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Spray Gel Formulation of Ethanolic Extract Senduduk Leaves (*Melastoma malabatricum*) Against Antioxidant Activity, SPF, and Chemical Components Analysis with LC-MS/MS

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Abstract—Senduduk leave (*Melastoma malabathricum*) is one of the species in the melastomaceae family that has long been used by local Indonesian people, one of which is the Suku Anak Dalam (SAD) for various needs and also as traditional medicine. The study aimed to examine the antioxidant activity of ethanolic extract of senduduk leaves. The extract was then formulated into spray gel preparations as UV-B sunscreen. The research method used was starting from sampling, determination, making samples, soxhlet, determining the IC_{50} value, spray gel preparation formulation, formulation stability test, measuring sun protection factor (SPF) values, and identifying extract chemical components with the LC-MS/MS instrument. The results was that the ethanolic extract of senduduk leaves had an IC_{50} value of 49.73 µg/mL with the best SPF value at a concentration of 70 ppm, which is 19.98. Spray gel preparations with a concentration of 70 ppm have an IC_{50} value of 44.22 µg/mL, an SPF value of 24.96, and a potent antioxidant intensity. So, extract spray gel can potentially have activity as antioxidants and can be used as UV-B sunscreen. The compounds identified include quercetin, quercitrin, DEET, n-boc-3-pyrrolidinone, medicarpine, taxinine, and other compounds. The ethanol extract of the soxhlet results showed more promising results for further tests of in-vitro, in-vivo, and in-silico bioactivity studies.

Keywords— *Antioxidant; LC-MS/MS; Melastoma malabathricum; Spray gel formulation; Sun protective factor (SPF).*

1. INTRODUCTION

Melastoma malabathricum is a species in the melastomaceae family that has long been used by the Suku Anak Dalam (SAD) as a traditional medicine. Suku Anak Dalam (SAD) uses it to overcome diarrhea [1-2]. *Melastoma malabathricum* is found in Southeast Asia. This plant includes shrubs that grow wild in swampy, grassland, and forest areas and has many properties as traditional medicine [3]. Various parts of the senduduk plant can be used to treat various diseases [4-7]. Traditionally, the leaves of this plant can be used as a remedy for diarrhea, dysentery, infection, inflammation, postpartum care, and hemorrhoids [8-9].

The body needs antioxidants to prevent or delay cell damage due to oxidant oxidation processes [10-12]. Antioxidants able to ward off free radical compounds sourced from cigarette smoke, radical-triggering substances in food, and the results of ultraviolet (UV) irradiation [13-14]. Ultraviolet (UV) rays on the skin can cause sunburn, erythema, pigmentation, premature aging, and skin cancer. Ultraviolet (UV) light is the part of sunlight that is an electromagnetic wave [15] which is generally divided into three categories based on wavelength: UV-A (320-400 nm), UV-B (290-320 nm), and UV-C (200-280 nm). So efforts are needed to protect the skin which is the outermost protection of the body, one of which is by using sunscreen [16].

Sunscreen should be used every 2-4 h daily to prevent UV rays' effects. It must be chosen in a suitable dosage form and easy to use [17]. Topical dosage formulations have now developed a lot, including the development of topical preparations for sunscreens and spray gel. The dosage form of spray gel has the advantage of being easier to use, preventing contamination of microorganisms because it is used by spraying without contact with hands [18].

Liquid chromatography-mass spectrometry (LC-MS) is a combination analysis technique of liquid chromatography as a separator of analyte components in a sample, with mass spectrometry as a detector. This method uses two mass analyzers arranged sequentially with a collision cell (collision cell) between

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them. A mass analyzer selects a specific mass-to-charge (m/z) ratio. The mass analyzer first analyzes the m/z ratio of the parent ion, then in the coalition cell, the parent ion collides with the gas molecule and fragments into smaller ions and obtains the m/z ratio in the second mass analyzer as product ions [19]. Another benefit of LC-MS is the ability to perform multicomponent analysis simultaneously, identifying and measuring multiple analyzed analytics simultaneously. The ability to analyze multicomponents can reduce costs, especially in sample preparation in biological matrices.

2. EXPERIMENTAL SECTION

The research was starting from the preparation of instrument and materials, sampling, determination, making samples, soxhlet, identification of extraction results with LC-MS/MS, antioxidant activity tests using the DPPH method, then formulated into spray gel preparations and antioxidant activity tests, as well as evaluating the physical properties of spray gel preparations which include organoleptic tests, homogeneity tests, viscosity tests, pH test, sticky dispersion test, spraying pattern test and stability test.

2.1. Materials

The materials used in this research were senduduk leaves, n-hexane (PT. Dwilab Mandiri Scientific), ethyl acetate (PT. Dwilab Mandiri Scientific), n-Butanol (PT. Dwilab Mandiri Scientific), Ethanol 96% (Emsure), DPPH (Sigma Aldrich TCI),® Ascorbic Acid (Emsure®), Hydroxypropyl Methyl Cellulose (Making Cosmetics), Carbopol 940 (Lubrizol), Propylene Glycol (PT. Brataco), Dimethylodimethyl Hydantoin (Nguyen BA), and Aquadest (PT. Brataco).

2.2. Instrumentations

The instrument used in this research consist of Soxhlet (Pyrex®), Rotary Evaporator (Buchi®), Waterbath (Six Hole Electric®), UV-Vis Spectrophotometer (Shimadzu UV-1800®), Ultra Performance Liquid Chromatography (UPLC) unit (LC System: ACQUITY UPLC®H-Class System, waters, USA) and mass spectrophotometry (Xevo G2-S Qtof, waters, USA), Analytical Balances (Ohauss®), Measuring Flask, Vial, Cuvette, Beaker Glass, Spray Bottle, Glass Plate, Watch Glass, Viscometer, pH Meter, Stopwatch, Oven, Refrigerator.

2.3. Sample Preparation

The leaf samples used were obtained in Telanaipura, Jambi Province. The sample used was part of a senduduk leaf obtained from Jambi. Determination of plant samples was carried out at the Plant Systematics Laboratory, Faculty of Biology, Gadjah Mada University by bringing all parts of the plant with an identification number No.0316/S.Tb./V/2023. Determining aims to ensure that the plant is a species of (*Melastoma malabatrhicum* L.). Fresh simplisia is washed under running water and then dried. Next, the samples were chopped and stored in a clean container.

2.4. Soxhlet Extraction

Extraction by the soxhlet method was carried out on the sample. The crushed senduduk leaves were wrapped using filter paper. N-hexane, ethyl acetate, n-butanol, and 96% ethanol were used as solvents in soxhlet extraction. Soxhlet equipment was heated with a heating mantle. The extraction process is stopped if the solvent in the extraction tube has cleared [20-21]. All obtained filtrates were collected. Then, the results of ethanol extract filtrate 96% of the soxhlet results obtained were concentrated with a rotary evaporator instrument and dried with a water bath [22-24]. The results obtained were weighed in weight, then calculated the yield with the equation (1).

$$\%\ Yield = \frac{Extracted\ weights}{Weight\ gained}\ x\ 100\% \quad (1)$$

2.5. Spray Gel Formulation

The preparations spray gel formulation were based on formula that can be seen in **Table 1**. HPMC, carbopol 940, propylene glycol, DMDM hydantoin, and aquadest were used in up to 100 parts of formulation designs. The active substance in 96% ethanol soxhlet method extraction was added to the formulation design [25-26].

Table 1. Spray gel formula design [25]

Material	Used	F0 (%)	F1 (%)
The ethanol fraction of senduduk leaves	Active ingredients	0	x
Hydroxypropyl methylcellulose (HPMC)	*Gelling agent*	0,1 %	0,1 %
Carbopol 940	*Gelling agent*	0,1 %	0,1 %
Propylene glycol (PEG)	Humectants	15 %	15 %
DMDM Hydantoin	Preservatives	0,1 %	0,1 %
Aquadest	Solvent	ad. 100	ad. 100

The ingredients were weighed according to the formula. HPMC was added with hot water at 80-90 °C and homogenized until a transparent gel mass was formed in beaker glass. Carbopol 940 was added with hot water and stirred until a transparent gel mass forms on different beaker glass. Both mixtures were put in 1 container, stirring until homogeneous. The senduduk leaf extract was put in different mortars, added with propylene glycol, and stirred until homogeneous. The masses was mixed and then into a beaker DMDM hydantoin was added. The prepared result was poured into a spray bottle, added aquades ad 100 mL, and shaken until homogeneous [25-29].

2.6. SPF Value Measurement

The SPF value was determined using a UV-Vis Spectrophotometer. The ethanol extract of senduduk leaves/spray gel preparation was weighed as much as 10 g, then put into a 100 mL measuring flask and diluted with ethanol. Then, in a pipette, 5 mL was put into a 50 mL measuring flask then diluted with ethanol until homogen. The solution obtained was measured with a UV-Vis spectrophotometer at wavelengths (290-320 nm) every 5 nm interval with ethanol as a blank [17, 30-32]. The absorbance result was recorded, and then the SPF value is calculated using the Mansur equation (Eq. 2). The sunscreen effectiveness was categorized based on SPF value (**Table 2**).

$$SPF = CFX \sum_{290}^{320} EE\,(\lambda) \times 1\,(\lambda) \times A\,(\lambda) \qquad (2)$$

Where *CF* is correction factor, *EE* is erythremal effect, I is intensity, *A* is sample absorbance.

Table 2. Sunscreen effectiveness based on SPF value [31-32]

SPF	Sunscreen Protection Category
2 – 4	Minimal protection
4 – 6	Medium protection
6 – 8	Extra protection
8 – 15	Maximum protection
≥ 15	Ultra protection

2.7. Evaluation of Physical Properties of Spray Gel Formulations

Organoleptic. Organoleptic evaluation was conducted by observing the physical appearance of spray gel preparations in the form of color, olor, and texture. This test was carried out by spraying the preparation on a dry, clean watch glass. The criteria for a good spray gel preparation were transparent or clear and not cloudy [17,25,30].

Homogeneity. The preparation is taken in a small amount and applied to the glass of the preparation, and after that, it is observed under a microscope with a magnification of 40× to see whether or not there are lumpy particles. The homogeneity test aims to determine the mixing of ingredients in spray gel preparations because the preparation must not contain coarse particles or lumps when touched [17,25,30].

Viscosity. The 100 mL of sample was put in the Brookfield Viscometer with a spindle of 61 and a speed of 12 rpm. The viscosity result was recorded after the number on the viscometer stabilizes. Suitable viscosity for spray gel preparations has a range of 500-5000 cPs [17,25,30].

pH. The pH value of the preparation was measured using a pH meter. The pH meter electrode was dipped in spray gel and left to stabilize. The pH value that appears on the screen was recorded. pH checking was carried out to observe the pH stability, whether it was still within the pH requirement range of topical preparations or not [4,5-7], to ensure that the preparation will not irritate the skin [17,25,30].

Spraying pattern. The spraying pattern test was carried out by spraying gel on a sheet of mica plastic already known to weigh at distances of 5, 10, 15, and 20 cm. Then, the mongering time was measured using a stopwatch, and mica plastic was weighed after spraying. In this test, the spray formation pattern was observed as the diameter of the spray pattern formed and the amount of preparation that comes out in grams. The criteria for spray gel spraying patterns were that the preparation can be sprayed and the particles formed are small and evenly distributed [17,25,30].

Stability. The stability test of the gel preparation was carried out by observing organoleptic changes, pH, and homogeneity carried out on each preparation during storage for three cycles [17,25,30].

2.8. Antioxidant Activity

Ascorbic acid was used as comparison (λ_{max} 265 nm), and ethanol 96% was used as the solvent. Then, a calibration curve was made with the order of concentration: 30, 40, 50, 60, and 70 ppm. UV-Vis spectrophotometer instrument was used in this measurement. Further, DPPH (1,1-diphenyl-2-picrylhydrazil) (λmax 517 nm) was used to determine the antioxidant activity of samples [33-35]. The calculation of the IC_{50} value was carried out on the soxhlet sample with ethanol 96% solvent and the results of the spray gel preparation formulation. The IC_{50} value is measured by calculating the inhibition percent through equation (3). The level of antioxidant activity in the DPPH method has been categorized accordingly IC_{50} value (**Table 3**) [36].

$$\%\,Inhibition = \frac{(abs\ blanks - abs\ Sample)}{abs\ blanks}\ x\ 100\% \qquad (3)$$

Table 3. The level of antioxidant activity in the DPPH method

Antioxidant intensity	IC_{50} value
Very High	<50 ppm
High	50-100 ppm
Medium	100-150 ppm
Low	>150 ppm

2.9. Analysis of Chemical Compounds by LC-MS/MS

Soxhlet samples of ethanol 96% extract were prepared by the SPE method (Solid Phase Extraction) [37-38]. LC-MS/MS analysis was performed by Ultra Performance Liquid Chromatography (UPLC) unit (LC System: ACQUITY UPLC®H-Class System, waters, USA) and mass spectrophotometry (Xevo G2-S Qtof, waters, USA). The column type used was ACQUITY UPLC® HSS C18 (1.8 µm 2.1×100 mm, waters, USA) at temperatures of 50°C (column) and 25°C (room). LC analysis was used eluent A that consist of water and ammonium formate (99.9 : 0.1 ratio), and eluent B that consist of acetonitrile and formic acid (99.9: 0.1 ratio) with a flow

rate of 0.2 mL/min (step gradient) for 23 min and the injected volume was 5 µL (sample filtered through filter 0.2 µm first) [39]. The gradient elusion ratio has been presented in **Table 4.**

Table 4. Gradient elusion system ratio

Time (min)	Flow rate (mL/min)	Eluent A (%)	Eluent B (%)
0.00	0.200	95.0	5.0
2.00	0.200	75.0	25.0
3.00	0.200	75.0	25.0
14.00	0.200	0.0	100.0
15.00	0.200	0.0	100.0
19.00	0.200	95.0	5.0
23.00	0.200	95.0	5.0

Mass spectrometry analysis was performed using electrospray ionization in positive mode with an analysis mass range of 50 – 1200 m/z and source temperature and desolvation of 100°C and 350°C, respectively. Furthermore, cone gas flow rates and desolvations were 0 L/h and 793 L/h. The collision energy used was 4 volts (low energy), and the collision energy is 25-60 volts (high energy). The software used for interpretation, acquisition, analysis, and control of instruments is "Masslyx vers 4.1".

3. RESULT AND DISCUSSION

Ethanol solvent was used for soxhlet because it highly available, efficient, environmentally safe, and have a high extraction rate [37]. The viscous extract obtained from the extraction results using the soxhlet method was then calculated as the yield value. Yield was the weight value of viscous extract obtained compared to the weight of samples used [40]. Determining the percent yield value aims to compare extract results against the resulting samples. The viscous extract of senduduk leaves obtained was 5.750 g from 285.71 g of senduduk leaf samples (yield 1.75%).

The compound content in the extract is still in the form of complex compounds (impure), while vitamin C is a pure compound [41]. In this situation, it can be interpreted that the ethanol extract of senduduk leaves and vitamin C can ward off free radicals. This can be seen from the ability of the ethanol extract of senduduk leaves to reduce free radical compounds in DPPH in this study, which is less stable and less optimal, while the ability of vitamin C to reduce free radical compounds in DPPH in this study was optimal.

Determination of Sun Protection Factor (SPF) value of senduduk leaf extract was carried out in vitro using a UV-Vis spectrophotometer with a 290 nm – 320 nm wavelength. This wavelength represents the wavelength of UV-B light in the erythrogenic region that can cause sunburn. UV-B rays were a group of harmful rays that can cause damage faster and easier than UV-A rays [17,30,31].

SPF value measures the length of time sunscreen can last under light without damaging the skin. The higher the SPF value, the more effective it to protect the skin from the adverse effects of UV rays. Based on in vitro sunscreen activity tests using UV-Vis Spectrophotometry. The result at SPF was 16.07; 17.02; 19.05; 19.58; 19.98 with concentration order 30, 40, 50, 60, 70 ppm respectifully. The best SPF value founded in ethanol extracts with concentrations of 70 ppm was 19.98 (**Table 6**). All concentrations tested have sunscreen activity with SPF values above the range of >15 in the category of ultra protection, the most prolonged protection (**Table 2**) [17,30-32]. Based on the results, the ethanol extract of senduduk leaves has excellent potential as a sunscreen.

The ethanol extract of senduduk leaves was formulated as the active substance of spray gel and tested antioxidants with concentrations of 70 ppm, which had an IC_{50} value of 49.73 µg/mL with powerful antioxidant intensity. The results of the organoleptic test obtained a formula made in semi-solid form. Furthermore, spray gel preparations were carried out homogeneity tests, which aim to determine whether the ingredients used in manufacturing have been mixed well. In the homogeneity test result, there was no coarse grains in all spray gel formulas [25,27,28,42,43].

An organoleptic examination was carried out to observe the color of the texture of the spray gel preparation that has been made. The resulting spray gel preparation is semi-solid, has a characteristic odor, and cloudy brown in color. The homogeneity test was a reasonably necessary parameter in cosmetic preparation because this parameter shows the level of fineness of the resulting preparation. The preparation was considered homogeneous if there is an even color equation and no refined grains found [44]. For spray gel preparations and comparison bases, there was no grains found on the object glass, so spray gel preparations and comparison bases have good homogeneity.

The soxlet ethanol extract was identified by LC-MS/MS to provide information about the molecular weight, structure and identity of specific sample components. Compounds were separated based on relative interaction with the chemical layer of particles (stationary phase) and solvent elution through a column (mobile phase) [45]. LC-MS/MS results showed 29 spectral peaks (**Fig. 1**) and found eighteen compound including quercitrin, myricitrin 2"-O-gallate, medicarpin, DEET, taxinine, scortechinone F, and others (**Table 5**). The compound obtained was not a single compound because the sample identified results from extractation.

Antioxidant activity can be determined by the IC_{50} value obtained. The first step was to measure the wavelength of DPPH. The results show that DPPH has an absorbance value of 0.790 with a wavelength of 513 nm. These result was different from the theory. Previous research conducted by Tunny et al. (2020) [46] stated that the wavelength of DPPH is 515-517 nm. This was due to differences in solvents (methanol) and tools

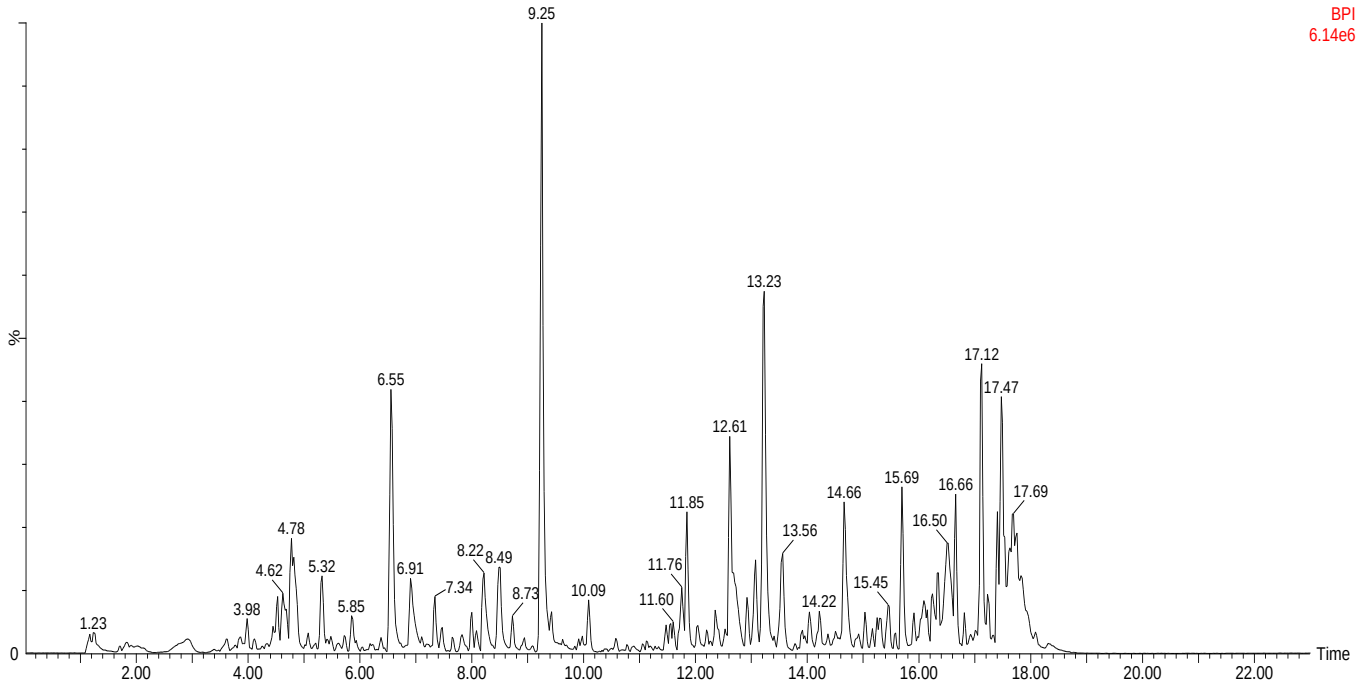

Fig. 1 Chromatogram of Senduduk leave (*Melastoma malabatricum*) by LC-MS/MS instrument

[41]. The greater the concentration of the test solution, the smaller the absorbance produced, meaning the ability of the test solution is more extraordinary in reducing free radicals. The smaller the IC_{50} value obtained, the higher the antioxidant activity [35, 47-50].

The IC_{50} value obtained for vitamin C is 40.26 µg/mL (**Table 6**), classified as a powerful antioxidant. The antioxidant compounds in the ethanol extract of senduduk leaves were very good at inhibiting the work of DPPH free radicals. This is according to the IC_{50} value obtained for the extract (49.73 µg/mL) which was classified as a very high antioxidant level (**Table 3**). It can be concluded that the ethanol extract of senduduk leaves and vitamin C can ward off free radicals. The SPF of spray gel with concentrations of 70 ppm was 24.96 (**Table 6**)

The results of pH test observation was determined to safe pH for avoids skin irritation. If the pH was too low or acidic, it will irritate the skin, and if the pH was too high, it will cause the skin to become dry [42]. The result obtained was that formula X and spraygel base has an average pH of 5.7 and 5.9 respectifully (**Table 7**). The pH test results illustrate that all spray gel formulas conform to the normal pH of the skin (4.5-6.5).

Viscosity measurement of the preparation was carried out to determine convenience the product applied to the skin's surface. In this case, a spray applicator can deliver viscosity checks on the spray gel preparation. Viscosity was a statement of the resistance of a liquid to flow. The higher the viscosity, the more excellent the resistance, and vice versa. Viscosity was strongly influenced by thickening agents (gelling agents) [51]. Viscosity measurement of spray gel preparations formulated using Brookfield LV spindle no.1 Viscometer with a speed of 6 rpm. In spyaygel formulation and spraygel base, the average viscosity is 806.6 cPs and 671.6 cPs respectifully. When making spray gel, after adding the ethanol extract of senduduk leaves, it is known that the viscosity value of the preparation. decreases. This was because the viscosity significantly reduced when dissolving the ethanol extract of senduduk leaves. Viscosity was still included in the viscosity range of spray gel preparations (500-5000 cps) [42].

The spraying distance was directly proportional to the large diameter of the spraying pattern of the preparation [52]. One that affects the variation of spraying patterns was the spraying distance and the viscosity of the preparation [42]. Spraying distance and dry time testing is an interrelated thing. The ideal time for the spray gel to dry is less than 5 min [43]. The results of the dry time test show that formula X at a distance of 5 cm, 10 cm, 15 cm and 20 cm was 4.98; 6.55; 5.98 and 6.66 min. The best of dry time with a spraying distance of 5 cm. The ideal spray gel has a fast dry time, so it is comfortable to apply to the skin and tends not to stick [43].

An antioxidant activity test of spray gel preparations was carried out to determine whether spray gel from the ethanol extract of senduduk leaves had antioxidant activity. It was obtained that FX containing ethanol extract of senduduk leaves has an IC_{50} value of 44.22 µg/mL (**Table 6**) with a powerful antioxidant intensity.

The greater the concentration of extracts in the preparation, the greater the antioxidant activity [53]. The results of measuring the SPF value in FX spray gel preparations ethanol extract of senduduk leaves have an SPF value in the ultra protection category.

Table 5. Compound analysis results of Senduduk leave (*Melastoma malabatricum*) LC-MS/MS

No.	Measured Mass (m/z)	Molecular Formula	Compound Name	Reference
1	381	$C_{17}H_{17}O_{10}$	Tetramethyl (1R,2S,4R,5S)-3,9-dioxotetracyclo[3.3.1.0 2,8 .0 4,6]nonane-1,2,4,5-tetracarboxylate	CSID 8493084
2	617	$C_{28}H_{25}O_{16}$	Myricitrin 2"-O-gallate	CSID 4475609
3	449	$C_{21}H_{21}O_{11}$	Quercitrin	CSID 4444112 HMDB0033751
4	186	$C_9H_{16}NO_3$	N-Boc-3-Pyrrolidinone	CSID 413992
5	395	$C_{20}H_{27}O_8$	ailantinol B	CSID 8914722
6	741	$C_{39}H_{33}O_{15}$	Kandelin A1	CSID 8208496
7	192	$C_{12}H_{18}NO$	DEET	CSID 4133 HMDB0250930
8	343	$C_{24}H_{39}O$	(22E)-Chola-5,22-dien-3-ol	CSID 4515386
9	271	$C_{16}H_{15}O_4$	Medicarpin	CSID 298082 HMDB0146681
10	518	$C_{22}H_{44}N_7O_7$	3,6-Diamino-N-[2-({2-amino-5-[glycyl(methyl)amino]-3,6-dihydroxy-4-methoxycyclohexyl}oxy)-6-(aminomethyl)-3,4-dihydro-2H-pyran-3-yl]hexanamide	CSID 170077
11	607	$C_{35}H_{35}N_4O_6$	Pheophorbide b	CSID 10381281 HMDB0031149
12	609	$C_{34}H_{41}O_{10}$	Scortechinone K	CSID 9170846
13	593	$C_{34}H_{41}O_9$	Scortechinone F	CSID 10140412
14	834	$C_{47}H_{72}N_5O_8$	Benzyl N6-[(adamantan-2-yloxy)carbonyl]-L-lysyl-L-isoleucyl-N6-[(adamantan-2-yloxy)carbonyl]-L-lysinate	CSID 8828425
15	607	$C_{35}H_{43}O_9$	Taxinine	CSID 16736472
16	413	$C_{21}H_{37}N_2O_6$	2-Ethoxyethyl {[6-{[butyl(ethyl)amino]methyl}-1-(2-methoxyethyl)-4-oxo-1,4-dihydro-3-pyridinyl]oxy}acetate	CSID 123560223
17	338	$C_{22}H_{44}NO$	(13E)-13-Docosenamide	CSID 4517397
18	441	$C_{28}H_{41}O_4$	Remangilone C	CSID 352717

Table 6. Antioxidant activity and SPF of ethanolic extract Senduduk leaves and vitamin C

Sample	IC_{50} Extract (µg/mL)	IC_{50} Spray gel (µg/mL)	SPF Extract	SPF Spray gel
Ethanolic Extract Senduduk Leaves	49.73	44.22	19.98	24.96
Vitamin C	40.26	-	-	-

Table 7. Results of organoleptic test

Circle	Observation	Formula	pH	Viscosity (cPs)	Distance (cm)	Dry Time (min)	Spraying pattern (cm)
1	Color	Cloudy brown	5.9	725	5	5.54	7.00
	Odor	Specific odor		670	10	4.02	6.66
	Texture	Semi solid		640	15	3.03	5.25
	Homogeneity	Homogeneous			20	2.08	3.00
2	Color	Cloudy brown	5.8	720	5	5.85	7.00
	Odor	Specific odor		665	10	3.58	6.16
	Texture	Semi solid		630	15	3.03	4.83
	Homogeneity	Homogeneous			20	2.13	3.25
3	Color	Cloudy brown	5.7	710	5	6.04	6.83
	Odor	Specific odor		650	10	4.05	5.66
	Texture	Semi solid		610	15	3.11	5.00
	Homogeneity	Homogeneous			20	2.05	3.16

The spray gel preparation is greater than the SPF value of the ethanol extract before being made into a preparation due to the combination factor and concentration of the spray gel ethanol extract of sunscreen. The effect of the combination of each excipient was that the higher the concentration of the extract content, the higher the SPF value. The higher the SPF value of a product or active substance of sunscreen, the more effective it is to protect the skin from the of UV rays exposure [31,32].

The stability test aims to see the stability of the spray gel preparation at a certain period. The spray gel

preparation of the ethanol extract of Senduduk leaves was stable because all formulas have no significant change in color, odor, texture, homogeneity, pH, viscosity, and spraying pattern (**Table 7**). The insignificant decrease in pH value in the spray gel preparation of the ethanol extract of the leaves still meets the established quality requirements. This decrease was due to the acidic properties of ethanol extract [44]. The minimal viscosity decrease in the spray gel preparation of the ethanol extract of senduduk leaves still meets the viscosity range of 500-5000 cPs [42]. This decrease in viscosity was due to a temperature increase of 40°C. Heating of spray gel preparations of ethanol extract causes the molecules to move so that the interaction force between molecules weakens. Thus, the preparation become slightly more liquid [44]. The dry time (**Table 7**) at a distance of 5 cm was more than 5 min due to the large number of preparations that stick, and the form of dosage that comes out was not uniform. A good spray gel preparation lasts less than 5 min [43]. The increase in the diameter of the spraying pattern (**Table 7**) shows an insignificant difference. This was due to the viscosity and spraying distance of the preparation [42,52].

CONCLUSION

It can be concluded that the ethanol extract of senduduk leaves has activity as an antioxidant. The ethanolic extract of senduduk leaves had an IC_{50} value of 49.73 µg/mL with the best SPF value at a concentration of 70 ppm, which is 19.98. Spray gel preparations from ethanol extract can be used as a UV-B absorption sunscreen. Spray gel preparations with a concentration of 70 ppm have an IC_{50} value of 44.22 µg/mL, an SPF value of 24.96, and a potent antioxidant intensity. Eighteen compounds have been identified, including quercetin, quercitrin, DEET, n-boc-3-pyrrolidinone, medicarpine, taxinine, and other compounds. The ethanol extract of the soxhlet results showed more promising results for further tests of in-vitro, in-vivo, and in-silico bioactivity studies.

SUPPORTING INFORMATION

There is no supporting information of this paper. The data that support the findings of this research are available on request from the corresponding author (LA).

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CONFLICT OF INTEREST

All authors have no conflict of interest to disclose.

AUTHOR CONTRIBUTIONS

RY and LA were in charge of designing the research from the beginning of the process to the end of the process. RH and HAA contributed to the design of the preparation. RH and SHA contributed to the analysis of the antioxidant activity of RY, LA, and SP, contributing to the analysis of chemical component data. RY and LA contribute to article creation and data processing.

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