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Effects of Solvent Polarity on Phytoconstituents, Antioxidant and Anti-inflammatory Activities of *Dracaena angustifolia* Roxb Root Bark Extracts

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ABSTRACT

Dracaena angustifolia Roxb. is a medicinal plant originally from Bali, Indonesia. Its root bark is a promising source of bioactive compounds. The present study aimed to investigate the effects of solvent polarity on the phytochemical constituents and biological activities of *Dracaena angustifolia* root bark (DARB) extracts. The DARB was extracted using different solvents, including methanol, ethanol, ethyl acetate, acetone, and n-hexane. Each extract was subjected to qualitative phytochemical screening. The total phenol (TPC) and flavonoid contents (TFC) of the extracts were determined. Antioxidant and anti-inflammatory activity assays were conducted on the DARB extracts. The results showed that the extraction yield, TPC, TFC, and biological activities of the extracts were significantly influenced by the solvents used for extraction. For every solvent utilized, the phytochemical compounds resulted in different results. Methanol extract (ME) significantly resulted in the highest extraction yield (10.27±0.27%). Ethyl acetate extract (EAE) had the highest TPC (1399.24±76.99 mg GAE/g) and TFC (65.05±4.01 mg QE/g). The IC_{50} values of EAE (28.60±0.37 µg/mL), acetone extract (AE) (29.11±0.42 µg/mL), and ME (45.89±0.94 µg/mL) were classified as very powerful antioxidants. The extract with the strongest anti-inflammatory activity was EAE, maintaining membrane stability at 98.67±0.27%, which was not significantly different from diclofenac sodium as a drug reference. In conclusion, EAE is recommended as the optimal solvent to obtain high TPC and TFC contents and high antioxidant and anti-inflammatory activities from DARB for utilization in pharmacognosy. Further studies should focus on isolating and identifying active secondary metabolites from these extracts.

***Keywords*:** Anti-inflammatory, Antioxidant, *Dracaena angustifolia*, Root bark extract, Solvent effect

Introduction

Pharmaceutical development has greatly benefited from the discovery of drugs derived from natural compounds, particularly those with anti-inflammatory and antioxidant properties. Natural products provide various chemical resources with diverse and biologically active molecular structures.[1] Natural drugs have the advantage of being less toxic and having fewer side effects, as well as being affordable and having good therapeutic efficacy.[2] These efficacious antioxidant agents are promising pharmaceutical products for preventing oxidative stress, and diseases, and maintaining health.[3] Furthermore, these natural antioxidants are acknowledged as potential anti-inflammatory agents, providing safe protection against inflammation in the human body, thereby preventing diseases, and disorders caused by inflammation.[4] The antioxidant activity of natural substances is associated with their total phenol and flavonoid contents.[5] Phenolics and flavonoids are two groups of phytochemical compounds that play an essential role in combating free radicals, contributing to various degenerative diseases and anti-inflammatory processes.[6]

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Therefore, further studies are required to find novel, safe metabolites from natural products that have anti-inflammatory and antioxidant properties.

Extraction is the first process to obtain bioactive compounds from biomass materials. The extraction process aims to maximize the quantity of target compounds, and the highest biological activity can be obtained from these extracts[7]. The extraction yield and biological activity of the natural products are not only affected by the extraction technique but also by the extraction solvent.[8] Various solvents, such as methanol, ethanol, acetone, ethyl acetate, chloroform, n-hexane, and water, have been used to extract bioactive compounds from plant materials.[9] The optimal solvent for extraction depends on the specific plant materials and the compounds that need to be isolated, as different bioactive compounds have varying solubility properties in various solvents. Therefore, it is generally challenging to recommend a suitable extraction solvent for individual plant materials.[10]

Dracaena angustifolia Roxb has been used in traditional medicine, utilizing various parts of the plant, such as the roots, stem bark, leaves, and seeds. The roots of *D. angustifolia* Roxb have been utilized in ethnomedicine for digestive inflammation, sedation, tonic and leukemia treatment, gastritis, and kidney diseases.[11,12] The orange-coloured root bark of this plant, called "Kayu Sugih" in Usadha Bali, Indonesia, is used as an antidote and medication for stomach aches. The majority of the research on *D. angustifolia* was concerned with screening and identifying bioactive compounds. However, no study has reported the effect of solvent on the extraction of bioactive compounds from the root bark of *D. angustifolia* or the biological activity of the extracts.

The present study was conducted to investigate the impact of organic solvents (methanol, ethanol, ethyl acetate, acetone, and n-hexane) on

the phytochemical profile, extraction yield, phenolic and flavonoid contents, and biological activities of *D. angustifolia*.

Materials and Methods

Source of plant samples

The orange-coloured root bark of *D. angustifolia* Roxb was collected from Ped Village, Nusa Penida District, Klungkung Regency, Bali, Indonesia (-8º40'48", 115º29'27''), in May 2023. The root bark was cleaned in running water and dried in a hybrid room with a humidity of 25% and a temperature between 40 and 50°C. The dried root bark was ground to obtain a powder with a water content of 4.009% and referred to as DARB (*D. angustifolia* root bark). The *D. angustifolia* plant was identified at the Taxonomy, Structure, and Plant Development Laboratory, Department of Biology, Brawijaya University, Indonesia (No. 0270/UN10.F09.42/10/2022).

Extraction of Dracaena angustifolia root bark

The DARB was macerated in a solution containing methanol, ethanol, ethyl acetate, acetone, and n-hexane (Merck, Germany) at a ratio of 1:8 (DARB: solvent). Approximately 100 grams of DARB and 800 mL of solvent were used to complete each maceration process. The maceration process was conducted for 24 hours, with occasional stirring. The filtrate was evaporated using a rotary evaporator (BUCHI R-300, Swiss) at 40^0C, 150 mbar. The filtrate was then weighed to determine the extraction yield.[13] This procedure was carried out in triplicate. Afterward, the extracts were referred to as ME (methanol extract), EE (ethanol extract), EAE (ethyl acetate extract), AE (acetone extract), and HE (n-hexane extract). Subsequently, each crude extract was analyzed for total flavonoids and phenolic contents, and antioxidant activity (IC_{50}). The crude extracts categorized as very powerful antioxidants were tested for anti-inflammatory activity.

Phytochemical screening of Dracaena angustifolia root bark extracts

Qualitative phytochemical screening was performed on the *Dracaena angustifolia* root bark extracts. The phytoconstituents alkaloids, flavonoids, phenol, tannins, terpenoids, steroids, and saponins in 0.05 g of extracts were identified following previous reports, with some modifications.[14,15,16,17,18] To detect alkaloids, the root bark extract was dissolved in 1 mL of methanol and filtered. The resulting liquid was mixed with 2 mL of 1% hydrochloric acid (Merck, Germany) and one drop of Dragendorff's reagent (Merck, Germany). The formation of a reddish-brown precipitate with turbidity indicated the presence of alkaloids.[14] Flavonoids were identified by adding sodium hydroxide (Merck, Germany) to an extract and dissolved in 1 mL of methanol. Then, 37% hydrochloric acid was added to the root bark extract solution. The clear colour, which changed from the yellow colour, indicated the flavonoid content.[15] For tannin, 2 mL of 15% $FeCl_3$ (Merck, Germany) was added to the root bark extract, and a dark green or blue-black precipitate indicated the presence of tannin.[15]

For screening terpenoid content in the *D. angustifolia* root bark extracts, 5 mg of plant extract was dissolved in 1 mL of chloroform (Merck, Germany), then sonicated at 40 kHz for 5 min and later left to dry. Then, 1 mL of 96% sulfuric acid (Merck, Germany) was added and heated to 75°C in a water bath for 2 min. The gray color indicated the presence of terpenoids.[15] In detecting the steroids, 15 mg of plant extract was dissolved in 1 mL of chloroform and sonicated at 40 kHz for 5 min. Then, the supernatant was added to 1 mL of 96% sulfuric acid. The red-colored lower layer indicated the presence of steroids.[16] Root bark extract solutions were treated with 3-4 drops of ferric chloride solution for phenol identification. The formation of a bluish-black colour indicated the presence of phenols.[17] To identify saponins, an aliquot of 1 mL of the extract was dissolved in 8 mL of hot distilled water. The filtrate that was produced after the solution was filtered and placed in a test tube. Then, 2 mL of hot distilled water was added to the test tube and vigorously shaken. The presence of saponins was indicated by the formation of a persistent foam, measuring 1-10 cm in height, which lasted for at least 10 minutes, and the foam did not disappear when 37% HCl was added.[18]

Determination of the total phenol and flavonoid contents of root bark extracts

The total phenol content (TPC) in each extract was assessed using the Folin-Ciocalteu technique with a minor modification.[19] A total of 10 mg of the sample was dissolved in 10 mL of methanol (99.9%), homogenized, and centrifuged (NUVE Z10. NF 1200, Turkey) at 3000 rpm for 15 minutes to obtain the supernatant. The supernatant was filtered, and then 0.4 mL of the filtrate and 0.4 mL of Folin–Ciocalteu reagent (Merck, Germany) were mixed, vortexed (WINA 701, Indonesia), and after 5 minutes was added with 4.2 mL of Na_2CO_3 (5%). The mixture was incubated for 30 minutes and measured using a UV/Vis spectrophotometer (BIOCHROM Libra S60, UK) at 760 nm. A standard curve was prepared using 0-140 mg/L of gallic acid solutions. Total phenolic content was calculated as milligrams of gallic acid equivalents per gram of extract (mg GAE/g),[20] using a gallic acid calibration curve ($y = 0.0087x-0.00717$, $R^2 = 0.9667$).

The total flavonoid content (TFC) in each extract was confirmed by the colorimetric method using aluminum chloride.[21] A total of 10 mg of the extracted sample was dissolved in 10 mL of ethanol (99,9%). Afterwards, 0.5 mL of the supernatant was mixed with distilled water and $NaNO_2$ (5% w/v), and left to rest for 5 minutes. The mixture was added to 0.3 mL of $AlCl_3$ (10%) and 2 mL of NaOH (1%) and later incubated for 30 minutes at room temperature. The absorbance of the solution was measured at 415 nm using a UV/Vis spectrophotometer. A standard curve was prepared by dissolving quercetin in 99.9% ethanol at concentrations ranging from 0 to 140 mg/L. Total flavonoid content was calculated as milligrams of quercetin equivalents per gram of extract (mg QE /g),[20] using a standard curve ($y = 0.0064x - 0.0003$, $R^2 = 0.9825$).

Antioxidant activity assay on root bark extracts

The antioxidant capacity of *D. angustifolia* root bark extracts was determined using the DPPH (2,2-diphenyl-1-picrylhydrazyl) method.[22] Different concentrations of each extract (1 mL) were mixed in the test tubes with 1 mL of DPPH solution (0.1 mM in methanol) (Merck, Germany) and incubated for 30 minutes. The mixture of 99% methanol (1 mL) and DPPH reagent (1 mL) was used as a control, and methanol (99% v/v) was used as a blank. The absorbance of the sample, control, and blank was measured using a UV/Vis spectrophotometer (BIOCHROM Libra S60, UK) at 517 nm. The antioxidant capacity was calculated using the linear regression equation; $y = ax + b$. A lower IC_{50} (inhibitory concentration 50%) value indicates that the sample possesses a stronger and greater ability to act as an antioxidant against free radicals. Based on the IC_{50} values of the extracts, the antioxidant potential was classified: extracts with $IC_{50} < 50$ µg/mL were regarded as very powerful antioxidants; extracts with IC_{50} values of 50–100 µg/mL indicated powerful antioxidants; extracts with $IC_{50} < 101$–150 µg/mL indicated medium antioxidants; and extracts with $IC_{50} > 150$ µg/mL were classified as weak antioxidants.[23] Antioxidant activity index (AAI) value calculation shows how strong the antioxidant is in the sample. It was achieved by dividing the concentration of DPPH (µg/mL) by the IC_{50} value (µg/mL). When the AAI value of a plant extract is less than 0.5, it is regarded as a poor antioxidant; when it is between 0.5 and 1.0, it is regarded as moderate; between 1.0 and 2.0, it is regarded as strong; and when it is greater than 2.0, it is regarded as very powerful.[24]

Anti-inflammatory activity assay on root bark extracts

The anti-inflammatory activity of the DARB extracts was tested using the human red blood cells (HRBC) method with slight modifications. Fresh whole blood was obtained from healthy human volunteers (4 people) who had not taken non-steroidal anti-inflammatory drugs (NSAIDs) for two weeks before the experiment. This study received ethical clearance from the Health Ministry Polytechnic Denpasar (Approval No.: LB.02.03/EA/KEPK/0588/2023). Venous blood was collected into ethylenediaminetetraacetic acid (EDTA)-coated tubes (1.6 mg/mL) to prevent clotting. Human red blood cell samples were resuspended in a normal saline solution (0.9% w/v NaCl) and centrifuged at 3,000 rpm for 10 minutes. This process was repeated three times until the supernatant was clear. The packed cells were measured and reconstituted as a 10% v/v HRBC suspension with a

normal saline solution for the experiment. Samples of the ME, EAE, AE, and standard drugs (sodium diclofenac and aspirin) were prepared at a concentration of 100 ppm. The test solution was prepared by mixing 1 mL of DARB from each concentration, 1 mL of phosphate buffer (0.15 M, pH 7.4), 2 mL of hyposaline (0.36% w/v NaCl), and 0.5 mL of 10% HRBC suspension. Two controls were prepared: one with normal saline solution instead of the extract (Control 1) and another with normal saline solution instead of the HRBC suspension (Control 2). Diclofenac sodium and aspirin were used as standard drugs. The assay mixture was then incubated at 37°C for 30 minutes in an incubator. After 30 minutes of incubation, the suspension was centrifuged at 3,000 rpm for 20 minutes. The haemoglobin content in the supernatant was measured by determining the absorbance at 560 nm using a UV/Vis spectrophotometer. The percentage of membrane stability was calculated using the following equation:

$$\% \text{ membrane stability} = 100 - (As - Ac2/Ac1) \times 100$$

Where As denotes the absorbance of the sample, Ac1 and Ac2 denote the absorbance of Control 1 and Control 2, respectively.[25] The control represents 100% HRBC lysis.

Statistical analysis

The results of the phytochemical analysis were graphically represented using Microsoft Excel (2010) and GraphPad Prism (9.5.1). The statistical analysis of the data was carried out using the Statistical Package for the Social Sciences (SPSS; version 23). Experimental data were analyzed by one-way ANOVA and the significance of the difference between means was determined by Tukey's test, the level of significance was set at p-value < 0.05.

Results and Discussion

Phytochemical constituents of Dracaena angustifolia root bark extracts

The analysis of phytochemical constituents is crucial for assessing the identified bioactive compounds. Phytochemical screening is a straightforward examination that can be employed to ascertain the composition of secondary metabolites in a plant.[26] All extracts derived from *D. angustifolia* root bark underwent qualitative phytochemical screening using standard chemical tests. As illustrated in Figure 1, the root bark extract of *D. angustifolia* in each solvent exhibited distinct phytochemical profiles. Each phytochemical component in the extracts was graded on a scale of 0 to 5, where 0 denotes absence, while scores of 1 to 5 indicate the presence of the compound in ascending order compared to the control (without crude extract). Among the extracts, AE and HE demonstrated the highest levels of alkaloids (score 5), followed by ME, EE, and EAE. Also, EAE and AE exhibited the highest flavonoid content (score 4), surpassing ME and EE (score 3), while HE showed no flavonoid presence (score 0). Concerning phenolic compounds, ME, EAE, and AE displayed the highest levels (score 5), followed by EE (score 4), with HE showing no phenolic content. Tannins were absent in the HE extracts, and saponins were only detected in the ME and EE extracts. Notably, steroids were not found in any of the studied extracts.

Several studies have reported phytochemical screening in the genus *Dracaena*, showing variation in phytochemical contents in different solvents. The root extracts of *D. arborea* (Link) and *D. mannii* (Bak) with water as the solvent showed the presence of flavonoids and saponins, but no alkaloids were detected.[27] The root extract of *D. terniflora* showed positive results in the hexane, ethyl acetate, ethanol, and water extracts, indicating the presence of phenols, flavonoids, tannins, alkaloids, terpenoids, saponins, and steroids.[28] Several studies have reported the presence of polyphenols and flavonoids in the roots of *D. reflexa*,[29] and *D. cambodiana*.[30]

Effects of different solvents on extraction yield

Until present, no research has been conducted on the extraction of *D. angustifolia* root bark. The extraction was performed using five different solvents with varying polarity on *D. angustifolia* root bark, namely ME, EE, EAE, AE, and HE. The difference in polarity affected the amount of extract obtained. According to Table 1, the extraction yield (%) of ME was the highest, followed by EE, EAE, and AE, and the lowest was HE. Statistical analysis using one-way ANOVA indicated a significant difference ($p < 0.05$) in the extraction yields from the five solvents. Subsequently, Tukey's test results showed that all solvents significantly differed (letters a, b, c, d, and e). The difference in extraction results is based on the polarity of each solvent. The percentage of extraction yield obtained from each solvent was due to the variation in the solubility of bioactive compounds. Solvents having a polarity value close to the polarity of the solute are likely to perform better and vice versa, according to the laws of similarity and impermissibility (like dissolves like). Polar compounds dissolve in polar solvents, while non-polar compounds dissolve in non-polar solvents. The bioactive components in DARB tend to be more polar, and extraction efficiency occurs in solvents with higher polarity. Methanol and ethanol are commonly used polar solvents for extracting polar compounds. Compared to the other four solvents employed in this investigation, methanol is a more polar solvent. This leads to a higher yield, suggesting that a wider range of bioactive compounds, including lactones, polyphenols, phenones, saponins, tannins, anthocyanins, and terpenoids, can dissolve in methanol.[31] Studies on the roots of *D. angustifolia* that used methanol as the extraction solvent produced a yield of 17.73% and revealed glycoside groups, sapogenin spirostanol, and saponin furostanol.[32] Acetone and ethyl acetate have lower polarity than methanol and ethanol, resulting in fewer soluble active compounds. Non-polar bioactive compounds in DARB extracts are present in lower quantities in n-hexane extract.

Effects of solvents on total phenolic and flavonoid contents, and antioxidant activity

The results of TPC and TFC on DARB extracts in each solvent are shown in Table 1. Based on the ANOVA in this study, there was a significant ($p < 0.05$) difference in the TPC of the DARB extract using the five solvents. The highest TPC was found in the EAE, followed by the ME, AE, EE, and HE. Tukey's test results indicated significant differences between ME and the other solvents, as well as between EAE and HE (letters a, b, c, and d). There was no significant difference between EE and AE. The ANOVA of TFC also showed a significant ($p < 0.05$) difference among the five solvents. The TFC in EAE was higher and showed a significant difference compared to the other solvents. Based on Tukey's test results, ME, EE, and AE showed no significant difference in the letters a, b, and c.

The polyphenol and flavonoid contents influence antioxidant activity (IC_{50}). Based on the ANOVA, there was a significant ($p < 0.05$) difference in antioxidant activity among the five solvent extracts used. Tukey's test results showed that the IC_{50} of the methanol extract was significantly different from the other solvent extracts, as well as EE and HE. However, the IC_{50} values (µg/mL) of EAE and AE did not differ significantly (Table 1). According to the classification of antioxidant strength in natural product extracts,[23] the IC_{50} values of EAE, AE, and ME were classified as very powerful antioxidants, followed by the EE (powerful antioxidants category), and HE (weak antioxidants). Based on Figure 2, EAE and AE were classified as having strong antioxidant activity, ME and EE were classified as moderate, and HE was classified as a poor antioxidant. The statistical test results showed that there were significant differences in AAI values for each extract, but EAE and AE were not significantly different. This is indicated by the alphabets (a, b, c, and d) on the graph, so that EAE and AE have the same strength of antioxidant activity.

The solubility of flavonoids in different solvents varies, so the solvents are chosen according to the polarity of the flavonoids.[33] Nonpolar flavonoids, such as isoflavones, flavanones, flavones, and flavonols, exhibit a preference for solvents like dichloromethane, ethyl acetate, diethyl ether, and chloroform.[34] In contrast, flavonoid glycosides and aglycones are examples of polar flavonoids extracted using solvents like ethanol or methanol.[35] Flavonoids with glycosylation, like rutin and isoquercetin, exhibit insolubility in certain solvents, such as acetone and acetonitrile.[36] Based on Table 1, the TPC and TFC in the ethyl acetate extract of *D. angustifolia* are higher compared to other solvents, indicating a higher solubility of nonpolar flavonoids. Ethyl acetate is an intermediate-polarity solvent that efficiently extracts phenolic compounds from plants.[37] The ethyl acetate extract, which exhibited the highest phenolic compounds, flavonoids, and antioxidant activity, is consistent with earlier research findings on the roots of *D. cambodiana*.

The TPC, TFC, and antioxidant activity of natural product roots vary depending on the type of solvent used and their bioactive components. Therefore, for the DARB extract, it is preferable to use ethyl acetate and acetone solvents to obtain the highest TPC, TFC, and antioxidant activity. To identify the components in both DARB extracts that may be developed into antioxidants for use in medical applications, more investigation is required.

Anti-inflammatory efficacy of Dracaena angustifolia root bark extracts

Because they demonstrated superior antioxidant activity compared to other solvents and fell into the group of very powerful antioxidants, EAE, AE, and ME were investigated for their *in vitro* anti-inflammatory activity. The anti-inflammatory effectiveness was evaluated by measuring the inhibition of hypotonicity-induced lysis of HRBC membranes. The stability of cell membranes using the HRBC method in ME, EAE, AE, and drug reference is shown in Figure 3. The percentage of membrane stabilization for each sample was calculated at a concentration of 100 µg/mL. Aspirin and diclofenac sodium were used as reference drugs. The results of the ANOVA indicated a significant difference in the membrane stabilization ability among the samples ($p < 0.05$). As a reference drug, aspirin showed the highest membrane stabilization ability (99.44±0.05%) compared to the other samples. This was followed by EAE (98.67±0.27%), diclofenac sodium (98.39±0.12%), AE (98.22±0.02%), and ME (98.06±0.07%) in descending order. The Tukey test results (letters a, b, and c) showed a significant difference in membrane stabilization ability between aspirin and the other samples, as well as between EAE and the other samples. However, there was no significant difference between AE and ME. Diclofenac sodium did not significantly differ from EAE. This study used the HRBC method to evaluate the antioxidant capacity for maintaining cell membrane stability. The HRBC is considered a relevant model because the red blood cell membrane is highly sensitive to oxidative damage, and changes in the membrane can reflect antioxidant protection.[25] When HRBC experiences hypotonic stress, the release of haemoglobin from RBC is prevented by anti-inflammatory drugs due to membrane stabilization. Therefore, membrane stabilization of HRBC with drugs against hypotonicity-induced haemolysis is a highly useful *in vitro* method for assessing the anti-inflammatory activity of a compound. The HRBC test results in this study showed that the extracts of EAE, AE, and ME can inhibit erythrocyte haemolysis caused by heat and hypotonicity. This indicates that the extract has the property of stabilizing biological membranes, preventing plasma membrane damage due to stress. This ability is also supported by phytochemicals, such as phenols, flavonoids, saponins, and tannins, which protect against membrane damage caused by stress. The flavonoids have a notable antioxidant effect against damage caused by both water-soluble and hydrophobic exogenous oxidants. Tannin and saponin compounds stabilize membranes by binding with cations.[38] The interaction between tannins and cell membrane surfaces can potentially lead to the formation of clusters and rafts, thereby inhibiting erythrocyte swelling and haemoglobin release.[39] Terpenoids defend against abiotic stress by directly interacting with oxidants within cells or at the leaf-atmosphere interface, stabilizing membranes, and indirectly modifying signaling pathways associated with reactive oxygen species (ROS).[40]

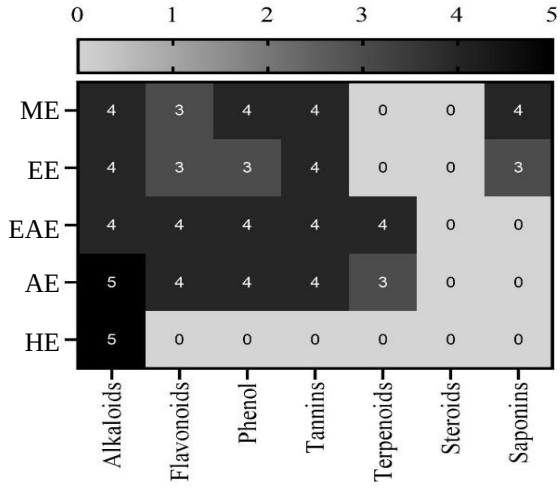

Figure 1: The heatmap of phytochemical constituents from each solvent of *Dracaena angustifolia* root barks. The colour scale is shown on the top side of the heatmap

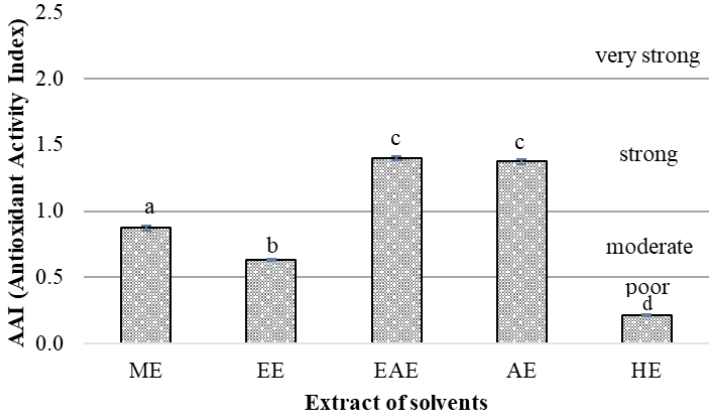

Figure 2: The antioxidant activity index (AAI) of *Dracaena angustifolia* root bark extracts with different solvents.
ME: Methanol extract; EE: Ethanol extract; EAE: Ethyl acetate extract; AE: Acetone extract; HE: n-hexane extract; Values are the mean ± standard deviation (SD); n=3; Means within different alphabets (a, b, c, and d) significantly differ by Tukey's test at $p < 0.05$ probability level.

Table 1: Yield, total phenolic, total flavonoid contents, and IC_{50} on the *Dracaena angustifolia* root bark extracts in each solvent.

Extracts of solvents	Yield (%)	TPC (mg GAE/g of Extract)	TFC (mg QE/g of Extract)	IC50 (µg/mL)
ME	10.27±0.27^a	1170.99 ± 13.45^a	42.12 ± 0.27^a	45.89 ± 0.94^a
EE	5.08±0.12^b	919.58 ± 9.09^b	45.26 ± 1.90^a	63.09 ± 0.79^b
EAE	1.58±0.05^c	1399.24 ± 76.99^c	65.05 ± 4.01^b	28.60 ± 0.37^c
AE	1.05±0.09^d	1008.49 ± 16.42^b	47.71 ± 1.42^a	29.11 ± 0.42^c
HE	0.10±0.03^e	317.13 ± 45.52^d	12.75 ± 0.76^c	185.19 ± 5.11^d

ME: Methanol extract; EE: Ethanol extract; EAE: Ethyl acetate extract; AE: Acetone extract; HE: n-hexane extract; Different alphabets (a, b, c, d, and e) indicate significant differences by Tukey's test at a $p < 0.05$ probability level; Values are the mean ± standard deviation (SD); n = 3.

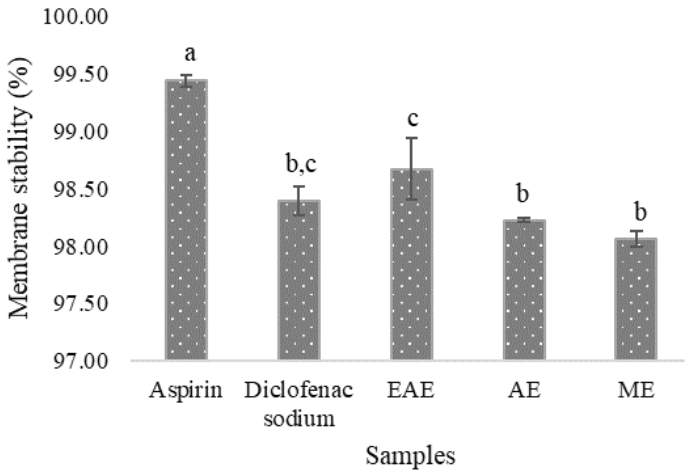

Figure 3: Anti-inflammatory efficacy of aspirin, diclofenac sodium, and *Dracaena angustifolia* root bark extracts.
EAE: Ethyl acetate extract; AE: Acetone extract; ME: Methanol extract; Values are the mean ± standard deviation (SD); n = 3; Means within different alphabets (a, b, and c) significantly differ by Tukey's test at $p < 0.05$ probability level.

Conclusion

The findings of the present study revealed that the yield, phytochemical compounds, total phenolic, and flavonoid contents, as well as the antioxidant activity of *D. angustifolia* root bark extracts, have different results for each solvent used. The best antioxidant activity was exhibited by EAE and AE, whereas EAE had the most effective anti-inflammatory properties in maintaining membrane stability. The novelty of this study is determining the type of solvent with the highest bioactivity in *D. angustifolia* root bark, since it may be used as a starting point for future research into the development of novel herbal medicines. Further studies are needed to isolate and characterize the bioactive compounds from each solvent extract of *D.angustifolia* root bark.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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