ISSN 1859 - 4735

JOURNAL OF MEDICINAL MATERIALS

No. 5 - Vol. 31
9/2026

NATIONAL INSTITUTE OF MEDICINAL MATERIALS

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JOURNAL OF MEDICINAL MATERIALS (Print and Electronic Journals)

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Journal of Medicinal Materials, 2026, Vol. 31, No. 5 (383 - 390)

INVESTIGATION OF FLAVONOID CONSTITUENTS AND ANTIOXIDANT ACTIVITY OF LEAF EXTRACTS FROM *COCCOLOBA UVIFERA* (L.) L.

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Received March 4th, 2026 Accepted September 20th, 2026

Summary

Coccoloba uvifera (L.) L. is widely cultivated in coastal regions of Vietnam, but phytochemical data on Vietnamese-grown material remain limited. This study investigated the flavonoid constituents and antioxidant activity of *C. uvifera* leaves using a bioactivity-guided approach. The leaves were extracted with 80% ethanol and successively partitioned with *n*-hexane, chloroform, ethyl acetate, and water. Among the tested fractions, the ethyl acetate fraction showed the highest DPPH radical-scavenging activity and was selected for chromatographic isolation. Five flavonols were identified by MS and NMR analyses as quercetin, avicularin, quercitrin, isoquercitrin, and myricetin. The isolated compounds exhibited DPPH radical-scavenging activity with IC_{50} values ranging from 2.12 to 3.94 µg/mL. These findings indicate that flavonols are important contributors to the antioxidant activity of *C. uvifera* leaves cultivated in Vietnam.

Keywords: *Coccoloba uvifera; Seagrape; Flavonoids; Bioactivity-guided isolation; Antioxidant activity; DPPH assay.*

1. Introduction

Oxidative stress, characterized by an imbalance between the excessive production of reactive oxygen species (ROS) and the body's antioxidant defense mechanism, plays a pivotal role in the pathogenesis of various chronic diseases, including cardiovascular disorders, diabetes, neurodegenerative diseases, and cancer [1],[2]. Consequently, natural antioxidants derived from medicinal plants have garnered significant interest due to their perceived safety and synergistic pharmacological benefits compared to synthetic alternatives [3]. Among these, flavonoids stand out as a primary group of plant secondary metabolites, recognized for their potent radical scavenging capacity and metal-chelating properties [4]. The genus *Coccoloba* (Polygonaceae) comprises over 120 species distributed throughout tropical and subtropical regions [5],[6]. Several members of this genus are known to synthesize bioactive constituents, particularly flavonoids, anthranoids, and triterpenoids [6]. Among them, *Coccoloba uvifera* (L.) L., commonly known as seagrape, has been traditionally used for the treatment of diarrhea and inflammatory conditions [7]. Previous phytochemical studies have identified flavonoids and other phenolic compounds in different parts of the plant [6],[8]. Extracts from *C. uvifera* have demonstrated antioxidant and other biological activities. The fruit extract exhibited significant antioxidant capacity [9], while leaf extracts showed antioxidant and hypoglycemic effects [10]. Although *C. uvifera* is widely cultivated in several coastal provinces of Vietnam, comprehensive phytochemical investigations of Vietnamese-grown material remain limited. To the best of our knowledge, detailed isolation and identification of antioxidant flavonoids from *C. uvifera* leaves cultivated in Vietnam have not been previously reported. Therefore, this study aimed to investigate the flavonoid constituents of *C. uvifera* leaves through bioactivity-guided fractionation and to evaluate their *in vitro* antioxidant activity using the DPPH radical scavenging assay, providing a scientific basis for the valorization of this coastal medicinal plant as a potential natural antioxidant source.

2. Materials and Methods

2.1. Plant material

Fresh leaves of *C. uvifera* (L.) L. (Polygonaceae) were collected from mature plants in Phu Yen Province, Vietnam, in March 2025. The plant material was identified by Dr. Vo Van Leo, Faculty of Pharmacy, University of Medicine and Pharmacy at Ho Chi Minh City. A representative voucher specimen of the collected material was deposited at the University of Medicine and Pharmacy at Ho Chi Minh City and assigned specimen No. 01-2025/A for future reference. The collected leaves were washed with

distilled water, air-dried at room temperature (25–30 °C) under shade until constant weight, and then ground into a coarse powder. The powdered material was stored in airtight containers at room temperature prior to extraction.

2.2. Chemicals and reagents

Ethanol (80%), *n*-hexane, chloroform, ethyl acetate, methanol, formic acid, and acetic acid of analytical grade were obtained from Thermo Fisher Scientific (USA). *Silica gel* (SiO_2, 60–120 mesh) for column chromatography and pre-coated TLC plates (*silica gel* 60 F_{254}, 20 × 20 cm) were supplied by Merck (Germany). 2,2-Diphenyl-1-picrylhydrazyl (DPPH, ≥95% purity) was purchased from Sigma-Aldrich (USA). Ascorbic acid (99.5% purity), supplied by the Institute of Drug Quality Control – Ho Chi Minh City (IQC-HCMC), Vietnam, was used as the positive control in the DPPH assay. All reagents and solvents were used without further purification.

2.3. Extraction, fractionation, and preliminary phytochemical screening

The powdered leaves of *C. uvifera* were moistened with 80% ethanol and extracted by counter-current percolation using 80% ethanol as the extraction solvent. The ethanolic extract was collected and concentrated under reduced pressure to remove ethanol, yielding the crude extract. The crude extract was then diluted with distilled water, allowed to stand, and decanted to remove insoluble materials. The resulting aqueous suspension was successively partitioned with *n*-hexane (3 × 5 L), chloroform (3 × 5 L), and ethyl acetate (3 × 5 L). Each organic phase was collected, dried over anhydrous sodium sulfate, filtered, and evaporated under reduced pressure to obtain the corresponding fractions. The extraction yield of each fraction was calculated relative to the mass of the crude extract. Only the *n*-hexane, chloroform, and ethyl acetate fractions were subjected to subsequent phytochemical and antioxidant evaluations; the remaining aqueous fraction was also used for investigations.

Preliminary phytochemical screening of the crude extract and solvent fractions was performed using standard qualitative methods to detect major classes of secondary metabolites, including flavonoids using the Shinoda test, phenolic compounds using the ferric chloride test, terpenoids using the Salkowski reaction, and phytosterols using the Liebermann–Burchard reaction.

2.4. DPPH radical scavenging assay

The antioxidant activity of the crude extract, solvent fractions, and isolated compounds was evaluated using the DPPH radical scavenging assay according to modified methods described by Molyneux and by Kedare and Singh [11],[12]. DPPH solution (0.5 mM) was freshly prepared in methanol and protected from light prior to use. Sample solutions were prepared in methanol at appropriate concentrations.

For preliminary screening, the crude extract and solvent fractions were prepared at a concentration of 18 µg/mL. In the assay, 1.0 mL of each sample solution was mixed with 3.5 mL of methanol and 0.5 mL of DPPH solution, giving a final reaction volume of 5.0 mL and a final sample concentration of 3.6 µg/mL. The reaction mixture was vortexed and incubated in the dark at room temperature (25 ± 2 °C) for 30 min. The absorbance was measured at 517 nm using a UV–Vis spectrophotometer (Shimadzu UV-1800, Japan). Methanol was used as the blank. The control solution was prepared by replacing the sample solution with methanol under the same assay conditions. For colored samples, a sample blank containing the sample solution and methanol without DPPH was used for background correction. Ascorbic acid was used as a positive control.

The radical scavenging activity was calculated using the following equation:

$$\text{Radical scavenging activity (\%)} = [(A_{control} - A_{sample}) / A_{control}] \times 100$$

where $A_{control}$ is the absorbance of the control solution and A_{sample} is the corrected absorbance of the sample solution.

For IC_{50} determination, the ethyl acetate fraction and isolated compounds were evaluated at five different concentrations, for example, 1–20 µg/mL. The percentage of radical scavenging activity was plotted against concentration, and IC_{50} values were calculated from concentration–response curves [13],[14]. Because the experimental concentration series were prepared on a mass-concentration basis, IC_{50} values are reported in µg/mL throughout this study. All experiments were performed in triplicate (n = 3), and the results are expressed as mean ± standard deviation (SD).

2.5. Isolation of flavonoids

A portion of the ethyl acetate fraction (60.0 g) was subjected to vacuum liquid chromatography (VLC) on a *silica gel* column (400 g; 40 × 7 cm). The sample was adsorbed onto *silica gel* and loaded onto the column in the dry state. Elution was performed using a stepwise gradient of $CHCl_3$–EtOAc (100:0→20:80, v/v). Eluates were collected in 100-mL portions and monitored by TLC on *silica gel* F_{254} plates using EtOAc–MeOH–formic acid (95:5:0.5, v/v/v) as the developing system. TLC profiles were examined under UV light at 254 and 365 nm and after derivatization with vanillin–sulfuric acid and 5% $FeCl_3$ reagents. Fractions showing similar chromatographic profiles were combined to afford eight major fractions (F1–F8). Selected fractions were concentrated under reduced pressure and purified by precipitation or crystallization from MeOH, followed by repeated washing with cold MeOH. The purity of the isolated compounds was evaluated by TLC and UPLC-PDA prior to spectroscopic identification.

2.6. Structural identification

The structures of the isolated compounds were elucidated by UV, MS, and NMR analyses. The ^{1}H- and ^{13}C-NMR spectra were recorded on a Bruker AVANCE 500 spectrometer at 500 and 125 MHz, respectively, using DMSO-d_6 as the solvent and TMS as the internal standard. Spectral data were compared with published literature values for identification [15-19].

3. Results

3.1. Extractive values and preliminary phytochemical screening

A total of 12.0 kg of air-dried powdered leaves of *C. uvifera* (moisture content: 9.88%) were extracted with 80% ethanol to obtain 2.5 kg of crude ethanol extract. The extraction yield was 20.83% (w/w) based on the air-dried material and 23.12% (w/w) after correction for the moisture content of the plant material.

The crude ethanol extract was subjected to liquid–liquid partition using solvents of increasing polarity. The entire crude ethanol extract (2500 g) was suspended in water and successively partitioned, yielding *n*-hexane (10.27 g), chloroform (11.97 g), and ethyl acetate fractions (220.00 g). These values corresponded to 0.41%, 0.48%, and 8.80% of the crude ethanol extract, respectively, calculated based on the actual weights of the fractions obtained after solvent removal. The total mass of the three organic fractions was 242.24 g, indicating that a major portion of the crude extract remained in the residual aqueous phase. Therefore, although the ethyl acetate fraction was larger than the *n*-hexane and chloroform fractions, it should not be considered the largest fraction when the residual aqueous portion is taken into account. The residual aqueous portion was retained for preliminary DPPH screening but was not further partitioned with *n*-butanol or subjected to chromatographic isolation in the present study. The moisture contents of the crude extract and solvent fractions were not determined; therefore, the fraction yields were not corrected for residual moisture.

Preliminary phytochemical screening revealed the presence of flavonoids, tannins, saponins, carotenoids, free triterpenoids, anthocyanosides, anthraglycosides, proanthocyanidins, organic acids, reducing compounds, and polyuronic compounds, whereas alkaloids, coumarins, cardiac glycosides, fats, and essential oils were not detected. Flavonoids, tannins, and saponins were among the most prominent phytochemical groups detected. These results are consistent with previous reports on the genus *Coccoloba* [6].

3.2. Antioxidant activity of extracts and fractions

The antioxidant activity of the crude extract and solvent fractions was evaluated using the DPPH radical scavenging assay at a concentration of 3.6 µg/mL as a preliminary screening.

Table 1. DPPH radical scavenging activity of crude extract and solvent fractions at 3.6 µg/mL

Sample	Radical scavenging activity (%)
Control	-
Crude extract (TP)	47.39 ± 1.21
n-Hexane (H)	4.85 ± 0.82
Chloroform (C)	34.12 ± 1.05
Ethyl acetate (EA)	66.56 ± 1.34
Aqueous (N)	7.34 ± 0.91
Ascorbic acid	79.87 ± 1.12

At the tested concentration, noticeable differences in DPPH radical scavenging activity were observed among the crude extract and solvent fractions. Under the present assay conditions, the ethyl acetate fraction showed the highest radical scavenging activity (66.56%), followed by the crude extract (47.39%) and the chloroform fraction (34.12%), whereas the *n*-

hexane and aqueous fractions showed weak activity. The reference antioxidant ascorbic acid displayed a scavenging activity of 79.87% under the same conditions.

The relatively higher activity of the ethyl acetate fraction suggests that antioxidant constituents may be enriched in this medium-polar fraction. In contrast, the low activity observed in the *n*-hexane and aqueous fractions indicates that non-polar and highly polar constituents contributed less to radical scavenging under the present DPPH assay conditions. These observations suggest a possible polarity–activity relationship, in which compounds of intermediate polarity, such as flavonoids and other phenolic constituents, may contribute to the observed antioxidant effect.

However, because the evaluation was conducted at only one concentration, these results should be considered preliminary screening data rather than a definitive comparison of antioxidant potency. Therefore, the ethyl acetate fraction was selected for further phytochemical investigation based on its comparatively higher radical scavenging activity under the present screening condition.

3.3. Bioactivity-guided isolation of flavonoids

Bioactivity-guided fractionation of the EtOAc extract yielded eight major VLC fractions (F1–F8), of which F1, F2, F4, F5, and F7 afforded five flavonoids. Fraction F1 yielded COC-1 (905.6 mg), whereas F2, F4, F5, and F7 afforded COC-5 (38.77 mg), COC-2 (47.53 mg), COC-3 (24.00 mg), and COC-4 (279.62 mg), respectively. The overall isolation scheme is presented in Fig. 1.

The isolated compounds showed single predominant peaks by UPLC-PDA, with retention times of 22.00, 16.75, 16.93, 15.35, and 18.79 min for COC-1–COC-5, respectively. Subsequent UV, MS, and NMR analyses identified COC-1, COC-2, COC-3, COC-4, and COC-5 as quercetin, avicularin, quercitrin, isoquercitrin, and myricetin, respectively.

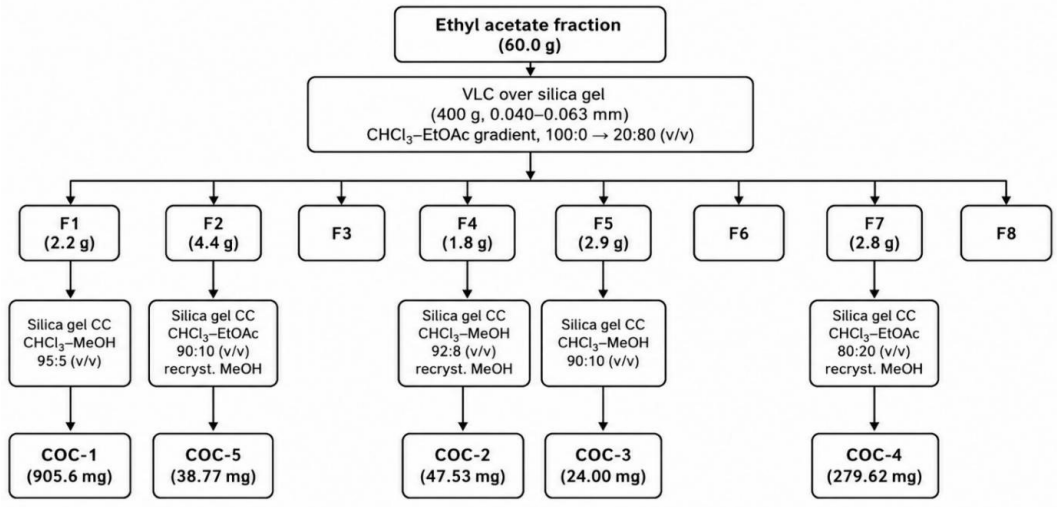


Fig. 1. Fractionation and isolation scheme of compounds COC-1–COC-5 from the ethyl acetate fraction

3.4. Structural identification

The structures of the isolated compounds COC-1–COC-5 were elucidated by combined spectroscopic analyses, including UV, MS, ^{1}H-NMR, ^{13}C-NMR, DEPT, HSQC, and HMBC, and by comparison with published spectral data. The diagnostic ^{13}C-NMR and ^{1}H-NMR data are summarized in Tables 2 and 3, while the chemical structures are shown in Fig. 2.

Table 2. ^{13}C-NMR data of COC-1–COC-5 (125 MHz, DMSO-d_6).

C	COC-1	COC-2	COC-3	COC-4	COC-5
2	146.8	156.3	157.3	156.3	146.8
3	135.7	133.4	134.2	133.3	135.8
4	175.8	177.7	177.7	177.4	175.7
5	160.7	161.2	161.3	161.2	160.7
6	98.1	98.6	98.6	98.6	98.1

7	163.8	164.2	164.2	164.1	163.8
8	93.3	93.5	93.6	93.5	93.2
9	156.1	156.9	156.4	156.2	156.1
10	103.0	103.9	104.0	104.0	103.0
1′	121.9	120.9	120.7	121.2	120.8
2′	115.0	115.5	115.4	116.2	107.2
3′	145.0	145.1	145.2	144.8	145.7
4′	147.7	148.4	148.4	148.4	135.8
5′	115.6	115.6	115.6	115.2	145.7
6′	119.9	121.7	121.1	121.6	107.2
1″		107.8	101.8	100.9	
2″		82.1	70.5	74.1	
3″		76.9	70.3	76.5	
4″		85.9	71.1	69.9	
5″		60.6	70.0	77.5	
6″			17.4	61.0	

Table 3. ^{1}H-NMR data of COC-1–COC-5 (500 MHz, DMSO-d_6, δ in *ppm*, *J* in Hz).

H	COC-1	COC-2	COC-3	COC-4	COC-5
	δ_H (*ppm*)	δ_H (*ppm*)	δ_H (*ppm*)	δ_H (*ppm*)	δ_H (*ppm*)
6	6.19 *d* (2.0)	6.20 *d* (2.0)	6.20 *d* (2.0)	6.20 *d* (1.5)	6.18 *d* (2.0)
8	6.40 *d* (2.0)	6.41 *d* (2.0)	6.39 *d* (2.0)	6.40 *d* (2.0)	6.37 *d* (2.0)
2′	7.68 *d* (2.0)	7.48 *d* (2.0)	7.30 *d* (2.0)	7.58 *d* (2.0)	7.24 *s*
5′	6.88 *d* (8.5)	6.85 *d* (8.5)	6.86 *d* (8.5)	6.84 *d* (9.0)	
6′	7.54 *dd* (8.5, 2.0)	7.56 *dd* (8.0, 2.0)	7.25 *dd* (8.5, 2.0)	7.58 *dd* (8.0, 2.0)	7.24 *s*
1″		5.59 *s*	5.25 *d* (1.5)	5.46 *d* (7.5)	
2″		4.15 *s*	3.13 – 3.23 *m*	3.23 – 3.27 *m*	
3″		3.72 *d* (4.5)	3.50 – 3.52 *m*	3.23 – 3.27 *m*	
4″		3.55 – 3.58 *m*	3.13 – 3.23 *m*	3.44 *m*	
5″		3.26 – 3.34 *m*	3.97 *s*	3.23 *m*	
6″			0.82 *d* (6)	3.56 – 3.60 *m*	

COC-1 showed two meta-coupled A-ring protons at δ_H 6.19 and 6.40 and an ABX system at δ_H 7.68, 6.88, and 7.54, characteristic of a 3′,4′-dihydroxylated B-ring. The ^{13}C-NMR/DEPT spectra showed 15 carbons, including a conjugated carbonyl at δ_C 175.8, with no signals attributable to a sugar moiety. HSQC and HMBC correlations supported the assignments of the aromatic protonated and quaternary carbons. Together with published spectral data, COC-1 was identified as quercetin [20].

The aromatic NMR patterns of COC-2, COC-3, and COC-4 closely resembled those of COC-1, indicating the same quercetin aglycone, but additional signals characteristic of sugar residues were observed. For COC-2, an anomeric proton/carbon pair at δ_H 5.59/δ_C 107.8, together with the oxygenated methylene at δ_C 60.6, was consistent with an arabinofuranosyl unit. The HMBC correlation from H-1″ to C-3 (δ_C 133.4) established glycosylation at C-3, identifying COC-2 as avicularin (quercetin-3-*O*-*α*-L-arabinofuranoside).

For COC-3, the anomeric signals at δ_H 5.25/δ_C 101.8 and the characteristic methyl signals at δ_H 0.82/δ_C 17.4 indicated a rhamnopyranosyl moiety. The HSQC correlation of H-1″/C-1″ and the HMBC correlation from H-1″ to C-3 (δ_C 134.2) confirmed a 3-*O*-linked rhamnose residue. COC-3 was therefore identified as quercitrin (quercetin-3-*O*-*α*-L-rhamnopyranoside) [17],[18].

For COC-4, an anomeric proton at δ_H 5.46 (d, *J* = 7.5 Hz) and six sugar carbons at δ_C 100.9, 74.1, 76.5, 69.9, 77.5, and 61.0 were consistent with a *β*-glucopyranosyl unit. An HMBC correlation from H-1″ to C-3 (δ_C 133.3) established the site of glycosylation, leading to the identification of COC-4 as isoquercitrin (quercetin-3-*O*-*β*-D-glucopyranoside) [19].

In contrast, COC-5 contained no sugar signals and retained the flavonol A-ring pattern observed for COC-1. However, the ABX B-ring pattern of quercetin was replaced by a singlet at δ_H 7.24 integrating for two equivalent protons (H-2′/H-6′), with corresponding equivalent carbons at δ_C 107.2 and oxygenated C-3′/C-5′ at δ_C 145.7. This symmetrical 3′,4′,5′-trihydroxylated B-ring distinguished COC-5 from quercetin and supported its identification as myricetin.

Thus, COC-1–COC-5 were identified as quercetin, avicularin, quercitrin, isoquercitrin, and myricetin, respectively. COC-2–COC-4 are 3-*O*-glycosides of the quercetin scaffold represented by COC-1, whereas COC-5 differs primarily by the additional hydroxylation and resulting symmetry of the B-ring.

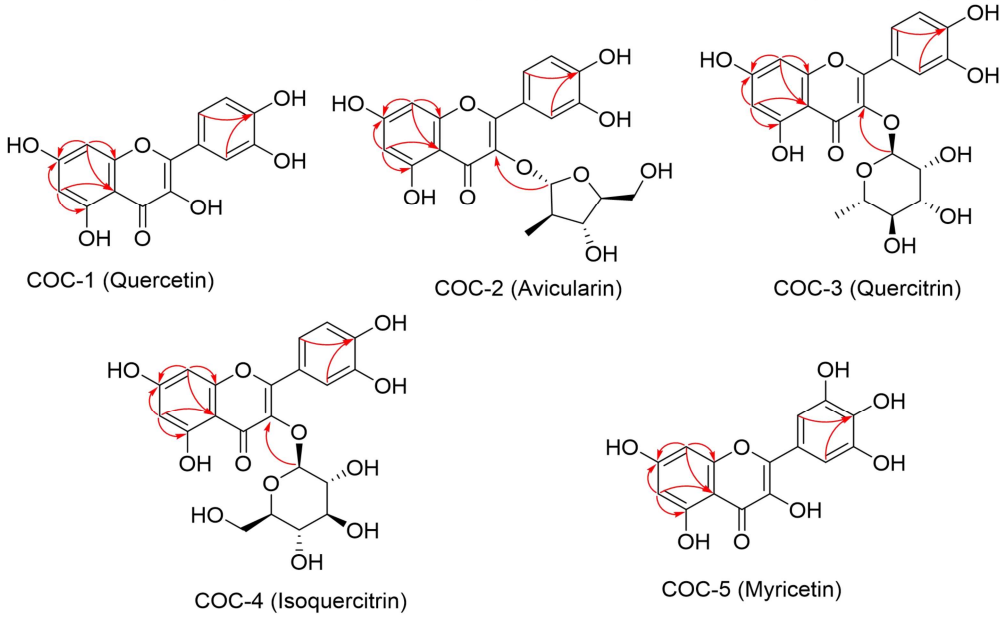


Fig. 2. Chemical structures of COC-1–COC-5 and key HMBC correlations for glycosidic linkages

3.5. Antioxidant activity of isolated compounds

The DPPH radical-scavenging activities of the ethyl acetate fraction and the isolated flavonoids were evaluated and compared with ascorbic acid as the reference antioxidant. The calculated IC_{50} values, regression equations, and coefficients of determination (R^2) are summarized in Table 4. Lower IC_{50} values indicate stronger radical-scavenging activity.

All tested samples showed concentration-dependent DPPH radical-scavenging activity. The IC_{50} values of the isolated compounds ranged from 2.12 ± 0.01 to 3.94 ± 0.01 µg/mL: myricetin (COC-5), 2.12 ± 0.01 µg/mL; quercetin (COC-1), 2.19 ± 0.01 µg/mL; avicularin (COC-2), 2.56 ± 0.01 µg/mL; quercitrin (COC-3), 3.82 ± 0.01 µg/mL; and isoquercitrin (COC-4), 3.94 ± 0.01 µg/mL. The ethyl acetate fraction displayed an IC_{50} value of 3.00 ± 0.01 µg/mL, whereas ascorbic acid showed an IC_{50} value of 2.29 ± 0.01 µg/mL. Because the numerical IC_{50} values are relatively close and no inferential statistical comparison among the IC_{50} estimates was performed, the observed numerical differences should not be interpreted as statistically established differences in antioxidant potency. The regression models showed high coefficients of determination (R^2 = 0.9900–0.9983), supporting the fit of the concentration–response models used to estimate IC_{50} values.

Table 4. IC_{50} values and regression equations of the ethyl acetate fraction, isolated compounds, and reference antioxidant

Sample	IC_{50} (µg/mL)	Regression equation	R^2
Myricetin	2.12 ± 0.01	Y = 32.79 x – 19.54	0.9920
Avicularin	2.56 ± 0.01	Y = 29.02 x – 24.42	0.9967
Quercitrin	3.82 ± 0.01	Y = 15.09 x – 7.72	0.9982
Isoquercitrin	3.94 ± 0.01	Y = 12.89 x – 0.86	0.9930
Quercetin	2.19 ± 0.01	Y = 33.41 x – 23.15	0.9900
Ethyl acetate fraction	3.00 ± 0.01	Y = 27.76 x – 33.39	0.9983
Ascorbic acid	2.29 ± 0.01	Y = 22.00 x – 0.29	0.9970

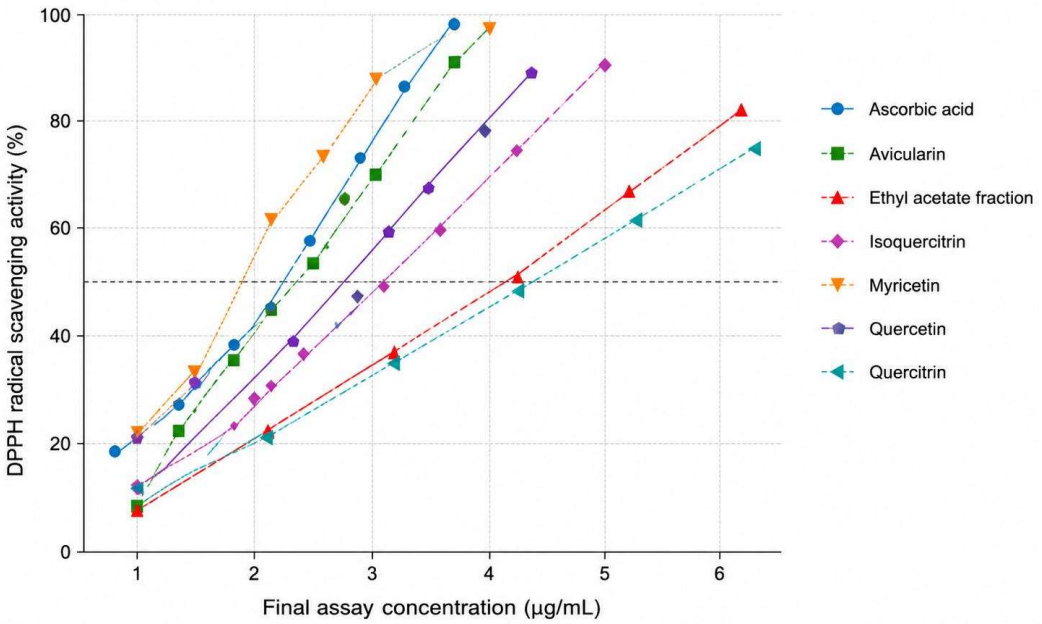


Fig. 3. Concentration–response curves of the ethyl acetate fraction, isolated compounds, and ascorbic acid in the DPPH radical scavenging assay. Data are expressed as mean ± SD (n = 3).

4. Discussion

The present study provides additional phytochemical and antioxidant data on *C. uvifera* leaves cultivated in Vietnam. The detection of flavonoids and other phenolic constituents is consistent with previous reports on *C. uvifera* and related *Coccoloba* species [6-9]. Unlike earlier studies that mainly focused on crude extracts or preliminary biological screening, the present work used DPPH-guided fractionation to isolate five flavonols—quercetin, myricetin, avicularin, quercitrin, and isoquercitrin—from the active ethyl acetate fraction and evaluated their individual radical-scavenging activities.

All five isolated flavonols showed DPPH radical-scavenging activity within a relatively narrow IC_{50} range (2.12–3.94 µg/mL). Because no inferential statistical comparison was performed among these IC_{50} estimates, their numerical ordering should not be interpreted as a statistically established structure–activity relationship. Previous studies have likewise demonstrated DPPH-scavenging activity for quercetin and its glycosides, although the reported IC_{50} values vary considerably with assay conditions. Kim et al. reported DPPH IC_{50} values of 20.7, 27.6, and 24.5 µM for quercetin, quercitrin, and isoquercitrin, respectively [20]. Li et al. reported DPPH IC_{50} values of 4.45 ± 0.17 and 5.89 ± 0.25 µg/mL for quercitrin and isoquercitrin, respectively [21]. Avicularin has also been reported to show concentration-dependent DPPH radical-scavenging activity [22]. These published data support the antioxidant capacity of the flavonols identified in the present study, while also indicating that direct quantitative comparisons among studies should be made cautiously because solvent systems, DPPH concentration, incubation time, reference antioxidants, concentration units, and calculation methods may differ.

The relatively high activity of the ethyl acetate fraction is consistent with enrichment of medium-polar antioxidant constituents, particularly flavonols, and supports its selection for further isolation based on biological activity rather than extraction yield. Because phytochemical composition and antioxidant activity may vary with geographical origin, cultivation conditions, plant part, extraction procedure, and assay conditions, direct quantitative comparisons with previous studies should be interpreted cautiously.

The present study is limited by the use of a single *in vitro* antioxidant assay and by the lack of further investigation of the residual aqueous fraction. Future studies should include

complementary antioxidant assays, quantitative determination of major flavonoids, cellular and *in vivo* models, and comparisons among samples from different geographical and cultivation conditions.

5. Conclusion

Five flavonol derivatives, namely quercetin, avicularin, quercitrin, isoquercitrin, and myricetin, were successfully isolated from the ethyl acetate fraction of *C. uvifera* leaves cultivated in Vietnam. The ethyl acetate fraction and all isolated compounds showed DPPH radical-scavenging activity under the present assay conditions. The IC_{50} values of the isolated compounds ranged from 2.12 to 3.94 μg/mL. These findings indicate that flavonols contribute to the antioxidant activity of *C. uvifera* leaves and support further investigation of this species as a natural source of antioxidant constituents.

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