# Determination of SPF Value of Mareme Leaf Extract (*Glochidion Arborescens* Blume.), Meniran Herb (*Phyllanthus Niruri* L.) and its Combination in *Lotion* by UV-Vis Spectrofotometry Method

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## ABSTRACT

Sunscreen is a substance that protects the skin from UV radiation by absorbing, dispersing, and reflecting UV rays. The protection level provided by sunscreen can be measured using SPF (Sun Protection Factor), a higher SPF value indicates greater protection. The SPF value influenced by the antioxidant content of the active ingredients in the sunscreen formulation. Mareme leaves and Meniran herbs are known for their strong antioxidant properties.

Method: The SPF values of Mareme leaf extract (*Glochidion arborescens* Blume.), Meniran herb extract *(Phyllanthus niruri* L.), and a combination of both extracts at a concentration of 600 ppm were tested Subsequently, the combined extracts were formulated in lotion, organoleptic testing, homogeneity testing, pH testing, and SPF testing

Results: Mareme leaf and Meniran herb extract (in a ratio of 2:1) yielded an SPF value of 17.32, indicating ultra protection. Furthermore, the lotion containing the combination of Mareme leaf and Meniran herb extract (in a ratio of 2:1) had an SPF value of 2.55, indicating minimal protection. Evaluation of the lotion demonstrated compliance with requirements in terms of texture, color, odor, homogeneity, and pH.

**Keywords*:*** Sunscreen, SPF, Lotion, Mareme Leaf Extract, Meniran Herb Extract

## INTRODUCTION

Sunlight plays a beneficial and crucial role in the lives of living organisms. However, excessive exposure to sunlight can overwhelm the skin's defence system, as radiation from UV A and UV B rays can cause sunburn, erythema, inflammation, and photoaging. Therefore, additional protection for the skin is needed, such as the use of sunscreen products, which are capable to shield the skin from UV radiation by absorbing, scattering, and reflecting the UV rays that come into contact with the skin (Latha et al., 2013; He at al 2021).

The effectiveness of sunscreen in protecting the skin from UV exposure can be measured by determining its Sun Protection Factor (SPF). The higher the SPF value generated, the greater the level of protection provided (Avianka, Mardhiani, & Santoso, 2022). The SPF value can be influenced by the antioxidant content of the active ingredients present in the sunscreen formulation (Rusita & A.S, 2017). Flavonoids and phenolics, known for their strong antioxidant properties, are considered to prevent or reduce the harmful effects caused by UV radiation. Flavonoids, with their conjugated double bond (chromophore group), have aromatic rings within their molecular structure that can efficiently absorb light in the UV range of 200-400 nm, making them potential sunscreens (Cefali et al., 2016).

Plants with high antioxidant can be used as sunscreen Chakravarty et al., (2021). Mareme leaves (figure A) and meniran herbs (figure B) have been reported for theirs antioxidant activity. Mareme leaves (*Glochidion arborescens* Blume. Family *Euphorbiaceae*) have an $IC_{50}$ value of (5.32-5.62 µg/mL, indicating their potent antioxidant activity (Indra, et al, 2019; Indra et al, 2022), while meniran herbs (*Phyllanthus niruri* L. Family *Phyllanthaceae*) have an $IC_{50}$ value of 17.55 ppm, categorizing them as strong antioxidants (Tambunan,

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Swandiny, & Zaidan, 2019). Since both plants have good $IC_{50}$ values, they have the potential to be used as sunscreen agents, especially when combined to produce a high SPF value (Morocho-Jácome et al., 2021).

One of the widely available forms of sunscreen products in the market is lotion. Lotion application is convenient as it dries quickly without causing discomfort. Despite its fast-drying character, lotion still leaves a thin layer of its components on the skin's surface (Mitsui, 1997; Saginala et al., 2016; Grigalavicius et al., 2021). The Sun Protection Factor (SPF) is a very popular instrument in the marketing of sunscreens.

To our knowledge, the activity of mareme leaf, meniran herb extract and their combination as sunscreen has been not reported yet. Therefore, this study aims to determine the SPF value of mareme leaf extract, meniran herb extract, and their combination, both before and after formulation into lotion.

Figure A. Mareme Leaf (https://www.bing.com)

Figure B. Meniran Herb (https://www.bing.com)

## METHODS

### Equipment and Materials

**Equipment:** Maceration bottles, mortar and pestle, glass stirrer, spoon, wooden clamps, filter paper, measuring glass, beaker glass, funnel, measuring flask, evaporating dish, scissors, pH meter (Thermo Scientific), ruler, volumetric pipette, analytical balance (Sartorius BSA 244S), Rotary evaporator (Rotary IKA-HB 10-RV10), Centrifuge (Series M815P- elektro.mag), UV-VIS spectrophotometer (Tryte Technologies).

**Materials:** Mareme Leaf (*Glochidion arborescens* Blume.), Meniran Herb (*Phyllanthus niruri* L.) Ethanol

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(Merck) Distilled water (Bratachem), Stearic acid (Bratachem), Liquid paraffin (Bratachem), Cetyl alcohol (Bratachem), Glycerine (Bratachem), Triethanolamine (TEA (Bratachem), Nipagin (Merck), Nipasol (Merck).

**Procedure Extraction**

Meniran (*P. niruri* Linn.) plants (300 g) from local plant location, harvesting in the morning, 3 month age of herb, Palembang, Indonesia. Mareme leaf (500 g) from local plant location, harvesting in the morning, 1 year age of plant, Palembang , Indonesia both were identified in Pharmacology department Health Polytechnic Palembang. Process extraction is carried out using the maceration method. The mareme leaf and meniran herb were washed with running water, and the chopped and dried in an open and shady place for 7 days Then, the dried meniran herb and mareme leaf were ground and sieved to obtain powders form. Amount of 200 g meniran and mareme powders were soaked for 5 days with a maceration procedure using 2 L 96% ethanol solution of each and stirred once daily for 5 days. The solution was separated from the solid component by filtration and then concentrated by using using a flannel cloth, and the extract was evaporated using a rotary evaporator at a temperature of 70°C at 0.14 ×g speed.

**Lotion Preparation**

All of the ingredients were weighted and grouped. Weigh the necessary ingredients and separate them into oil phase (stearic acid, cetyl alcohol, nipasol, and liquid paraffin) and aqueous phase (triethanolamine, nipagin, and glycerine). Each phase was placed in separate dishes and heated Place each phase in separate dishes and heat them on a water bath at 70°C. Subsequently, both phases were mixed and stirred until homogenous. The extract was then added into the mixed phase and stirred again. Stir both phases until homogenous, then add the extract and stir again until completely homogenous

Tabel 1. Formula Lotion Extract Combination Mareme Leaf (*Glochidion arborescens* Blume.) and Meniran Herb (*Phyllanthus niruri* L.)

| **Materials** | **Amount (g)** | **Function** |
|---|---|---|
| Extract combination from high ratio | 0.5 | Active ingredient |
| Stearic acid | 2.5 | Emulsifier |
| Triethanolamine | 1.0 | Emulsifier |
| Cetyl alcohol | 0.5 | Emollient |
| Paraffin Liquid | 7.0 | Emollient |
| Glycerine | 5.0 | Humectane |
| Nipagin | 0.1 | Preservative agent |
| Nipasol | 0.1 | Preservative agent |
| Distilled Water | ad 100 | Solvent |

Formulated modification, Kartamihardja *and* Lisna, (2019)

**Test SPF Value**

SPF values were measured using spectrophotometry by measuring absorbance values in extract and lotion solutions at concentrations of 400 ppm, 500 ppm and 600 ppm for SPF values in single extracts and 600 ppm concentrations in a combination of extracts and lotions, using a wavelength of 290-320 nm and recorded every 5 nm. After obtaining the absorbance value, it is calculated using the equation formula:

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

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Information:

CF = Correction factors (10)

EE = Effect erythemal

I = Intensity of UV light at wave length in each measurement

Abs = Absorbance of sample

(Dutra *et al*, 2004).

Lotion Evaluation

The evaluation of the lotion carried out includes: organoleptic test (color, aroma and texture), homogeneity test and pH test.

## RESULT

We have extracted from mareme leaf and meniran herb rendemen persentage 8,7% and 5,8% respectively.

**Testing SPF Value of Each Extracted**

SPF level extract mareme leaf for 400 ppm, 500 ppm and 600 ppm concentration.

Tabel 2. SPF value of extract mareme leaf (*Glochidion arborescens* Blume.)

| **λ (nm)** | **EE × I** | **EE × I × Abs** | | |
|---|---|---|---|---|
| | | **400 ppm** | **500 ppm** | **600 ppm** |
| 320 | 0,018 | 0,036954 | 0,037278 | 0,037854 |
| 315 | 0,0839 | 0,164192 | 0,165115 | 0,166374 |
| 310 | 0,1864 | 0,34745 | 0,348009 | 0,350991 |
| 305 | 0,3278 | 0,577911 | 0,593646 | 0,595613 |
| 300 | 0,2874 | 0,452368 | 0,450931 | 0,453517 |
| 295 | 0,0817 | 0,101063 | 0,103596 | 0,104004 |
| 290 | 0,015 | 0,01026 | 0,01032 | 0,010515 |
| **Total** | | 1,690198 | 1,708894 | 1,718868 |
| **SPF** | | 16,90 | 17,08 | 17,18 |
| **Protection Value** | | Ultra | Ultra | Ultra |
| Sunscreen can provide protection against UV radiation if the SPF value produced is more than 2 mean value (Indarto et al, 2022) | | | | |

SPF value of meniran herb extract concentration 400 ppm, 500 ppm and 600 ppm

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Tabel 3. SPF value of meniran herbal extract (*Phyllanthus niruri* L.)

| **λ (nm)** | **EE × I** | **EE × I × Abs** | | |
|---|---|---|---|---|
| | | **400 ppm** | **500 ppm** | **600 ppm** |
| 320 | 0,018 | 0,035766 | 0,035874 | 0,036576 |
| 315 | 0,0839 | 0,162011 | 0,16436 | 0,165535 |
| 310 | 0,1864 | 0,343908 | 0,345213 | 0,351178 |
| 305 | 0,3278 | 0,577584 | 0,586434 | 0,589384 |
| 300 | 0,2874 | 0,442021 | 0,44432 | 0,440872 |
| 295 | 0,0817 | 0,099184 | 0,099756 | 0,102615 |
| 290 | 0,015 | 0,01017 | 0,010245 | 0,01029 |
| **Total** | | 1,670644 | 1,686202 | 1,69645 |
| **SPF value** | | 16,24 | 16,86 | 16,96 |
| **Define level of protection** | | Ultra | Ultra | Ultra |
| Sunscreen can provide protection against UV radiation if the SPF value produced is more than 2 (Indarto et al, 2022) | | | | |

SPF value of combination of ethanol extract of mareme leaf and meniran herb at a concentration of 600 ppm

Table 4. SPF value of combination extract of mareme leaf and meniran herb at a concentration of 600 ppm

| **combination Ekstract** | **Testing SPF Value** | | | **Mean** | **Protected level** |
|---|---|---|---|---|---|
| | **I** | **II** | **III** | | |
| 1: 1 | 17,25 | 17,21 | 17,23 | ± 17,23 | Ultra |
| 1: 2 | 16,98 | 17,10 | 17,08 | ± 17,05 | Ultra |
| 2: 1 | 17,33 | 17,30 | 17,35 | ± 17,32 | Ultra |
| Sunscreen can provide protection against UV radiation if the SPF value produced is more than 2 (Indarto et al, 2022) | | | | | |

**Testing of Level SPF in Lotion Formulated**

SPF value test of lotion combination of ethanol extract of mareme leaf and meniran herb (2: 1) at a concentration of 600 ppm

Tabel 5. SPF Lotion value test of combination of extract of mareme leaves and meniran herb (2: 1) at a concentration of 600 ppm

| **Replicated Tested** | **SPF Value** | **Mean Value** |
|---|---|---|
| I | 2,53 | ± 2,55 |
| II | 2,58 | |
| III | 2,56 | |
| Sunscreen can provide protection against UV radiation if the SPF value produced is more than 2 mean value (Indarto et al, 2022) | | |

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Comparison of SPF values of combination extracts before and after formulated in lotion

Tabel 6. Comparison of SPF Values of Combination Extracts Before and After Formulated in Lotion

| **Ratio Extracted** | **SPF value** | ***Ratio of Lotion*** | **SPF value** | **Decreased** | **%** |
|---|---|---|---|---|---|
| 2:1 | 17,32 | 2:1 | 2,55 | 14,77 | 85,27% |

Table 7. Comparative data analysis of combined SPF values of extracts before and after formulated in lotion using paired samples test

| **Paired Sample Test** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **Paired differences** | | | | | | | |
| | | **Mean SD** | **Std Deviation** | **Std Error mean** | **95% confidence interval of the difference** | | **t** | **df** | **Sig.(2-tailed)** |
| | | | | | **Lower** | **Upper** | | | |
| Pair 1 | SPF Extract -SPF lotion | 14.76667 | 0.02082 | 0.01202 | 14.71496 | 14.81838 | 1228.661 | 2 | 0.000 |

**Evaluation Lotion**

**Organoleptic test**

Table 8. Organoleptic Observation

| **Organoleptic** | **Observation** | **Notify** |
|---|---|---|
| Texture | Soft | Eligible |
| Colour | Soft green | Eligible |
| Odor | Smell of leaf | Eligible |
| Homogeneity test | No particles coarse/Clear | Eligible |

Table 9. Test of pH

| **Sample Test** | **pH** | **Average** | **Notify** |
|---|---|---|---|
| 1 | 6.33 | ± 6,4 | Eligible |
| 2 | 6.42 | | |
| 3 | 6.45 | | |
| Range Standard pH of skin test: 5,5 – 6,5 (Mitsui, 1997) | | | |

## DISCUSSION

Sunscreens are important tools used to protect the skin against harmful effects of ultraviolet (UV) radiation. Sunscreens protect the skin against erythemal radiation. In this study, the SPF values of Mareme leaf, Herba

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Meniran herb, and their combination, both before and after formulation into the lotion had ultra protection level. SPF (Sun Protection Factor) is the skin's protection from UVB rays. SPF is generally followed by a number that codes how much protection is provided to the skin. SPF 15 filters 93% of UVB exposure, SPF 30 blocks 97%, while SPF 50 blocks 98% of UVB exposure. Related to different formulations of sunscreen exist today, which can be confusing to the consumer. In this article, have to make clear the meaning of SPF value. Some articles highlight and address sunscreen myths that exist today including the benefits of higher SPF sunscreen, use of sunscreen in darker skin types, and also the effects of sunscreen on vitamin D production ( Grigalavicius et al., 2016; Benntt et al., 2022).

Regarding to the yield percentages was differ from those reported in previous studies. Study of Indra, et al (2019) reported a yield of 35% for ethanol extract of mareme leaf, while Nabila et al. (2022) reported a yield of 17.073% for ethanol extract of meniran herb. The process it can be made different. The differences in yield percentages can be attributed to several factors, including the degree of fineness of the plant material. This aligns with the findings of Nwabanne2012), who observed that smaller particle sizes of plant material result in greater extraction efficiency, as finer particles allow for easier access of the solvent to the active compounds. Higher yield values indicate a greater amount of active compounds obtained (Hughes et al., 2021; Hunger et al., 2021). Chemical analysis of the mareme leaf and meniran herb extracts revealed the presence of flavonoids, tannins, and terpenoids. The presence of flavonoid compounds in both extracts suggests their potential use as sunscreen agents. According to Cefali et al., (2016), flavonoid compounds have conjugated double bonds (chromophore groups) within their molecular structure, containing aromatic rings capable of absorbing light in the UV wavelength range of 200-400 nm, making them potentially effective as sunscreens

The SPF values of mareme leaf and meniran herb extracts were tested at concentrations of 400 ppm, 500 ppm, and 600 ppm. These concentrations were selected based on previous research by Putri, Kartamihardja, and Lisna (2019), which found SPF values of 11.052 categorized as maximal at 500 ppm. Additionally, at 600 ppm, an SPF value of 20.79 was categorized as ultra (Lestari, Prajuwita, and Lastri, 2021). Study of Indra et al. 2022 seems any different how to prepare and handling the sample preparation. Its not clear said only ration 1:2 of sample and DPPH. Therefore, considering these findings, concentrations of 500 ppm and 600 ppm were chosen to ensure maximal and ultra protection. An additional concentration of 400 ppm was added to assess if the SPF value could still fall within the maximal category.

Based on Tables 2 and 3, both mareme leaf and meniran herb extracts exhibited good SPF values, with values exceeding 15 at concentrations of 400 ppm, 500 ppm, and 600 ppm. For mareme leaf extract, SPF values were 16.90, 17.08, and 17.18 at 400 ppm, 500 ppm, and 600 ppm, respectively. Similarly, for meniran herb extract, SPF values were 16.70, 16.86, and 16.96 at the same concentrations. Thus, both extracts at all three concentrations can be used as sunscreens providing ultra protection against UV radiation. A lot of aspects of the SPF are confusing, e.g. the race for higher and higher numbers, the effect on SPF when less sunscreen is applied and if sunscreen should be used at all because they may block the Vitamin D synthesis (Osterwalder 2009).

In Table 4, the SPF values were tested by combining mareme leaf and meniran herb extracts at three ratios: 1:1, 1:2, and 2:1, tested at a concentration of 600 ppm. Each combination was tested three times for replication. The results showed SPF values of 17.23, 17.05, and 17.32 for combinations of 1:1, 1:2, and 2:1, respectively, all categorized as ultra protection. The combination of mareme leaf and meniran herb extracts at a ratio of 2:1 yielded a higher SPF value compared to the other two combinations. This may be attributed to the higher SPF value of Leaf Mareme extract before combination and the synergistic effect of the active compounds in the mixture, leading to increased sunscreen activity and SPF value. This finding is consistent with the research of Handayani, Purba, and Rahmad (2020), which indicated that the SPF value of palm oil before combination was lower than that of nyamplung seed oil, but when combined, the SPF value increased due to synergistic effects among the compounds in the extract related to Ikawa el al., (2022).

Showing in Table 5, the combination of extracts tested was mareme leaf and meniran herb at a ratio of 2:1 gave an SPF value decreased. After conducting SPF value testing at a concentration of 600 ppm with three replications, an SPF value of 2.55 was obtained, categorized as minimal protection. Based on Tables 5 and 6, there was a decrease in SPF value between before and after formulation into lotion by 85.27%. This is

consistent with the findings of Putri, Kartamihardja, and Lisna (2019), who found an SPF value of 15.24 for stevia leaf extract and a decrease to 11.052 after formulation into lotion. The decrease in SPF value may be influenced by the combination and concentration of the lotion or cream, lotion or cream type, and the effects and interactions of the carrier components of the lotion, such as emollients, which can increase or decrease UV absorption by the sunscreen, as evidenced by the decrease in SPF value (More et al., 2013; Kolbe et al., 2019). In the testing data using paired sample t-tests with a confidence level of 95%, the result of sig value was 0.000 < 0.005, indicating a significant difference in SPF value before and after formulation into lotion. Based on Tables 8 and 9, the evaluation conducted on the lotion, including organoleptic testing, homogeneity testing, and pH testing, yielded results that met the requirements for lotion. The lotion exhibited a light green colour, soft texture, aromatic leaf scent, homogeneity with no coarse particles, and a pH of 6.4 range (Cefali et al.,2021)

## CONCLUSION

The SPF values of ethanol extracts from mareme leaf for concentrations of 400 ppm, 500 ppm, and 600 ppm were 16.90, 17.08, and 17.18, respectively, all of which fall within the range of ultra-protection sunscreen. Similarly, the SPF values of ethanol extracts from meniran herb for concentrations of 400 ppm, 500 ppm, and 600 ppm were 16.70, 16.86, and 16.96, respectively, all falling within the range of ultra-protection sunscreen. The SPF values of combinations of ethanol extracts from mareme leaf and meniran herb at a concentration of 600 ppm, with ratios of 1:1, 1:2, and 2:1, were 17.23, 17.05, and 17.32, respectively, all falling within the range of ultra-protection sunscreen. There was a significant decrease in the SPF value of the combination of ethanol extracts from mareme leaf and meniran herb (2:1) from 17.32 before formulation to 2.55 after formulation into lotion, representing an 85.27% decrease Further research can be conducted to explore the selection of extract types with high potential as sunscreen ingredients for formulation into lotion suggest that naturally-based sunscreens supplemented with synthetic UV.

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