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Research Article

BREADFRUIT PEEL AS THE MOST POTENT RADICAL SCAVENGERS FOR SKIN PROTECTION

Syamsurizal[1,*], Elisma[1], Puspa Dwi Pratiwi[1]

[1] Pharmacy Department, Faculty of Medicine and Health Sciences, Universitas Jambi, Jambi, Indonesia
Corresponding author email: syamsurizal68@unja.ac.id

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Abstract
The sun's ultraviolet radiation causes erythema, premature aging, sunburn, hyperpigmentation, inflammation, and dry skin. For this purpose, sunscreen with an SPF value of >15 is needed to protect the skin against UV rays. Breadfruit peel containing flavonoids may protect against free radicals and UV radiation. This study aims to increase SPF value from breadfruit fractionate by combining niacinamide and α-tocopherol. The ABTS and BSLT methods were used to screen potent free radical scavengers in n-hexane, dichloromethane, ethyl acetate, and methanol extracts. The dichloromethane extract had the highest potential as a free radical scavenger, with IC50: 20,90±0,54 µg/mL, and the lowest toxicity, with LC50: 234,42±1,06 µg/mL. Then, the scavenging activities and selective index of fractionates of dichloromethane were evaluated to show that the DM-2 fraction had the strongest free radical scavenging activity and the lowest toxicity, with the highest selective index value of 46.08. The main active ingredient was DM-2, combined with niacinamide and α-tocopherol into five compositions. The results of the lotion dosage forms revealed that the fifth formula, F5, met the requirement SNI standards and was stable during storage, with SPF value:20.61±0.75, which was three times higher than the positive control with an SPF value of 6.67±1.28.

Keywords: ABTS, *Artocarpus altilis*, BSLT, Lotion, Scavenging, SPF

INTRODUCTION

Nowadays, commercial sunscreens do not adequately protect the skin from the impacts of UV radiation, many people suffer from dry skin with black patches, blisters, skin inflammation, and skin cancer (Mohiuddin, 2019). As a result, new solutions for protecting the skin from the effects of sun exposure are required. One method is to use active secondary metabolites as antioxidants required by plants to defend themselves from UV exposure (photoprotective). In this work, breadfruit dichloromethane fractionate was utilized, which has been shown to have anti-free radical activity (Lai & Lim, 2011). Oxidative reactions triggered the skin radicalization process cause skin damage such as dry, rough, wrinkled, and dull skin (Setiati, 2003). Sunlight, which contains ultraviolet (UV) radiation, is one source of radicals that cause skin damage. UV radiation is classified into three types: UVA, UVB, and UVC. UVA light (320-400 nm) promotes skin cell damage and wrinkles. UVB light (290-320 nm)

damages DNA and can cause cancer, but UVC radiation (200-290 nm) reacts with the stratospheric ozone layer, preventing it from reaching the earth's surface (Wilson et al., 2012).Therefore, antioxidant chemicals are required by the skin to manage and prevent UVA and UVB light damage. Essentially, the body has the ability to produce natural antioxidant compounds to inhibit radical oxidation. However, the body requires external antioxidant to control oxidation reaction and inhibit free radicals that enter the human body (Tjandrawinata & Raymond, 2011).

Several studies have found that flavonoid compound useful as antioxidant (Selawa et al., 2013). The ability of sunscreen to block UV lights can be determined from the Sun Protector Factor (SPF) value which is also related to the value of preventing free radicals, phenolic and flavonoid contents (M. A. Ebrahimzadeh et al., 2014). *A. altilis* or breadfruit is the one of plant that found has high flavonoid compounds. Utilizing lotion formulated specially by natural products are directly prevent the dangers of UV radiation (Solichah et al., 2021).

Previous research by Wen et al, was found that 12 compounds of flavonoids isolation from heartwood and cortex of the *A. altilis* shown potent radical scavenging activity(Lan et al., 2013). Other research about the dichloromethane fractionate of breadfruit peel has the potential to scavenge free radical with IC_{50} value 13.34 µg/mL. The result was twice effective compared to α-tocopherol with IC_{50} value 30.32 µg/mL. Sari et al (2021) reported that high antioxidant activity of breadfruit peel with IC_{50} value 15.72 µg/mL which was almost three times higher than positive control (Sari et al., 2021). There is no previous research about cytotoxic assay and SPF value in *A. altilis* peel but the previous research by Himawan et al (2018) was found that the correlation between antioxidant activity and SPF value. It is reported that high antioxidant activity was increased the SPF value (Himawan et al., 2018).

In the other research concerned, the potential of α-tocopherol as an antioxidant applied topically can reduce erythema, sunburned cells and skin damage (Rocha, 2002). Clinical studies have also proven that antioxidant protection with a combination of α-tocopherol shows increased elasticity and moisture of skin by increasing the ability of the stratum corneum to retain moisture, enhanced epithelialization, and skin protection. Moreover, the potential of niacinamide has been proven to help reduce the effects of dangerous oxidative reactions due to pollution or exposure to dust (Narda et al., 2018). Oxidative reactions trigger cell damage and skin aging due to over exposure of UV A and UV B light (Shanbhag et al., 2019a). Niacinamide can also improve facial lines, prevent wrinkles, hyperpigmentation spots, red spots on the face, elasticity, increase collagen production and protect the skin from UV light. In other related research, niacinamide can also used as protection against UV radiation with an SPF value of 30 (Mohiudin, 2019). Topical use of niacinamide in combination with other active compounds are able to slow the progression of skin aging and hyperpigmentation (Ong & Goh, 2024; Ungurianu et al., 2021). Previous research has also investigated the benefits of lotions containing a mixture of niacinamide, panthenol, and tocopherol acetate on face skin, with the results indicating that the combination of these compounds could diminish hyperpigmentation, even out skin tone, and brighten skin. Several studies have shown that niacinamide concentrations of 1-5% provide anti-pigmentation, anti-wrinkle, and skin smoothing effects for topical treatment (Bissett et al., 2004), while α-tocopherol concentrations range from 0.2-1%. Therefore, in this study, a lotion formulation containing niacinamide and tocopherol were tested to determine how it affected the SPF value.

Search for radical scavenger potential from breadfruit peel were conducted based on bioassay guided fractionation using the ABTS method while toxicity impact by using BSLT method, among the samples were evaluated to show DM-2 fractionate with the highest selective index value of 46.08 which was used as an active antioxidant ingredient in lotion preparation. Therefore, this research specifically designed a sunscreen formula with a high SPF value that can be applied topically.

RESEARCH METHOD

Breadfruit peel (*A. altilis*), 2,2-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) (ABTS), dichloromethane (Brataco, Indonesia), distilled water (Brataco, Indonesia), *n*-hexane (Brataco, Indonesia), ethyl acetate (Brataco, Indonesia), methanol (Brataco, Indonesia), ethanol pro analysis (Brataco, Indonesia), α-tocopherol (Brataco, Indonesia), cerium sulfate (Ce(SO4)2)) (Brataco, Indonesia), silica gel GF254 (Brataco, Indonesia), TLC plate (Brataco, Indonesia), niacinamide (Brataco, Indonesia), cethyl alcohol (Brataco, Indonesia), stearic acid (Brataco, Indonesia), glycerine (Brataco, Indonesia), olive oil (Brataco, Indonesia), methyl paraben (Brataco, Indonesia), propyl parabens (Brataco, Indonesia), breadfruit starch (Brataco, Indonesia), oleum rosae (Brataco, Indonesia), and commercial lotion.

Breadfruit (*A. altilis*) was obtained from Mendalo Indah Village, Muaro Jambi. The breadfruit peel was separated, wet sorted, cutted into small pieces, dried in the sun for seven days, ground with grinder to form powder. The powder (1 kg) was extracted successively with 4 L of *n*-hexane, dichloromethane, ethyl acetate, and methanol by maceration method at room temperature for 24 hours. Then each extract was filtered using filter paper to remove residue and concentrated using a rotary evaporator. Each extract was evaluated for its free radical scavenging activity and toxicity. According to the results of the ABTS and BSLT tests, the CH_2Cl_2 and the EtOAc extract exhibited the highest selectivity among the four extracts assessed for free radical scavenger potential and toxicity. To identify potential fractionates as active lotion ingredients, both extracts (5 grams each other) were fractionated using vacuum liquid chromatography with a gradient eluent of n-hexane/ethyl acetate, ethyl acetate, and methanol, and silica gel was used as a stationary phase, yielding fractionates EA-1 (82 mg), EA-2 (128 mg), EA-3 (201 mg), EA-4 (98 mg), and EA-5 for the EtOAc extract. (119 mg), while the CH_2Cl_2 extract yielded fractions DM-1 (115 mg), DM-2 (130 mg), DM-3 (182 mg), DM-4 (205 mg), DM-5 (165 mg), and DM-6 (205 mg). The fractionates of the two extracts were classified based on the TLC stain pattern with the same Rf value. Next, each fraction was tested for free radical scavenging activity using the ABTS method and a cytotoxic test using Brine Shrimp Lethality Test (BSLT) (Abubakar & Haque, 2020; Zhang et al., 2010).

Free radical scavenging activity was determined by ABTS method of Pellegrini with some modified. ABTS stock solution with concentration of 7 mM was dissolved in distilled water. The stock solution was then reacted with a potassium persulfate solution with a concentration of 2.45 mM. The mixture was incubated for 16 hours in the dark at room temperature to produce radical (ABTS•+). The solution was diluted with ethanol until the absorbance of the solution was 0.7 ± 0.02 at wavelength of 734 nm. The test sample (1 mL) was added to the diluted ABTS•+ solution (1 mL) then the absorbance was read after 6 minutes using a spectrophotometer at a wavelength of 734 nM. α-tocopherol was used as a standard (Baliyan et al., 2022; Pellegrini et al., 1999).

Cytotoxic assay was determined by the method of Meyer with some modified. Artificial seawater was prepared by dissolving sea salt (20 g) in distilled water (500 ml) and filtered using Whatman paper. Each sample was prepared in DMSO and diluted with artificial seawater into concentrations of 600, 300, 150, 75 and 37.5 μg/mL respectively. This experiment used α-tocopherol as a positive control. Shrimp eggs were incubated in a container filled with sea water divided into two sides. One side with shrimp eggs and covered with carbon paper while the other side was illuminated with a lamp. Shrimp eggs were hatched in an aeration chamber for 48 hours until they become adult larvae. Each test tube contained 3 ml of sea water and 10 shrimp larvae were inserted into the test sample and sea water was added to add up to 5 mL in each test tube. Then each test tube was placed at room temperature under lighting for 24 hours. After that, the number of living larvae was observed and counted. The LC_{50} value is calculated using the probit method (Meyer et al., 1982; Niksic et al., 2021).

Lotion preparation method refers to Sari, et al (2021) research with some modified. Total weight of formula was 100 grams. The formula of lotion shown in table 1. Each formula has 0,9% of dichloromethane fractionate (DM-2). Oil soluble ingredients (stearic acid, olive oil, propyl paraben, and cetyl alcohol) then water soluble ingredients (aquadest, glycerin, methyl paraben, triethanolamine, and distilled water) were heated and stirred until completed soluted at temperature 70°C. Oil water soluble ingredients were mixed in hot mortar with high speed until homogeneous lotion was formed. Active ingredient, *oleum rosae*, α-tocopherol, niacinamide, and breadfruit starch were added little by little into lotion base until homogenous. Lotion preparation were characterized organoleptic, homogeneity, pH, viscosity, spreadability, and stickiness (Sari et al., 2021).

Table 1. Lotion formula

Compositions	Properties	Formula (%)						
		1	2	3	4	5	-	Base
Fractionated Dichloromethane	Active ingredient	0.9	0.9	0.9	0.9	0.9	0.9	-
α-Tocopherol	Antioxidant	1.0	0.8	0.6	0.4	0.2	-	-
Niacinamide	Antioxidant	1.0	2.0	3.0	4.0	5.0	-	-
Cetyl alcohol	thickener	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Stearic acid	Emulsifying agent	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Triethanolamine	Emulsifying agent	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Glycerine	Humectant	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Olive oil	Emollient	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Breadfruit starch	Softener	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Methyl paraben	Preservatives	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Propyl paraben	Preservatives	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Oleum rosae	Perfume	q.s	q.s	q.s	q.s	q.s	q.s	q.s
Aquadest	Solvent	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100

- : Negative control
Commercial lotion X with niacinamide and α-tocopherol was used as positive control

SPF value was carried out on lotion formula, base, negative control, and positive control. Sample (1 gram) was dissolved in 100 mL of 96% ethanol, 5 mL from the solution was taken and added 25 mL ethanol. The sample's absorbance was measured at wavelengths between 290-320 nm at 5 nm intervals, then the SPF value was calculated using Mansur method (Alrosyidi, 2021).

The free radical scavenger activity was analyzed by looking for IC_{50} value. The IC_{50} value was calculated based on the linearity curve from the graph of the relationship between sampel concentration and percent inhibition. Next, the selectivity index value was conducted by the comparation between IC_{50} value and LC_{50} value. The highest selectivity index value was become the active ingredient in lotion formulation. The lotion preparation was designed with five different compositions and each formula was determined the SPF value based on following equation (Almeida, 2019):

$$SPF = CF\ x \sum_{290}^{320} EE\ (\lambda) x\ I\ (\lambda)\ x\ abs\ (\lambda) \ldots (1)$$

EE = *Erythemal effect spectrum*
I = *Solar intensity spectrum*
Abs = *Absorbance of sunscreen product*
CF = *Correction factor* (=10).

RESULTS AND DISCUSSION

Determination of an active ingredient was carried out based on bioassay guided fractionation using the ABTS and BSLT methods. The results found out 15 samples consist of four extracts and 11 fractionates were evaluated. Among the samples were figure out DM-2 fractionate with the highest selective index value of 46.08 as seen in Table 2. The calculation of the selective index value was intended to evaluate the level of toxicity for predict the therapeutic potential of a sample (Lica, 2021).The sample with the most potential was indicated with highest concentrations of toxic effect while their therapeutic potential was at lowest concentrations (Indrayanto et al., 2020). The results of this screening became a benchmark in determining the active ingredient of the lotion formula because it was proven to have potential as a free radical scavenging with an IC_{50} of 48.56 ± 0.87 µg/mL and the toxic effects at concentration of LC_{50} 2238 ± 2.08 µg/mL. This breadfruit peel was expected to be useful in protecting the skin due to exposure to UV rays from the sun as shown in Table 2.

Table 2. IC_{50}, LC_{50} value and selective index of samples

Sample	Free scavenging activity (IC_{50}) µg/mL	Cytotoxic (LC_{50}) µg/mL	Selective index
n-heksan extract	286.25 ± 0.81*	2691.53 ± 2.01*	9.4
CH_2Cl_2 extract	20.9 ± 0.54*	234.42 ± 1.06*	11.21
EtOAc extract	9.46 ± 1.10*	125.90 ± 1.65*	13.31
MeOH extract	18.23 ± 0.81*	66.48 ± 0.60*	3.6
DM-1 fractionate	20.79 ± 1.16*	104.71 ± 0.95*	5.03
DM-2 fractionate	48.56 ± 0.87*	2238 ± 2.08*	46.08
DM-3 fractionate	41.44 ± 1.14*	63.09 ± 1.06*	1.52
DM-4 fractionate	15.52 ± 1.70*	71.44 ± 0.60*	4.60
DM-5 fractionate	13.34 ± 0.72*	173.78 ± 0.57*	13.03
DM-6 fractionate	13.53 ± 1.10*	144.54 ± 0.97*	10.68
EA-1 fractionate	591.20 ± 1.01*	2041.73 ± 1.01*	3.45
EA-2 fractionate	565.88 ± 0.64*	4897.78 ± 1.42*	8.65
EA-3 fractionate	9.17 ± 0.94*	346.74 ± 1.05*	37.8
EA-4 fractionate	6.89 ± 0.61*	107.15 ± 1.04*	15.5
EA-5 fractionate	11.32 ± 0.54*	24.55 ± 1.40*	2.17
Positive control	30.23 ± 0.20*	2691.53 ± 1.78*	89.03

Based on Table 2, samples extracted with organic solvents of varying polarity exhibited variable bioactivities. It has been demonstrated that samples extracted using semipolar solvents, specifically dichloromethane and ethyl acetate, have a higher selectivity index as free radical scavengers than non-polar solvents such as *n*-hexane and polar solvents such as methanol.

The ABTS and BSLT tests were being used to investigate the antioxidant potential of breadfruit peel in order to identify fractionates with the highest selective index value and potential as free radical scavengers while being low in toxicity (Calderón-Montaño et al., 2021). The fractionation process focused on CH_2Cl_2 and EtOAc extracts, which have high selective index values, indicating that the more polar the fractionate, the greater free radical scavenger activity, and conversely, the toxicity, as seen in DM-3 to DM-6 and EA-4 and EA-5, resulting in a low selective value. In contrast to the semipolar fractionate in DM-2, although the radical scavenger activity decreases with IC_{50}; 48.56 µg/ml, but the toxicity value was very low with LC_{50}; 2238 µg/ml, so the selective index value was the highest of all fractionates at 46.08, therefore DM-2 was prioritized for use as an active ingredient component of the lotion, contributing to the high SPF value of lotion preparations from breadfruit peel.

In order to identify potential free radical scavengers that represent the bioactivity of the CH_2Cl_2 extract fractionates DM-1 to DM-6, their bioactivity were assessed, and the more polar fractionates DM-4 to DM-6 demonstrated a significant increase in free radical scavenger activity when compared to the CH_2Cl_2 extract activity. However, toxicity remains considerable, resulting in a low selective index value for the three fractionates. Although free radical scavenger activity did not increase from DM-1 to DM-3, however DM-2 had the lowest toxicity, resulting in the highest selective index value and being selected as an active ingredient component in sunscreen lotion. The EtOAc extract has three times the free radical scavenger activity of α-tocopherol with IC_{50} of 9.46 µg/ml. However, only three polar fractionates, EA-3 to EA-5, have potential with free radical scavenger activity similar to the bioactivity of the EtOAc extract, but the selective index value was lower compared to DM-2. EA-1 and EA-2 exhibited no bioactivity as radical scavengers.

The previous study of lotion preparation with dichloromethane fractionate of breadfruit peel was found have good physicochemical properties with the concentration of 0.9% (Sari et al., 2021). Furthermore, the best lotion formula in previous research was modified by adding commercial antioxidant active ingredients, niacinamide and α-tocopherol, which were expected to contribute greatly to increasing the SPF value so it can be protect the skin due to sun exposure (Jerajani et al., 2010). The lotion formula design was modified by adding various commercial antioxidant concentrations into five formulas (F1-F5) as shown in Table 1.

The addition of dose response of niacinamide and α-tocopherol to each formula was aim to find out the highest SPF value and the physicochemical properties required for a lotion applied and

conducive to use for skin with high stability in accordance with the Indonesian National Standard (SNI 16-4399 -1996) such as pH, viscosity, spreadability and stickiness (Standar Nasional Indonesia, 1999). The physicochemical properties (F1-F5) as shown in Table 3, which based on statistical analysis exhibited significant differences in the composition of each formula with a p value <0.05, thus resulting in differences in the values of physico-chemical properties such as pH, viscosity, adhesion and spreadability remain within the range of values in accordance with SNI standards. Several data in Table 3 demonstrated all designed formulas (F1-F5) apparently met the ideal requirements as a lotion can be applied to human skin where the quality of its physicochemical properties were compared with a commercial lotion from Brand X which also contains niacinamide and α-tocopherol more better.

Table 3. The evaluation of physicochemical lotion formula

Category	T* (°C)	Formula					A*	B*	C*
		1	2	3	4	5			
Organoleptic	4 25 40	Greenish yellow, rose smell, form semi-solid, soft consistency					Greenish yellow, oil odor, semi-solid, soft consistency		
Homogeneity	4 25 40	Homogeneous							
pH	4	6.12 ± 0.03	6.01 ± 0.10	5.64 ± 0.06	5.45 ± 0.03	5.08 ± 0.03	4.52 ± 0.04	6.30 ± 0.05	6.45 ± 0.06
	25	6.15 ± 0.02	6.06 ± 0.02	5.67 ± 0.03	5.48 ± 0.13	5.16 ± 0.03	4.83 ± 0.10	6.35 ± 0.06	6.50 ± 0.03
	40	6.17 ± 0.07	6.09 ± 0.04	5.73 ± 0.05	5.52 ± 0.11	5.17 ± 0.06	4.99 ± 0.05	6.50 ± 0.08	6.53 ± 0.05
Spreadability	4	5.66 ± 0.05	5.58 ± 0.08	5.47 ± 0.14	5.38 ± 0.07	5.25 ± 0.09	5.78 ± 0.07	5.63 ± 0.13	5.63 ± 0.06
	25	5.88 ± 0.15	5.50 ± 0.11	5.35 ± 0.07	5.25 ± 0.14	5.17 ± 0.09	6.08 ± 0.15	5.89 ± 0.19	5.83 ± 0.10
	40	5.69 ± 0.08	5.64 ± 0.07	5.52 ± 0.07	5.38 ± 0.04	5.20 ± 0.08	6.026 ± 0.08	5.75 ± 0.08	5.81 ± 0.01
Adhesive	4	1.67 ± 0.04	1.69 ± 0.05	1.72 ± 0.04	1.77 ± 0.07	1.89 ± 0.06	1.30 ± 0.14	1.47 ± 0.11	1.33 ± 0.08
	25	1.37 ± 0.05	1.58 ± 0.14	1.63 ± 0.05	1.58 ± 0.03	1.74 ± 0.10	1.27 ± 0.07	1.44 ± 0.18	1.41 ± 0.11
	40	1.31 ± 0.04	1.47 ± 0.09	1.57 ± 0.05	1.62 ± 0.11	1.66 ± 0.07	1.17 ± 0.01	1.38 ± 0.17	1.20 ± 0.10
Viscosity	4	7269.28 ± 186.34	8811.73 ± 85.63	9205.63 ± 182.12	9774.65 ± 143.11	11732.73 ± 417.54	5011.67 ± 135.57	5160.67 ± 187.32	6438.90 ± 230.35
	25	6808.60 ± 39.30	8107.85 ± 138,17	8801.03 ± 39.93	9336.58 ± 140.63	10509.36 ± 214.89	3692.51 ± 194.74	4554.75 ± 149.49	6007.51 ± 137.18
	40	6319.27 ± 121.54	7796.42 ± 94.56	8298.74 ± 87.15	8693.99 ± 100.34	10104.78 ± 147.18	3739.03 ± 310.22	4116.07 ± 114.57	5320.00 ± 171.95

Note: *Values are mean of three replicate determinations (n =3) ± standard deviation
A* positive control
B* negative control
C* base
T* Temperature

The dosage forms were tested at different temperature *i.e.* 4℃, 25℃, and 40℃ to ensure its stability in cold, room, and warm temperatures. The research results reveal that the dosage form was stable, as evidenced by the fact that the results of all evaluations remain within the SNI range. SNI

standard of lotion in organoleptic are stable, no discoloration, odor, semi-solid form with a soft consistency; pH 4,5-8; spreadability 5-7 cm, adhesive >1 second, and viscosity 2000-50.000 cPs.

The study revealed that the concentration of α-tocopherol and niacinamide had an effect on the lotion's physical qualities. The pH and spreadability of the niacinamide- α-tocopherol mixture fall as the total composition increases, whereas viscosity and stickiness rise. On the other hand, depending on the components of each molecule, decreasing the concentration of tocopherol and increasing the concentration of niacinamide results in a drop in pH and spreadability while increasing viscosity and stickiness.

Then, the SPF value of each formula (F1-F5), which was also compared with a commercial lotion apparently the SPF value enhanced. The highest SPF value was figure out at the fifth formula (F5) which containing 5% niacinamide and 0.2% α-tocopherol was proven to have the ability to protect the skin three times higher than commercial lotions. SPF value is an indicator describing the efficiency of a preparation in reducing erythema due to UV rays or protecting the skin from UVB rays. The SPF value is closely related to the antioxidant value where antioxidant activity can reduce free radicals from UV rays (M. Ebrahimzadeh, 2014). The SPF of a sunscreen or lotion product is generally followed by a number that describes how much protection the lotion provides for the skin. An SPF value of 15 means it protects 93.33% of exposure to UVB rays, SPF 30 protects 96.67%, while SPF 60 inhibits 98.33% of exposure to UVB rays. A number higher than 60 is considered ineffective because SPF cannot protect up to 100% of UVB exposure (Schalka & Reis, 2011).

Table 4. SPF Value of Formula

Formula					Negative control	Base	Positive control
1	2	3	4	5			
15.11 ± 0.47	16.09 ± 0.45	17.62 ± 0.48	19.16 ± 0.62	20.61 ± 0.75	12.61 ± 1.31	10.31 ± 1.14	6.67 ± 1.28

Based on the results of determining the SPF value, it can be seen that the SPF value of the preparation is influenced by the concentration of niacinamide and tocopherol. The higher the concentration of niacinamide contained in the lotion preparation can increase the SPF value of the preparation. However, the opposite was true for tocopherol concentrations. The decreasing concentration of tocopherol in the dosage form can increase the SPF value. However, if we look at the total composition of the active compound in the combination of niacinamide and tocopherol, formulas 1 to 5 have an increasing total composition. This can also cause an increase in the SPF value even though there is a decrease in the tocopherol value.

Formula 5 has a higher SPF value (20.61 ± 0.75) and meets SNI standards, making it the best option based on preparatory testing findings. The SPF value (>15) means the effectiveness category of dosage forms that have ultra protection against UV radiation, which implies it can protect against UVB rays by 93% (Shanbhag et al., 2019b).

CONCLUSION

The active ingredient DM-2 as free radicals scavenging used in the lotion formula (F1-F5) from breadfruit peel with the highest index value of 46.08. The fifth formula, F5 exhibited the physicochemical properties met the SNI requirements and stable during storage. The higher concentration of niacinamide and otherwise the smaller the concentration of α-tocopherol in F1-F5 apparently increased the SPF value. The research showed that the fifth formula (F5) which of SPF value of 20.61 ± 0.75 three times higher than the SPF value of commercial Lotion of 6.67 ± 1.28.

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AUTHOR CONTRIBUTIONS

Conceptualization, Syamsurizal; Literature search, Syamsurizal and Elisma; Experimental studies, Elisma and Puspa Dwi Pratiwi; Data analysis, Puspa Dwi Pratiwi; Manuscript preparation and editing, Syamsurizal, Elisma and Puspa Dwi Pratiwi; Review: Syamsurizal; Supervision, Syamsurizal.

CONFLICTS OF INTEREST

The author(s) declare no conflict of interest.

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