Sun protecting factor value of the Ficus benjamina Linn. fruits extract

A A Aloinis¹,², M Karundeng¹, V I Paat³, S M T Tengker¹ and O Siwu¹

¹Chemistry Department, Universitas Negeri Manado, Indonesia
²Pharmacy Department, Universitas Kristen Indonesia Tomohon, Indonesia

*andersonaloanis@unima.ac.id

Abstract. Sun Protection Factor or SPF is defined as the ratio between the amount of sunlight energy (UV-B) needed to cause minimal erythema on sun-protected skin with the amount of energy required to cause minimal erythema on the skin that is not protected by sunscreen. This study aims to determine the SPF value of the n-hexane fraction, the ethyl acetate fraction, methanol fraction, ethanol fraction, and butanol fraction from the Ficus benjamina Linn. fruits. SPF measurements can be done using UV-Vis spectrophotometry. The result is the SPF value of n-hexane fraction is 4.935, the ethyl acetate fraction is 19.917, methanol fraction is 4.056, ethanol fraction is 8.342, and butanol fraction is 0.422. The ethyl acetate fraction of Ficus benjamina Linn. fruits has the highest SPF value, and it’s categorized as high-protection.

1. Introduction
The sun is a source of light and human energy. Apart from light and energy benefits, the sun provides Ultraviolet radiation that can harm our skin. Based on its wavelength, Ultraviolet light is divided into three, namely UV A, UV B, and UV C [1,2]. The skin is the part of the body that feels the impact of UV rays. The skin can be protected from UV rays with sunscreen products. Sunscreen is divided into physical sunscreen, where this sunscreen works by reflecting UV radiation or commonly called UV blocker, and UV absorbent sunscreen or sunscreen that absorbs UV radiation. The amount of UVA exposure usually remains constant, whereas UVB exposure occurs more in the summer [3].

Sunscreen is a cosmetic preparation designed to reduce the harmful effects of skin exposure to ultraviolet rays. In general, the mechanism of sunscreens' action is particles from ultraviolet light radiation called photons meeting a pair of electrons in sunscreen molecules [4]. Determination of the potential of a good sunscreen can be viewed from its ability to absorb or reflect ultraviolet light by determining the SPF (Sun Protecting Factor) value and the percentage of erythema and pigmentation [5]. SPF is a universal indicator that explains the effectiveness of a product or substance that is UV protective [6]. The more effective a product is to protect the skin from the harmful effects of ultraviolet rays, the greater the SPF value.

Aloe vera is known as a plant that can prevent sunburn and has a significant SPF value. Many sunscreens using the aloe vera extract to be the base of their formula. Other plants such as Leucas zeylanica, Ophiorrhiza mungos, and Crataegus pentagyna also have a great SPF value, and these plants contain polyphenol compounds [7,8]. Research about natural polyphenol compound shows that polyphenol offer both antioxidant activity and photoprotective features [9,10].
According to previous research, *Ficus benjamina* Linn. contains polyphenol compound, and its fruit has antioxidant activity also a high total antioxidant content [11–14]. The antioxidant activity indicates that the fruit of *Ficus benjamina* Linn. can be used as a source of antioxidants that can ward off free radicals and as a preventative for several degenerative diseases. The combination of antioxidant activity and photoprotective characteristics can be interesting components for pharma-photoprotection formulations. This encourages us to continue to this step, to test the potential for sunscreens where the phenolic compounds in *Ficus benjamina* Linn. fruit can block/absorb UV A and UV B rays that hit the human body.

2. **Methods**

2.1. **Materials**

The materials used in this study were methanol pro analysis (Merck), methanol, n-hexane, ethyl acetate, n-butanol and distilled water.

2.2. **Extract preparation**

*Ficus benjamina* Linn. fruit was taken in Minahasa Regency, North Sulawesi. The fruit taken was ripe purplish red. The fruit was dried without any direct contact with sunlight for 1-2 weeks. The dried fruit was smoothed. Samples weighing 500 grams that had been refined were extracted by maceration method with methanol and ethanol solvents re-distilled beforehand. The maceration process was carried out 24 hours at room temperature. This process was repeated eight times for each solvent. The macerated filtrate was then evaporated at 40°C to obtain thick methanol and thick ethanol extract. The thick methanol extract was then fractionated by liquid-liquid extraction using n-hexane, ethyl acetate, and butanol. The filtrate and residue from the liquid-liquid extraction were evaporated to obtain the n-hexane, ethanol, and butanol fractions.

2.3. **Sun protective factor (SPF) determination**

The Sun Protective Factor value of the *Ficus benjamina* Linn. fruit was conducted in vitro. The absorption spectra of 1000 ppm of *Ficus benjamina* Linn. fruit extract in solution were obtained in the range of 290-320 nm using 1 cm quartz cell and methanol as a blank. The absorption data were obtained every 5 nm, and three determinations were made at each point. After that, the absorbance value is entered in equation (1) known as Mansur equation, to obtain the FPS value [15,16].

$$FPS = CF \times \sum_{290}^{320} EE(\lambda) \times I(\lambda) \times \text{Abs}(\lambda)$$  \hspace{1cm} (1)

FPS means the value of the sun protection factor. CF is a correction factor (10) of EE (erythmogenic effect of radiation with wavelength \(\lambda\)). I in the equation is the spectrum of intensity from the sun where the results of EE x I at a wavelength of 290-320 nm can be seen in table 1. Abs is the absorbance value of the measurement results with the UV-Vis instrument.

3. **Results and discussion**

The SPF is a quantitative measurement of the effectiveness of a sunscreen formulation. To effectively prevent sunburn and other skin damage, a sunscreen product should have a wide range of absorbance, between 290 and 320 nm. The in vitro SPF is useful for screening tests during product development as a supplement to the in vivo SPF measure. The absorbance of *Ficus benjamina* Linn. fruit extract shown in table 1. The absorbance shows that ethyl acetate extract absorbed more UV light. In 290 nm, the ethyl acetate extract absorbed 2.588 - 2.686. The other extract absorbed medium to low range amount of UV light. The most insufficient absorbance recorded to butanol extract compares to the other extract.
Table 1. The absorbance value of *Ficus benjamina* fruits extract.

| Sample   | Wavelength | 290  | 295  | 300  | 305  | 310  | 315  | 320  |
|----------|------------|------|------|------|------|------|------|------|
| Methanol | A1         | 0.496 | 0.430 | 0.364 | 0.312 | 0.269 | 0.237 | 0.213 |
|          | A2         | 0.680 | 0.589 | 0.500 | 0.429 | 0.370 | 0.327 | 0.293 |
|          | A3         | 0.688 | 0.595 | 0.506 | 0.434 | 0.375 | 0.331 | 0.297 |
| Ethanol  | A1         | 0.890 | 0.837 | 0.795 | 0.76  | 0.729 | 0.701 | 0.674 |
|          | A2         | 0.954 | 0.899 | 0.855 | 0.817 | 0.783 | 0.752 | 0.723 |
|          | A3         | 1.060 | 0.998 | 0.949 | 0.907 | 0.869 | 0.836 | 0.804 |
| n-hexane | A1         | 0.711 | 0.612 | 0.515 | 0.466 | 0.405 | 0.366 | 0.333 |
|          | A2         | 0.740 | 0.652 | 0.570 | 0.489 | 0.438 | 0.410 | 0.367 |
|          | A3         | 0.721 | 0.636 | 0.552 | 0.482 | 0.424 | 0.380 | 0.345 |
| Ethyl Acetate | A1     | 2.608 | 2.389 | 2.163 | 1.944 | 1.739 | 1.573 | 1.430 |
|          | A2         | 2.588 | 2.395 | 2.182 | 1.962 | 1.757 | 1.591 | 1.446 |
|          | A3         | 2.686 | 2.451 | 2.222 | 1.944 | 1.785 | 1.616 | 1.469 |
| Butanol  | A1         | 0.054 | 0.050 | 0.047 | 0.045 | 0.042 | 0.039 | 0.037 |
|          | A2         | 0.051 | 0.047 | 0.044 | 0.040 | 0.037 | 0.036 | 0.034 |
|          | A3         | 0.052 | 0.048 | 0.044 | 0.040 | 0.037 | 0.035 | 0.033 |

Based on the results of the calculation of the Mansur equation and absorbance value in table 1, we can see the sun protection factor in table 2. It can be seen that all samples of the extract of *Ficus benjamina* Linn. have activity as sunscreen, the SPF value indicates this in each extract. In line with the amount of absorbance value, the sun protection factor shows that ethyl acetate has the biggest SPF value with 19,917 ± 0,180. Butanol fraction also has the lowest SPF value because it absorbed a minimum amount of UV light with 0,422 ± 0,232. According to the sunscreen's effectiveness based on SPF value of *Ficus benjamina* Linn. fruit extract, methanol fraction and hexane fraction were categorized as moderate protection, ethanol fraction and ethyl acetate fraction classified as high-protection. The sunscreen protection category is based on the Japanese cosmetic industry association guidelines [3].

The amount of polyphenol correlates to SPF value [17]. A lot of polyphenols compound contain in ethyl acetate fraction. *Ficus benjamina* Linn. have polyphenol compounds such as kaempferol, chlorogenic acid, ferulic acid, and caffeic acid. The moderate protection of n-hexane fraction because essential oil contained in the fraction help the fraction to absorb more UV light [18,19].

Table 2. Sun Protection Factor (SPF) value of *Ficus benjamina* fruits extract.

| Samples    | SPF Value |
|------------|-----------|
| Methanol   | 4.056 ± 0.714 |
| Ethanol    | 8.342 ± 0.745 |
| Hexane     | 4.935 ± 0.189 |
| Ethyl Acetate | 19.917 ± 0.180 |
| Butanol    | 0.422 ± 0.232 |

The skin itself has melanin to absorb the UV light to protect from sunburn. The cause of light and dark skin is the amount of melanin in the skin. Melanin exists in a minimal amount in people with light skin, while melanin exists a lot in dark skin people. How long a person spends in the sun, combined with their skin type, determines if and when a person burns. Darker people don't sunburn because they have more natural sunscreen than those with less melanin.
4. Conclusion
All samples of *Ficus benjamina* Linn. have sunscreen activity. The result is the SPF value of n-hexane fraction is 4.935, the ethyl acetate fraction is 19.917, methanol fraction is 4.056, ethanol fraction is 8.342, and butanol fraction is 0.422. The SPF value of *Ficus benjamina* Linn. fruit methanol extract and hexane fraction were categorized as having moderate protection while ethanol fraction and ethyl acetate fraction classified as high-protection.

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