

## Research Article

## Potential of Frangipani (*Plumeria alba*) Leaves Extract as Ultra Violet Protection

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**Abstract**

Sunlight is the source of life and energy. Besides that, sunlight also creates skin challenges such as sunburn, pigmentation, wrinkles, dermatitis, aging, and skin cancer. Natural sunscreen protection is a popular and preferred way among various regions of the world to reduce sunlight's harmful effect. This study aimed to determine the potential of frangipani (*Plumeria alba*) leaves extract in some concentrations as ultraviolet protection. *Plumeria alba* extract contained secondary metabolites such as flavonoids, phenolics, and alkaloids that function as impeding ultraviolet radiation. This study used an experimental method consisting of four treatments and six replications. This study shows that the extract with concentration 2500; 5000; 7500; and 10000 ppm consecutively have SPF value of 6.24; 12.00; 18.45; and 22.64. It can be concluded the *P. alba* leaves extract potential as ultraviolet protection.

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**INTRODUCTION**

Sunscreen is a substance or material that can protect the skin against ultra violet (UV) radiation's harmful effects by absorbing, diffusing, or reflecting the rays, reducing the energy that affects the skin (Eff *et al.*, 2018; Latha *et al.*, 2013). Cosmetic preparation that contains sunscreen is usually labeled with a specific Sun Protection Factor (SPF) strength. The SPF value is in 2-60 range, this figure shows how long the product can protect or block UV ray that causes sunburn, pigmentation, wrinkles, dermatitis, and skin cancer (Geoffrey *et al.*, 2019; Ngoc *et al.*, 2019; Surdu *et al.*, 2013). In general, sunscreens with an SPF 15 value are used to protect the skin from the adverse effects of UVA and UVB (Paul, 2019). A user can determine the duration of effectiveness only by multiplying the SPF number by the length of time it takes to burn his skin when not wearing sunscreen (Wacker & Holick, 2013).

Sunscreen cosmetic preparations on the market come in various forms such as creams, lotions, ointments, gels, or sprays applied to the skin (Perugini *et al.*, 2019). The ingredients of this sunscreen are varied, ranging from synthetic to natural ingredients. Recently, people prefer to use natural sunscreens. This is because the natural ingredients have a less negative impact (Mishra *et al.*, 2011). Natural sunscreen ingredients often added to sunscreens cosmetic products, e.g., carrot, soy, avocado, aloe vera, walnut, citrus fruits, lemon, marigold, sesame seeds, jojoba, and other extracts (Korać & Khambholka, 2011; Geoffrey *et al.*, 2019; Shanbhag *et al.*, 2019).

Frangipani (*Plumeria alba*) plants are a relatively abundant plant in Indonesia, especially in Bali. This plant, originating from America, is straightforward to find in Bali, where almost every Balinese household has this plant because it is easy to grow, and it is rich in benefits.

To grow this plant, people only need to cut the branching of the stem and stick it into the soil or fertile land, and without the need for over care, this plant will thrive. These plants have many benefits, ranging from being used as herbal medicines with various properties such as treating swelling, diarrhea, tinea versicolor, toothache, and consuming such as making vegetables (Wrasianti *et al.*, 2011; Ningsih *et al.*, 2014). The Balinese Hindu community uses many flowers from this plant for prayer ceremonies.

*Plumeria alba* offers many benefits, but the use of its leaves for sunscreen is still unknown. Various studies on *P. alba* leaves show that these leaves contain secondary metabolites such as flavonoids, alkaloids, phenolic compounds (Gupta *et al.*, 2016). These secondary metabolites are compound capable of absorbing UV rays because it has a conjugated aromatic benzene group (Panche *et al.*, 2016). Therefore, this study aimed to determine *P. alba* leaves' potential as a sunscreen by calculating the SPF value.

## MATERIALS AND METHODS

### Materials

The materials used include 70% ethanol, distilled water, *P. alba* leaves, methanol, Dragendorff's reagent, FeCl<sub>3</sub> reagent, and 20% NaOH. The tools used were vacuum rotary evaporator, desiccators, maceration chamber, Erlenmeyer flasks, analytical scales, micropipette, and UV-Vis spectrophotometer.

### Sample sources and determination

*Plumeria alba* leaves were collected from Tibubeneng village, Badung Bali, in March 2020. Plant determination is carried out by the Eka Karya Botanical Garden Conservation Center, Indonesian Institute of Sciences with specimen number B154-2 to ensure that the sample used is *P. alba* from the Apocynaceae family.

### Sample preparation

The samples were green *P. alba* leaves 15-30 cm long. Samples were washed with flowing water and cut into small pieces. Then the samples were drained and dried by using an oven at 45°C for 24 hours. The samples were blended until achieving a certain degree of smoothness, and afterward, it was sieved by using an 80 mesh sieve to obtain the *P. alba* leaves powder (Ersalina *et al.*, 2020).

### Sample extraction

*Plumeria alba* leaves powder weighed for 750 g was dissolved with ethanol solvents (materials : ethanol ratio = 1 : 7 b/v). Extraction of the sample was filtered with fine filter paper. The filtrate obtained was evaporated using a rotary vacuum evaporator at 40°C and 40 rpm until extract was obtained in the paste form (Ersalina *et al.*, 2020).

### Qualitative test of flavonoids compounds

As much as 2 mL of extract was added with 1 mL of 2 N NaOH. The presence of yellow color indicates the presence of flavonoids (Altemimi *et al.*, 2017).

### Qualitative test of alkaloids compounds

As much as 1 mL of extract was stirred with 5 mL of 1% aqueous HCl. Then a few drops of Dragendorff's reagent were added. The presence of green color or white precipitate indicates alkaloids' presence (Altemimi *et al.*, 2017).

### Qualitative test of phenolic compounds

As much as 0.05 g of the *P. alba* extract was put in the test tube, then mixed with 2 mL ethanol. The mixture was then added with two drops of 5% FeCl<sub>3</sub>. Positive reactions were indicated by black-green or blue color (Altemimi *et al.*, 2017).

### Determination of SPF value

The *P. alba* extract sample was weighed at 0.1 g and was dissolved in 10 mL ethanol p.a. Sample testing was conducted by measuring its absorbance using a

spectrophotometer at  $\lambda$  290-320 nm with a measurement interval of 5 mm. The SPF value was performed by using a constant set (Fonseca & Rafaela, 2013). The sample SPF value is calculated using the formula below (Cefali et al., 2019; Donglikar & Deore, 2016):

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

CF: Correction Factor; EE: Erythematous Effect; I: Spectrum of solar intensity at wavelength ( $\lambda$ ); Abs: Absorbance of sunscreen products at wavelength

## RESULTS AND DISCUSSION

### Preliminary phytochemical screening

Preliminary phytochemical screening was conducted to determine secondary metabolites content in *P. alba* extract. The test results can be seen in Table I, where *P. alba* extract is positive for flavonoids, alkaloids, and phenolics. This is in line with research conducted by (Gupta et al., 2016), where the *P. alba* extract tested also contained these secondary metabolites.

**Table I.** Qualitative phytochemical screening in *P. alba* extract

Reagent	Phytochemical	Results
NaOH	Flavonoids	+
Dragendorff's	Alkaloids	+
FeCl <sub>3</sub>	Phenolics	+

(+): presence of phytochemicals

### SPF value

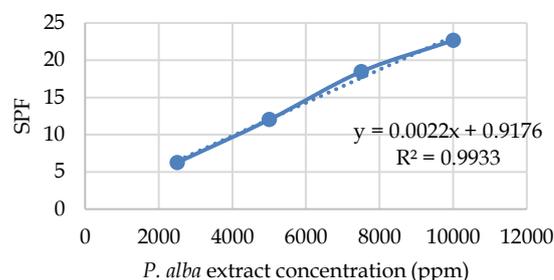
The SPF values of the *P. alba* extract obtained are presented in Table II. The sunscreen ability is categorized as classified by Wasitaatmadja (1997). From Table II, *P. alba* extract with 2500 ppm concentration can potentially be a sunscreen with an extra protection category. *Plumeria alba* extract with a concentration of 10000 ppm can potentially be a sunscreen with an ultra-protection category (Damogalad et al., 2013). *Plumeria alba* leaves extract has an SPF value due to its flavonoids, alkaloids, and phenolic contained in the extract. Phenol compounds have conjugated double bonds in the benzene ring. If it is exposed to UV light, the resonance

will occur in the form of electron transfer. Flavonoids and alkaloids have UV protective properties because of the presence of a chromophore group, which is considered as a conjugated aromatic system having the ability to absorb light rays in the UV wavelength range in both UV A and B (Becker et al., 2013; Costa et al., 2015; Laeliocattleya, 2019). The SPF value is then used to construct the regression curve, as shown in Figure 1. From Figure 1, a regression equation that serves to predict the resulting SPF value with a specific concentration can be obtained. The higher the concentration extract used, the higher the SPF value would be.

**Table II.** SPF value in *P. alba* extract

Extract concentration (ppm)	SPF value	Protection category*
2500	6.24 ± 0.55	Extra
5000	12.00 ± 0.88	Maximum
7500	18.45 ± 0.18	Ultra
10,000	22.64 ± 0.18	Ultra

\*Classification based on Wasitaatmadja (1997)



**Figure 1.** Regression curve of the SPF value of *P. alba* extract

Although at high concentrations *P. alba* extract can be categorized as ultra-protection, when compared to other plant extracts, the *P. alba* extract's SPF value tends to be relatively low. For example, research on SPF from the ethanol extract of *Curcuma mangga* reported by Yulianti et al. (2015) showed an SPF value of 35.12 from the extract at a concentration of 5000 ppm. Another study by Widyastuti et al. (2016) reported that the ethanol extract of *Fragaria ananassa* leaves at a concentration of 200 ppm showed an SPF value of 26.121. From the results of phytochemical screening in both studies, *C. mangga* and

*F. ananassa* extracts also contain the same secondary metabolites shown by *P. alba*, such as flavonoids, alkaloids, and phenolics that can act as sunscreens. The difference in the SPF value obtained is thought to be due to the quantitative difference in each secondary metabolite's amount of content.

## CONCLUSION

From the research results, it can be concluded that *P. alba* leaves extract has less potential as UV protection with an SPF value of 22.64 at 10000 ppm with ultra-protection category. For further research activities, it is necessary to test the phytochemical content of *P. alba* extract quantitatively and also to test the SPF value of this extract with the sunscreen base preparation.

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