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Potential of purple eggplant skin fraction (Solanum Melongena Var. Serpentinum L.) as an in vitro sunscreen

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ABSTRACT

Sunscreen is a product that is used as skin protection against sun exposure. The skin of purple eggplant is known to contain secondary metabolites which are used as sunscreens. This study aims to determine the activity of sunscreen fraction of the purple eggplant (Solanum melongena var. serpentinum L.) in vitro. Testing of sunscreen activity was carried out by calculating the value of SPF (Sun Protection Factor), %TE (Percent Transmission of Erythema) and %TP (Percent Transmission of Pigmentation) using the UV-Vis Spectrophotometry method. The purple eggplant skin fractionation method is by using LVC (Liquid Vacuum Chromatography). The results of the fractionation were identified using phytochemical screening and combined TLC. The fraction results were tested for SPF (Sun Protection Factor), %TE and %TP values. The results showed that the extract yield was 26.33%. The fractions used are fraction 9; 10; 11; and 12 which showed the same stain after being evaporated, which was a brownish yellow stain with a yield of 21,24%. The purple eggplant skin fraction (Solanum melongena var. serpentinum L.) has SPF, %TE and %TP values with optimal protection at a concentration of 400 ppm with each value obtained being 19; 1.35 and 9.79. The results of the statistical test of the purple eggplant skin fraction showed that the data were normally distributed but not homogeneous. The results of the homogeneity test for each concentration of results showed that the data were not significantly different.

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1. Introduction

When human skin is exposed to ultraviolet (UV) radiation, it is neither measurable nor visible to the naked eye, potentially leading to skin conditions such as sunburn and even skin cancer [1]. Sunscreen is used to reduce the absorption of UV rays by the skin [2]. Natural ingredients are considered safer and have lower side effects compared to chemical ingredients [3]. Sunscreen in the UV and infrared wavelength emission regions effectively absorbs sunlight. According to research, purple eggplant skin contains chemical compounds such as alkaloids, phenolics, saponins, and flavonoids [4]. The presence of H atoms in flavonoid compounds, N atoms in alkaloid compounds, hydroxyl groups in phenolic compounds, and saponins that can quench superoxide through the formation of hyperoxide intermediates indicate that these compounds can counteract free radicals, thereby having the potential as a sunscreen capable of absorbing UV rays [5].

This background led to the research on the sunscreen activity test with SPF (Sun Protection Factor) value, %Erythema Transmittance, and %Pigmentation Transmittance using UV-Vis Spectrophotometry.

2. Method

The test materials used were purple eggplant skin, 96% ethanol, n-butanol, acetic acid, distilled water, n-hexane, ethyl acetate, methanol, distilled water, tissue, aluminum foil, filter paper, cotton, TLC (Thin Layer Chromatography) plates, and silica gel 60 GF254.

The equipment used included a knife, blender, maceration bottle and cap, glass funnel, stirring rod, pipette, spatula, stand, clamp, digital balance, analytical balance, filter cloth, rotary evaporator, glassware, vials, TLC chamber, capillary tube, volumetric flask, volumetric pipette, measuring pipette, water bath, Vacuum Liquid Chromatography, vacuum pump, and UV-Vis Double Beam Spectrophotometer.

Purple eggplant skin was macerated, dried, and ground before being macerated using the maceration method with 96% ethanol in a ratio of 1:10 (raw material: solvent) for 3x24 hours [6]. After maceration, the mixture was filtered, and the filtrate was evaporated in a rotary evaporator at 50°C. The resulting concentrate was further concentrated using a water bath at 50°C to obtain a thick extract, which was then stored in an airtight container in the refrigerator.

Fractionation: Activate silica gel 60 GF254, insert filter paper and silica gel to approximately ¾ column height. Add the impregnated material and filter paper. Elution was performed using different ratios and collected according to the ratio. The first solvent added was n-hexane, followed by a mixture of n-hexane:ethyl acetate based on low to high polarity, and then methanol. The mobile phase ratios used are indicated in the table below.

Table 1. Comparison of mobile phases

No Eluen	Motion Phase	Comparison
1	n-heksan	100%
2	n-heksan : etil asetat	90:10
3	n-heksan : etil asetat	80:20
4	n-heksan : etil asetat	70:30
5	n-heksan : etil asetat	60:40
6	n-heksan : etil asetat	50:50

7	n-heksan : etil asetat	40:60
8	n-heksan : etil asetat	30:70
9	n-heksan : etil asetat	20:80
10	n-heksan : etil asetat	10:90
11	Etil asetat	100%
12	Metanol	100%

Determination of Purple Eggplant Skin Fractions

Combination TLC (Thin Layer Chromatography) was conducted using a mobile phase of glacial acetic acid: butanol: water (1:4:5), followed by visualization using ammonia vapor.

Testing of Compounds in Purple Eggplant Skin Extract and Fractions

The identification included phytochemical screening for compounds such as flavonoids, alkaloids, saponins, phenols, and anthocyanins.

Testing of Purple Eggplant Skin Fractions

Fractions were prepared as stock solutions with a concentration of 1000 ppm. The stock solution was then diluted to obtain test solutions. The concentrations of the test solutions were 100, 200, 300, 400, and 500 ppm [7]. Sunscreen activity testing was performed using a UV-Vis spectrophotometer.

The SPF values were read by measuring absorbance at 5 nm intervals within the wavelength range of 290 to 320 nm. %Erythema Transmittance (%TE) and %Pigmentation Transmittance (%TP) were measured at wavelengths causing erythema (290 – 320 nm) and pigmentation (320 – 375 nm), respectively, with 5 nm intervals for each measurement.

3. Results and Discussion

The process of using solvents to separate specific compounds is often referred to as extraction [8]. The extraction process was carried out using the maceration method with 96% ethanol as a solvent at a solvent-to-material ratio of 1:10. Solvent exchange, performed every 24 hours, was conducted for a total of 3 cycles. The use of 96% ethanol was chosen due to its semi-polar nature, allowing it to extract both polar and semi-polar compounds. The extraction yielded a 26.33% yield.

The extracted material underwent fractionation using Vacuum Liquid Chromatography. The fractionation process resulted in 12 fractions with different polarities using n-hexane, ethyl acetate, varying n-hexane:ethyl acetate ratios, and methanol as eluents. Increasing polarity during elution aimed to separate compounds based on their polarity. Following the extraction and fractionation, phytochemical screening was conducted [9].

The fractions selected from the Vacuum Liquid Chromatography were fractions 9, 10, 11, and 12, as they exhibited the same yellow-brownish color after evaporation using ammonia. Phytochemical screening results indicated the presence of flavonoids, alkaloids, saponins, and phenolics in both the extract and fractions. These compounds are known to have free radical-scavenging properties. Flavonoids play a role in scavenging free radicals due to their good chromophoric groups against free radicals [10]. Alkaloids can counteract free radicals as they contain nitrogen atoms with free electron pairs to neutralize free radical activity [5]. Phenolic compounds with hydroxyl groups can donate hydrogen to

neutralize electron deficiencies in free radicals [11]. Saponins exhibit antioxidant activity by quenching superoxide through the formation of hyperoxide intermediates, preventing biomolecular damage by free radicals [5].

Table 2. Test results of spf values for purple eggplant skin fractions (solanum melongena var. serpentinum l.)

Concentration	R1	R2	R3	Mean	Information
100 ppm	5.5760	5.6096	5.4443	5.54	Medium Protection
200 ppm	9.9538	10.2950	10.1533	10.13	Maximum Protection
300 ppm	14.6856	14.7353	14.5902	14.67	Maximum Protection
400 ppm	18.9499	18.9974	19.0467	19.00	Ultra Protection
500 ppm	24.7407	28.6681	25.1257	26.18	Ultra Protection

The SPF value testing was conducted within the wavelength range of 290 nm - 320 nm, with a 5 nm interval. The SPF value testing revealed that the higher the concentration of the purple eggplant skin fraction, the greater the protection provided. In other words, it becomes more effective as a sunscreen in protecting the skin from sunlight.

The determination of %Erythema Transmittance (%TE) was carried out within the wavelength range of 290-320 nm, which can cause sunburn because at these wavelengths, light can penetrate through the epidermal layer. The %Pigmentation Transmittance (%TP) value determination was conducted within the wavelength range of 320-375 nm, at 5 nm intervals, causing pigmentation or tanning. At these wavelengths, light can penetrate through the dermal layer, where the melanin layer of the skin is located. The testing results for %TE and %TP can be seen in Table 3.

Table 3. Test Results for %TE and %TP of Purple Eggplant Skin Fraction (Solanum melongenavar. serpentinum L.)

	Concentration	R1	R2	R3	Mean	Information
%TE	100 ppm	28.2012	27.5651	28.5236	28.0966	-
	200 ppm	10.4699	9.3663	9.7039	9.8467	Standard Suntan
	300 ppm	3.6508	3.3605	3.4242	3.4785	Extra Protection
	400 ppm	1.5020	1.3018	1.2487	1.3508	Sunblock
	500 ppm	0.4833	0.3581	0.2797	0.3737	Sunblock
	Concentration	**R1**	**R2**	**R3**	**Mean**	**Information**
%TP	100 ppm	41.0959	41.0383	41.7421	41.2921	-
	200 ppm	22.0853	22.7775	23.4554	22.7727	Sunblock
	300 ppm	14.6355	13.5055	14.7493	14.2968	Sunblock
	400 ppm	10.2747	9.4137	9.6865	9.7917	Sunblock
	500 ppm	7.6955	7.7481	7.7093	7.7176	Sunblock

Purple eggplant skin fraction (Solanum melongena var. serpentinum L.) exhibits potential sunscreen activity, producing low values of %Erythema Transmittance (%TE) and %Pigmentation Transmittance (%TP) at optimal concentrations. Based on the data obtained from %TE and %TP testing, it is evident that compounds in purple eggplant skin can absorb ultraviolet (UV A) and (UV B) rays, thereby preventing skin damage caused by sunlight. Normality testing indicates that SPF, %TE, and %TP values have normally distributed data. Homogeneity testing results for %TE and %TP values show homogeneous distribution, while SPF values indicate non-homogeneous distribution, prompting further Mann-Whitney testing.

The Mann-Whitney test results indicate that concentrations of 100, 200, 300, 400, and 500 ppm show no significant differences as the Asymp. Sig values are ≥ 0.05. One-Way ANOVA results demonstrate that SPF, %TE, and %TP values produce Sig. values <0.05, indicating differences among concentrations.

4. Conclusion

There is Sunscreen Activity in the Purple Eggplant Skin Fraction (Solanum melongena var. serpentinum L.) in vitro. There are Differences in Sunscreen Activity of Purple Eggplant Skin Fraction (Solanum melongena var. serpentinum L.) at Concentrations of 100, 200, 300, 400, and 500 ppm. The Purple Eggplant Skin Fraction (Solanum melongena var. serpentinum L.) has an SPF (Sun Protection Factor) Value with Ultra Protection at a Concentration of 400 ppm, providing optimal protection with an SPF value of 19. The purple eggplant skin fraction (Solanum melongena var. serpentinum L.) has %Erythema Transmittance (%TE) and %Pigmentation Transmittance (%TP) with optimal sunblock protection in the 400 ppm concentration category, with %Erythema Transmittance at 1.35 and %Pigmentation Transmittance at 9.79.

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