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Micro-morphological traits of *Aglaonema griffithii* and its chemical and antioxidant properties

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Summary

Aglaonema griffithii Schott is a helophytic plant widely found in the southern Vietnam and some regions of southeastern Asia. The aim of this study is to provide the anatomical characteristics, chemical compounds and antioxidant activity of this species for the first time. The micro-morphological traits of the studied species are performed using the iodine green-carmine double staining method. The anatomical characteristics of the different parts of *A. griffithii* are used as a monograph in the herbal medicine standardization of this plant. The gas chromatography/mass spectrometry assay is also used to determine the chemical compounds in the ethanolic extracts obtained from *A. griffithii*. Of these, sucrose is the most abundant component found in the rhizome and petiole extracts while the leaf extract is found to be rich in phytol as the highest percent component. The antioxidant properties of the ethanol extracts of the *A. griffithii* leaf, rhizome, and petiole were also investigated using DPPH radical scavenging assay with IC_{50} values of 193.08, 234.61, and 270.65 µg/mL, respectively.

Key words: Aglaonemateae, anatomy, antioxidant effects, chemical compounds

Introduction

The tribe Aglaonemateae Engler consists of two genera, including *Aglaonema* Schott and *Aglaodorum* Schott. The first genus comprises over 22 accepted species widely found in northeastern India, southern China, New Guinea, and southeastern Asia (Nicolson, 1969; Hay, 1998; Li and Boyce, 2010). Meanwhile, the later one contains only one species, *Aglaodorum griffithii* Schott, distributed on the tidal mudflats in so many regions of Asian countries, i.e. Cambodia, Thailand, Sumatra, south and west through Peninsular Malaysia, east to north Borneo, and southern Vietnam (Nicolson, 1969; Hay, 1998; Li and Boyce, 2010; Van et al., 2020). In 1956, Schott was the person who firstly described the species *Aglaonema griffithii* collected from Peninsular Malaysia (Schott, 1856). Two years later, this species was moved to a new genus, *Aglaodorum* Schott because of its morphologically resembled traits with other *Aglaonema* plants, however (Schott, 1858). So many botanists agreed that *Aglaodorum griffithii* was monotypic species of the genus *Aglaodorum* (Mayo et al., 1997; Pham, 2000; Boyce et al., 2012; Nguyen, 2017; Van, 2017) whereas others treated *Aglaodorum griffithii* beneath the genus *Aglaonema* (Hooker, 1883; Ridley, 1925). Notably, based on the molecular and morphological data, Van et al. (2020) proposed that the species *Aglaodorum griffithii* should be placed within the genus *Aglaonema*, and that the name *Aglaonema griffithii* should be resurrected (Van et al., 2020).

Aglaonema griffithii Schott, a helophytic plant, is widely found in Cambodia, Thailand, Sumatra, south and west through Peninsular Malaysia, east to north Borneo, and southern Vietnam. Most of parts of this species such as fruits, petioles, peduncles, and rhizomes are characterized by the sponge structures to respond to the habitat on the tidal mudflats (Nicolson, 1969; Hay, 1998; Li and Boyce, 2010; Van et al., 2020). Several surveys on the flora diversity in the Mekong delta, southwest of Vietnam have provided the medicinal values of this species used by the local communities (Dang, 2009; Le et al., 2014; Dang et al., 2018; Truong et al., 2022). So far, studies on *A. griffithii* have been limited and thus, the current report aims to provide the anatomical characteristics, chemical compounds and antioxidant activity of this species for the first time.

Materials and methods

Materials

The specimens of *A. griffithii* was collected from Da Phuoc ward, Binh Chanh district, Ho Chi Minh City, Vietnam, coordinates of 10°40'29.1"N 106°38'19.7"E. The voucher specimen of the collected plants (Le-Tran 01) was deposited at Institute of Biotechnology and Food Technology, Industrial University of Ho Chi Minh City. Upon collection, the fresh samples were subject to immidiate processing for further analyses.

Micro-morphological characteristics

Different parts of *A. griffithii*, such as leaf, petiole, and root were transversely cut into thin slices and then bleached by sodium hypochlorite (NaOCl). Double staining method (iodine green-carmine) was used to stain the studied specimens. The specimens were washed with distilled water several times and preserved in 10% glycerol (Truong et al., 2007). In principle, cellulose cell walls are visualized as pink due to carmine stain while lignified cell walls are visualized as green due to iodine green stain. The specimens were then observed and imaged using Olympus BX53 Digital Upright Microscope.

Extract preparation

The petioles, leaves, and rhizomes were dried at 50 °C using the Memmert UFE 400 Sterilizer Laboratory Oven until constant weight was obtained. The dried samples were then grinded into fine powder using Power Grinder PG2500 and they were homogenised by sieving through 0.3 mm mesh. For extraction, 50 grams of powder was soaked in 500 mL of 99% acetone solution (Thermo Fisher Scientific, USA) for 48 hours. The extract was filtered using Whatman filter paper (10 µm particle retention, Ahlstrom 631, USA). The sample was further extracted two more times using the same procedure. The three filtrates were then combined and subjected to solvent removal on a rotary vacuum evaporator (IKA company, Germany) at 45 °C.

Gas chromatography-mass spectrometry (GC/MS) analysis

Sample profiling was conducted on Thermo Scientific™ ISQ™ 7000 GC-MS system (Thermo Fisher Scientific, USA). The system

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equipped with a gas chromatograph GC TRACE 1310 and a single quadrupole mass spectrometer ISQ 7000 (Thermo Fisher Scientific, USA) was employed to analyze the chemical composition of the sample. Agilent GC column DB-5MS (30 m, 0.25 mm, 0.25 µm) was the stationary phase while helium was used as carrier gas with a flow rate of 1.2 mL/min. An aliquot of 1.0 µL of sample was injected into the GC system, whose conditions were injector temperature of 250 °C; split flow of 36 mL/min, split ratio of 30:1 and splitless time of 1 min. The oven conditions were programmed to start at 80 °C with a 5 minute hold. The temperature was then increased 20 °C/min to 280 °C with a 10 minute hold before ramping 20 °C/min to 300 °C with 3 minute hold. The other conditions included the transfer line temperature of 280 °C, the ion source temperature of 250 °C, and the ionization energy of 70 eV. The scan range of 29-650 m/z was used with the dwell time of 0.2 seconds. The total GC/MS-runtime was about 28.64 minute. For sample profiling, the mass spectral data obtained were compared with the NIST 2017 library.

Antioxidant activity

Fifty microlitres of various concentrations of samples or standards were added to a test tube containing 2 mL of 60 µM DPPH solution (Alfa Aesar, Thermo Fisher Scientific, USA) prepared in methanol solution (Thermo Fisher Scientific, USA). The mixture was kept in the dark at room temperature for 60 min and the bsorbance measurements were conducted at 517 nm using a spectrophotometer (Genesys 20, Thermo Scientific, USA). Ascorbic acid (Bio Basic, Canada) was used as a control. A blank sample containing the same amount of methanol and DPPH solution was used as the negative control (A_0). The percentage inhibition $[(A_0 - A_1/A_0) \times 100]$ was plotted against sample or standard content and IC_{50} was determined (concentration of the extracts or standard able to scavenger 50% of DPPH free radical).

Data analysis

All antioxidant activity analyses were performed in triplicate. Analysis of variance (ANOVA) and comparison of means were performed using Statgraphics Centurion 20 (StatPoint Technologies, Inc.) software, with a 95% confidence level ($p \leq 0.05$) determined using the least significant difference (HSD) method. The results are shown as the mean ± standard deviation.

Results

Taxonomic treatment

***Aglaonema griffithii* Schott**, Syn. Aroid. 123, 1856; Hook. f., Fl. Brit. India 6: 528, 1893; Ridl., Mat. Fl. Malay Penins. 19, 1907; Ridl., Fl. Malay Penins. 5: 100, 1925; Thaiszia - J. Bot. 30. 2020. Synonym: *Aglaodorum griffithii* (Schott) Schott, Gen. Aroid. 58: 58, 1858. (Fig. 1)

Type: W. Griffith 5991 (K, holo & iso, seen on-line), Malacca, Malaysia, 1842.

Distribution: The species was found in Cambodia, Thailand, Sumatra, south and west through Peninsular Malaysia, east to north Borneo, and southern Vietnam.

Habitat: *A. griffithii* is a helophytic plant, thus, most parts of this species such as fruits, petioles, peduncles, and rhizome are characterized by the sponge structures to respond to the habitat on the tidal mudflats.

Micro-morphology of *A. griffithii*

***Root* (Fig. 2)**

Transverse section has a nearly circular shape divided into 2 regions, 4/5 radius of transverse section is the cortex region while the stele occupies 1/5 of the radius. *Cortex*: The piliferous layer includes a layer of polygonal cells, irregular size, with thin cellulose walls or impregnated with cork. The exodermis consists of 1-4 layers of polygonal cells, cork-impregnated walls, arranged haphazardly. The outer cortical parenchyma has 7-10 layers of polygonal cells arranged in leaving small intercellular spaces, inner cortical parenchyma has 16-20 layers of cells, arranged in leaving large intercellular spaces; endodermis with Casparian strip. *Stele*: The pericycle is a layer of polygonal cells with cellulose walls, nearly uniform in size, arranged

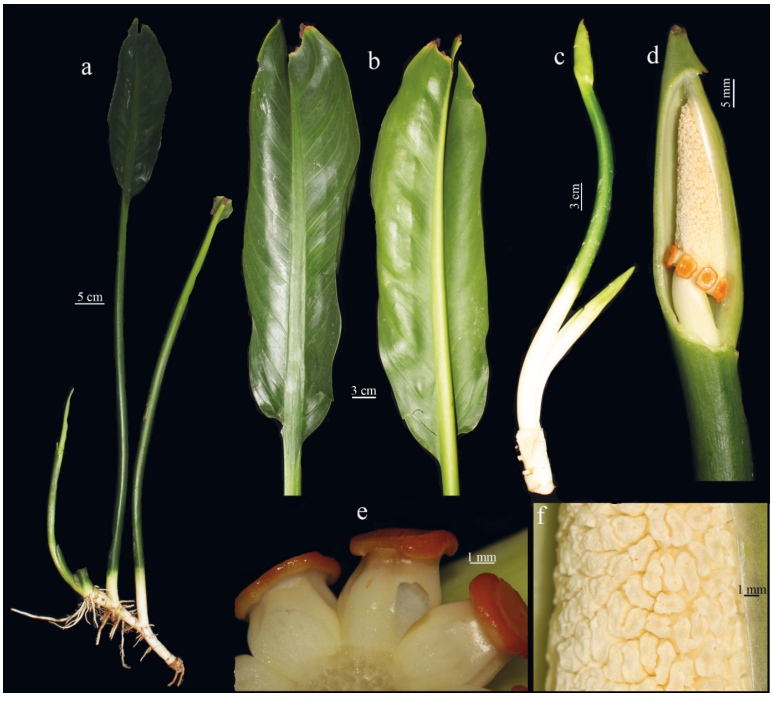

Fig. 1: *Aglaonema griffithii* Schott. a: whole plant, b: leaf blade, c: inflorescence (peduncle and spathe), d: spadix, e: ovaries and stigmas, f: stamens

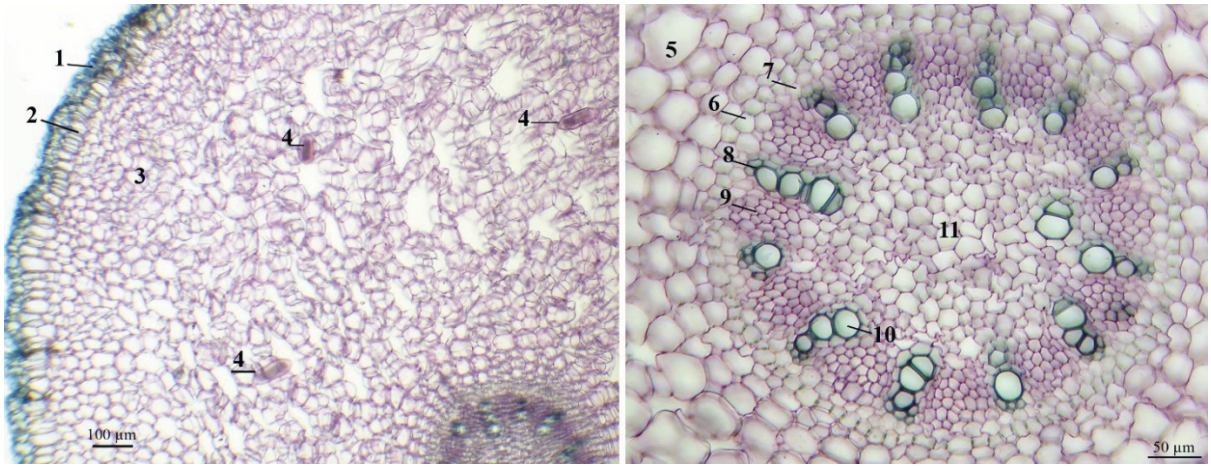

Fig. 2: Transverse section of *Aglaonema griffithii* Schott root. 1: piliferous layer, 2: exodermis, 3: outer cortical parenchyma, 4: calcium oxalate crystals, 5: inner cortical parenchyma, 6: endodermis with casparian strip, 7: pericycle, 8: protoxylem, 9: phloem, 10: metaxylem, 11: medullary parenchyma

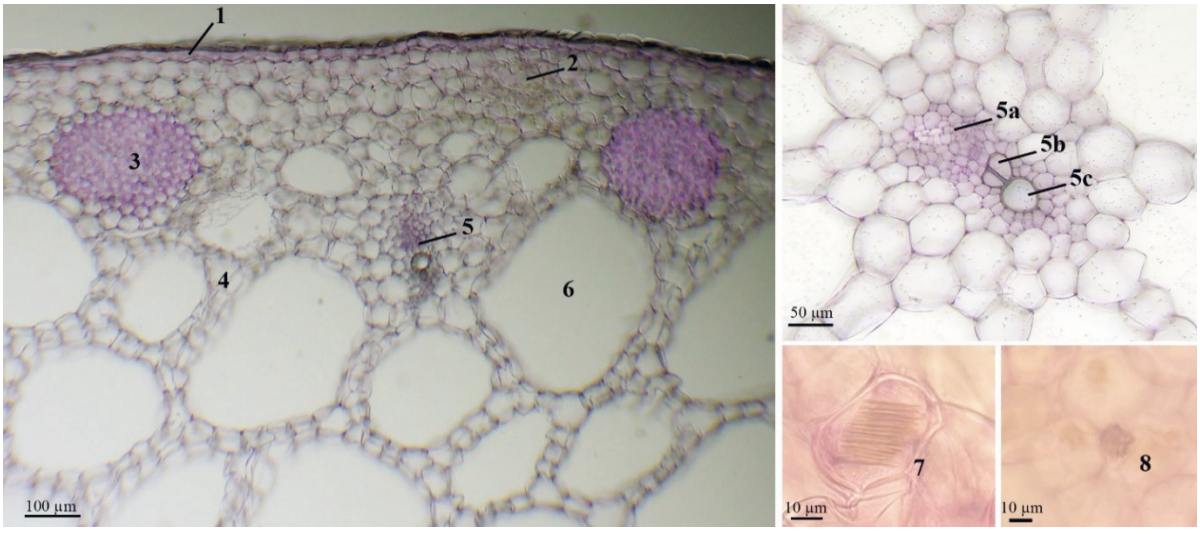

Fig. 3: Transverse section of *Aglaonema griffithii* Schott petiole. 1: epidermis, 2: chlorenchyma, 3: angular collenchyma, 4: spongy parenchyma, 5: vascular bundle (5a: phloem, 5b: protoxylem, 5c: metaxylem), 6: large air cavity, 7: needle-shaped calcium oxalate crystals, 8: spiny-shaped calcium oxalate crystals.

alternately with the endodermis. The system of vascular bundles consists of 11-14 phloem bundles and 11-14 protoxylem bundles alternating with in a ring, separated by medullary rays. Phloem bundles form oval clusters, polygonal cells, irregular. Protoxylem bundles consist of 2-5 polygonal xylem vessels, centripetally differentiated. 14-18 metaxylem vessels arrange below primary phloem and protoxylem, metaxylem vessels are often attached to the protoxylem bundle, rarely separate. Medullary rays have 1 row of horizontally flattened polygonal cells, cellulose walls. Medullary parenchyma has 6-8 layers of polygonal cells, cellulose walls, closely arranged. There are cells containing spherical and needle-shaped calcium oxalate crystals.

***Petiole* (Fig. 3)**

Transverse section is round, no distinction between cortex and stele. Epidermis includes 1 layer of cells, rectangular, cellulose wall. Chlorenchyma consists of 3-4 layers of polygonal cells, arranged to form small intercellular spaces. The angular collenchyma arranges in oval clusters, each cluster consists of 5-7 layers of polygonal cells, closely arranged. The vascular bundles with phloem above xylem, haphazardly arranged in the cortex cortical parenchyma, the vascular bundles gradually enlarge inwards. The xylem vessels are few, each xylem bundle consists of 1-2 small protoxylem vessels and 1-2 larger metaxylem vessels located below the protoxylem. Surrounding the vascular bundles and occupying the entire pith area is parenchyma with very large intercellular spaces. There are cells containing spherical and needle-shaped calcium oxalate crystals.

***Leaves* (Fig. 4)**

The leaf blade is convex on both sides, including the midrib and the main lamina on both sides. *Midrib:* The upper and lower epidermis consist of a layer of polygonal cells, the outer surface is thinly cutinized. The chlorenchyma comprises a layer of long, narrow cells, arranged closely, perpendicular to the upper epidermis. The angular collenchyma is arranged in small, round or oval clusters, in a row below the chlorenchyma and in a row above the lower epidermis. The vascular bundles with xylem lie on the phloem, scattered in many rows in the midrib, the outer bundles are smaller than the inner

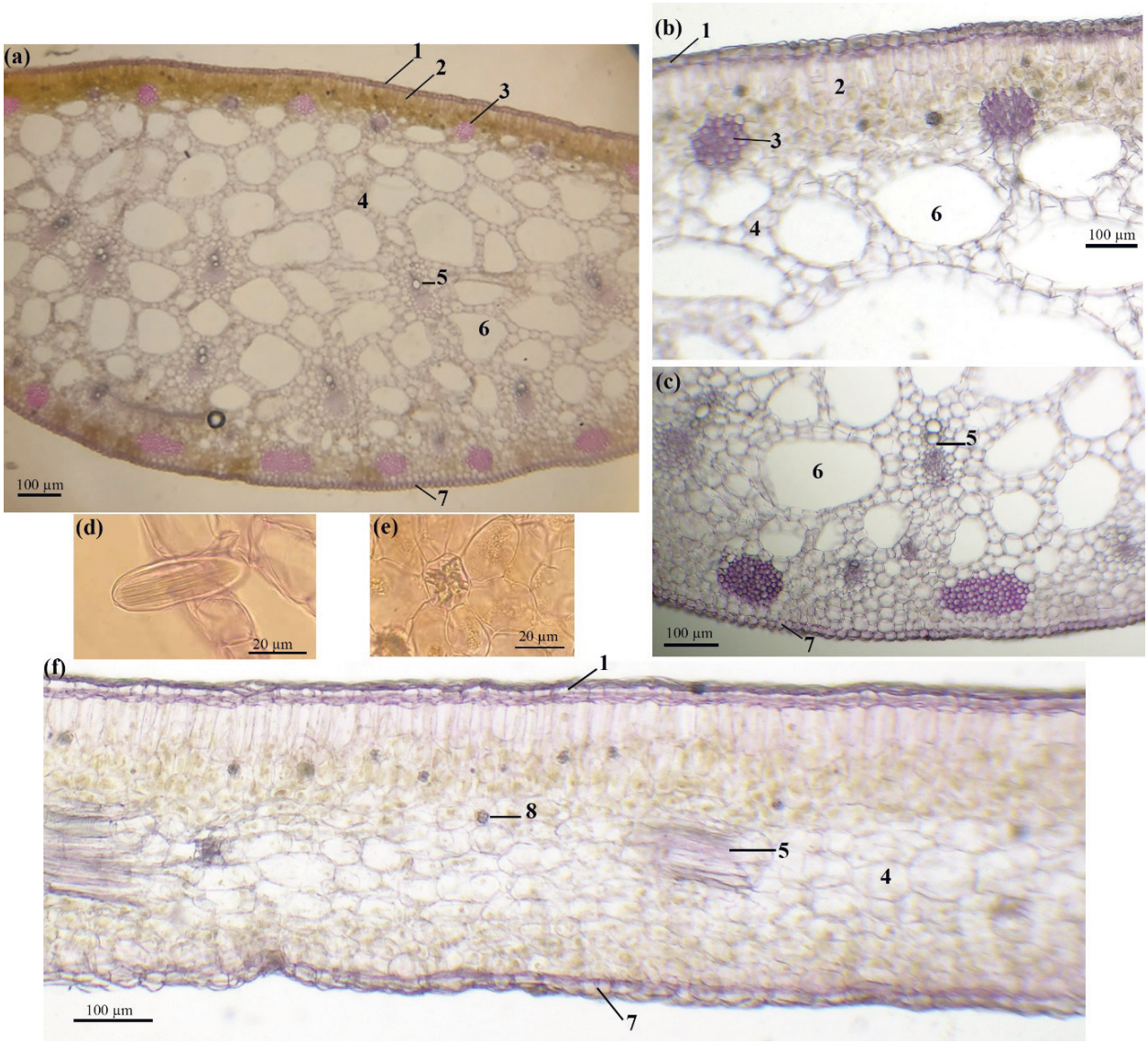

Fig. 4: Transverse section of *Aglaonema griffithii* Schott leaves with midrib (a, b, c), needle-shaped calcium oxalate crystal (d), spiny-shaped calcium oxalate crystal (e), and lamina (f). 1: upper epidermis, 2: chlorenchyma, 3: angular collenchyma, 4: spongy parenchyma, 5: vascular bundle, 6: large air cavity, 7: lower epidermis, 8: spiny-shaped calcium oxalate crystal.

bundles. Surrounding the vascular bundles is the parenchyma with large intercellular spaces. *Lamina:* The upper and lower epidermis consist of a layer of polygonal cells, cellulose walls, and stomata appear on both sides of the epidermis. The chlorenchyma has 2-3 layers of long, narrow, thin-walled cells, perpendicular to the upper epidermis. The spongy parenchyma includes polygonal cells, irregular, and disorderly arranged. The small vascular bundles are arranged in a row in the parenchyma region.

In the roots, petioles, and leaves, there are cells containing spherical and needle-shaped calcium oxalate crystals, most abundant in the leaves.

Chemical compounds of ethanolic extracts from *A. griffithii*

The chemical components of the ethanolic extracts from *A. griffithii* petiole, leaf, and rhizome were performed using gas chromatography/mass spectrometry assay (Tab. 1). Accordingly, a total of 29 compounds were found in 3 studied extracts. Of these, the petiole extract was found to be rich in sucrose (19.69%), phytol (12.78%), glyceraldehyde (7.18%), neophytadiene (7.03%), 2-propanone, 1,3-dihydroxy- (6.51%), and n-hexadecanoic acid (6.38%). The leaf extract was characterized by the predominance of phytol (34.56%), neophytadiene (9.41%), n-hexadecanoic acid (8.77%), γ-tocopherol (7.74%), linolenic acid (7.56%) whereas sucrose (29.26%), n-hexadecanoic acid (21.80%), 9(E),11(E)-conjugated linoleic acid (18.42%), stigmasterol (10.46%), and palmitoleamide (7.64%) were the major compounds in the rhizome extract.

Antioxidant activity of ethanol extracts from *A. griffithii*

Tab. 2 showed the antioxidant properties of the ethanol extracts of the *A. griffithii* rhizome, petiole, and leaf. Accordingly, the leaf extract showed the strongest DPPH radical scavenging effect with IC_{50} value of 193.08 µg/mL, followed by the rhizome and petiole extracts with IC_{50} values of 234.61 and 270.65 µg/mL, respectively. However, the DPPH radical scavenging effects of all the aforementioned parts were significantly lower than that of Ascorbic acid C (IC_{50} value of 2.77 µg/mL).

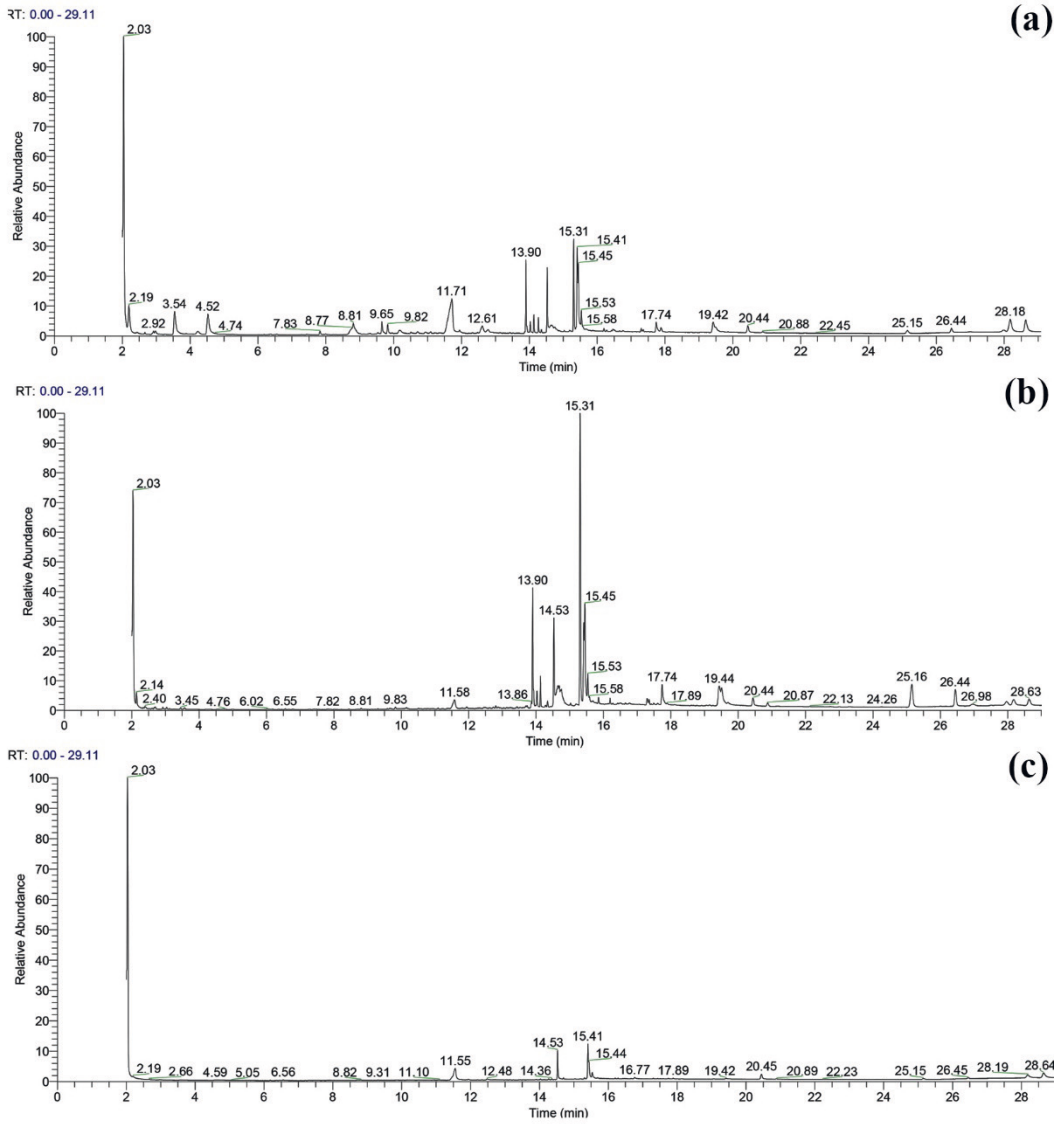

Fig. 5: The GC chromatogram of ethanol extracts from petiole (a), leaf (b), and rhizome (c) of *Aglaonema griffithii* Schott

Discussion

Our previous work showed the anatomical characteristics of *Aglaonema cochinchinensis* and its micro-morphological traits were similar to those of *Aglaonema griffithii* (Van et al., 2024). Accordingly, the root transverse section of both species were characterized by the same structure in having: the cross-section has a nearly circular shape; the cortex is much larger than the stele; the piliferous layer includes a layer of polygonal cells, irregular size, with thin cellulose walls or impregnated with cork; cortical parenchyma includes round or polygonal cells, cellulose walls, arranged haphazardly with intercellular spaces; endodermis with casparian strip; medullary rays consists of 1-2 rows of polygonal cells between phloem and xylem bundle; vascular system includes phloem bundles alternating with xylem bundles on a ring, separated by medullary rays. Meanwhile, the root transverse section of *A. griffithii* differs from *A. cochinchinensis* in the number of the vascular bundles (11-14 vs. 13-17) (Van et al., 2024). In addition, the leaf cross-sections of these species also share the following characteristics: epidermis has thin cuticle layer; stomata scatters on both epidermis layers; angular collenchyma is located in small, round or oval clusters; vascular bundles with xylem above phloem, scattered in many rows in the midrib. However, the leaf cross-section of the studied plant can be only distinguished from *A. cochinchinensis* in having: midrib is convex on both sides; surrounding the vascular bundles is the parenchyma with very large intercellular spaces (vs. midrib is concave on the upper surface, convex on the lower surface; surrounding the vascular bundles is the parenchyma with much smaller intercellular spaces) (Van et al., 2024). The anatomical characteristics of *A. griffithii* and *A. cochinchinensis* are extremely similar. This result further confirms that the species *Aglaodorum griffithii* placed within the genus *Aglaonema* is reasonable conclusion (Hooker, 1883; Ridley, 1925; Van et al., 2020).

Owing to the calcium oxalate crystals in their cells, a large number of species belonging to the Araceae family cause swelling of the mouth, lips, and throat once eaten raw. Thus, the calcium oxalate crystals, especially the needle shaped calcium oxalate crystals (raphide) have been known as an important indicator of Araceae plants (Bradbury and Nixon, 1998; Johns and Kubo, 1988; Paull et al., 1999; Sakai, 1979). Studies demonstrated that species within the genus *Aglaonema* also contained the calcium oxalate crystals. For instance, the *Aglaonema modeslum* leaves consisted of two types of calcium oxalate crystals, including raphide and druse idioblasts (Genuaf and Hillson, 1985). Furthermore, Md et al. (2012) provided that both

Tab. 1: Chemical compositions of ethanolic extracts from *A. griffithii*

RT	Compounds	Relative percentage		
		Petiole	Leaf	Rhizome
2.40	Topotecan	-	0.33	-
2.70	Propanoic acid, 2-methyl-	-	0.32	-
2.92	Propane, 2,2-diethoxy-	-	0.17	-
3.03	l-Alanine, n-propargyloxycarbonyl-, ethyl ester	-	0.23	-
3.54	Glyceraldehyde	7.18	-	-
4.52	2-Propanone, 1,3-dihydroxy-	6.51	-	-
8.81	Pyranone	5.66	-	-
9.65	5-Hydroxymethylfurfural	2.14	-	-
9.82	1,2,3-Propanetriol, 1-acetate	1.31	-	-
11.55	Sucrose	19.69	2.88	29.26
12.61	3-Deoxy-d-mannoic lactone	2.46	-	-
13.90	Neophytadiene	7.03	9.41	-
14.27	Dimethyl palmitamine	1.45	-	-
14.34	Squalene	-	0.71	-
14.53	n-Hexadecanoic acid	6.38	8.77	21.80
14.70	Palmitic acid, ethyl ester	-	-	1.39
15.31	Phytol	12.78	34.56	-
15.41	9(E),11(E)-Conjugated linoleic acid	5.07	4.31	18.42
15.45	Linolenic acid	3.30	7.56	3.69
15.53	Stearic acid	2.15	2.39	4.44
15.85	trans-Geranylgeraniol	-	0.89	-
17.74	Palmitin, 2-mono-	1.82	3.46	-
19.42	Linolein, 1-mono-	3.47	2.87	-
19.51	2-Monolinolenin	-	1.34	-
20.44	Palmitoleamide	1.45	1.57	7.64
25.16	γ-Tocopherol	-	7.74	1.71
26.44	dl-α-Tocopherol	1.02	4.50	-
28.18	Campesterol	4.73	2.12	-
28.63	Stigmasterol	3.80	2.06	10.46
	Total	**99.40**	**98.19**	**98.81**

Tab. 2: DPPH radical scavenging activity of ethanol extracts from *A. griffithii*

	Rhizome	Petiole	Leaf	Ascorbic acid
IC_{50} (μg/mL)	$234.61^{c} \pm 1.96$	$270.65^{d} \pm 3.81$	$193.08^{b} \pm 1.35$	$2.77^{a} \pm 0.01$

Different letters (a, b, c, and d) in the same row indicate significant differences ($p \leq 0.05$) between samples.

raphide and druse idioblasts were also found in the *A. commutatum* leaves. Accordingly, the druse idioblasts were featured to contain the small spherical which was found to locate throughout the lamina mostly in sub-epidermal regions. The study have found two types of the raphide idioblasts, including the non-defensive raphide and defensive raphide idioblasts (Md et al., 2012). Along with other members of the family Araceae, the cells of roots, petioles, and leaves *Aglaodorum griffithii* in current report also consisted of the spherical and needle-shaped calcium oxalate crystals.

Studies provided the chemical compositions of the different extracts isolated from other *Aglaonema* species. For instance, the methanolic extracts from the root and stem of *A. simplex* contained terpenoids, steroids, glycosides, alkaloids, phenolics (Ismail et al., 2017). Similarly, Napiroon et al. (2017) indicated that the lipophilic extract of *A. simplex* rhizome consisted of terpenoids, coumarins, alkaloids, phenolics, and organic compounds. β-sitosterol, a bioactive compound, isolated from the *A. simplex* rhizome was demonstrated to have the high hyaluronidase inhibition (Khammee et al., 2020). The methanolic extracts isolated from the *A. simplex* leaf, stem, and root also contained reducing sugars, alkaloids, phenolics, glycosides, steroids, and terpenes (Ahmad et al., 2017). In addition, 2,5-dideoxy-2,5-imino-D-mannitol and α-homonojirimycin were the main iminosugars in the *A. commutatum* extracts (Rodríguez-Sánchez et al., 2016). So many polyhydroxy alkaloids such as β-homomannojirimycin,; 2(R),5(R)-bis-(hydroxymethyl)-3(R),4(R)-dihydroxypyrrolidine; 7-O-β-D-glucopyranosyl-α-homonojirimycin; 5-O-α-D-glucopyranosyl-α-homonojirimycin; β-homonojirimycin, α-3,4-di-epi-homonojirimycin, α-homonojirimycin, α-homomannojirimycin, were found in the *A. treubii* extract (Asano et al., 1997). Additionally, the ethanolic extract of the leaf of *A. hookerianum* consisted of some bioactive compounds, including alkaloid, tannin, glycoside, reducing sugar, gum, and saponin (Roy et al., 2011).

In the current study, sucrose is the most abundant compound found in the rhizome and petiole extracts with the percentage of 29.26% and 19.69%, respectively. Studies also demonstrated that sucrose was one of the major components of the *Aglaonema commutatum* extract (Rodríguez-Sánchez et al., 2015; Rodríguez-Sánchez et al., 2016). This compound has been known as the most common disaccharides in nature and it is available in daily human life as well as has an important role in food industry (Ni et al., 2022). Phytol, a component with high percentage in the leaf and petiole extracts of *A. griffithii,* and its derivatives (i.e. phytanic acid) have been reported to have a wide application in the fields of biotechnological and pharmaceutical industry because of their biological activities, including antimicrobial, antioxidant, cytotoxic, Anxiolytic, anticonvulsant, antinociceptive, anti-inflammatory properties (Islam et al., 2018). Studies demonstrated that n-hexadecanoic acid, one of the major components in all studied extracts *A. griffithii,* possessed the inflammatory and antioxidant activities (Aparna et al., 2012; Ganesan et al., 2022). The increase in the expression of endogenous antiinflammatory factor, interleukin-1 receptor antagonist in RAW 264.7 cells were reportedly attributed to 9(E),11(E)-conjugated linoleic acid (Lee et al., 2009). Furthermore, beneficial effects in prevention of atherosclerosis, different types of cancer, hypertension and the improvement in immune function were also linked to conjugated linoleic acid (Bhattacharya et al., 2006). Known as an essential omega-3 (n-3) fatty acid, α-Linolenic acid (ALA, 18:3n-3) has been extensively used in production of food, health, and pharmaceutical products (Zhu et al., 2024).

In general, a lower IC_{50} value indicates higher antioxidant activity. The significantly lower IC_{50} value of ascorbic acid compared to the samples is expected, as ascorbic acid is a very potent antioxidant and is commonly used as a reference standard. Until now, the studies on the DPPH radical scavenging activity of the extracts from *Aglaonema* plants have been limited so far. However, the DPPH radical scavenging effects of various species belonging to the Araceae family have been reported by prior studies. For example, the methanolic and hydroalcoholic extracts of *Amorphophallus paeoniifolius* was found to be the strong antioxidant. Accordingly, at dose 500 μg, the methanolic and hydroalcoholic extracts showed the DPPH radical scavenger with the percentage inhibition of 42.83% and 72.13% (Nataraj et al., 2008). The methanolic extract of the *Arisaema tortuosum* tuber showed the DPPH radical scavenger with IC_{50} value of 852 mg/mL (Nile and Park, 2014) while the root extract of *Arisaema jacquemontii* showed 64.16% DPPH scavenging effect at dose 500 μg/mL (Baba and Malik, 2015). Furthermore, the methanol, ethanol, and chloroform extracts isolated from the *Typhonium trilobatum* leaves showed strong DPPH scavenging activities with IC_{50} values of 168.22, 83.54, and 200.13 μg/mL, respectively (Shahriar et al., 2015). The hydroalcoholic extract of

Alocasia indica leaves was also found in the strong DPPH radical scavenger with IC_{50} value of 9.15 µg/mL (Mulla et al., 2009) while the aqueous and ethanolic extracts obtained from the tuber of this plant showed the DPPH radical scavenging activities with IC_{50} values of 3.22 and 1.31 mg/mL, respectively (Pal et al., 2014). The different extracts isolated from the *Alocasia longiloba* showed the potent antioxidant activities. Accordingly, the hexane extract possessed the strongest DPPH radical scavenger with IC_{50} value of 2.519 µg/mL, followed by the ethyl acetate extract (IC_{50} value of 2.758 µg/mL) and the methanol extract (IC_{50} value of 9.542 µg/mL) (Nur-Izzati et al., 2021). The antioxidant effect of the ethanol extract obtained from the *Colocasia fallax* tuber identified using DPPH assay was investigated with IC_{50} values of 78.94 µg/mL (Zilani et al., 2016).

Conclusion

This study firstly provides the micro-morphological characteristics, chemical compounds and antioxidant activity of *A. griffithii*. Along with its anatomical traits, the high antioxidant capacity and bioactive compounds isolated from the ethanol extracts of different parts of this species show a great promise for use in the food or pharmaceutical applications.

Conflict of interest

No potential conflict of interest was reported by the authors.

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