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The Effect of The Concentration of Bangle Ethyl Acetate Fraction Toward SPF Value in Temugiring Extract Cream

(Pengaruh Konsentrasi Fraksi Etil Asetat Bangle Terhadap Nilai SPF Krim Ekstrak Temugiring)

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Abstract: The concentration of *bangle* (*Zingiber cassumunar*) ethyl acetate fraction added in the formulation of the *temugiring* (*Curcuma heyneana*) extract cream formulation must be determined precisely since it may affect the Sun Protection Factor (SPF) value. This research aims to determine the effect of concentration variations of *bangle* ethyl acetate fraction on the SPF value of the *temugiring* extract cream. In this research, *temugiring* extract and *bangle* extract were obtained by remaceration employing ethanol, while the *bangle* ethyl acetate fraction was obtained by fractionation using n-hexane, ethyl acetate, methanol, and water. The *bangle* ethyl acetate fraction obtained was formulated in cream formulations of *temugiring* extract formulas 1, 2, and 3 with variations in the concentration of *bangle* ethyl acetate fraction 2%; 3%; and 4%. Furthermore, the SPF value was conducted using the UV-Vis spectrophotometry method. The results show that *bangle* ethyl acetate fraction concentration variations produced different SPF values for each cream formula. The SPF value for formulas 1, 2, and 3 was 11.466; 12.122; and 17.266. One Way ANOVA test produced a p-value of 0.037. Thus, it can be concluded that the concentration of the *bangle* ethyl acetate fraction would affect the SPF value in the cream temugiring extract.

Keywords : bangle, *Curcuma heyneana*, sun protection factor, *temugiring*, *Zingiber cassumunar*

Abstrak: Konsentrasi fraksi etil asetat bangle (*Zingiber cassumunar*) yang ditambahkan dalam formula sediaan krim ekstrak temugiring (*Curcuma heyneana*) harus ditentukan secara tepat karena kemungkinan akan berpengaruh terhadap nilai *Sun Protection Factor* (SPF). Penelitian ini bertujuan untuk mengetahui pengaruh variasi konsentrasi fraksi etil asetat bangle terhadap nilai SPF krim ekstrak etanol temugiring. Dalam penelitian ini, ekstrak temugiring dan ekstrak bangle diperoleh dengan metode remaserasi menggunakan pelarut etanol, sedangkan fraksi etil asetat bangle diperoleh dari fraksinasi ekstrak bangle menggunakan pelarut n-heksana, etil asetat, metanol, dan air. Kemudian fraksi etil asetat bangle yang diperoleh diformulasikan dalam sediaan krim ekstrak temugiring formula 1, 2, dan 3 dengan variasi konsentrasi fraksi etil asetat bangle 2%; 3%; dan 4%. Selanjutnya, penentuan nilai SPF dilakukan dengan metode spektrofotometri UV-Vis. Hasil penelitian menunjukkan variasi konsentrasi fraksi etil asetat bangle menyebabkan nilai SPF yang berbeda pada setiap formula. Nilai SPF formula 1, 2, dan 3 adalah 11,466; 12,122; and 17,266. Uji *One Way Anova* menghasilkan *p-value* 0,037. Dengan demikian, dapat disimpulkan bahwa konsentrasi fraksi etil asetat bangle akan berpengaruh terhadap nilai SPFnya.

Kata kunci: bangle, *Curcuma heyneana*, *sun protection factor*, temugiring, *Zingiber cassumunar*

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INTRODUCTION

BESIDES beneficial effects, ultraviolet (UV) radiation exposure also brings disadvantageous impacts that can harm the human body. However, it depends on the wavelength and frequency of exposure, sunlight intensity, and sensitivity of individuals exposed[1]. Exposure to UV radiation can impact sunburn, erythema, hyperpigmentation, premature aging, and even skin cancer[2]. One way to overcome the problems caused by UV radiation exposure is to use sunscreen[3]. Sunscreen can absorb, reflect, and scatter UV radiation. Hence, it can protect the skin from dangerous effects[4]. As a matter of fact, the phenolic compound is a secondary metabolite compound that has the potential as sunscreen.

The phenolic compound has potential as sunscreen due to its chromophore group capable of absorbing UV radiation, both UV A and UV B. Thus, it can reduce the intensity on our skin. In addition, a compound with antioxidant activity has the potential as sunscreen since antioxidants in sunscreen preparation can increase photoprotective activities and prevent diseases incurred by UV light radiation. Several compounds reported as being able to protect from UV light radiation are flavonoids, tannins, anthraquinones, and cinnamates[5]. Those active sunscreen compounds can be obtained from natural products such as *temugiring* rhizome (*Curcuma heyneana*) and bangle (*Zingiber cassumnar*) rhizome. Based on the research of Kristianto et al. (2020), bangle rhizome and *temugiring* rhizome contain groups of polyphenolic compounds, curcumin, and polyphenols[6]

Temugiring contains curcumin[7] as a potential sunscreen. According to the research of Kusumawati et al. (2018), the antioxidant activity of *temugiring* extract was determined in vitro using DPPH; the IC_{50} value was 62.5-500 µg/mL[8]. Temugiring extract inhibits tyrosinase and collagen by 31.25-250 µg/mL. Moreover, from those researches, it is known that the curcumin concentration correlated with the anti-aging activity in *temugiring* extract. It indicates that temugiring extract contains curcumin compounds as a potential anti-aging and candidate in phytocosmeceutical[8]. Furthermore, according to Li et al. (2019), it was identified that the *bangle* ethyl acetate fraction has the potential as a phytocosmeceutical, namely as an anti-aging(9). The ethyl acetate fraction of the bangle rhizome contains antioxidant activity against DPPH with an IC50 value of 22.96±0.87 µg/mL. Moreover, bangle fraction can inhibit tyrosinase 42.56±1.02 µg/mL[9]. According to the research of Suksaeree et al. (2015), bangle rhizome essential oil is identified to contain terpinene-4-ol compounds that act as an anti-inflammatory, and its application to the skin provides a relaxing effect and relieves stress[10]. Therefore, temugiring rhizome and bangle rhizome has the potential as active ingredients in sunscreen preparation.

The efficacy of sunscreen is usually expressed by the sun protection factor (SPF). According to Souza (2013), it was clarified that plant extracts could act synergistically with chemical and physical filters to increase the SPF value[11]. The calculation of the SPF value in vitro by UV-Vis spectrophotometry applied Mansur mathematical[12]. In our previous research, temugiring extract cream with an extract concentration of 10% has an SPF value of 4.966±0.244 (with a correction factor (CF) is 10), and it was classified as a medium protection category as a sunscreen. Hence, we have continued our research to produce a sunscreen cream formula with a combination of ethyl acetate fraction in *bangle* rhizome and ethanol extract in *temugiring* rhizome to obtain a synergistic action of each compound. Thus, it can increase the SPF value in the cream.

Based on the above descriptions, this research aimed to determine the effect of concentration variations of the *bangle* ethyl acetate fraction towards SPF value in the cream temugiring extract.

MATERIALS AND METHODS

MATERIAL. Plants collection and authentication. *Temugiring* rhizomes (*Curcuma heyneana*) were obtained and identified at UPT Materia Medica, Batu, East Java. Bangle rhizomes (Zingiber cassumunar) were obtained and identified at Tropical Biopharmaca Research Center, Bogor.

Chemicals solvents and reagents. Ethanol (Fulltime), methanol (Fulltime), magnesium powder, iron (III) chloride, chloride acid, and boric acid employed in this research had analyst grade, which was obtained from Merck. Stearic acid, paraffin, cetyl alcohol, triethanolamine (TEA), cera alba, nipasol, propylene glycol, nipagin, and aqua dest was obtained from PT. Brataco.

Instruments. In this research, some instruments employed were glass, digital balance, oven (Memmert), pH meter, volume pipet, object-glass, waterbath, vacuum rotary evaporator, porcelain dish, aluminum foil, desiccator, Whatman filter paper no. 40, and UV-Vis spectrophotometer (Thermo Fisher Scientific – Genesys 10S UV-Vis/Model G10S UV-Vis).

METHODS. Preparation of Temugiring and Bangle Ethanol Extract. *Temugiring* and *bangle*, each rhizome simplicia powder as much as 800 g was remacerated (3 x 24 hours) with 8 liters of 96%

ethanol. The obtained filtrate was then evaporated using a vacuum rotary evaporator to obtain *Temugiring* extract and *bangle* extract.

Preparation of *Bangle* Ethyl Acetate Fraction. Every 25 g of *bangle* extract obtained was dissolved in 500 mL of methanol and 100 mL of aqua dest. Then it was fractionated by employing n-hexane, ethyl acetate, and aqua dest[9,13]. These procedures with modification are based on Li et al. (2019) and Syarifah et al. (2019) research. The ethyl acetate fraction obtained was then evaporated by employing a vacuum rotary evaporator to obtain the ethyl acetate fraction.

Phytochemical Screening. Polyphenol compounds were identified by dissolving 0.5 g of fraction in 10 ml of distilled water and then filtered. The filtrate obtained was then added 2-3 drops of 3% $FeCl_3$ solution. Polyphenol compound is indicated by the blue-green to black color. Meanwhile, the identification of flavonoid compounds was conducted by reacting 2 mL of the fraction with 0.5 mL of 36% HCl and 0.5 g of Mg powder. The dark red (magenta) color indicated Flavonoid color[13]. In addition, curcumin compound identification was carried out by reacting 2 mL of the fraction with 5% boric acid solution (boric acid and citric acid each 5% in methanol). Curcumin was represented by the yellow or brownish-red color[7].

Formulation of Bangle Ethyl Acetate Fraction Cream. Stearic acid, paraffin, cetyl alcohol, triethanolamine (TEA), cera alba, and nipasol (oil phase) were put in a porcelain dish and then heated at 70° C. At the same time, propylene glycol and nipagin (water phase) were dissolved in a glass beaker with hot water. Next, the oil phase was transferred to a preheated mortar. Then the water phase was added little by little into the oil phase mixture in the hot mortar while continuously stirring. The mix of the water phase and oil phases mix was continuously stirred until a creamy mass was formed. After the cream was formed and reached room temperature, the *temugiring* ethanol extract (10%) and *bangle* ethyl acetate fraction (2%; 3%; 4%) were added little by little into the cream base while continuously stirring until homogeneous. The cream formula with varying concentrations is illustrated in Table 1.

Table 1. The Formula of Cream Formulation of Temugiring Ethanol Extract with Concentration Variations of the Bangle Ethyl Acetate Fraction

Ingredients	Formula (%)		
	F1	F2	F3
Ethanol extract of *temugiring* rhizome	10	10	10
Ethyl acetate fraction of *bangle* rhizome	2	3	4
Liquid paraffin	5	5	5
Propylene glycol	20	20	20
Triethanolamine (TEA)	2	2	2
Stearic acid	5	5	5
Cetyl alcohol	2	2	2
Cera alba	20	20	20
Nipasol	0.02	0.02	0.02
Nipagin	0.12	0.12	0.12
Aquadest	33.86	32.86	31.86

Physical Quality Test of Cream Formulation of *Temugiring* Ethanol Extracts with Concentration Variations of the *Bangle* Ethyl Acetate Fraction. An organoleptic test was conducted by putting sufficient cream onto the microscope slide. Then, the smell, color, and texture were observed. Meanwhile, the homogeneity test was carried out by putting an adequate amount of cream onto a glass object, and the top was lid by the glass cover. Here, homogeneity was observed. Furthermore, the pH test was carried out by diluting 1 g of the cream with 10 mL of distilled water. Then, the pH was measured using a pH meter. Good and non-irritating preparation must have a normal skin pH of 6 – 9[14]. Additionally, the dispersion test was carried out by putting 0.5 g cream onto the middle of the glass object. Then the top of it was covered and added load of 50 g until 250 g. Next, it was left aside for one minute, and then the dispersion cream diameter was measured. Likewise, the cream type test was carried out using the dilution method, namely by dissolving the cream in water and oil. If the cream is soluble in water, then the cream is an o/w cream. Otherwise, if the cream is soluble in oil, then the cream is a w/o.

SPF Value Calculation. SPF value calculation was conducted by preparing a test solution with a concentration of 1,000 ppm, namely each cream of *temugiring* ethanol extract with concentration variations of the *bangle* ethyl acetate fraction are 2%, 3%, and 4% weighed as much as 0.025 g added 25 mL of pro-analyst ethanol. Hence, a test solution was obtained with a concentration of 1,000 ppm. Furthermore, the absorbance value of the test solution with a wavelength of 290 – 320 ppm could be calculated. The CF value calculation was carried out using Parasol SPF 15 or the CF value is 10[15].

Data Analysis. To investigate the effect of the concentration increase of *bangle* ethyl toward acetate fraction toward SPF value in cream formulation *temugiring* extract, the SPF value data obtained were analyzed by statistical tests using the one-way variance test called One Way ANOVA. Meanwhile, the SPF value was calculated based on the Mansur equation as follows[16]:

$SPF = CF \times \sum_{320}^{290} EE(\lambda) \times I(\lambda) \times absorbance(\lambda)$

CF = Correlation Factor

EE = Erythema Effect Spectrum

I = Light Intensity Spectrum

Abs = Sunscreen sample absorbance

EE value x I is the Constanta. The value of the wavelength 290-320 nm and every gap of 5 nm was

determined as illustrated in Table 2. Meanwhile, the sunscreen effectiveness based on the SPF value is demonstrated in Table 3.

Table 2. EE value x I[16]

Wavelength (nm)	EE value x I
290	0.015
295	0.0817
300	0.2874
305	0.3278
310	0.1864
315	0.0839
320	0.018
Total	**1**

Table 3. Sunscreen Effectiveness[1]

SPF	Sunscreen Protection Category
2-4	Minimum protection
4-6	Medium protection
6-8	Extra protection
8-15	Maximum protection
≥ 15	Ultra protection

RESULTS AND DISCUSSION

Ethanol Extract of Temugiring Rhizome and Acetate Ethyl Fraction of Bangle Rhizome. The ethanol extract of temugiring rhizome obtained was dark yellow-brown viscous liquid; meanwhile, the bangle rhizome extract was brownish-yellow viscous liquid as illustrated in Figures 1(a) and 1(b). In this research, the remaceration method was selected as the extraction method to stabilize the non-resistant compounds to high-temperature heating. Hence, its concentration did not decrease[17]. Furthermore, in this extraction method, 96% ethanol was used since potential compounds such as sunscreens, such as flavonoids and curcumin had low solubility in hydrocarbon compounds and were easily soluble in ethanol. Flavonoids and curcuminoids had some OH groups attached to their aromatic rings, so they were polar and soluble in ethanol[7].

The ethyl acetate fraction of bangle rhizome was obtained by stepwise fractionation method with different polarities solvent, sequentially using n-hexane, ethyl acetate, methanol, and water. The ethanol extract of the bangle rhizome obtained was first dissolved in methanol to dissolve polar and non-polar compounds in the fractionation method. Afterward, it was fractionated with n-hexane so the non-polar compounds could be dissolved in n-hexane solvent, whereas polar compounds remain in the methanol fraction. Then, the methanol fraction was fractionated with ethyl acetate and water. This step was carried out since curcumin and flavonoid aglycone compounds' solubility was more soluble in polar solvents such as ethyl acetate and methanol than in water. This fractionation was also conducted to separate compounds still heavily bound to sugars (glycosides), such as flavonoid glycosides[8]. Finally, the fractionation process produced the ethyl acetate fraction of the bangle rhizome illustrated in Figure 1(c), which would be added to the temugiring ethanol extract cream. Furthermore, the researchers calculated the SPF value to prepare the ethanol extract cream of temugiring rhizome, which had been added to the ethyl acetate fraction of bangle rhizome in several concentrations.

Figure 1. (a) Temugiring rhizome ethanol extract; (b) bangle rhizome ethanol extract; (c) Ethyl acetate fraction of bangle rhizome

Phytochemical Screening. The screening results for polyphenol, flavonoid, and curcumin identified that the *bangle* ethyl acetate fraction contained positive polyphenol, flavonoids, and curcumin. A red-brownish (magenta) color showed the flavonoid compound. Meanwhile, the dark color indicated the polyphenol compound, and the orange color indicated the curcumin compound. The results of the phytochemical screening are illustrated in Figure 2.

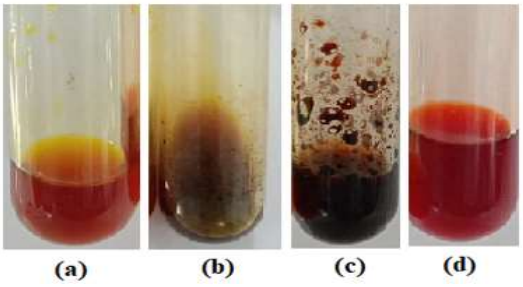

Figure 2. Phytochemical Screening Result. (a) bangle ethyl acetate fraction (control); (b) bangle ethyl acetate fraction reacted with HCl 36% and Mg powder; (c) bangle ethyl acetate fraction reacted with $FeCl_3$ reagent of 3%, (d) bangle ethyl acetate fraction reacted with a boric acid reagent of 5%

Physical Quality Test of Cream Formulation of *Temugiring* Ethanol Extracts with Concentration Variations of the *Bangle* Ethyl Acetate Fraction. Organoleptic. The physical quality test included organoleptic, homogeneity, pH, dispersion, and cream type. The organoleptic observations of *temugiring* ethanol extract cream with concentration variations of ethyl acetate fraction *bangle* are presented in Table 4.

Table 4. Organoleptic Cream of Temugiring Ethanol Extract with Concentration Variations of the Bangle Ethyl Acetate Fraction

Sample	Organoleptic		
	Texture	Color	Smell
F1	semisolid	Brownish-yellow	*Temugiring* and *bangle*
F2	semisolid	brownish-yellow	*Temugiring* and *bangle*
F3	semisolid	brownish-yellow	*Temugiring* and *bangle*

The organoleptic test results indicated that the three cream formulations made had a semisolid and characteristic *temugiring* and *bangle* smell. The resulting color was brownish yellow for F1, F2, and F3. Each formula is presented in Figure 3. The brownish-yellow color of the preparation was caused by the addition of ethanol extract of temugiring rhizome and ethyl acetate fraction of bangle rhizome. Meanwhile, the aroma produced by the temugiring ethanol extract cream and the ethyl acetate fraction depended on the concentration of the ethyl acetate fraction added to the cream preparation. The higher the fraction concentration is, the stronger the aroma produced. In addition, of the three formulas discovered above, the strongest bangle aroma was generated by Formula 3.

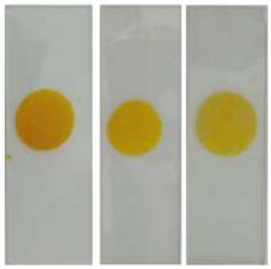

Figure 3. Cream Formulation with Concentration Variations of the Bangle Ethyl Acetate Fraction (a) Formula 1 (2%); (b) Formula 2 (3%); (c) Formula 3 (4%)

Homogeneity. A homogeneity test was conducted to validate that all material used, whether the water phase, oil phase, or extract and fraction, had been homogenously blended. Hence, if it is applied to the damaged skin, that skin has the same chance of getting the efficacy of that cream formula's substances. Moreover, Figure 3 presents that the cream had been blended homogenously, proven by the absence of rough particles on the object-glass.

The pH of Cream Formulation. The pH of creams was determined to examine the possible side effects of acidic or alkaline pH, which can lead to skin irritation. According to Pratama, et al. (2091) research, the cream generally has a pH of 6-9 for sunscreen[14]. As the data presented in Table 5, it is evident that the pH of the ethyl acetate fraction of the *bangle* rhizome ranged from 7-7.75. The data from Table 5 reveals that the cream pH decreased along with the increase in the concentration of the ethyl acetate fraction of bangle rhizome added to the cream preparation. It was because the ethyl acetate fraction of the bangle rhizome had acidic pH. The more the fraction concentration added, the more acidic the cream pH is. Nevertheless, the decrease in cream pH was likely small since the acid content of fractions such as flavonoids, tannins, and curcumin were weak acids. Hence, H^+ dissociated was only the small portion. It was proven by data analysis using SPSS, where the pH value in each formula was normally distributed ($p>0.05$). In addition, a one-way ANOVA test was performed to obtain $p>0.05$, namely $p=0.240$. Therefore, it can be concluded that there was no significant effect between increasing concentration on pH of cream preparation. Nonetheless, the cream pH preparation still follows the standard of sunscreen cream and is not too alkaline. Too alkaline pH in the cream will cause the skin to flake; meanwhile, too acidic pH will irritate our skin.

Table 5. pH of Cream of Temugiring Ethanol Extract with Concentration Variations of the Bangle Ethyl Acetate Fraction

Sample	pH		
	F1 (2%)	F2 (3%)	F3 (4%)
Replication 1	7.64	7.58	7.66
Replication 2	7.77	7.69	7.65
Replication 3	7.75	7.67	7.64
Average±SD	7.72±0.07	7.65±0.06	7.65±0.01

Dispersion of Cream. The average dispersion in the data shown in Table 6 indicates that the cream preparation dispersion follows the standard. The greater the load given, the wider the dispersion is. Furthermore, based on SPSS data analysis, the dispersion in each formula was normally distributed ($p>0.05$). In addition, after the one-way ANOVA test, $p>0.05$ was obtained. By these findings, it could be concluded that there was no significant effect between increasing concentration on the pH of the cream preparation. It is indicated in the dispersion data at F1, F2, and F3 after being given a load of 250 g and has a p-value of 0.857.

Table 6. Dispersion of Temugiring Ethanol Extract Cream with Variation in Bangle Ethyl Acetate Fraction Concentration

Load	Dispersion (cm)		
	F1 (2%)	F2 (3%)	F3 (4%)
	Average±SD		
50	3.920±0.10	3.700±0.25	3.947±0.28
100	4.258±0.14	4.090±0.11	4.338±0.20
150	4.620±0.02	4.363±0.07	4.661±0.23
200	4.835±0.07	4.847±0.05	4.933±0.17
250	5.220±0.14	5.252±0.04	5.185±0.14

Data were presented in average ± SD, n=3

Type of Cream. The type of cream emulsion was determined by two methods, namely the dilution method and the staining method. In the dilution method, the cream was dissolved in water and oil. If the cream is soluble in water, the emulsion type is classified as oil in water or o/w. On the other hand, if the cream is not soluble in oil, then the type of emulsion is a w/o cream. Based on the study results, the cream could be dissolved in water. Therefore, the type of emulsion cream in this study is included in the type of oil in water o/w. Furthermore, the determination of the type of cream emulsion using the staining method also showed the same results, namely the o/w emulsion type. When the three formulas were reacted with methylene blue, the color changed to blue, which indicated that the emulsion type was oil in water. The resulting cream had an emulsion type of oil in water (o/w). The results of the emulsion type test are presented in Figure 4.

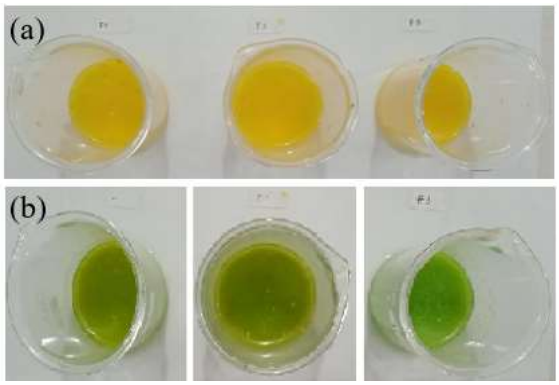

Figure 4.The results of emulsion type (a) before reaction with blue methylene; (b) after reaction with blue methylene (o/w)

SPF Value of Cream Formulation of *Temugiring* Ethanol Extracts with Concentration Variations of the *Bangle* Ethyl Acetate Fraction. The SPF value was determined in vitro using the UV-Vis spectrophotometry method with a 290-320 nm wavelength range[18]. Then, the absorbance data from the measurement result was analyzed using the Mansur formula. In this research, the Correction Factor (CF) is 10[15,16]. The data of SPF value in cream of formula 1, 2, and 3 are presented in Table 7.

Table 7 above described that the SPF value of those three cream formulas subsequently were 11.466; 12.122; and 17.266. Those results identified that all formulas qualified as sunscreen with the maximum and ultra categories. According to Table 7, the bigger fraction concentration, the greater the SPF value of cream preparation is. SPF is the universal indicator representing the effectiveness of a product with a UV protector. The greater the SPF value in a product or sunscreen active substances, the more effective it is to protect skin from the harmful impacts of UV light. The SPF value increases due to the greater concentration of the added fraction in the preparation. Hence, compound concentration contributing to absorbing UV radiation is greater. In line with the results of phytochemical screening, the ethanolic extract of temugiring and the ethyl acetate fraction of bangle rhizome contained flavonoid, phenolic (tannin), and curcumin compounds. All of these have the potential as antioxidants and are useful as active ingredients that have the potential as sunscreens due to the capability of chromophore groups in absorbing UV sunlight, both UV A and UV B. As a result, these three compounds reduce the intensity on the skin. FDA requires an SPF value of a minimum of 2 for sunscreen products. If the SPF value is less than 2, it cannot protect our skin sufficiently from UV light. In other words, it does not have the potential of a sunscreen. Hence, the results of this research, SPF values of those three cream formulas subsequently were 11.466; 12.122; and 17.266. Those results identified that formulas qualified as sunscreen with the maximum and ultracategoriesy. Therefore, this research showed that the concentration variations of *bangle* ethyl acetate fraction would directly affect SPF value in cream formulation *temugiring* extract.

Table 7. SPF Value of Cream Formulation of Temugiring Ethanol Extract with Concentration Variations of the Bangle Ethyl Acetate Fraction

Formula	Replication	Ethyl Acetate Concentration (%)	SPF Value	Average SPF Value
Formula 1	1	2	11.978	
	2	2	10.000	11.466±1.05
	3	2	12.421	
Formula 2	1	3	10.821	
	2	3	13.477	12.122±1.08
	3	3	12.069	
Formula 3	1	4	13.949	
	2	4	20.783	17.266±2.79
	3	4	17.067	

In this research, data analysis was conducted using SPSS (version 16) to decide the effect of ethyl acetate fraction of bangle rhizome increase on cream SPF value. The analysis employed was a normality test using *Shapiro-Wilk*. The One Way ANOVA variant test would be conducted if the data were distributed normally and homogeny. Nonetheless, if the data were not distributed normally, a Kruskal-Wallis analysis would be conducted. The test results of SPF value in cream preparation of *bangle* ethyl acetate fraction were conducted three times. The normality test indicated that the data in the three formulas (F1, F2, and F3) was distributed normally ($p > 0.05$). Meanwhile, the homogeneity test identified that the data was homogeny ($p > 0.05$) which was 0.317. In addition, the One Way ANOVA test resulted in

0.037 where the $p < 0.05$. Thus, H0 was rejected, and H1 was accepted. It implies that there were effects on the addition of ethyl acetate fraction of *bangle* concentration toward SPF cream value. Hence, it can be concluded that *bangle* ethyl acetate extract contains substances that can increase the SPF value.

CONCLUSION

The variation concentration of the *bangle* ethyl acetate fraction in the cream formulation significantly affected the SPF value of the *temugiring* ethanol extract cream based on the One Way ANOVA test. The respective SPF values for formula 1 (2%), formula 2 (3%), and formula 3 (4%) respectively were 11.466; 12.122; and 17.266.

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AUTHORS CONTRIBUTIONS

All the authors have contributed equally.

CONFLICT OF INTERESTS

The authors have no conflict of interest to declare.

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