Lotion Formulation of Ethyl Acetate Fraction in Okra Fruit and Its Antioxidant and Suncreen Activity Test

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Abstrak

Sinar matahari memberi akibat tidak baik terhadap kulit seperti penuaan dini, spot hitam di kulit dan yang paling parah adalah mengakibatkan kanker kulit. Fraksi etil asetat buah okra memiliki kandungan senyawa fenolik total sebesar 252,0116 mgQA/gr dan senyawa kandungan senyawa fenolik total sebesar 127,6178 mgQE/gr. Penelitian ini bertujuan memformulasi dan menguji fraksi etil asetat yang kaya dengan kandungan senyawa fenolik terutama senyawa flavonoid. Fraksi etil asetat diformulasi dalam 3 konsentrasi dalam satu formula lotion. Penelitian menunjukkan hasil bahwa fraksi etil asetat buah okra dapat dimanfaatkan sebagi tabir surya dengan formula yang sama dengan konsentrasi yang berbeda-beda maka memberikan hasil semakin tinggi konsentrasi fraksi etil asetat memberikan nilai SPF yang meningkat serta persen eritema dan persen pigmentasi yang menurun. Harga SPF tertinggi sebesar 20.0962 ± 1.0684 diberikan pada formula ketiga dengan konsentrasi fraksi etil asetat tertinggi yaitu 0, 15% yang termasuk kategori ultra dan nilai persen eritema sebesar 6.0032 ± 0.04430 yang termasuk kategori extra protection dan nilai persen pigmentasi sebesar 5.8840 ± 0,1745 yang termasuk kategori total blok. Untuk evaluasi karakteristik fisik sediaan lotion menunjukkan bahwa lotion yang diperoleh bentuknta semisolid, memiliki warna hijau, homogen, pH lotion antara 6.698-8,02; viskositas lotion antara 3545-4053 cps; daya lekat antara 3,23-3,57 detik; daya sebar antara 7,02-7,33 dan termasuk kategori tipe minyak dalam air

Kata Kunci: etil asetat; lotion; buah okra; tabir surya

Abstract

Sunlight has a bad effect on the skin such as premature aging, black spots on the skin, and the worst causing skin cancer. The ethyl acetate fraction of okra fruit contains 252.0116 mgQA/gr of phenolic compounds and 127.6178 mg QE/gr of total flavonoid components. This research to aims to formulate and test ethyl acetate fraction that are rich in phenolic compounds, particularly flavonoid compounds. The ethyl acetate fraction is formulated in 3 concentrations in one lotion formula. Research shows the results that the ethyl acetate fraction of okra fruit can be used as a sunscreen with the same formula with different concentrations, resulting in higher results, the concentration of ethyl acetate fraction provides an increase SPF value and a decreased percent of erythema and percent of pigmentation. The highest SPF value of 20.0962 ± 1.0684 is given in the third formula with the highest ethyl acetate fraction concentration 0.15% which belongs to the ultra category and the percent erythema value of 6.0032 ±0.2079 which belongs to the extra protection category and the percent pigmentatiom value is 5.8840 ±0.1745 which belongs to the total block category. For the evaluation of the physical characteristics of lotion preparation showed that the lotion obtained has a semi-solid consistency, has a green color,

homogeneous; pH lotion 8.02-6.98; the viscosity of the lotion is 3545-4053 cps, the average adhesion is 3.23-3.57 seconds; the average spreadability is 7.33-7.

Keywords: *ethyl acetae, lotion, okra fruit, UV protective*

1. INTRODUCTION

Skin is the boundary layer between the internal and external environment of our body. It protects us from radiation, mechanical trauma, and microbial attack. Chronic exposure to ultraviolet (UV) rays from the sun have a negative impact in the from of changes in structure, skin composition and oxidative stress (Abou-Dahech et al., 2022). The skin has a mechanism to synthesize melanin when exposed to UV rays, but this ability is often unable to compensate for the free radicals produced by UV rays, resulting in a biological response from within the body.

Photooxidative reactions due to exposure to UV radiation cause biomolecular damage, affect the origin of skin cells which contribute to pathological processes and are responsible for the emergence of many skin disorders (de Assis, Tonolli, Moraes, Baptista, & de Lauro Castrucci, 2021). Continuous exposure to sunlight and other environmental factors can result in the induction of oxidative stress which has a high reactivity with genetic material, peptides, and fatty acids which often cause significant antioxidant damage (Vijayakumar et al., 2020). To protect the skin against UV radiation, you can try to use sunscreen and antioxidants. The ability of sunscreen to protect the skin by delaying erythema is expressed by the Sun Protection Factor (SPF) (Kolbe et al., 2019).

Sunscreen is expected to absorb erythema radiation, non-photolabile, non-toxic,–not dissolve in sweat and not cause irritation and allergies. On the other hand, the use of sunscreen with active chemical compounds has some disadvantges effects on the skin, including irritation, infection, hypersensitivity, and even cause skin cancer. So, it is necessary to find a sunscreen from natural ingredients in order to minimize the side effects of using chemical sunscreen (Ghazi, 2022; Romanhole et al., 2020). Compounds of natural ingredients which are able to provide sunscreen activity and act as antioxidants are organic compounds with chromophore groups. They have an ability to absorb UV light due to the occurrence of electronic transfers in the sunscreen molecule where the energy of the transition is equivalent to the energy of UV light (Wang et al., 2022).

Natural compounds containing chromophore groups that have potential as sunscreens and antioxidants are phenolic compounds. These phenolic compounds are abundant in okra fruit. Based on previous studies, testing of the ethyl acetate fraction of okra fruit was carried outhas phenolic and flavonoid content of 251.0116 mgGAE/g and 127.6178 mgQE/g and an IC50 value of 40.2254 ppm. For sunscreen activity, the ethyl acetate fraction at a concentration of 100ppm gives an SPF value of 8.5973; 200ppm 49.7069 and 400ppm 77.4765 which shows that the ethyl acetate fraction is able to provide ultra-protection; percent transmission of pigmentation (Tp) 100ppm is 0.3441; 200ppm of 0.1447 and 400ppm of 0.1113 and the percent transmission of erythema (Te) 100ppm of 0.3407; 200ppm of 0.1436 and 400ppm of 0.1102 which shows the potential of the ethyl acetate fraction as a natural sunscreen. The SPF number indicates that the ethyl acetate fraction is capable of providing ultra-protection, and based on the percentage of erythema and percentage of pigmentation, the ethyl acetate fraction of okra fruit may

be utilized as a sunblock (Astutiningsih & Anggraeni, 2022b). This concentration will be used as a reference for the concentration of the ethyl acetate fraction to be added to the lotion. The higher the antioxidant activity, the more the sample will have a better ability to protect the skin from UV rays, which is indicated by an increase in the SPF value of the tested sample (Kurzawa, Wilczyńska, Brudzyńska, & Sionkowska, 2022).

To make it easier and more practical to use, it is necessary to make preparations for the ethyl acetate fraction. There are several formulas of sunscreen including oil-based products (ointments, spray); water based product (gels); emulsion based products (creams, lotion) (Tanner, 2006). Suncreen in lotion formulation is a preparation that is widely found on the market. Lotion is a topical preparation with an emulsion base that is more liquid than cream (Mayba and Gooderham, 2017).

Emulsion systems consist of polar and nonpolar phases that can be formulated for water soluble or insoluble filters. Oil in water emulsions are preferred by consumers, because the outer phase is water and provides a cool feeling when used (Romanhole et la., 2020). Sunscreen formulations in the form of lotion can be found in several studies such as cempedak leaf extract lotion (Damayanti, 207); pineapple peel lotion (Gurning, 2016); bran extract lotion (Safira and Safira, 2020).

So that in this study we will formulate the fraction of okra fruit which contains the highest total phenolic compounds and total flavonoids compared to other extracts and solvent fractions in order to reduce the use of sunscreens containing synthetic chemicals which if used excessively and continuously can cause hypersensitivity effects, allergies and if these chemical compounds accumulate in the skin can even cause carcinoma cancer (Wang et al., 2022).

The ethyl acetate fraction of okra fruit is formulated into a lotion preparation, which is a semisolid preparation in the form of a suspension or dispersion intended for application to the skin. The semi-solid form of lotion makes it easier to apply to the skin since it can be applied more evenly and rapidly across a big region. After application, lotion dries fast and leaves a thin coating of therapeutic ingredients on the skin's surface. It is required to perform research to assess the activity and durability of sunscreen lotion formulations derived from the okra fruit ethyl acetate fraction.

2. METHODS

Tool

Glassware, UV lamp, rotary evaporator, analytical balance, spectrophotometer, pH meter, brookdfield viscometer.

Material

Okra fruit from the Toroh area, Purwodadi; 80% ethanol (Brathacem); stearic acid (Brathachem); glycerin (Brathacem); triethanolamine (Brathacem); cera alba (Bratachem); liquid paraffin (Bratachem); methylparaben (Brathacem); paraben propyl; Ethanol pa (Merck).

Research procedure

Preparation of ethyl acetate fraction

The okra fruit is cleaned and dried in a drying cupboard, then the simplicia is crushed and sifted. The extract was carried out by remaceration method with 80% ethanol, every 200 grams was soaked with 1 liter of immersion solvent and solvent replacement was carried out for 5x 24 hours. The filtered liquid extract was collected and evaporated with an evaporator at 500C and continued to concentrate the extract using a water bath. The concentrated extract was fractionated with n-hexane, ethyl acetate and water. The fractions of each solvent were then concentrated on a water bath until thick (Astutiningsih, 2021).

Lotion Preparation Formulation

This study formula lotion which to made in table 1. The oil phase mixture consisting of stearic acid, cera alba and liquid paraffin was melted at 70^0C. The water phase mixture, consisting of glycerin, triethanolamine, methyl paraben, and propyl paraben, is homogenized by melting it with a quantity of distilled water at 700 degrees Celsius. Thereafter, the oil phase was added gently to the water phase at 700 degrees Celsius while stirring constantly until the mixture was homogenous and a lotion base was created. The ethyl acetate fraction of okra fruit was then slowly added to the base, followed by the addition of oleum rosae, and the mixture was agitated until a lotion of okra ethyl acetate fraction was formed (Kusumawati, Munawaroh, & Fikayuniar, 2021).

Table 1. Sunscreen Lotion Formulas

Material	Concentration (%)			
	F1	**F2**	**F3**	**F4**
Ethylacetate fraction	-	0.05	0.1	0.15
Stearic acid	4,5	4,5	4,5	4,5
Cera alba	3	3	3	3
Liquid paraffin	7	7	7	7
Triethanolamine	1	1	1	1
Glycerin	5	5	5	5
Methyl paraben	0.2	0.2	0.2	0.2
Propyl paraben	0.03	0.03	0.03	0.03
Oleum rosae	qs	qs	qs	qs
Aquades	ad 100 ml	ad 100 ml	ad 100 ml	ad 100 ml

Organoleptic: observed the color and smell of the lotion preparation; homogeneity test of the lotion preparation is taken sufficiently placed between two glass objects then the glass object is pressed and observed visually, it is said to be homogeneous if the color of the preparation is evenly mixed; pH test is measured with a pH meter; viscosity test: measured with a Brookfield DV-1ME viscometer; The adhesion test is carried out by placing lotion between 2 glass objects whose area has been determined, then pressing them again with a load for 5 minutes, then placing the glass object on the test equipment, releasing a load weighing 50 grams and recording the time until the two glass objects are released (Azkiya, Ariyani, & Nugraha, 2017);

The spreadability test was carried out by comparing the diameter of the spread of the lotion on the glass plate after being loaded and continued each time with the addition of 50 grams of weight and allowed to stand for 1 minute, the diameter of the spread of the lotion was recorded until a constant spreadability was obtained (Latifah, Sugihartini, & Yuwono, 2016).

The adhesion test is done by putting 0.5 grams of lotion in a glass then left for 1 minute. The area formed is measured in area. Loads weighing 50, 100, 150 and 200 grams are allowed to stand for 1 minute and the dispersion is measured (Garg et al., 2002).

Stability Test (Freeze thaw cycle): The test was carried out for six cycles by storing the lotion preparation at 4 ± 20C for 24 hours and then being transferred to 40 ± 20C for 24 hours (one cycle). After that, it was observed whether there was a phase separation from the lotion preparation (Oktaviasari & Zulkarnain, 2017).

Sunscreen Activity Test

Determination of sunscreen was carried out in vitro with a UV-Vis spectrophotometer. The preparation was weighed 0.1 gram dissolved in ethanol up to 25 ml pa to obtain a concentration of 400 ppm, then read on the

spectrophotometer. The absorbance spectrum of the sample in solution was read at wavelengths between 290 and 375. nm at 5 nm intervals using a 1 cm quvette and ethanol as blank. The SPF value, percent erythema and percent pigmentation of the okra fruit fraction were calculated using a mathematical equation (Ngoc et al., 2019).

3. RESULTS AND DISCUSSION

This study used the ethyl acetate fraction of okra fruit in the manufacture of sunscreen lotion preparations. Okra fruit contains phenolic secondary metabolites, especially flavonoids, which have the potential to be developed in sunscreen preparations. In this study, 3 variations of concentration were used to compare the activity of each sunscreen with the method of determining the SPF value, percent erythema, and percent pigmentation. Figure 1 shows the outcomes of the lotion formulation using the ethyl acetate fraction of the okra fruit ethyl acetate fraction. The organoleptic, homogeneity, pH, viscosity, spreadability, adhesion, and kind of lotion were the parameters that were evaluated throughout the process of carrying out the ethyl acetate fraction lotion test. Testing of the preparation's stability was also conducted while it was being stored; the results of this testing can be seen in table 2 below. This testing was done so that the preparation's stability could be determined.

The organoleptic evaluation of lotions F1, F2, F3, and F4 revealed that the lotion preparations were white for the base, the color changed to a light green after the addition of the ethyl acetate fraction, and the color deepened with increasing additions of the ethyl acetate fraction to the lotion base. The preparations showed uniform results after being tested for homogeneity. The homogeneity test aims to determine how easily each ingredient in the preparation can be mixed. When the lotion preparation is applied to the glass, there should not be visible spots or coarse grains between the constituent components of the lotion (Rabima & Marshall, 2017).

(F_1) (F_4) (F_3) (F_2)

Figure 1. Lotion preparations of the ethyl acetate fraction of okra fruit (F_1) Lotion Base; (F_4) Lotion 0.15% ethyl acetate content (F_3) Lotion 0.1% content ethyl acetate fraction; (F_2) Lotion content of 0.05%

Table 2. Results of Evaluation of Physical Characteristics and Stability of Okra Fruit Ethyl Acetate Fraction Lotion

Physical Characteristics	Lotion Formulas			
	F1	F2	F3	F4
Organoleptic				
Color	White	Light green	Light green	Light green
Smell	Rose special	Rose special	Rose special	Rose special
Consistency	Half solid	Half solid	Half solid	Half solid
Homogenity	Homogeneous	Homogeneous	Homogeneous	Homogeneous
pH	8.02 ± 0.155	7.56 ± 0.1140	7.23 ± 0.1854	6.98 ± 0.2153
Viscosity (cps)	3545 ± 80.5264	3753 ± 93.7337	3986 ± 80.4829	4053 ± 84.6020
Spreadability (cm)	7.63 ± 0.2176	7.33 ± 0.2631	7.17 ± 0.2077	7.02 ± 0.2270
Stickiness (seconds)	5.23 ± 0.1834	5.45 ± 0.3967	5.51 ± 0.2877	5.57 ± 0.1722
Type emulsion	o/w	o/w	o/w	o/w
Stability test	Organoleptic unchanged	Organoleptic unchanged	Organoleptic unchanged	Organoleptic unchanged

A homogeneity test is performed to guarantee that the active substance and lotion base have been evenly mixed in the preparation. If the preparation is uniform, it is assumed that the level of the active substance will always be the same when used (Kulkarni & Shaw, 2016). The homogeneity test was carried out by visual observation on the part of the lotion flattened on the object glass and based on observations the three formulas showed that a homogeneous lotion means that the fraction is evenly mixed with the lotion base.

Next pH evaluation of the lotion preparation is carried out to determine whether the pH of the lotion produced is in accordance with the pH of the skin. The pH of the four formulas is 6.98– 8.02 (Standar Nasional Indonesia, 1996). The base is slightly alkaline and will decrease with increasing amounts of ethyl acetate fraction of okra added, thus showing that the ethyl acetate fraction of okra added tends to be acidic. Several studies show that bases that have an alkaline pH when mixed with extract or fraction (Damayanti et al., 2017; Sumbayak and Diana, 2018). The compatibility between the pH of the skin and the pH of the topical preparation influences the skin's acceptance of the preparation. Based on the pH values of all formulae, the pH of the lotion satisfies the formulation's pH standards of 4.5-8. A lotion with a pH that is too alkaline might dry out the skin, whereas a lotion with a pH that is too acidic would cause irritation. This suggests that the concentration of the ethyl acetate portion had no effect on the pH of the lotion formulations (Astutiningsih & Anggraeni, 2022a). The results of pH data anlysis with SPSS show p value of 0.000<0.05 which menas that variations in the concentration of ethyl acetate fraction of okra fruit produce lotions with different pH values meaningfully.

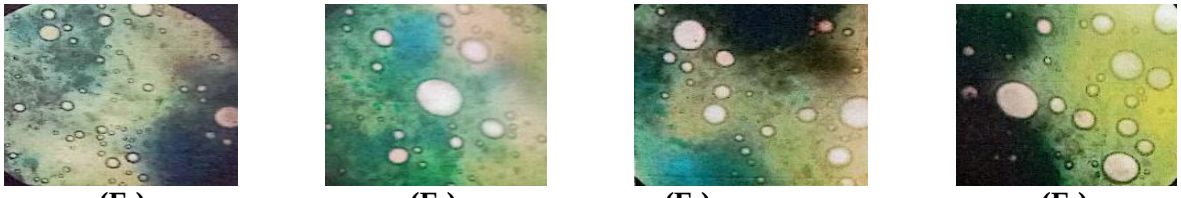
In this study, the viscosity measurement used a Brookfiled viscometer. The viscosity requirements for sunscreen preparations according to SNI 1996 are 2000-50,000 so the lotion preparation of the ethyl acetate fraction of okra fruit fulfills these physical requirements (Standar Nasional Indonesia, 1996). The higher the viscosity will increase the resistance of the preparation to flow which will affect the activity of the sunscreen, spreadability and adhesion. Some studies show the same result that the addition of extracts or fraction will increase the viscosity of the preparation (Damayanti et al., 2017; Sartika dan Taniasari, 2018; Wuryandari & Sugihartini, 2019). The thickness of the preparation will rise proportionally with the viscosity of the liquid. The findings of the test to determine the viscosity of the ethyl acetate fraction lotion made from okra fruit indicated that the viscosity increased in direct proportion to the concentration of the ethyl acetate fraction that was added. Nevertheless, if the preparation is too thick, it will be difficult to apply it to the skin, which will result in a restricted distribution of the substance. The resulting viscosity was then analyzed statistically, and the results showed that there was a significant difference between the viscosity data of all of the lotion preparations. Since this indicates that the concentration of the ethyl acetate fraction had an effect on the viscosity of the lotion preparations, the ethyl acetate fraction had an effect.

A high spreading power suggests that the preparation will be dispersed in a manner that is both more effective and more even. The findings of the physical features of the ethyl acetate portion of okra fruit sunscreen lotion satisfied the requirements for the spreadability range, which was 7.63-7.02. It can be shown that there is an inverse relationship between the difference in the viscosity of the preparation and the spreading power of the preparation. This means that the greater the viscosity of the preparation, the lower the spreading power will be. Some studies the same result that increasing the

concentration of fractions will decrease the dispersion of the preparation (Damayanti et al., 2017; Sartika dan Taniasari, 2018; Wuryandari & Sugihartini, 2019). The resultant spreadability was then subjected to statistical analysis, which revealed that the spreadability data of all lotion preparations showed a significant difference. Since this indicates that the concentration of the ethyl acetate fraction had an effect on the spreadability of the lotion preparations, it can be deduced that the ethyl acetate fraction influenced the spreadability of the lotion preparations.

The purpose of the adhesion test is to establish whether or not the lotion has the capacity to adhere to the skin after it has been applied. It is reasonable to anticipate that the sunscreen lotion will remain in touch with the skin for a larger amount of time if its adhesiveness is increased. The adhesive power is directly related to the viscosity; therefore, if the final viscosity is high, the adhesive power that is created will also be high for a longer period of time. The adhesion test is designed to determine how long a preparation may remain adhered to the skin before it begins to interfere with the body's ability to absorb the active ingredient. The maximum amount of the active ingredient will be released if the active material is allowed to remain in contact with the skin for an extended period of time. More than four seconds is considered to be the benchmark for satisfactory adherence in semisolid preparations (Sari et al., 2015). According to the findings of the analysis of the sunscreen lotion's physical properties, the active ingredient, which is an ethyl acetate fraction of okra fruit, has a more natural adhesion of 4 seconds, namely 5.23–5.27 seconds. Some studies show the same result that the addition of fraction concentration will decrease the adhesion of the preparation (Wuryandari & Sugihartini, 2019; Ulandari dan Sugihartini, 2020). The lotion stays in touch with the skin for a longer period of time, which results in a greater beneficial impact. The adhesion that was produced was then analyzed statistically, and the results showed that there was a significant difference between the adhesion data of all of the lotion preparations. This indicated that the concentration of the ethyl acetate fraction had an effect on the adhesiveness of the lotion preparations.

Testing the type of sunscreen lotion using methylene blue. Methylene blue as a water-soluble dye. The blue color is the water phase while the oil phase is in the form of clear granules. Methylene blue is a polar substance so that it can bind to the polar water phase. The bond between the water phase and methylene blue is indicated by the appearance of a blue color in the lotion preparation. The result of testing the type of sunscreen lotion in the ethyl acetate fraction is the type of oil in water (m/a) which is visible in the presence of clear grains with a blue base that result this research can see at figure 2. Semisolid preparations will be more comfortable with this type of oil-in-water lotion because the oil phase gives a softer feel to the skin and water evaporates more easily, making it easier to wash off (Nonci, Tahar, & Aini, 2017).



(F_1) (F_2) (F_3) (F_4)

Figure 2. Type emulsion o/w lotion preparations of the ethyl acetate fraction of okra fruit (F_1) Lotion Base; (F_2) Lotion 0.05% ethyl acetate content (F_3)) Lotion 0.1% content ethyl acetate fraction; (F_4) Lotion content of 0.15

Testing the stability of the lotion includes the organoleptic test of the lotion preparation and the centrifugation test which is carried out to determine whether or not there is a phase separation in the lotion preparation made. Apart from the organoleptic stability of the lotion preparation, it was also carried out on the parameters of the preparation separation. Centrigation testing is needed to determine the effect of shocks during product transport on the physical appearance of the product. All lotion formulas are centrifuged, resulting in separation but not separation between the oil and aqueous phases. Separation is marked by the appearance of a color difference on the bottom of the preparation in the centrifugation tube which is called creaming. The preparation can be redispersed with light agitation and can form a homogeneous mixture. This shows that both of them are also not experiencing chemical reactions that can cause color and odor changes during the accelerated storage process as well as phase separation (Rabima & Marshall, 2017).

The next test is testing sunscreen with the parameters SPF, percent erythema, and percent pigmentation, the following results are obtained in table 3.

Table 3. Activity Test Results for Sunscreen Lotion Ethyl Acetate Fraction of Okra Fruit

Sample	SPF value	% Erythema	% Pigmentation
Lotion base (F1)			
1	1.0801	1.0728	1.0634
2	1.0604	1.0437	1.0394
3	1.0556	1.0437	1.0394
4	1.0553	1.0437	1.0394
5	1.0449	1.0437	1.0394
Average	1.0593 ± 0.0129	1.0495 ± 0.0130	1.0442 ± 0.0107
Lotions (F2)			
1	12.5840	4.7951	4.5406
2	11.4587	4.5268	4.2367
3	10.2522	4.3418	4.0724
4	11.7465	5.1216	4.7383
5	10.8973	4.7426	4.394
Average	11.0887 ± 0.6598	4.7056 ± 0.2944	4.3964 ± 0.2589
Lotions (F3)			
1	14.1534	5.1691	4.8420
2	16.5127	5.4038	5.0947
3	16.2231	5.5342	5.2113
4	15.8522	5.4026	5.0670
5	17.7456	5.6384	5.2984
Average	16.0974 ± 1.2984	5.4296 ± 0.1759	5.1027 ± 0.1728
Lotions (F4)			
1	18.5450	6. 0015	5.7095
2	20.1457	6.0046	5.8126
3	21.2596	6.0313	6.0905
4	19.6543	6.0378	5.7572
5	20.8765	5.9264	6.0500
Average	20.0962 ± 1.0684	6.0032 ± 0.0443	5.8840 ± 0.1745

The ethyl acetate fraction of okra was subjected to in vitro testing using a UV-Vis spectrophotometer in order to evaluate its potential efficacy as a sun protection agent. The results of the tests are presented in table 3, and it can be seen that F1 shows the highest percentage of erythema and pigmentation percent while also having the lowest SPF value. This is due to the fact that F1 lotion is merely a lotion base without any active compounds that can provide the same level of

protection as a sunscreen. For lotion formulas that have been added to the ethyl acetate fraction, the results are greater, the concentration is 0.15%, in formula F4, the ethyl acetate fraction is 0.1% in F3 and the ethyl acetate fraction is 0.05% in F2. The result is that the ability of the lotion as a sunscreen is also getting bigger, that the greater the concentration of the fraction used, the better its activity as a sunscreen. The lotion base has no potential as a sunscreen with an SPF value of less than 1. The results of the two formulas with the addition of the ethyl acetate fraction that can be used are formulas with the addition of 1% and above because sunscreen is recommended to have at least an SPF value of 15 (Rabima & Marshall, 2017). This means that someone who has natural resistance to sunlight for 30 minutes if using sunscreen with a minimum SPF value of 15 means that it will last for 30 x 15 minutes = 450 minutes or 7 hours 30 minutes in the sun (Li, Colantonio, Dawson, Lin, & Beecker, 2019).

Sunscreen activity was analyzed, namely measuring absorption at a wavelength of 292.5 nm to 400 nm with an interval of 5nm. To calculate the SPF parameter, it can be calculated from the absorption at a wavelength of 290 nm - 400 nm. The SPF value may be utilized to assess the efficacy of sunscreen formulations. Sun Protection Factor (SPF) is a global indication that describes the efficiency of a UV-protecting product or substance; the higher the SPF value of a product or active ingredient in a sunscreen, the more successful it is at shielding the skin from the damaging effects of UV rays. The SPF value may be established by comparing the minimal amount of UV radiation required to produce erythema on skin (Minimum Erythema Dose) on skin that has been smeared with sunscreen to skin that has not been smeared with sunscreen. MED is the UV dosage necessary for erythema to develop (Wenur, Yamlean, & Sudewi, 2016).

The percentage of transmission of erythema or pigmentation measures the proportion of sunlight that can continue to produce erythema or pigmentation after sunscreen application. The lesser the % erythema transmission value and pigmentation, the greater the potential of a sunscreen to protect the skin (Aguilera et al., 2021). And from these data it can be seen that the lotion formula 2 is still in the maximum sunscreen category while formulas 3 and 4 are in the maximum category. Meanwhile, based on the %Te and %Tp values, all concentrations of lotion preparations have a value of <1% so that they can be categorized as total sunblock. Sunblock is a preparation that protects the skin by reflecting ultra violet rays.

4. CONCLUSION

The lotion of ethyl acetate fraction in okra fruit can be used as a sunscreen with an average SPF value of 11.0887 in the lotion formula with 0.05% ethyl acetate fraction; 16.0974 for lotion with 0.1% ethyl acetate fraction and 20.0962 for lotion with 0.15% content. The lotion of ethyl acetate fraction in okra fruit adequates the physical characteristics and has good stability.

5. ACKNOWLEDGEMENTS

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6. REFERENCE

Abou-Dahech, M., Boddu, S. H. S., Devi Bachu, R., Babu, R. J., Shahwan, M., Al-Tabakha, M. M., & Tiwari, A. K. (2022). A mini-review on limitations associated with UV filters. *Arabian Journal of Chemistry*, *15*(11), 104212. https://doi.org/10.1016/j.arabjc.2022.104212

Aguilera, J., Vicente-Manzanares, M., De Gálvez, M. V., Herrera-Ceballos, E., Rodríguez-Luna, A., &

González, S. (2021). Booster effect of a natural extract of Polypodium leucotomos (Fernblock®) that improves the UV barrier function and immune protection capability of sunscreen formulations. *Frontiers in Medicine*, *8*, 684665. https://doi.org/10.3389/fmed.2021.684665

Astutiningsih, C. (2021). Isolation And Inhibition Test Of Quercetin Compound From Okra Fruit (Abelmoschus esculentus L.). *Jurnal Farmasi Sains Dan Praktis*, *7*(3), 356–364.

Astutiningsih, C., & Anggraeni, E. N. (2022a). Gel Formulation of Lipid Nanoparticles and Zn Nanoparticles of Okra Fruit Extract (Abelmoschus Esculentus L.) and Sunscreen Activity Test. *International Journal of Public Health Excellence (IJPHE)*, *2*(1), 360–368. https://doi.org/10.55299/ijphe.v2i1.233

Astutiningsih, C., & Anggraeni, E. N. (2022b). Kajian Fraksi Buah Okra (Abelmoschus esculentus L.) Sebagai Antioksidan, Tabir Surya dan Inhibitor Tirosinase. In *Research Reports*.

Azkiya, Z., Ariyani, H., & Nugraha, T. S. (2017). Evaluasi sifat fisik krim ekstrak jahe merah (Zingiber officinale Rosc. var. rubrum) sebagai anti nyeri. *JCPS (Journal of Current Pharmaceutical Sciences)*, *1*(1), 12–18.

Damayanti R,H. Meyllina, L. Rusli, R. (2017). Formulasi Sediaan Lotion Tabir Surya Ekstrak Daun Cempedak (Artocarpus champeden Spreng). *Proceeding of the 6th Mulawarman Pharmaceuticals Conferences*

de Assis, L. V. M., Tonolli, P. N., Moraes, M. N., Baptista, M. S., & de Lauro Castrucci, A. M. (2021). How does the skin sense sun light? An integrative view of light sensing molecules. *Journal of Photochemistry and Photobiology C: Photochemistry Reviews*, *47*, 100403. https://doi.org/10.1016/j.jphotochemrev.2021.100403

Ghazi, S. (2022). Do the polyphenolic compounds from natural products can protect the skin from ultraviolet rays? *Results in Chemistry*, *4*, 100428. https://doi.org/10.1016/j.rechem.2022.100428

Garg, A, Anggarwal, D., Garg, S., & Singla, a. K. (2002). Spreading of Semisolid Formulations. *Pharmaceutical technology*

Guo, M., Xue, W., Liao, L., Ling, X., Yu, D., Lan, X., … LiLi. (2022). Anti-allergic activity of natural plant products for the treatment of sensitive skin: A review. *Pharmacological Research - Modern Chinese Medicine*, *3*, 100117. https://doi.org/10.1016/j.prmcm.2022.100117

Karisma, V. W., Wu, W., Lei, M., Liu, H., Nisar, M. F., Lloyd, M. D., … Zhong, J. L. (2021). UVA-Triggered drug release and photo-protection of skin. *Frontiers in Cell and Developmental Biology*, *9*, 598717. https://doi.org/10.3389/fcell.2021.598717

Kolbe, L., Pissavini, M., Tricaud, C., Trullás Cabanas, C., Dietrich, E., & Matts, P. J. (2019). Anti-inflammatory / anti-oxidant activity of ingredients of sunscreen products? Implications for SPF. *International Journal of Cosmetic Science*, *41*(3), 320–324. https://doi.org/10.1111/ics.12540

Kulkarni, V. S., & Shaw, C. (2016). *Chapter 7 - Preparation and Stability Testing* (V. S. Kulkarni & C. B. T.-E. C. for F. of S. and L. D. Shaw, Eds.). Boston: Academic

Press. https://doi.org/10.1016/B978-0-12-801024-2.00007-8

Kurzawa, M., Wilczyńska, E., Brudzyńska, P., & Sionkowska, A. (2022). Total Phenolic Content, Antioxidant Capacity and UV Radiation Protection Properties of Marigold (Calendula officinalis), Carrot (Daucus carota), Tomato (Solanum lycopersicum) and Hop (Humulus lupulus) Extracts. *Cosmetics*, Vol. 9. https://doi.org/10.3390/cosmetics9060134

Kusumawati, A. H., Munawaroh, A., & Fikayuniar, L. (2021). Formulation and Physical Evaluation of Body Lotion Preparation of Kacip Fatimah (labisia pumila) Ethanolic Extracts as Antioxcidant. *IOP Conference Series: Materials Science and Engineering*, *1071*(1), 12010. IOP Publishing.

Latifah, F., Sugihartini, N., & Yuwono, T. (2016). Evaluasi sifat fisik dan daya iritasi sediaan lotion minyak atsiri bunga cengkeh (Syziqium aromaticum) dengan berbagai variasi konsentrasi. *Traditional Medicine Journal*, *21*(1), 1–5.

Li, H., Colantonio, S., Dawson, A., Lin, X., & Beecker, J. (2019). Sunscreen Application, Safety, and Sun Protection: The Evidence. *Journal of Cutaneous Medicine and Surgery*, *23*(4), 357–369. https://doi.org/10.1177/1203475419856611

Mahmoud, B. H., Ruvolo, E., Hexsel, C. L., Liu, Y., Owen, M. R., Kollias, N., … Hamzavi, I. H. (2010). Impact of Long-Wavelength UVA and Visible Light on Melanocompetent Skin. *Journal of Investigative Dermatology*, *130*(8), 2092–2097. https://doi.org/10.1038/jid.2010.95

Mayba J,N. and Gooderham, M,J.(2017). A Guide to Topical Vihicle Formulations. *Journal of Cutaneous Medicine and Surgery.* Vol. 22(2)

Ngoc, L. T. N., Tran, V. Van, Moon, J.-Y., Chae, M., Park, D., & Lee, Y.-C. (2019). Recent trends of sunscreen cosmetic: An update review. *Cosmetics*, *6*(4), 64.

Nonci, F. Y., Tahar, N., & Aini, Q. (2017). Formulasi dan Uji Stabilitas Fisik Krim Susu Kuda Sumbawa dengan Emulgator Nonionik dan Anionik. *Jurnal Farmasi UINAlauddin Makasar*, *4*(4), 169–178.

Oktaviasari, L., & Zulkarnain, A. K. (2017). Formulasi dan uji stabilitas fisik sediaan lotion O/W pati kentang (Solanum tuberosum L.) serta aktivitasnya sebagai tabir surya. *Majalah Farmaseutik*, *13*(1), 9–27.

Rabima, & Marshall. (2017). Uji Stabilitas Formulasi Sediaan Krim Antioksidan Ekstrak Etanol 705 dari Biji Melinjo (Gnetum gnemon L). *Indonesian Natural Research Pharmaceutical Journal*, *2*(1), 107–121.

Ritonga, N. B., Rini, R., & Anggraini, T. (2020). Formulation and Evaluation of Sun Block Lotion Made from Virgin Coconut Oil (VCO) with the addition of the Extract of Telang Flower (Clitoria ternatea, L) and Pandan Leaves (Pandanumusa paradisiaca, L). *AJARCDE (Asian Journal of Applied Research for Community Development and Empowerment)*, *4*(1), 59–63.

Romanhole, R. C., Fava, A. L. M., Tundisi, L. L., Macedo, L. M. de, Santos, É. M. dos, Ataide, J. A., & Mazzola, P. G. (2020). Unplanned absorption of sunscreen ingredients: Impact of formulation and evaluation methods. *International Journal of Pharmaceutics*, *591*, 120013. https://doi.org/10.1016/j.ijpharm.2020.120013

Sari, D. K., Sugihartini, N., & Yuwono, T. (2015). Evaluasi Uji Iritasi dan Uji Sifat Fisik Sediaan Emulgel Minyak Atsiri Bunga Cengkeh (Syzigium aromaticum. *Pharmaciana*, *5*(2), 115–120.

Sartika W, A, D and Taniasari, N. (2018). Formulasi Sediaan Lotion Antioksidan Ekstrak Etanol Kulit Buah Rambuatn (Nephelium lappaceum L.). *Journal of Pharmaceutical-Care anwar Medika.* Vol 1(1)

Standar Nasional Indonesia. (1996). *164399: Sediaan Tabir Surya*. Jakarta: Standarisasi Nasional.

Sumbayak A, R and Diana V, E. (2018). Formulasi Hand Body Lotion Ekstrak Etanol Kulit Buah Semangka (Citrillus vulgaris). *Jurnal of The Pharmaceutical Word.* Vol 2 (2). 70-76

Tanner P, R. (2006). Sunscreen Product Formulation. *Dermatoloc Clinics* . Vol 24 (1). 53-62

Ulandari A, S. and Sugihartini, N. (2020). Evaluasi Sifat Fisik Sediaan Lotion dengan Variasi Konsentrasi Ekstrak Daun Kelor (Moringa oleifera L.). *Jurnal Penelitian dan kajian Kesehatan.* Vol 6. No. 1

Vijayakumar, R., Abd Gani, S. S., Zaidan, U. H., Halmi, M. I. E., Karunakaran, T., & Hamdan, M. R. (2020). Exploring the Potential Use of Hylocereus polyrhizus Peels as a Source of Cosmeceutical Sunscreen Agent for Its Antioxidant and Photoprotective Properties. *Evidence-Based Complementary and Alternative Medicine*, *2020*, 7520736. https://doi.org/10.1155/2020/7520736

Wang, T., Zhao, J., Yang, Z., Xiong, L., Li, L., & Gu, Z. (2022). Polyphenolic sunscreen for photoprotection. *Green Chemistry*, *4*, 3605–3622. https://doi.org/10.1039/d1gc04828

Wenur, S., Yamlean, P. V. Y., & Sudewi, S. (2016). Formulasi dan PenentuN Nilai SPF dari Sediaan Losio Ekstrak Etanol Kulit Buah Pisang Goroho (Musa acuminafe L.). *Jurnal Ilmiah Farmasi UNSRAT*, *5*(4).

Wuryandari, T and Sugihartini, N. ***(2019).*** Emulgel Formulation of Purified Extract of Moringa (*Moringa oleifera* L.) Leaf. *Folia Medica Indonesiana (2355-8393) . Mar2019, Vol. 55 Issue 1, p17-24. 8p.*