible, and infrared. There are three types of UV rays produced by the sun, namely UV A, UV B, and UV C. The sunlight that reaches the Earth's surface and has a negative impact on skin damage is UV A and UV B rays, while UV C is blocked because it is fully absorbed by the ozone layer, preventing it from reaching the Earth's surface. The wavelength of UV-B rays ranges from 290 to 320 nanometers. UV-B rays are known to cause skin damage, such as sunburn and increase the risk of skin cancer. Whereas UV A rays have a wavelength of 320-400 nm and more than 90% can reach the Earth's surface and penetrate the skin to the dermis layer (deep) of the skin, which can damage DNA and cause skin damage (1).

In Indonesia itself, it is one of the tropical countries with relatively high sun exposure intensity (2). That exposure has a very detrimental effect on the epidermal layer of the skin. This can cause the connective tissue within the stratum corneum to change. Based on this, additional protection for the facial skin is necessary by using cosmetic preparations

known as protectors for the facial skin, namely sunscreen or commonly known as sunscreen (3).

Sunscreen is a compound used to protect the skin from sunlight, especially ultraviolet (UV) rays. This sunscreen includes a chemical cream that can be used as a sunblock. Sunscreen can penetrate the skin and absorb ultraviolet rays before they reach the skin layers and cause damage to the skin (4). The use of sunscreen is very important to prevent skin problems, as evidenced by a study at Dr. Soetomo Hospital in Surabaya, where the prevalence of patients with skin damage due to sun exposure reached 14.1%, with 99.2% of them being women (5).

A good sunscreen has the effectiveness in protecting the skin from UV exposure based on high antioxidant activity and Sun Protection Factor (SPF) value because this combination in skincare products can provide double protection, with SPF protecting against UV exposure, while antioxidants protect against damage caused by free radicals. Antioxidants can be obtained in synthetic and natural forms. Synthetic antioxidants such as butylated hydroxytoluene (BHT), butylated hydroxyanisole (BHA), and tert-butylated hydroxyquinone (TBHQ) can effectively inhibit oxidation. Synthetic antioxidants are carcinogenic over a certain period and can cause toxins in the body, so safer natural antioxidants are needed. Natural antioxidants can be found in vegetables that contain phytochemicals, such as flavonoids, isoflavones, flavones, vitamin C, vitamin E, and anthocyanins (6).

The potential of natural materials that can protect against sun exposure and contain antioxidants, one of which comes from the Jernang rattan plant (Daemonorops draco (Willd.) Blume) that grows abundantly in Jambi Province. Jernang resin is one of the leading commodities in Jambi Province, commonly found in several forests in Jambi. This resin is used as a wound healer, antibacterial, and has antioxidant properties. Pharmacological research shows that jernang resin is rich in flavonoid, polyphenol, and triterpenoid compounds. These compounds are known to have the ability to counteract free radicals, which are one of the main causes of skin damage due to sun exposure. With this protection, facial skin can be shielded from the harmful effects of UV rays, such as premature aging and the risk of skin cancer. Based on these findings, jernang resin has great potential to be developed as a main ingredient in sunscreen products in the domestic cosmetics industry (7).

This research aims to produce sunscreen utilizing jernang resin as the main ingredient with the best formulation based on physical property tests, accelerated stability tests, and Sun Protection Factor (SPF) tests. By utilizing the potential of jernang resin, which contains active compounds beneficial for the skin, it has great potential due to its antioxidant and anti-inflammatory properties that can help maintain skin health and prevent damage from sun exposure. Therefore, it is very appropriate to develop it as a main ingredient in cosmetic products, which are expected to optimize the use of natural jernang resin and its ability to protect the skin from UV rays. Based on the potential of jernang resin, research was conducted on "Formulation and Stability Testing of the Physical Properties of Jernang Resin Sunscreen (Daemonorops Draco (Willd.) Blume) as an Antioxidant and UV Ray Protector."

METHOD

Research Time and Place

This study will be carried out at multiple sites. First, at Jambi University's Pharmacy Laboratory, which is a part of the Faculty of Medicine and Health Sciences, and the Agroindustry and Natural Materials Laboratory, which is situated in the Faculty of Science and Technology. Seko Besar Village in Sarolangun Regency, Jambi Province, would be the site of the jernang resin collection. The study is scheduled to begin in April 2024 and go through the end of 2024.

Research Materials

The material used in this study is resin from the jernang fruit (Daemonorops draco (Willd.) Blume) which has a reddish-black color,

amounting to 5 kg. The sample used is jernang resin. The chemicals used in this research are: propylene glycol (Raja Kimia), olive oil (TSb), moringa seed oil (TSb), butylene glycol, niacinamide, emulsified, cetyl alcohol (Raja Kimia), vitamin E, Na EDTA, phenoxyethanol, and aquadest.

Research Instruments

The tools used in this research include a Kassa, digital scale (Pioneer), mortar and pestle, spatula, measuring glass (Iwaki), thermostatic water bath (HH-S), beaker glass (Iwaki), stirring rod, oven (Memmert), dropper (Iwaki), funnel (Iwaki), pH meter (Nesco pH paper), Brookfield viscometer, microscope slide (Iwaki), evaporating dish (Iwaki), petri dish (Iwaki), microscope (Olympus), brush, and container for sedpropylen glycol.

Sunscreen Formulation Design

Table 1. Sunscreen Formulation

Nama Bahan	Formula				Keterangan
	F0	F1	F2	F3	
Resin Jernang	0 gr	100 mg	200 mg	300 mg	Zat aktif
Propylene Glycol	0 gr	10 ml	10 ml	10 ml	Solvent
Olive oil	5 ml	5 ml	5 ml	5 ml	Emollient sunscreen
Moringa seed oil	2,5 ml	2,5 ml	2,5 ml	2,5 ml	Emollient sunscreen
Butylene glycol	2 ml	2 ml	2 ml	2 ml	Enhance spreading
Niacinamide	4 gr	4 gr	4 gr	4 gr	Enhance spreading
Emulged	4,5 gr	4,5 gr	4,5 gr	4,5 gr	Emulsifier
Cetyl alcohol	1,5 gr	1,5 gr	1,5 gr	1,5 gr	Thickening agent
Vitamin E	1 ml	1 ml	1 ml	1 ml	Antioxidant
Phenoxyethanol	0,8 ml	0,8 ml	0,8 ml	0,8 ml	Preservative
Na EDTA	0,2 gr	0,2 gr	0,2 gr	0,2 gr	Chelating agent
Aquadest add	78, 5 ml	78, 5 ml	78, 5 ml	78, 5 ml	Solvent

Preparation of Sunscreen Formulation

The process of making the cream preparation begins by melting the oil phase (olive oil, moringa seed oil, Emulsifying wax NF, and cetyl alcohol) using a water bath at a temperature of 70℃, and for the water phase (niacinamide, Na EDTA, and aquadest), it is heated to the same temperature. The emulsion is made by slowly mixing the water phase into the oil phase while stirring for 4 minutes, and then letting it sit until a homogeneous emulsion is formed. Dragon's blood resin is ground using a mortar and pestle, then the cream base is added gradually and stirred until homogeneous (modification by Uce Lestari and Tommy Julianto). From the formulation of this jernang resin cream preparation, three concentrations will be obtained, consisting of: F1: 0.1%, F2: 0.2%, and F3: 0.3%.

Physical Evaluation

a. Organoleptic Test

The cream is evaluated organoleptically, including changes in color and odor (rancidity) visually. The specifications for the cream that must be met are having a homogeneous preparation color and a non-rancid smell (8).

b. Homogeneity Test

Homogeneity observation is conducted by weighing 1 gram of cream, then applying it to the center of a transparent object glass and observing to see if phase separation occurs. A good sunscreen cream must have a homogeneous appearance. That means the cream should show a uniform composition without any spots or coarse particles (9).

c. pH Test

The cream is placed in a glass beaker, then its pH is measured with a pH meter that has been previously calibrated with standard buffers (pH 4.5 and pH 7). The measurements were taken on the freshly made cream, after 1 month of storage, and after 3 months of storage. The cream should have a skin pH of 4.5-7.537 (9).

d. Spread Test

The spreadability test was conducted by weighing 0.5 grams of cream and placing it in the center of an inverted petri dish. After that, another petri dish is placed on top of the cream and left for one minute. Next, the diameter of the spread cream was measured. An additional load of 50 grams was added and

left for one minute, then the diameter was measured after the load reached 50, 100, and 150 grams. The spreadability test for topical preparations is expected to have a diameter of around 5-7 cm (10).

e. Adhesion Test

The adhesion test was conducted using two object glasses, a stopwatch, cream, and a gram scale. First, the cream is applied adequately on one object glass, then covered with another object glass and pressed with a 0.5 kg weight for five minutes. After the weight is lifted, the two glass slides are released while noting the time it takes for them to separate. The adhesion of the cream is influenced by viscosity, meaning that the higher the viscosity, the longer the cream adheres to the skin. A good topical preparation has an adhesion time of more than 1 second. The longer the cream adheres, the more active ingredients are released for penetration into the skin (11).

f. Cream Type Test

The type test of this cream is conducted using the dilution method. The cream that has been made is placed in a vial, then diluted with water. If the emulsion can be diluted, then its emulsion type is oil in water (O/W) (12).

g. Viscosity Test

The viscosity of the cream was measured using the ViscoQC 300 Anton Paar viscometer, and each formula was replicated three times. The cream preparation was placed into a 100-gram pot, then the spindle was installed and the rotor was run. The viscosity results are recorded after the viscometer needle shows a stable reading after five rotations. This viscosity test aims to determine the thickness level of the produced cream. Viscosity indicates how easily or difficultly a liquid flows; the higher the viscosity, the greater the resistance. The desired viscosity ranges from 2,000 cp to 50,000 cp (10).

h. Stability Test

Stability testing was conducted by storing the cream at room temperature for 3 months and using the cycling test method for 6 cycles. The testing observes the physical changes of the cream, including organoleptic properties, homogeneity, pH, spreadability, and adhesion (13).

Data Analysis

Data analysis in this study was conducted using a descriptive approach to provide an overview of the obtained data. Additionally, the ANOVA statistical test is used to examine the differences in means between the concentrations of the Jernang resin sunscreen formulation, provided that the data are normally distributed and homogeneous. If the obtained data do not meet the normal distribution requirement, the non-parametric Kruskal-Wallis test will be used as an alternative to test the differences between the concentrations of the Jernang resin sunscreen formulation. This approach ensures that data analysis is conducted comprehensively and in accordance with the characteristics of the existing data.

RESULTS

Sunscreen Formulation Preparation

In order to prepare the cream, the oil phase (olive oil, moringa seed oil, cetyl alcohol, and emulsifying wax NF) is melted in a water bath at 70°C. The water phase (niacinamide, Na EDTA, and distilled water) is then heated to the same temperature. The process of creating the emulsion involves gradually combining the water and oil phases, stirring for four minutes, and then allowing the mixture to settle until a uniform emulsion is achieved. The cream base is added gradually and mixed until homogenous after the dragon's blood resin has been pulverized with a mortar and pestle (a modification made by Uce Lestari and Tommy Julianto). Three concentrations were derived from the formulation of this jernang resin cream product.

Table 2 Results of Organoleptic Evaluation

Formula	Shape	Color	Aroma
K (+)	Semi solid	White	Aloe vera
K (-)/F0	Semi solid	White	Vanilli
F1	Semi solid	Pale pink	Vanilli
F2	Semi solid	Pink peach	Vanilli
F3	Semi solid	Peach	Vanilli

Table 3 Results of Homogeneity Evaluation

Formulasi	Results
K(+)	Homogen
K(-)/F0	Homogen
F1	Homogen
F2	Homogen
F3	Homogen

Table 4 pH Evaluation Results

Formula	Hasil Uji pH (Rata-Rata ± SD)		
	0 Bulan	1 Bulan	3 Bulan
F0/K-	5,92 ± 0,03	5,82 ± 0,04	5,78 ± 0,06
F1	6,07 ± 0,16	5,76 ± 0,04	5,85 ± 0,05
F2	5,83 ± 0,13	5,71 ± 0,02	5,73 ± 0,01
F3	5,77 ± 0,13	5,70 ± 0,01	5,72 ± 0,02
K+	7,50 ± 0,00	7,49 ± 0,00	7,49 ± 0,00

Table 5 Results of Spread Evaluation

Formula	Hasil Daya Sebar (cm) (Rata-Rata ± SD)		
	0 Bulan	1 Bulan	3 Bulan
F0/K-	6,52 ± 0,27	6,69 ± 0,09	6,80 ± 0,02
F1	5,47 ± 0,13	5,55 ± 0,09	5,64 ± 0,02
F2	5,27 ± 0,22	5,42 ± 0,15	5,51 ± 0,10
F3	5,16 ± 0,06	5,29 ± 0,09	5,48 ± 0,04
K+	5,86 ± 0,00	5,90 ± 0,00	5,98 ± 0,00

Adhesion 6 Strength Evaluation Results

Formula	Hasil Daya Lekat (s) (Rata-Rata ± SD)		
	0 Bulan	1 Bulan	3 Bulan
F0/K-	7,5 ± 0,03	7,35 ± 0,06	7,32 ± 0,06
F1	7,72 ± 0,06	7,62 ± 0,03	7,55 ± 0,03
F2	10,8 ± 0,03	10,71 ± 0,03	10,72 ± 0,01
F3	21,57 ± 0,01	21,52 ± 0,03	21,48 ± 0,03
K+	23,68 ± 0,00	23,59 ± 0,00	23,55 ± 0,00

Table 7 Results of Cream Type Evaluation

Formulasi	Pewarna Metilen Blue	Tipe Krim
F0	Homogen	M/A
F1	Homogen	M/A
F2	Homogen	M/A
F3	Homogen	M/A

Table 8 Viscosity Evaluation Results

Formula	Viskositas (Rata-Rata ± SD)	
	Awal	Akhir
F0/K-	1313,33 ± 3,51	960,50 ± 3,80
F1	3549,67 ± 39,27	2688,67 ± 34,56
F2	4304,00 ± 17,35	4291,00 ± 19,70
F3	4779,33 ± 8,02	3254,67 ± 4,51
K+	3928 ± 0,00	4524 ± 0,00

Table 9 Results of Stability Test Recapitulation

Parameter	Suhu Kamar (3 Bulan)			Cycling Test		
Formula	1	2	3	1	2	3
Bentuk	V*	V*	V*	V*	V*	V*
Warna	V*	V*	V*	V*	V*	V*
Aroma	V*	V*	V*	V*	V*	V*
Homogenitas	V*	V*	V*	V*	V*	V*
pH	v	v	V*	v	v	V*
Daya sebar (cm)	V*	v	v	V*	v	v
Daya lekat (s)	v	v	V*	v	v	V*
Total	5/7	4/7	6/7	5/7	4/7	6/7
%	71, 42	57, 14	85, 71	71, 42	57, 14	85, 71

DISCUSSION

Physical Quality Test of Sunscreen

a. Organoleptic Test

The organoleptic test involves parameters such as shape, color, and aroma. The organoleptic test is conducted directly using human senses and is performed in three replications for each formula. The observation results show that each formula has the same form, which is a semi-solid cream, and the vanilla aroma from vanilla oleoresin is in accordance with the formula specifications. The results of the organoleptic evaluation are presented in the following table 2.

The organoleptic test results conducted on the jernang resin sunscreen, which were tested with 3 replications, showed no significant differences in the organoleptic properties of each formula. The form of the sunscreen preparation tested over a period of 3 months remained unchanged, which is semi-solid. The color obtained in the basic formula or cream base without the addition of extract is a white preparation. Formula 1 has a light pink color, and formula 2 has a peach pink color, while formula 3 has a peach color. The difference in color intensity is caused by the varying concentrations of extracts, where formula 3 contains more extract compared to formulas 1 and 2, thus affecting the cream's color. The higher the concentration of the extract added, the more intense the resulting color. The addition of vanilla oleoresin imparts

a characteristic vanilla aroma to the cream. Likewise, when compared to the positive control, which showed consistent results during the 3-month storage period, all formulas remained stable in terms of shape, color, and aroma, indicating that the cream produced has good organoleptic stability during that storage period.

b. Homogeneity Test

The homogeneity test aims to examine the mixing of ingredients in the cream. This test is conducted visually by observing the color of the cream and ensuring that there are no poorly mixed parts. The absence of grains or coarse particles in the cream indicates that each ingredient has been well mixed in each formula, resulting in a uniform cream48. The appearance of each cream formula can be observed in Appendix 6, and the results of the homogeneity evaluation are presented in Table 3 below.

c. pH Test

The degree of acidity or pH is an important parameter in cosmetic products. Therefore, the pH of cosmetic products should be adjusted to match the pH of the skin, which is between 4.5-7.5. The pH test aims to ensure the safety of the product so that it does not cause skin irritation. If the product has a low pH (acidic), it can irritate the skin, while a pH that is too high can make the skin scaly and dry. The pH testing also aims to determine the stability of the resin jernang sunscreen cream's pH during storage at room temperature, specifically on the first day, after 1 month of storage, and after 3 months of storage. The results of the pH testing of the cream are presented in the following table 4.5.

From the observation results, it can be seen that all preparations meet the requirements based on SNI 16-4399-199646. This is also supported by research conducted by 44 which states that the pH of facial skin typically ranges from 4.1 to 6.8. In this test, it can be seen that this formulation does not have irritation potential because the pH meets the requirements. Similarly, the statistical evaluation using Two Way ANOVA yielded a p-value of 0.000 for the formula and 0.002 for the shelf life. In this case, based on those values, it can be concluded that variations in extract concentration and storage time will affect the pH test of the preparation. Duncan's test was conducted, and the best formula, namely F3, was obtained based on the pH test results.

d. Spread Test

The spreadability test is conducted to determine the ability of the cream to spread on the skin surface; the larger the spread diameter value, the higher the spreading rate of each preparation. A good cream has a high spreading power, allowing it to be applied to the skin surface without excessive pressure. A spreadability of 5-7 cm indicates a semisolid consistency that is very comfortable to use.

The results of the spreadability test met the requirements, falling within the range of 5.0 – 7.0 cm. In this case, all formulas along with their replications have met the requirements at 0, 1, and 3 months after storage. This can be reinforced by previous research conducted by Lestari and Asra (2023) on Jernang resin SPF 15 sunscreen, which stated that the sunscreen cream from Jernang resin has a diffusion capacity of 3-7 cm. Based on the statistical assessment using Two Way ANOVA, a p-value of 0.000 was obtained for the formula and 0.002 for the shelf life. In this case, based on those values, it can be concluded that variations in extract concentration and shelf life will affect the spreadability test of the preparation. Duncan's test was conducted, and the best formula was found to be K-, followed by F1 based on the spreadability test results (14).

e. Adhesion Strength Test

In the test results conducted, it was observed that all formulas and their replications were above 4 seconds, which means the data values met the requirements. The longer the adhesion time, the better it is because it allows for the effective and controlled release of active ingredients. Based on the statistical testing using Two Way ANOVA, a p-value of 0.000 was obtained for the formula and 0.000 for the shelf life. In this case, based on those values, it can be concluded that variations in

extract concentration and shelf life will affect the adhesion test of the preparation. Duncan's test was conducted, and the best formula, F3, was obtained based on the spreadability test results (15).

f. Cream Type Test

The results of the sunscreen cream type test using Jernang resin can be reinforced by previous research conducted by Asra and Lestari (2023), where the study also used Jernang resin as an active ingredient for sunscreen production and obtained an oil-in-water (O/W) result using a staining method marked by methylene blue spreading evenly (16).

g. Viscosity Test

Based on the viscosity test results, the viscosity values for the preparations of all formulas were obtained with 3 replications. If the viscosity of the preparation decreases, the consistency of the preparation becomes thicker, and vice versa. Based on SNI 16-4399-199646 requirement values, those that meet the standards fall within the range of 2,000 – 50,000 cps are F1, F2, F3, and K+. The viscosity value is influenced by the coagulant, surfactant, the proportion of the dispersed phase, and the particle size. Cetyl alcohol is a coagulant agent that can trigger a viscosity of 8. Additionally, the viscosity value will also affect the spreadability test results, where a smaller viscosity value will result in greater spreadability. Based on statistical testing. Two Way ANOVA obtained a p-value of 0.000 for the formula and 0.000 for the shelf life. In this case, based on those values, it can be concluded that variations in extract concentration and shelf life will affect the viscosity of the preparation. Based on the Duncan test, the best viscosity value of the preparation was found in F2 (17).

h. Stability Test

The stability test of the cream is conducted by observing physical changes, including organoleptic aspects, homogeneity, pH, spreadability, and adhesion at room temperature. This observation was conducted using two methods: storage at room temperature for 3 months and using the cycling test method for 6 cycles. This was done on all cream formulas with 3 replications. At each stage of testing, changes occurring in each parameter are observed and recorded to determine whether the cream remains stable during the storage period. The observed stability includes texture/shape, color, aroma, acidity level, the cream's ability to spread on the skin surface, and its adhesion. The results of these tests are very important to ensure that the cream remains effective and safe to use throughout the expected shelf life. The results of the stability test recap can be seen in the table below.

This test aims to obtain an overview of the occurrence of syneresis in cream, which can happen due to the release of some intercellular fluid, as well as to observe changes that indicate the instability of the preparation. Testing with both methods involves organoleptic tests, homogeneity, pH, spreadability, and adhesiveness. During the testing, each cream formula showed an unchanged and physically homogeneous appearance. However, the noticeable difference is the reduction in vanilla aroma at each stage of the testing.

The examination of pH values in each formula shows changes that are not significantly different in both stability test methods. Overall, the pH of F0, F1, F2, and F3 with the room temperature storage method has values in the range of 5-6. In the cycling test method, the overall pH values obtained are in the range of 5.94-6.09. This proves that the pH of the cream is in accordance with the skin pH, which is between 4.5-7.5. The changes in pH values did not yield significantly different results, so it can be said that the cream is stable and still within its standard parameters, which is the range of 4.5-7.5.

The requirement for good spreadability for topical preparations is around 5-7 cm. The average spreadability values obtained after testing with the room temperature storage method for all cream formulas were in the range of 5.31-6.67, while the average spreadability values obtained using the cycling test method were in the

range of 5.7-6.7, indicating that the formulas meet the spreadability requirements. Good spreadability results in extensive contact between the active ingredient and the skin, thereby allowing for rapid absorption of the active ingredient into the skin. The adhesion of the cream during storage at room temperature undergoes relatively stable changes with an average value range across all formulas of 7.5-21.58, while the average adhesion value obtained using the cycling test method falls within the range of 8.69-12.6. This indicates that the adhesion obtained from all formulas meets the requirement of >4 seconds.

Based on the obtained data, it can be concluded that the best formula is F3. This formula shows superiority in six out of seven test parameters conducted, with performance achievements above 80%. This indicates that formula 3 has significant stability and effectiveness compared to the other formulas in this study.

CONCLUSIONS

Based on the research conducted, it can be concluded that the best jernang sunscreen formula is formula 3, as evidenced by physical property tests and stability tests. The IC50 value of the best resin jernang sunscreen formula is 70.683 ppm, which reflects a high antioxidant effectiveness in countering free radicals. In addition, the Sun Protection Factor (SPF) value of the jernang resin sunscreen in formula 3 is 2.543, which falls into the minimal protection category. With these results, it can be concluded that the jernang resin sunscreen with formula 3 is more suitable for use as an antioxidant cream rather than a sunscreen cream because it has a low SPF value but high antioxidant effectiveness. This cream is not only safe to use, but also very effective in countering free radicals that can damage the skin.

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