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Antioxidant activity of invasive species *Solanum jamaicense*

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Abstract. *Yuliani N, Rachmadi R, Oksari AA, Wanda IF. 2024. Antioxidant activity of invasive species* Solanum jamaicense. *Nusantara Bioscience 16: 54-61. Solanum jamaicense* Mill. belongs to the Solanaceae family and is categorized as an invasive species. The leaves of *S. jamaicense* own some of these compounds, which are known to contain several compounds, including phenolics, coumarins, and flavonoids, which have the potential to be a source of antioxidants. This study aims to determine the content of phytochemical compounds and antioxidant activity of the leaves of *S. jamaicense*. Phytochemical testing includes tests for alkaloids, flavonoids, saponins, tannins, steroids, and terpenoids. The total phenolic content was tested using tannic acid as a comparison by spectrophotometry. They tested the antioxidant activity of *S. jamaicense* leaf extract by using spectrophotometric method. The antioxidant activity of the extract is expressed in the value of 50% Inhibition Concentration (IC_{50}). Based on the results of the phytochemical test, the ethanol extract of *S. jamaicense* leaves contains alkaloids, flavonoids, tannins, saponins, and steroids. The research showed that the total phenolic content was 59.953 $mg.g^{-1}$ of the extract, and the antioxidant activity was intense, with an IC_{50} value of 10.41 $mg.L^{-1}$ (active). *S. jamaicense* leaves ethanol extract has the potential as a source of natural antioxidants.

Keywords: Antioxidant activity, phenolic, phytochemical, *Solanum jamaicense* leaves

INTRODUCTION

Invasive alien plant species grow and develop in certain areas outside their original range of distribution and harm native biodiversity, ecosystem services, and human well-being (IUCN 2021). The negative impact caused is due to the tendency of allelopathic content, including secondary metabolites such as terpenoids, alkaloids, steroids, polyacetylene, essential oils, phenolics, flavonoids, and saponins (Moses et al. 2014; Mushtaq and Siddiqui 2018). In addition, saponins, phenolics, and flavonoids have the potential as antioxidants (Khan et al. 2022). Utilizing the content of these compounds is expected to be one of the efforts in tackling the spread of invasive alien plant species.

Antioxidants can capture and neutralize free radicals that cause the cessation of oxidative stress to avoid cell damage. Thus, antioxidants can stop disease induction (Flieger et al. 2021). Researchers have studied using secondary metabolites found in invasive alien plant species as antioxidants within the Solanaceae family, namely *Solanum mauritanium* Scop. and *S. rostratum* Dunal are invasive alien plant species that cause severe environmental and agricultural impacts in Australian territory (Randall 2017). The *S. mauritanium* is known to produce several chemical compounds, including alkaloids, anthraquinone glycosides, steroids, tannins, saponins, phenols, and flavonoids, which have the potential as antioxidants (Jayakumar and Murugan 2015). Based on the research results of Chaitanya et al. (2015), *S. mauritanium* contains alkaloids, phenolic compounds, and flavonoid compounds that are potentially a source of antioxidants with a total saponin fraction showing an IC_{50} value of 101.68 $mg.L^{-1}$ (medium antioxidant activity). The results of research by Gutiérrez et al. (2014) showed that *S. rostratum* produced secondary metabolites, namely alkaloids α-, β-, γ-solanine, and α-, β-, γ-chaconne. In addition, the methanol extract of *S. rostratum* leaf has an inhibitory value of 86.76%, which is effective as an anti-free radical. In addition, other studies have shown that the ethanol extract from the leaves of the *Solanum* genus produces antioxidant activity. Species that are known to have antioxidant activity are invasive plant species, including *Physalis angulata* L. with an IC_{50} value of 59.73±0.24 ppm (intense antioxidant activity) and *S. torvum* Swartz of 107.42±0.43 ppm (moderate antioxidant activity) (Ozaslan et al. 2017; Musarella 2020). Another invasive alien plant species from the Solanaceae family with antioxidant activity is *Solanum jamaicense* Mill.

The *S. jamaicense* belongs to the Solanaceae family, is native to the Neotropics, and is an invasive alien plant species that grows in nature as an agricultural weed in Australia (Randall 2007; Diaz et al. 2008). In this research, The species was primarily found in the undergrowth at the location where it was discovered. According to Diaz et al. (2008), *S. jamaicense* is found mainly in wooded habitats, which can quickly become dominant in the understory. Still, it also occasionally grows in isolated patches in the open. The obtained information suggests that the leaves of *S. jamaicense* can be used as medicine. According to Schultes (1980), people use a warm leaf decoction to eliminate body parasites. *S jamaicense* leaves contain several compounds, including phenolics, coumarins, and flavonoids, which can be a source of antioxidants (Thiesen et al. 2018; Ramón-Valderrama and Galeano-García 2020;

Bouslamti et al. 2022). However, research on the antioxidant activity of *S. jamaicense* leaves is still limited. Differences in place and environments, such as altitude, rainfall, and temperature, will affect the content of secondary metabolites in plants (Yang et al. 2018). Therefore, researchers need to conduct further studies on the content of secondary metabolites and antioxidant activity in the leaves of *S. jamaicense*. This study aimed to determine the scope of phytochemical compounds and antioxidant activity of the plant *S. jamaicense* leaves.

MATERIALS AND METHODS

Materials

The materials used are the leaves of *S. jamaicense.* A sampling of *S. jamaicense* was carried out in Curug, Bojongsari Sub-district, Depok, West Java, Indonesia (6° 23' 51,5576" S and 106° 44' 13,5312" E). *S. jamaicense* was identified in Herbarium Bogoriense, Research Center for Biosystematic and Evolution, National Agency for Research and Innovation (BRIN), Bogor, Indonesia.

Procedures

Sample preparation

Mature leaves of *S. jamaicense* at the 5^{th} to 10^{th} positions were picked to ±3 kg, then wash the leaves with running water. After that, *S. jamaicense* was oven-dried at 40°C for 48 hours and blended until smooth. The *S. jamaicense* leaves blender results were sieved using a 40-mesh sieve (Suryani et al. 2016).

Determination of water content

Two bottles were oven-dried at 105ºC for 30 minutes and cooled in a desiccator for 15 minutes. The bottle is then measured in weight and is known as W. In the bottle, 2 g of *S. jamaicense* leaves powder was added and then measured in weight (known as W1). The leaf powder of *S. jamaicense* was then dried in an oven at 105°C for three hours. Then, the leaf powder of *S. jamaicense* Mill was put in a desiccator for 15 minutes and measured in weight (known as W2). The bottles with samples were oven-dried at 105°C for ±2 hours to obtain a constant weight (Suryani et al. 2016).

$$Water\ Content\ (\%\ bb) = \frac{(W1 - W2)}{(W1 - W)} \times 100$$

Extraction of the leaves of S. jamaicense

A sample of 50 grams was macerated with 250 mL of 96% ethanol solvent thrice in 24 hours. The mixture was filtered every 24 hours, and the filtrate obtained was collected in a closed container. The powder is added back with the same 96% ethanol solvent. The filtrate was combined and evaporated with a rotary evaporator at an 80°C temperature, 100 mBar pressure, and 100 rpm speed for 1 hour. The extract was then evaporated further with a water bath to obtain a thick extract of the leaves of the *S. jamaicense* (Julfitriyani et al. 2016).

Phytochemical test of the leaf of S. jamaicense

Phytochemical tests were carried out on alkaloids, flavonoids, terpenoids/steroids, tannins, and saponins based on the Sembiring et al. (2018) methods.

Alkaloid test

The *S. jamaicense* extract was put into a test tube and added with 10 mL of 0.05 N chloroform-ammonia. The test tube is shaken slowly and allowed to stand until it forms two layers. Then, the liquid on the top layer (chloroform) was dripped onto a drip plate. The liquid was added to Mayer's reagent, Wagner's reagent, and Dragendorff's. The formation of white precipitate indicated positive alkaloids in the extract with Mayer reagent, brown precipitate with Wagner reagent, and orange with Dragendorff reagent.

Flavonoid test

The *S. jamaicense* extract was put into a test tube, and ethanol was added. The solution is then added with magnesium tape and drops of concentrated HCl on the magnesium tape. The formation of red color indicates the presence of flavonoids.

Saponin test

S. jamaicense extract was added with 10 mL of hot water, cooled, and shaken vigorously for 10 seconds. Foam formed steadily for not less than 10 minutes as high as 1-10 cm indicates the presence of saponin compounds. The mixture added with 2N HCl solution will make the foam disappear.

Tannin test

The *S. jamaicense* extract was put into a test tube, soaked in hot water, and cooled. The extract was then added with 1 mL of 10% FeCl3 solution. The formation of dark blue, blue-black, or greenish-black color indicates the presence of tannins.

Steroid and triterpenoid test

The *S. jamaicense* extract was dissolved in 0.5 mL of chloroform and then added with 0.5 mL of acetic anhydride. This mixture is then dripped with 2 mL of concentrated H_2SO_4 through the tube wall. The formation of a green-blue color indicates the presence of steroids. A brownish or violet-colored ring that appears shows the presence of triterpenoid compounds.

Total phenolic content

The total phenolic content was determined using the Folin Ciocalteu method. A total of 1 mL of extract solution of 1,000 mg/L was put in a test tube, and then 1 mL of Folin Ciocalteu 50% reagent was added. The mixture was allowed to stand for 5 minutes, shaking with a vortex and 2 mL of 5% Na_2CO_3 solution. Then, the mixture was incubated in the dark for 1 hour. The absorbance was read at a wavelength of 725 nm with a spectrophotometer. Total phenol extract was expressed as milligram (mg) gallic acid equivalent per gram extract weight (TAE mg/g fruit extract). The total phenolic content was obtained by entering the absorbance value of the sample in the standard curve equation for tannic acid (Aryal et al. 2019).

Antioxidant testing method 2,2-diphenyl-1-picrylhydrazyl (DPPH)

The *S. jamaicense* extract and quercetin (as positive control) were put into a test tube with 2 mL of 0.1 mg/LDPPH solution and shaken with a vortex until homogeneous (four replications). The change from purple to yellow indicates the efficiency of free radical scavengers. The absorbance on the spectrophotometer was measured at a wavelength of 515 nm after being incubated for 30 minutes. Free radical scavenging activity (% inhibition) was calculated as the percentage of DPPH color reduction (Aryal et al. 2019).

$$\% \, Inhibition = \frac{Absorbance \ of \ standard - Absorbance \ of \ crude \ extract}{Absorbance \ of \ standard} \times 100$$

RESULTS AND DISCUSSION

Water content and leaf extract of *Solanum jamaicense*

The weight of the fresh leaves of *S. jamaicense* is 2.275 g, and after the drying process, it is 554 g, so the water content of the leaves of *S. jamaicense* is 75.65%. The results are different from the water content of *Solanum jamaicense* Mill leaves powder obtained was 8.96%. The water content of a sample below 10% is good, so it is expected to last a long time in storage.

Phytochemical screening analysis of *S. jamaicense*

The phytochemical analysis shows that the compounds in the thick extract of *S. jamaicense* leaves included alkaloids, flavonoids, saponins, tannins, and steroids (Table 1).

Total phenolic of *S. jamaicense*

The content of phenolic compounds in plant extracts can be determined by quantitative testing, and testing the total phenolic content can be done by the Folin-Ciocalteu method. The total phenolic content is expressed in mg of Tannic Acid Equivalent (TAE). The standard curve of tannic acid can be seen in Figure 1.

Antioxidant activity of *S. jamaicense*

The solution concentration and the inhibition value obtained were then processed to obtain the curve. The curve obtained will produce the equation y = ax+b value, which is needed to determine the Inhibition Concentration (IC_{50}) value. The positive control used in this study was quercetin to compare the amount of antioxidant potential contained in the ethanol extract of *S. jamaicense* with a comparable antioxidant. The standard curve of quercetin and ethanol extract of *S. jamaicense* can be seen in Figure 2.

Table 1. Phytochemical test results of *Solanum jamaicense* leaf extract

Secondary Metabolites	Test Method	Results
Alkaloid	Mayer	+
	Wagner	+ +
	Dragendoff	+ +
Flavonoid	HCl	+ +
Saponin	Warmup	+ +
Tanin	$FeCl_3$	+ + +
Steroid	H_2SO_4	+ + +
Triterpenoid	H_2SO_4	-

Note: + + +: Very concentrated, + +: Concentrated, +: Not concentrated, -: Negative

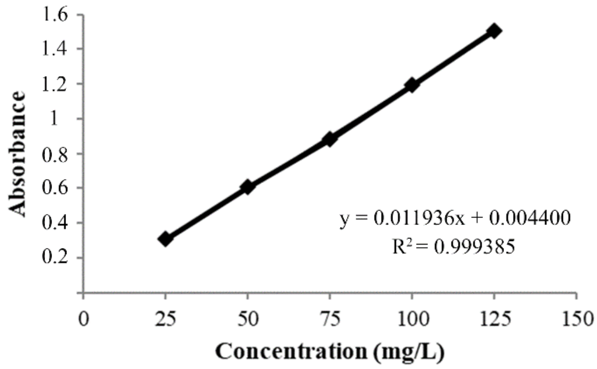

Figure 1. Standard curve of tannic acid

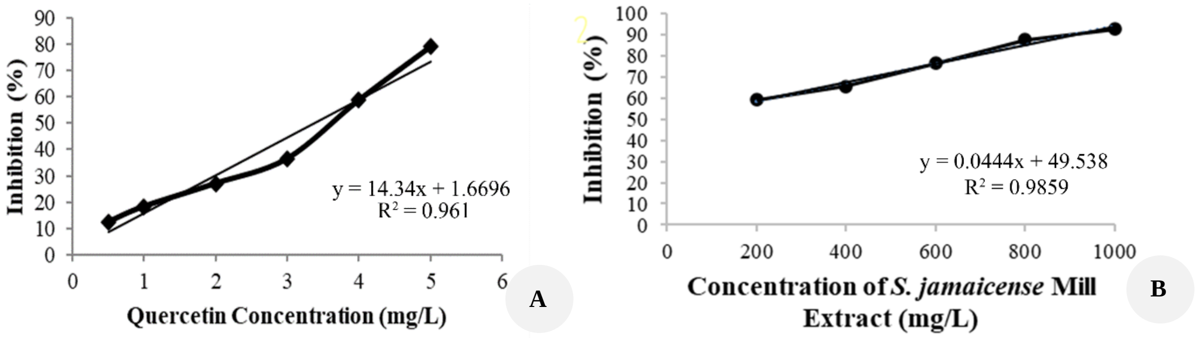

Figure 2. A. Standard curve of quercetin, B. Ethanol extract of *S. jamaicense* leaves

Discussion

Water content and leaf extract of Solanum jamaicense

The leaves' water content of *S. jamaicense* is probably influenced by the presence of fine hairs and spines on the surface of the leaves, which is a form of morphological adaptation in the face of drought stress. Nasruddin et al. (2019) state that the patchouli plant (*Pogostemon cablin* Benth) forms a thick layer of wax or hair that maintains water content.

The high water content in *S. jamaicense* leaves is probably related to the large number of stomata so that water from the environment is absorbed and fills the cavities in the leaves (Maylani et al. 2020). Leaves consist of several tissues, including sponge tissue that is not tightly packed, so many cavities exist. Water and nutrient minerals then fill the holes of leaf sponge tissue, a photosynthetic unit in plants (Ievinsh 2023).

Water content that is too large will trigger the growth of microorganisms in the sample, which can change the conformation of the chemical compounds in the sample (Hallsworth 2022). The moisture content of the leaf powder of *S. jamaicense* is possibly related to the leaf powder refining and sifting. The purpose of grinding and sifting leaf powder is to reduce the particle size to increase the surface contact between the sample and the solvent used in the extraction (Chaves et al. 2020).

The weight of the *S. jamaicense* leaf powder was 50 g, while the total weight of the *S. jamaicense* leaf extract obtained was 22.8537 g, so the yield value of the *S. jamaicense* extract was obtained by 45.71%. This yield is higher than the *S. nigrum* methanol extract value of 24% (Almoulah et al. 2017), probably due to the solvent's polarity and the substance's polarity to be extracted. Solvents with a polarity similar to the secondary metabolites in the sample will dissolve more of the secondary metabolite components in the material, which has implications for increasing the yield value of the extract obtained (Wakeel et al. 2019).

The polarity of flavonoid and alkaloid compounds is close to the polarity of the 96% ethanol solvent, which affects the extract yield, which is higher than other solvents such as acetone: water and ethyl acetate (Noviyanty et al. 2019). Niawanti et al. (2019) state that ethanol has a polar -OH group and a nonpolar CH_2CH_3 group, which allows it to extract both polar and nonpolar compounds. This high polarity of the ethanol solvent causes the extract yield to be higher than other solvents.

Therefore, using ethanol as a solvent is due to some of its properties. Ethanol is effective in obtaining more metabolite compounds, non-toxic, neutral extracts and has good absorption. Ethanol can mix with water in all ratios and has a boiling point that is not too high. Ethanol can dissolve alkaline, alkaloids, essential oils, glycosides, curcumin, coumarins, anrakinones, flavonoids, steroids, resins, and chlorophyll (Jacotet-Navarro et al. 2018).

Phytochemical screening analysis of S. jamaicense

In recent years, information on alternative therapeutic agent sources in dealing with synthetic drugs' side effects has been widely studied for their potential from several plants. The approach used in this study is a combination of traditional and advanced techniques (biological, ethnopharmacological, molecular, phytochemistry, and metabolic processes) (Chakraborty 2018; Süntar 2019). Therefore, we screened medicinal *S. jamaicense*, potential candidates for antioxidants, as part of a new drug discovery program using natural products.

Roy et al. (2022) state that secondary metabolites in natural plant extracts include alkaloids, saponins, terpenoids, polyphenols, flavonoids, and steroids. Secondary metabolites in *S. jamaicense* are related to non-protoplasmic components such as vacuoles, constituent parts of plant cells. The vacuole is filled with fluid and is lined by the tonoplast membrane, and the liquid in the vacuole stores secondary metabolite compounds such as alkaloids, terpenes, tannins, and flavonoids. Apart from that, vacuoles also store crystals, silica objects, and organic and inorganic materials such as salts and sugars, protein-forming amino acids, and phosphates (Tan et al. 2019).

The secondary metabolite contents stored in the vacuole come from the photosynthesis and cellular respiration results. The number of secondary metabolite compounds will increase with the plant's age, where the cell vacuoles will enlarge and dominate the cytoplasm (Tan et al. 2019).

The compounds included in this phytochemical test have the potential for medicinal, including antioxidants. Dalimunthe et al. (2018) and Sembiring et al. (2018) stated that compounds derived from the phenol, flavonoid, and alkaloid groups have many antioxidants, as well as Saponins and flavonoids also have antioxidants (Them et al. 2019). Tannins with -OH groups have antioxidant potential to reduce free radicals (Maisetta et al. 2019). In addition, flavonoids and tannins are included in natural phenolic compounds. Phenolic compounds are a group of compounds that act as natural antioxidants in plants (Pourreza 2013). The presence of the above compounds, especially the phenolic compounds in the leaf extract of *S. jamaicense*, makes this plant a potential source of antioxidants.

Total phenolic of S. jamaicense

Phenolics have a unique structure consisting of several hydroxyl groups, so one of these plant-derived substances is the leading free radical scavenger (Li et al. 2020). The significant phenolic substances have primary antioxidant activity or free radical scavengers. Therefore, the total amount of phenolic compounds in plant extracts is significant (Lou et al. 2014; Engida et al. 2015; Mursandi et al. 2022).

The standard curve for tannic acid is obtained by calculating the equation from linear regression between the concentration of tannic acid as the X value and the absorbance value of tannic acid as the Y value. The value of the regression equation obtained is y = 0.011936x + 0.0044 with R^2 = 0.999385. The equation value is used to calculate the total phenolic content of the sample. The determination of the total phenolic content of *S. jamaicense* ethanol extract was 59,953 mg TAE/g extract. The total phenolic content in the ethanol extract of *S. jamaicense* was much higher than that of the leaf extract of *Ipomoea* *batatas* L belonging to the order Solanales of 2.57 mgTAE/g extract (Kuddus et al. 2020).

The high total phenolic content of *S. jamaicense* leaves is thought to be influenced by several factors, including the ability of the leaves to synthesize secondary metabolites and sunlight. The leaves of *S. jamaicense* used are matured (5^{th} to 10^{th} leaves from the shoot) and are dark green. Mature leaves can produce secondary metabolites in optimum quantities so that the content of these compounds is higher than that of young leaves; young leaves have not yet grown on large amounts of secondary metabolites, containing less (Anwar et al. 2017). The results supported by Kingne et al. (2019) stated that mature avocado leaves (*Persea americana* Mill.) produced higher total flavonoid and phenolic content than young leaves. In addition, sunlight also affects the production of secondary metabolites; sunlight exposure determines the number of secondary metabolite compounds produced, such as anthocyanins, flavonols, and carotenoids (Yang et al. 2018). Excessive sun exposure reduces the production of secondary metabolites such as flavonoids and phenolic compounds in the leaves of *Orthosiphon stimaneus* Benth. (Ibrahim and Jaafar 2012).

The ability of phenolic compounds to form stable phenoxy radicals in oxidation reactions causes these compounds to potentially act as a source of antioxidants (Nurhasnawati et al. 2019). The activity of antioxidants from phenolic compounds, because of their redox properties, plays a vital role in absorbing and neutralizing free radicals, reducing singlet and triplet oxygen, and peroxide decomposition (Ningsih et al. 2016). Nur et al. (2019) revealed that the total phenolic content in white teak leaves (*Gmelina arborea* Roxb.) had a correlation value of 0.567, which means the total phenolic content influenced 56.7% of antioxidant activity. The study indicates a positive correlation between the range of phenolic compounds in the extract and antioxidant activity. The scavenging activity of DPPH is caused by its ability to transfer hydrogen atoms or electrons. Phenolic compounds have one (phenol) or more (polyphenols) phenol rings, namely hydroxy groups which is attached to an aromatic ring, so it is easy oxidized by donating hydrogen atoms on free radicals. The ability of these phenolic compounds to donate hydrogen atoms causes the DPPH radical to be reduced to a more stable form. The amount and position of phenolic hydrogen in the molecule affect phenolic compounds' free radical scavenging activity. The number of hydroxyl groups possessed by phenolic compounds is directly proportional to the antioxidant activity produced (Tian et al. 2021).

Antioxidant activity of S. jamaicense

The research on the antioxidant potential of *S. jamaicense* used the DPPH assay; DPPH is commonly used for antioxidant assay because of its simple application with high sensitivity. The scavenging activity of DPPH is caused by its ability to transfer hydrogen atoms or electrons; mainly by phenolic compounds such as polyphenols or flavonoids (Hidayati et al. 2017; Tohma et al. 2017; Kusumah et al. 2020).

The standard curves of quercetin and ethanol extract of *S. jamaicense* have different equation values of y = ax+b. The ordinary regression equation for quercetin is y = 14.34x + 1.6696, so the IC_{50} value of quercetin is 3.37 $mg.L^{-1}$, which includes a potent antioxidant activity. In comparison, the extract regression equation is y = 0.0444x + 49.538, so the IC_{50} value of the ethanol extract of leaves *S. jamaicense* Mill of 10.41 $mg.L^{-1}$, which includes a potent antioxidant activity. The presence of secondary metabolites of phenolic and flavonoid groups is thought to produce antioxidant activity capable of carrying out the free radical scavenging biological activity. This ability is because the phenolic and flavonoid groups are rich in hydroxyl, so they are suspected of providing good free radical scavenging activity (Ningsih et al. 2016; Widiyantoro et al. 2022). These results follow research conducted by Ismanto et al. (2017) that Surian leaves (*Toona sureni* (Bl.) Merr.) have antioxidant activity because this plant contains flavonoid and phenolic compounds.

According to Takao et al. (2015), the IC_{50} value of the standard quercetin is smaller than the extract because it is a pure compound that can bind to the DPPH molecule effectively. The ethanol extract of *S. jamaicense* has an IC_{50} value more significant than the quercetin standard, presumably because the sample is still a crude extract and interfering compounds may dissolve. Disruptive compounds such as proteins and fats can interfere with scavenging free radicals by flavonoid compounds (Martemucci et al. 2022).

The IC_{50} value of the *S. jamaicense* extract of 10.41 $mg.L^{-1}$ (active), including the potent antioxidant activity, is related to compounds detected in phytochemical testing and phenolic compounds. According to Venkatesan et al. (2019), antioxidant activity in plants is related to polar solvents used, such as ethanol, to dissolve phenolic compounds. Phenolic compounds are known to influence the antioxidant activity of a plant.

The antioxidant activity of the ethanolic extract of there the IC50 value of the *S. jamaicense* extract (at 10.41 $mg.L^{-1}$) was lower than that of *S. incanum* (177.9 $mg.L^{-1}$); *S. schimperianum* (156.1 mg.L-1); *S. nigrum* (179.1 $mg.L^{-1}$); *Physalis lagascae* (199.0 mg.L-1); *Withania somnifera* (168.9 $mg.L^{-1}$) (Almoulah et al. 2017). The antioxidant activity of the ethanolic extract of *S. jamaicense* is presumably due to different solvents during the extraction process.

The phenolic content in the above species is lower because it uses methanol as a solvent, while *S. jamaicense* extraction uses ethanol. The research by Mahasuari et al. (2020) showed that 75% ethanol as a solvent in extracting *Pluchea indica* L. leaves resulted in a higher total phenolic content than methanol solvent. Polar solvents like ethanol generally dissolve phenol compounds better, so the extracted levels are higher (Noviyanty et al. 2019). In addition, the drying method also affects the antioxidant activity revealed. The antioxidant activity of *S. jamaicense* is also more substantial than that of *S. mauritanium* Scop, with an IC_{50} value of 101.68 $mg.L^{-1}$ (Chaitanya et al. 2015), which has moderate antioxidant activity. The leaves of *S. jamaicense* were dried in an oven at 40°C for 48 hours, while the leaves of *S. mauritianum* were dried using indirect sunlight.

Adhamatika et al. (2021) revealed that the drying method in indirect sunlight with black cloth resulted in lower antioxidant activity than the oven drying method at 40°C on *Pandanus amaryllifolius* Roxb leaves. Damage to the material's antioxidant compounds, such as phenol, is due to the interaction between UV light and oxygen (Del Valle et al. 2020). Bernard et al. (2014) reported the effect of the drying method on total phenol, where the total phenol produced by the oven drying method was higher than that of drying in the sunlight and room temperature. This result is due to the faster inactivation of the enzyme. Therefore, the leaves of *S. jamaicense* can replace synthetic antioxidants and be used as potential sources of natural bioactive molecules. Antioxidants are one of the essential ingredients of today's therapy since they reduce in vivo oxidative damage. In addition, good natural antioxidants are found in many plants (Manurung et al. 2016).

This research concludes that the ethanolic extract of *S. jamaicense* leaves contains alkaloids, flavonoids, tannins, saponins, and steroids, a total phenolic content of 59.953 $mg.g^{-1}$ extract, and potent antioxidant activity with an IC_{50} value of 10.41 $mg.L^{-1}$. The search for plants with the potential as natural antioxidants and good medicinal value has attracted researchers, so they are expected to be substitutes for synthetic antioxidants. Further research is needed to determine the antioxidant activity of *S. jamaicense* using different types of solvents and extraction methods. In addition, its antioxidant activity can be compared with other plant parts of *S. Jamaicense*.

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