

## **Gel Preparation, In Vitro and In Vivo Test of Temu Giring (*Curcuma heyneana*) rhizome as Potential Sunscreen Material**

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**abstract.** Indonesia is a tropical country with high intensity of sun exposure. In this sunlight there are UV rays that can harm the body, therefore it can cause damage to the skin. Temu giring (*Curcuma heyneana*) contains high antioxidants so that it has potential to be used as a protection against the negative effects of UV light. The aims of this study were to determine the antioxidant activity and formulation of sunscreen derived from temu giring extract and to find out the optimum concentration of temu giring extract as sunscreen. Based on the in vitro test, it is found that the score of % Te and % Tp <1%, so that temu giring extract can be categorized as total sunblock. SPF score is obtained from variations in concentrations of 1%, 2.5% and 5% are 4.84, 8.76 and 18.86 respectively. From these data it is known that the SPF score increases following the concentration of the convergence of the temu giring. Antioxidant test show that all concentrations have IC<sub>50</sub> values between 50-100 µg/ml so that temu giring has strong antioxidant activity. The best IC<sub>50</sub> value is found in temu giring (extract gel with a concentration of 5% of 86.43086 µg / ml. In vivo test with erythema observations perform hat the curcuma heyneana extract concentration of 5% and positive control are both able to protect the skin from UV light so that the temu giring extract gel is optimal as a sunscreen gel with a concentration of 5%.

### **Introductiona**

Indonesia is a tropical country, this means that solar radiation occurs in high intensity. In sunlight there is ultraviolet light which can cause damage to human skin [1]. To overcome this, a sunscreen is needed to protect the skin. Sunscreen is a dosage form that has a content that can absorb and reflect radiation to the skin so that it can reduce the damaging effects on human skin [2]. Nowadays many solar materials use natural ingredients because natural ingredients are easier to obtain and do not cause negative effects compared to chemicals. Temu giring (*Curcuma heyneana*) is a plant belonging to the Zingiberaceae family which is widely used as traditional medicine. The chemical content of temu giring (*Curcuma heyneana*) includes starch, essential oil, resin, tannins, saponins, and flavonoids [3] which have the potential as antioxidants so that they have the potential to be used as sunscreens that protect the skin from light hazards ultraviolet (UV). In this study the sunscreen was made in the form of a gel with carbopol 940 as a gelling agent with the addition of other supporting materials. Carbopol

940 was chosen because this material has high viscosity so it can produce good gel. Based on this, the present study was conducted to prepare the rhizome of temu giring (*Curcuma heyneana*) gel preparation as a sunscreen gel with gelling Carbopol 940 agent through in vivo and in vitro test.

### Experimental Methods

Gel preparation begins by cutting 10 kg of temu giring rhizome into dried powder. This powder then extracted with ethanol 96% as solvent with maceration method for 3 x 24 hours. The filtrate from maceration was evaporated to form a thick extract. Whereas the stage for gel production was carried out by developing Carbopol 940 with 70-80°C distilled water in a mortar after expanding adding methyl paraben, glycerin and propylenglycol then the temu giring (*Curcuma heyneana*) extract was added in base gel mixture and added 100 ml of distilled water to form a homogeneous gel.

In vivo test was done by observing erythema in test animals arising from the effects of UV irradiation for 24 hours. In Vivo test was used white rats weighing 200 grams and aged 2-3 months. The mouse is shaved on its back with an area of  $\pm 4 \text{ cm}^2$ . White rats test animals were divided into 5 groups, each of 5 white rats with 5 treatments, that is: positive control smeared with market sunscreen gel, negative control that was not smeared with sunscreen, treatment I with 1% gel concentration, treatment II with gel concentration 2.5% and treatment III with gel concentration 5%. Erythema scores used are: 0 there is no erythema, 1 states very little erythema with a diameter of  $\geq 25 \text{ mm}$ , 2 states clear-cut erythema with diameters of 25,10-30,00 mm, 3 states moderate erythema to a diameter between 30,10-35, 00 mm and 4 declare erythema to form wrinkles and bright red diameter  $\geq 35.10 \text{ mm}$ .

Whereas in vitro testing was carried out by weighing 0.1 g of temu giring (*Curcuma heyneana*) extract for each concentration of 1%, 2.5% and 5% then diluted with 10 ml ethanol then vortexed for 2 minutes. The solution obtained was measured by a UV-Vis spectrophotometer at wavelengths of 290-372.5 nm with blanks in the form of ethanol. DPPH test was also carried out which serves to evaluate the potential of antioxidants in rimpang temu giring (*Curcuma heyneana*) to reduce free radicals. Determination of antioxidant activity using 2 mL of temu giring (*Curcuma heyneana*) samples for concentrations of 20 ppm, 40 ppm, 60 ppm, 80 ppm and 100 ppm, each of which was added with 1 mL of DPPH solution. Then homogenized and left for 30 minutes in a dark place. Uptake was measured at a wavelength of 517 nm with a visible spectrophotometer and a comparative compound as a positive control.

The measurement results using a UV-Vis spectrophotometer at wavelengths of 290-372.5 nm with 5 nm intervals obtained absorption values (A), then carried out the calculation of transmission (T) using the formula:

$$A = - \log T$$

$$\text{Percent of erythema transmission (\% Te)} = \frac{\sum(T \times Fe)}{\sum Fe}$$

$$\text{Percentage of pigmentation transmission (\% Tp)} = \frac{\sum(T \times Fp)}{\sum Fp}$$

Description:

T = Transmission

Fp = Pigmentation flux

Fe = erythema flux

Then to calculate the SPF score is used the Mansur methods:

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

Description:

CF = Correction Factor

EE = Spectrum effect of erythema

I = Spectrum of sun intensity

Abs = Absorbance of sample

On the DPPH test results, the results are IC<sub>50</sub> score. The IC<sub>50</sub> score is inversely proportional with antioxidant abilities.

## Results and Discussion

Gel of temu giring (*Curcuma heyneana*) is made using this formula in table 1.

**Table 1.** Formula of Preparation Rimpang Temu Giring (*Curcuma heyneana*) Extract Gel

Material	Concentration % (gram)			
	Formula 1	Formula 2	Formula 3	Formula 4
Ekstrakt	-	1	2,5	5
Karbopol 940	1	1	1	1
Gliserin	5	5	5	5
Propilenglikol	10	10	10	10
TEA	1	1	1	1
Metil paraben	0.1	0.1	0.1	0.1
Aquadest	ad 100	ad 100	ad 100	ad 100

Evaluation of gel preparations was carried out by checking physical conditions including organoleptic, pH and homogeneity.

### 1.1. Organoleptis test

**Table 2.** Organoleptic Gel Preparations Observation

Formula	Characteristics	Days saving			
		0	1	7	14
1	Smell	Typical	Typical	Typical	Typical
	Colour	Clear	Clear	Clear	Clear
	Form	Semisolid	Semisolid	Semisolid	Semisolid
2	Smell	Typical	Typical	Typical	Typical
	Colour	Yellow	Yellow	Yellow	Yellow
	Form	Semisolid	Semisolid	Semisolid	Semisolid
3	Smell	Typical	Typical	Typical	Typical
	Colour	Yellow	Yellow	Yellow	Yellow
	Form	Semisolid	Semisolid	Semisolid	Semisolid
4	Smell	Typical	Typical	Typical	Typical
	Colour	Yellow	Yellow	Yellow	Yellow
	Form	Semisolid	Semisolid	Semisolid	Semisolid

Based on data in table 2, it is known that there was no significant change in the temu giring (*Curcuma heyneana*) gel. This shows that the gel is quite stable.

### 3.2. pH test

pH testing was one using a universal pH stick. This test shows that all samples have a pH of 6 so that it is safely applied to the skin [4].

### 3.3. Homogeneity test

The gel of temu giring (*Curcume heyneana*) rhizome was a homogeneous with no coarse grain. In Vitro Test Results for Preparation of temu giring (*Curcuma heyneana*) rhizome extract gel

#### 3.3.1. %Te and%Tp results

Data %Te and %Tp was shown in table 3.

**Table 3.** Results of% Te and% TP

Concentration	%Te	%Tp	Category
1 %	0.328771555	0.434577045	Sunblock
2.5 %	0.130166436	0.169584021	Sunblock
5 %	0.013076612	0.022115011	Sunblock

From the test, it shows that gel of temu giring (*Curcume heyneana*) included in the category of sunblock which is a product that can protect the skin from the sun by reflecting it.

#### 3.3.2. SPF score results

SPF data was shown in table 4.

**Table 4.** Results of the SPF Assessment

Temu giring gel (%)	SPF Score
1%	4.84
2.5%	8.76
5%	18.86

From data in table 4, it is known that gel of temu giring (*Curcuma heyneana*) rhizome extract 1% can protect the skin from UV light for 48 minutes, at 2.5% concentration it can protect the skin for 87 minutes and at a concentration of 5% can protect for 188 minutes.

#### 3.3.3. Antioxidant Test

From the test it was found that the IC<sub>50</sub> score of 1% gel concentration was 93.77787 µg/ml, 2.5% gel concentration was 87.03876 µg / ml and 5% gel concentration was 86.43086 µg/ml. From these data, it can be seen that the greater concentration of a temu giring (*Curcuma heyneana*) extract gel the IC<sub>50</sub> value will be smaller. Strong antioxidant activity if the IC<sub>50</sub> value is 50-100 µg / ml [5], From the results of the study, it was found that the IC<sub>50</sub> temu giring extract gel (*Curcuma heyneana*) all concentrations had IC<sub>50</sub> values between 50-100 µg / ml so that the gel preparation had strong antioxidant activity. In Vivo test results of temu giring (*Curcuma heyneana*) rhizome extract gel preparation

**Table 5.** Results of Area Measurement and Erythema Score

Temu giring gel (%)	Repetition									
	Extensive Erythema					Score of Erythema				
	1	2	3	4	5	1	2	3	4	5
1%	-	14	-	-	17	0	1	0	0	1
2.5%	12	-	-	-	-	1	0	0	0	0
5%	-	-	-	-	-	0	0	0	0	0
Positive control	-	-	-	-	-	0	0	0	0	0
Negative control	25	27	32	26	28	2	2	3	2	2

From these results indicate that the best protection is temu giring (*Curcuma heyneana*) extract gel 5% and in the positive control, while the negative control treatment not given any protection indicates the worst occurrence of erythema.

### Conclusion

Antioxidant and sunscreen activity in the preparation of temu giring (*Curcuma heyneana*) gel can be seen from the IC<sub>50</sub> and SPF number in each concentration. The IC<sub>50</sub> score of temu giring (*Curcuma heyneana*) gel showed a vscore of less than 100mg / ml so that it can be categorized as a strong antioxidant, while the SPF score at a concentration of 1% is 4.84 (moderate protection), 2.5% is 8.76 (maximum protection) and 5% is 18.86% (protection ultra). The higher the SPF score, the longer it will protect the skin from UV light. And the optimum concentration of temu giring (*Curcuma heyneana*) extract as an antioxidant and sunscreen is at a concentration of 5% with an IC<sub>50</sub> score of 86.43086 µg / ml and an SPF value of 18.8.

### References

- [1] Mappa T, Hosea JE, Novel K. *Formulasi Gel Ekstrak Daun Sasaladahan (Peperomia Pellucida (L.) H.B.K) dan Uji Efektivitasnya terhadap Luka Bakar pada Kelinci (Oryctolagus cuniculus)*. Jurnal Ilmiah Farmasi, 2013, 2(2); 49-55.
- [2] Kantivan P, Samant M, Srivastava R. 2013. *Natural sunscreen agents: A Review*. Sch Acad J Pharm, 2(6), 458–463.
- [3] Evizal, R. 2013. *Tanaman Rempah dan Fitofarma*. Bandar Lampung: Lembaga Penelitian Universitas Lampung.
- [4] Trianggono, R.I., Latifah, F. 2007. *Buku Pegangan Ilmu Pengetahuan Kosmetik*. PT.Gramedia, Jakarta.
- [5] Verawaty, Febriyenti, & Halim, A. (2016). *Efektivitas Sistem Penghantaran Liposom pada Katekin Sebagai Antioksidan*. Jurnal Sains Farmasi Dan Klinis, 2(2), 176–182.