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Research Article

Sun Protection Factor Activity of Jamblang Leaves Serum Extract (*Syzygium cumini*)

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ABSTRACT

Background: The development of serum preparations containing natural ingredients for sun protection is growing rapidly. Jamblang (*Syzygium cumini*) leaves are rich in phenolic compounds that can inhibit free radicals causing premature aging. Therefore, this study aims to determine the potential of *S. cumini* serum extract as sun protection. **Methods:** The extract was prepared and included in the serum base. The formulations were evaluated for rheological, pH, dispersion coefficient, and stability examinations. Furthermore, Sun Protection Factor was tested using a UV-Vis spectrophotometer. **Results:** The test of phytochemical compounds showed the presence of alkaloids, flavonoids, polyphenols, tannins, saponins, quinones, monoterpenoids, sesquiterpenoids, triterpenoids, and steroids. The result also showed that all serum formulations met the predetermined requirements. Furthermore, the extract has protective activity against ultraviolet rays, which was indicated by the SPF value. The higher the dose of *S. cumini* extracts in the serum formulation, the higher the value obtained. Formulations 1, 2, and 3 have SPF of 9.35±0.11, 13.26±0.16, and 26.05±0.31, respectively. This indicates that they all met the Indonesian National Standard, that a sun protection preparation must have a minimum protection factor of 4. **Conclusion:** *S. cumini* extract serum has the potential to be developed as a new sun protection agent against ultraviolet radiation. However, further studies are still needed to determine the mechanism of its constituent active compounds.

Key words: *Syzygium cumini,* Serum, Sun Protection Factor, Ultraviolet.

INTRODUCTION

The skin is the outermost organ, which makes up the human body and covers the entire surface, hence, it is very vulnerable to receiving adverse effects from the external environment, such as exposure to ultraviolet (UV) radiation.[1] Excessive exposure to UV radiation can cause skin damage, leading to sunburn, cancer, oxidative stress, and photoaging, which depends on the amount and form of ray, as well as the type of individual exposed.[2] Consequently, most products, such as lotions, moisturizers, shampoos, creams, and other skin preparations contain sun protection that can reduce the harmful effects of these rays. The effectiveness of the protective component is indicated by the value of the sun protection factor (SPF). SPF is defined as the UV energy required to produce a minimal erythema dose (MED) on the protected skin, divided by the UV energy required to produce a MED on unprotected skin.[3] MED is defined as the lowest time interval or a dose of UV irradiation that is sufficient to produce a minimal visible erythema effect on unprotected skin.[4] The higher the SPF value, the more the protection provided against sun radiation. Recent studies revealed that sun protection materials cannot completely protect the skin from exposure these radiations.[1] Therefore, it is important to search for potential new compounds, which can be derived from natural ingredients. Previous studies revealed that natural compounds can be used as potential sources due to their absorption in the UV region as well as antioxidant activity.[5,6] Antioxidant compounds provide increased protective activity against these rays. They also have the potential to be used for the treatment and prevention of UV radiation-mediated diseases.[7]

Indonesia has the second largest biodiversity in the world with forest areas containing approximately 28,000 plant species, of which 2,500 have potential medicinal properties,[8,9] such as Jamblang plant (*Syzygium cumini*). This plant is widely used as a natural sun protection and a cosmetic ingredient, but it has to be processed into serum form because its direct use on the skin is considered less effective. Therefore, this study aims to determine the Sun Protection Factor (SPF) activity of *S. cumini* serum extract.

MATERIALS AND METHODS

Plant determination and extraction

A total of 1 kg of fresh *S. cumini* leaves were obtained from Anggadita Village, West Java, Indonesia. The samples were then transported to the phytochemical and pharmacology laboratory, University of Buana Perjuangan Karawang for cleaning, drying, grinding, and extraction. The plant was identified at the UPT Laboratory of Herbal Materia Medica Batu, Malang, East Java, Indonesia. A total of 300 grams of *S. cumini* powder was macerated with 70% ethanol for 3x24 hours. Subsequently, the liquid extract was collected and concentrated at 50°C using a rotary evaporator (Eyela OSB-2100).

Phytochemical screening

S. cumini extract was screened qualitatively to identify the presence of secondary metabolites, such as alkaloids, flavonoids, tannins, saponins, polyphenols, and steroids/triterpenoids.[10]

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Serum preparation

Serum preparations containing ethanolic extract of *S. cumini* leaves were prepared based on the predetermined formula.[11] Hydroxyethyl cellulose was dissolved in water at 50°C and mixed with sodium EDTA. The mixtire was then stirred constantly while maintaining the temperature to form a gel mass (mass I). Furthermore, sodium benzoate was dissolved in water at 50°C (mass II), and added slowly to mass I, followed by stirring until it became homogeneous (mass III). The mixture was then mixed with glycerin with continuous stirring until it became homogeneous (mass IV). The ethanolic extract was dissolved in propylene glycol based the formulation with a known concentration. The prepared mixture was placed into mass IV, and stirred until it became homogeneous. The composition of serum preparations used in the study is presented in Table 1.

Table 1: Serum formulations of *S. cumini* extract.

Ingredient	Concentration (%b/v)			
	Blank	F1	F2	F3
S. cumini extract	-	0.5	0.8	1.1
Hydroxyethyl cellulose	0.8	0.8	0.8	0.8
Sodium EDTA	0.005	0.005	0.005	0.005
Glyserin	8	8	8	8
Propylene glycol	8	8	8	8
Sodium benzoat	0.1	0.1	0.1	0.1
Aquadestilata	100 ml	100 ml	100 ml	100 ml

Physical examination

The prepared serum formulation was visually examined for its color, appearance, and consistency.[12]

Rheological study

Viscosity test was carried out on several serum formulations using a cone and plate viscometer with spindle 7 (Lamy Rheology, France). The assembly was connected to a thermostatically controlled water bath and maintained at 25°C. The formulation was then placed in a glass covered with a thermostatic jacket. Subsequently, the spindle was allowed to move freely into the serum and the results were recorded. The test was carried out at 100 rpm for 10 minutes.[13]

pH test

The pH of several serum formulations was measured using a pH meter (NeoMet, istek inc, Seoul). The formulations were placed in the container, after which the electrode was inserted into the container and the results were recorded.[14]

Spreading coefficient

The dispersion coefficient was determined by placing 1 g of the serum formulation on a transparent glass lined with graph paper. It was then covered with a glass plate, after which a load of 5-30 grams was exerted, and it was allowed to stand for 60 seconds. The calculation was made on the area given by the serum formulation. Shorter distance intervals indicated better dispersion coefficients.[11]

Stability test

Serum stability test using the Frezz and Thaw accelerated stability method was carried out by storing serum preparations of *S. cumini* extract at a low temperature of 4°C and a high temperature of 40°C for 16 days (4 cycles). The parameters observed were organoleptic examination, pH, and dosage viscosity.[11]

Sun protection factor (SPF) test

A total of 1 g of serum formulation was dissolved in 100 ml of ethanol p.a, followed by filtration. Subsequently, 4 ml of the solution was placed into the cuvette to determine the SPF value using a UV-Vis spectrophotometer (Shimadzu UV Mini-1240) at wavelengths of 290, 295, 300, 305, 310, 315, and 320 nm. It was then compared to ethanol as a blank with 4 repetitions. The SPF value was determined using the Mansur equation as follows:[15]

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

Where:

CF = 10 (correction factor).

EE = Erythemaous radiation effect spectrum.

I = Sunlight intensity spectrum.

Abs = Absorbance value of sunscreen products.

Statistical analysis

The experimental results were expressed as the mean±standard deviation (SD) of the four replicates. Furthermore, data were analyzed using SPSS (version 22) with one-way analysis of variance (ANOVA).

RESULTS AND DISCUSSION

Plant determination and *S. cumini* extraction

The plant was identified as *Syzygium cumini* at the UPT Laboratory of Herbal Materia Medica Batu, Malang, East Java, Indonesia with reference number 074/043/102.7-A/2022.

Taxonomic classification

Kingdom : Plantae

Phylum : Tracheophyta

Class : Magnoliopsida

Order : Myrtales

Family : Myrtaceae

Genus : Syzygium P. Br. ex Gaertn.

Species : *Syzygium cumini* (L.) Skeels

S. cumini extraction produced a concentrate of 87.75 g, which is equivalent to 29.25% yield. This was obtained by dividing the fixed weight of extract by the weight of simplicia, multiplied by 100%.

Phytochemical screening

Phytochemical screening of *S. cumini* extract revealed the presence of chemical elements such as alkaloids, flavonoids, polyphenols, tannins, saponins, quinones, monoterpenoids, sesquiterpenoids, triterpenoids, and steroids. A summary of the phytochemical screening of *S. cumini* extract is presented in Table 2.

Physical examination

The prepared serum formulations were visually examined for their color, appearance, and consistency, as shown in Table 3 and Figure 2.

Rheological study

The viscosity test on all serum formulations showed a change in each samples, namely F0 = 386 Cps, F1 = 534 Cps, F2 = 694 Cps, F3 = 750 Cps. However, these changes were still within the range that met the requirements. The desired viscosity was between 200-1200 cPs because

Table 2: **Phytochemical screening of *S. cumini* extract.**

Phytochemical compounds	Results
Alkaloids	+
Flavonoids	+
Polyphenols	+
Tannins	+
Quinones	+
Saponins	+
Monoterpenoids and Sesquiterpenoids	+
Triterpenoids and Steroids	+

(+) = Contained, (-) = Not contained.

Table 3: **Physical parameters of the *S. cumini* extract serum formulation.**

Formulation	Color	Homogeneity	Consistency
F0	Clear	Excellent	Excellent
F1	Brown	Excellent	Excellent
F2	Brown	Excellent	Excellent
F3	Brown	Excellent	Excellent

Figure 1: Jamblang Leaves (*Syzygium cumini* (L.) Skeels).

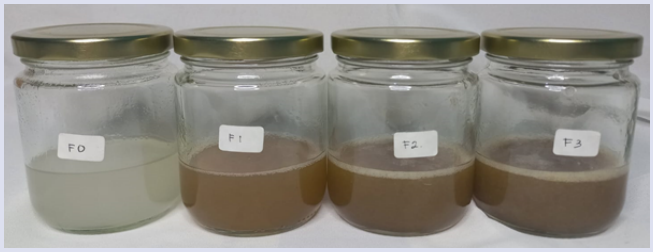

Figure 2: Serum formulations of *S. cumini* extract.

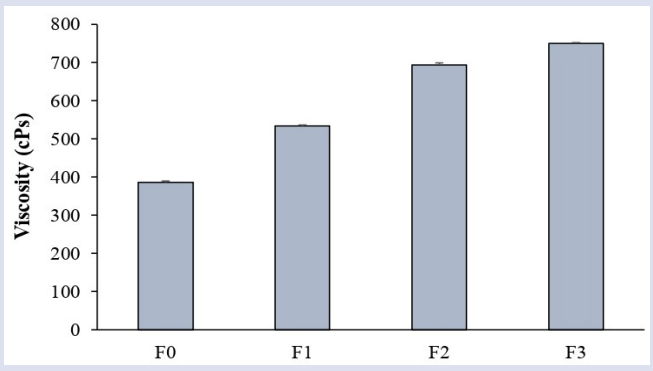

Figure 3: Viscosity of the formulations F0-F3 (mean ± SD).

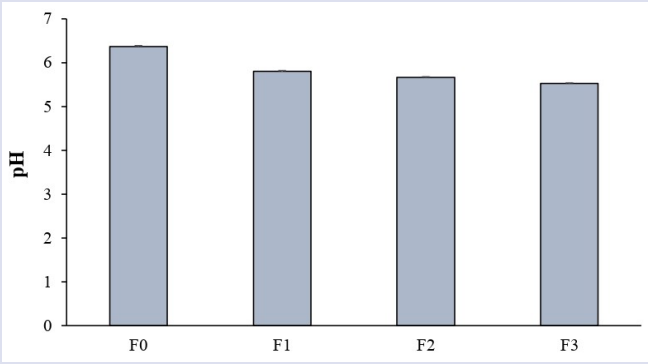

Figure 4: pH value of the formulations F0-F3 (mean ± SD).

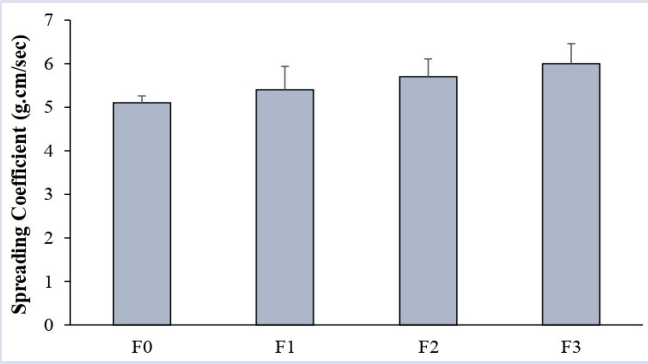

Figure 5: Spreading coefficient of the formulations F0-F3 (mean ± SD).

it can guarantee a longer contact period with the skin.[16] The rheology test is presented in Figure 3.

pH test

The pH value of a topical preparation must match the skin pH, namely 4.5-6.5. Extremely acidic values cause skin irritation and while extreme alkaline levels make the organ scaly.[16] The measurement for F0, F1, F2, and F3 showed average values of 6.37, 5.80, 5.66, and 5.53, respectively. This indicates that all formulations met the pH testing requirements, as shown in Figure 4.

Spreading coefficient

Good dispersion is an indicator that a serum sample is easy to apply. The dispersion test aims to determine the speed of spread and softness of the preparation on the skin.[17] Based on the results, there was no significant difference in the value of each formulation, namely F0 = 5.1 cm, F1 = 5.4 cm, F2 = 5.7 cm, F3 = 6.0, as shown in Figure 5. Therefore, all the formulations met the dispersion requirements, namely between 5-7 cm in diameter.[17]

Stability test

The stability test ensures that the serum samples have the same properties and meet the criteria parameters during storage. In this study, the test was carried out to obtain the optimum formulation of *S. cumini* serum extract in a short time by storing the samples in conditions designed to accelerate changes that usually occur under normal conditions.[18] The stability test results are presented in Table 4.

Sun protection factor (SPF)

SPF is a measure of protection from UV radiation, where the higher the SPF value, the higher the protection against the rays. This value can be

Table 4: Stability test of *S. cumini* serum extract.

Storage time (cycle)	Formulations	Physical observation			
		Color	Homogeneity	Form	Consistency
0	F0	Clear	Excellent	Liquid	Excellent
	F1	Brown	Excellent	Liquid	Excellent
	F2	Brown	Excellent	Liquid	Excellent
	F3	Brown	Excellent	Liquid	Excellent
1	F0	Clear	Excellent	Liquid	Excellent
	F1	Brown	Excellent	Liquid	Excellent
	F2	Brown	Excellent	Liquid	Excellent
	F3	Brown	Excellent	Liquid	Excellent
2	F0	Clear	Excellent	Liquid	Excellent
	F1	Brown	Excellent	Liquid	Excellent
	F2	Brown	Excellent	Liquid	Excellent
	F3	Brown	Excellent	Liquid	Excellent
3	F0	Clear	Excellent	Liquid	Excellent
	F1	Brown	Excellent	Liquid	Excellent
	F2	Brown	Excellent	Liquid	Excellent
	F3	Brown	Excellent	Liquid	Excellent
4	F0	Clear	Excellent	Liquid	Excellent
	F1	Brown	Excellent	Liquid	Excellent
	F2	Brown	Excellent	Liquid	Excellent
	F3	Brown	Excellent	Liquid	Excellent
pH parameters	**Storage time (cycle)**	**pH test**			
		F0	**F1**	**F2**	**F3**
(4.5-6.5)	0	6.42	5.91	5.76	5.70
	1	6.44	5.81	5.71	5.56
	2	6.42	5.73	5.56	5.43
	3	6.39	5.83	5.66	5.47
	4	6.19	5.75	5.60	5.50
Viscosity parameters	**Storage time (cycle)**	**Viscosity test**			
		F0	**F1**	**F2**	**F3**
(200-1200 cPs)	0	522	868	1179	1200
	1	407	531	808	813
	2	319	450	583	607
	3	342	380	457	495
	4	340	443	443	565

Table 5: Category of SPF value effectiveness of *S. cumini* serum extract.

Sample	Sun Protection Factor Value	Effectiveness
F0	0.83±0.01	Have not protection
F1	9.35±0.11	Maximum protection
F2	13.26±0.16	Maximum protection
F3	26.05±0.31	Ultra protection

used to determine the efficacy and effectiveness of sun protection.[19,20] The SPF value of *S. cumini* extract serum is presented in Table 5.

The effectiveness of UV protection of *S. cumini* extract serum showed differences in each formulation due to the different dosages of the extract. This was due to the different dosages of *S. cumini* extract from each formulation. The higher the dose in the serum formulation, the higher the SPF value. Therefore, F1, F2, and F3 met the Indonesian National Standard, that sun protection preparation must have a minimum SPF of 4. This is because most Indonesians have skin types IV and V, and the recommended value is 5-15.[21] The protective effect against UV is due to the flavonoid compounds in the extract, which have protective activity from ultraviolet radiation.[1] Several studies revealed that flavonoids can inhibit UVB-induced H_2O_2 formation in keratinocytes and reduce malondialdehyde levels after exposure to sunlight (UVB).[22,23] Meanwhile, a previous study reported that the use of topical photoprotective agents can significantly reduce lifetime UV exposure on the face compared to when it is not used. It can also prevent skin lesions in cutaneous lupus erythematosus (CLE) induced by these rays.[24-27]

CONCLUSION

This study showed that the *S. cumini* extract met the requirements of the serum formulation. It also has protective activity against UV rays, as indicated by the SPF in each formulation, where the higher the dose of *S. cumini* extract, the higher the value obtained. Based on these results, formulations 1, 2, and 3 met the Indonesian National Standard. This indicates that the serum extract has the potential as a new sun protection agent against ultraviolet radiation. However, further study must be carried out to determine the mechanism of action of the active compounds contained in *S. cumini*.

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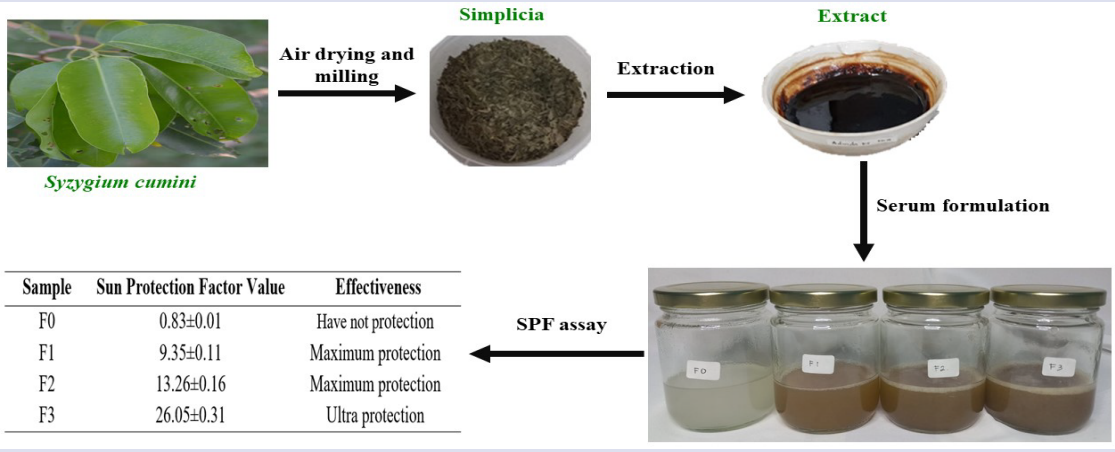
GRAPHICAL ABSTRACT



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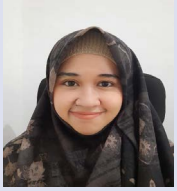

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