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The potential of Kelakai leaf peat plants (*Stenochlaena Palustris Bedd*) as sunscreen based on Sun Protecting Factor (SPF) values in vitro

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ABSTRAK: Kelakai (*Stenochlaena palustris* (*Burm. F.*) Bedd) adalah tumbuhan paku-pakuan yang tumbuh di lahan basah seperti rawa gambut. Daun kelakai mengandung senyawa metabolit sekunder flavonoid yang memiliki aktivitas antioksidan dan penangkal radikal bebas. Penelitian ini bertujuan untuk mengetahui potensi ekstrak daun kelakai (*Stenochlaena palustris* (*Burm.E*) Bedd) sebagai tabir surya. Radiasi sinar UV, yang terdiri dari UV-A (320-400 nm) dan UV-B (290-320 nm), dapat merusak kulit. UV-A menyebabkan pigmentasi, sedangkan UV-B menyebabkan eritema. Nilai SPF menunjukkan tingkat perlindungan kulit terhadap eritema akibat sinar matahari. Semakin tinggi nilai SPF, semakin baik perlindungannya. Hasil penelitian menunjukkan bahwa ekstrak etanol daun kelakai memiliki potensi sebagai tabir surya dengan nilai SPF masuk kategori hingga proteksi ultra. Ini menunjukkan bahwa ekstrak daun kelakai dapat memberikan perlindungan terhadap radiasi UV dan berpotensi dikembangkan sebagai bahan tabir surya alami.

Keywords:
Kelakai;
SPF;
in vitro,
UV-vis,
natural sunscreen

ABSTRACT: Kelakai (*Stenochlaena palustris* (*Burm. F.) Bedd*) is a fern that grows in wetlands such as peat swamps. Kelakai leaves contain secondary metabolite compounds of flavonoids that have antioxidant and free radical scavenger activities. This study aims to determine the potential of kelakai leaf extract (*Stenochlaena palustris* (*Burm.E*) *Bedd*) as a sunscreen. UV radiation, consisting of UV-A (320-400 nm) and UV-B (290-320 nm), can damage the skin. UV-A causes pigmentation, while UV-B causes erythema. The SPF value indicates the level of skin protection against erythema due to sunlight. The higher the SPF value, the better the protection. The results showed that the ethanol extract of kelakai leaves has the potential as a sunscreen with an SPF value in the category of ultra protection. This shows that kelakai leaf extract can provide protection against UV radiation and has the potential to be developed as a natural sunscreen ingredient.

1 INTRODUCTION

One of the islands in Indonesia that has biodiversity is Kalimantan, Kalimantan Island has many types of ferns, one of which is the kelakai plant (Stenochlaena palustris (Burm.F.) Bedd). Kelakai is a typical swamp plant in Kalimantan. The secondary metabolite content contained in kelakai leaves is alkaloid, steroid and flavonoid compounds [1]. Phenolic compounds, especially the flavonoid group, have the potential as sunscreen. Flavonoid compounds have chromophore groups (conjugated double bonds) that can absorb UV rays, both UV A and UV B, thereby reducing the intensity of exposure to the skin. According to [2], the ethanol extract of kelakai leaves contains quercetin flavonoids. According to research [1], the ethanol extract of kelakai leaves has an average high flavonoid content of (2.2159 ± 0.083%). In addition, research [3] stated that the ethanol extract of young kelakai leaves has antioxidant activity with an IC50 value of 143.1431 ppm which is included in the moderate category. The high antioxidant and flavonoid content in kelakai leaves is estimated to have sunscreen activity.

The definition of sunscreen ingredients is a material used to protect the skin from UV radiation by absorbing, emitting and scattering. Sunscreens have been widely developed to protect humans from harmful UV A and UV B radiation. The ability of sunscreen to protect the skin and prevent sun exposure is indicated by the Sun Protection Factor (SPF) value. The higher the SPF value of a sunscreen, the better its protection against UV B radiation. Active sunscreen ingredients from natural ingredients are relatively safer to use compared to chemicals. This is due to the presence of polyphenol and antioxidant compounds in plants which are photoprotective, can provide protection against oxidative stress, inflammation, and can avoid the side effects of using chemicals as active sunscreen ingredients on the

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skin. According to the background, kelakai leaves have the potential as sunscreen, but this research has not been widely conducted, especially in Palangka Raya.

The sun is very important for life on earth because it functions to support the life of living things through photosynthesis in plants and provides warmth and light. In addition, the sun is very important for human physical and physiological well-being. However, excessive exposure to sunlight can cause negative effects on unprotected skin such as sunburn, rough skin, premature aging, and skin cancer. These negative effects are caused by sunlight, namely ultraviolet rays or UV rays. UV rays are needed by living creatures as a source of energy, helping growth and metabolism processes, and helping the synthesis of vitamin D. However, the depletion of the ozone layer causes very high UV radiation, especially in equatorial areas. Skin exposed to high UV rays is darker, blackened, dull, and sunburned [4].

Excessive exposure to UV radiation can cause skin damage due to the formation of free radicals, so a material is needed to protect the skin from UV exposure. Materials that can protect the skin from UV exposure are called sunscreens or Sun Protecting Agents. One of the compounds that has activity as a sunscreen from natural ingredients is the phenolic compound group. The ability of a sunscreen to protect the skin by delaying erythema is expressed by the Sun Protection Factor (SPF).

The SPF value indicates how long the skin will be protected from UVB rays if using a sunscreen product so that it is safe in the sun without experiencing erythema. The higher the SPF value of a sunscreen, the better its protection activity. Measurement of the SPF value of a sunscreen preparation can be done in vitro. The method of measuring the SPF value in vitro is generally divided into two types. The first type is by measuring the absorption or transmission of UV radiation through the sunscreen product layer on a quartz plate or biomembrane. The second type is by determining the absorption characteristics of the sunscreen using spectrophotometric analysis of the dilution solution of the sunscreen being tested. Therefore, this study was conducted to determine the activity and potential of the sunscreen as a sunscreen, as well as to calculate the Sun Protecting Factor (SPF) value.

2 RESEARCH METHODS

Kelakai Leaf Extraction

The leaves of the kelakai plant that have been collected and dried are then ground into a coarse powder. The powder is weighed as much as 100g each and then extracted by the maceration method using 70% ethanol solvent with a ratio of 1:10 for 3x24 with solvent replacement every 24 hours. The results obtained from the maceration are then concentrated using a rotary evaporator, then evaporated on a water bath until a thick extract is formed. Ethanol extract from kelakai leaves is obtained.

Sunscreen Effectiveness Testing

Sunscreen effectiveness testing is carried out by determining the SPF value In Vitro using a UV-Vis spectrophotometer. Ethanol extract of kalakai leaves will be tested with concentrations of 75 ppm, 150 ppm, 225 ppm, 300 ppm and 375 ppm. The kelakai leaf extract to be used was diluted and divided into several concentrations and read using a UV-Vis spectrophotometer with a wavelength between 290-320 nm every 5 nm interval, the blank used was 70% ethanol. Then the absorbance results are calculated to be used to calculate the SPF value, using the following formula:

$$SPF = CF \; x \sum_{290}^{320} EE\ (\lambda)\ x\ I\ (\lambda)\ x\ A(\lambda)$$

Description:

CF: Correction Factor

EE: External Efficiency

I: Simulated Solar Spectrum

A: Absorption of Sunscreen Products

3 RESULTS AND DISCUSSION

This study used Kelakai leaf plants (Stenochlaena palustris (Burm.) Bedd.) taken in Palangka Raya, Central Kalimantan, the testing included organoleptic tests and SPF value testing measured using a UV-Vis Spectrometer.

Organoleptic Test of Kelakai Leaves

Organoleptic tests were conducted on kelakai leaf plants. The purpose of the organoleptic test was to see the physical appearance of the kelakai plant in the form of smell, color, shape and taste. Based on the results of the organoleptic test, it is known that the kelakai powder has a green color while for the smell, shape and taste both have a strong aromatic odor and have a bitter taste.

Determination of SPF Value of Kelakai Leaf Extract

The SPF (Sun Protection Factor) value is a general indicator that explains the effectiveness of a substance or product to protect against UV rays [5] Sun protection products are effective in protecting the skin from UV exposure, so the higher the sun protection value, the more effective it is in protecting the skin [6]. The results show that kelakai leaf extract has the potential as a sunscreen preparation because of the presence of flavonoid compounds that have conjugated double bond chromophore groups, so flavonoid compounds can absorb UV-A and UV-B radiation [7].

Determination of the SPF value in this study was made with the concentration of each kelakai leaf ethanol extract (75 ppm, 150 ppm, 225 ppm, 300 ppm and 375 ppm) and their combination (500 ppm) of pa ethanol solution (pro analysis) as a blank solution. The blank solution is used to correct the sample or spectrum value. Ethanol pa is used as a blank solution because the purity of this material is 99.5% [8]. The solution is then measured using a UV-Vis spectrophotometer with an absorption wavelength of 290-320 nm. This wavelength represents the wavelength of UV-B rays (290-320 nm) which can cause sunburn [9].

The results of absorbance measurements of each sample vary as shown in table 1. The highest absorption value is at a wavelength of 290 nm and the lowest at a wavelength of 320 nm, this is because the sample penetrates polychromatic light with a certain wavelength and its intensity decreases due to energy absorption, while the absorption value is a comparison of light absorbed through the sample. A high absorption value means that more light is absorbed by the sample. The longer the wavelength used, the lower the absorption power, so that less light is absorbed by the sample [10].

Table 1. Results of SPF Value of Ethanol Extract of Kelakai Leaves

Concentration	SPF Value	Category
75	2,98	Minimum Protection
150	6,69	Extra Protection
225	10,23	Maximum Protection
300	13,44	Maximum Protection
375	16,42	Ultra Protection

The SPF value obtained based on the provisions of the Food Drug Administration (FDA) has several categories, namely minimal protection (2-4), moderate (4-6), extra (6-8), maximum (8-15) and ultra (> 15). The kelakai leaf extract sample showed different SPF value results. The SPF value results in this test result have minimal, extra, maximum, and ultra protection. With the highest SPF value of kelakai leaf ethanol extract at a concentration of 375 ppm with a value of 16.42 ultra protection, a concentration of 300 ppm with a value of 13.44 maximum protection, a concentration of 225 ppm with a value of 10.23 maximum protection, a concentration of 150 ppm with a value of 6.69 minimum protection and at 75 ppm with a value of 2.98 minimum protection. This is because each extract concentration can absorb different levels of UV rays. This can be seen from the SPF value which increases with the increase in extract concentration, so that the higher the extract, the higher the SPF value [11] meaning that the higher the concentration, the greater the ability of the extract to protect the skin from UV radiation [12].

The Sun Protection Factor (SPF) value is measured as the ability of a material as a sunscreen. The higher the SPF value, the better the sunscreen's protection against UV rays. The SPF value is a comparison of how much UV is needed to burn the skin when protected with unprotected by sunscreen. The SPF value indicates the ability of a sunscreen product to reduce erythema caused by UV radiation [13].

A sunscreen is said to be able to provide protection if it has a minimum SPF value of 2 and a good category if the test sample has an SPF value above 15 which is included in the ultra-protection category sunscreen. This is because an SPF value above 15 will be able to provide better protection from the risk of long-term skin damage, such as skin cancer. In addition, SPF above 15 can protect the skin longer from sun exposure for approximately 4-5 hours, while SPF 10 can only protect the skin for 1.5 hours [14].

So based on the SPF value data obtained, it shows that the ethanol extract of kelakai leaves can function as an active ingredient in sunscreen because it is proven to have quite high activity and SPF value.

4 CONCLUSION

Based on the results of the research that has been conducted, it can be concluded that kelakai leaves (Stenochlaena palustris (Burm.F.) Bedd) have potential activity as a sunscreen, seen from the test results which show the ability to provide up to ultra protection.The SPF value of young kelakai leaves (Stenochlaena palustris (Burm.F.) Bedd) obtained at each concentration with variations of 75 ppm, 150 ppm, 225 ppm, 300 ppm and 75 ppm respectively are 2.98 (minimal protection); 6.69 (extra protec-

tion); 10.23 (maximum protection); 13.44 (maximum protection) and 16.42 (ultra protection).

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