Some compounds isolated from leaves of *Lumnitzera racemosa* growing in Vietnam

- **Nguyen Hoai Phuong**
- **Nguyen Thi Le Thuy**
- **Nguyen Trung Duc**
- **Nguyen Thi Thanh Mai**
- **Nguyen Kim Phi Phung**

University of Science, VNU-HCM

(Received on 16th November 2016, accepted on 30th October 2017)

ABSTRACT

*From L. racemosa leaves eight compounds were isolated: myricetin (**1**), quercetin (**2**), myricetin 3-O-α-L-rhamnopyranoside (**3**), myricetin 3-O-(2″-O-galloyl-α-L-rhamnopyranoside) (**4**), myricetin 3-O-(3″-O-galloyl-α-L-rhamnopyranoside) (**5**), 3-O-methylellagic acid (**6**), (3S,5R,6S,7E)-3,5,6-trihydroxy-7-megastigmen-9-one (**7**) and gallic acid (**8**). Their chemical structures were unambiguously elucidated by analysis of 1D and 2D NMR and high resolution ESI mass spectroscopic data, as well as by comparison with those reported in the literature. The α-glucosidase inhibition was evaluated on isolated compounds. Among them, **1**, **4**, **5**, **6** and **8** exhibited good activities with the IC_{50} values in the range of 1.3–19.3 μM.*

***Key words**: Lumnitzera racemosa Willd., Lumnitzera, Flavonoid, Megastigmane sesquiterpene*

INTRODUCTION

Lumnitzera racemosa, an Indo-West Pacific mangrove plant, wildly grows in many mangrove forests in Vietnam. Some extracts from *Lumnitzera racemosa* leaves were reported to possess bioactivities, e.g. antimicrobial, hepatoprotective and antioxidant. This species was traditionally used to treat asthma, diabetes and snake bite. Some reports on the chemical constituents of *Lumnitzera racemosa* have been reported and there had one study on the antioxidant and cytotoxic activities of this plant growing in Vietnam [3]

MATERIALS AND METHOD

General

The NMR spectra were measured on a Bruker Avance spectrometer, at 500 MHz for ^{1}H and 125 MHz for ^{13}C; the HR-ESI-MS were recorded on a HR-ESI-MS MicrOTOF–Q mass spectrometer in the University of Science, National University – HCM City.

Plant material

Leaves of *L. racemosa* Willd. (Combretaceae) were collected in Ha Tien district, Kien Giang province, Viet Nam in August of 2014. The scientific name of plant was identified by Faculty of Biology – Biotechnology, University of Science, VNU-HCM.

Extraction and isolation

Fresh leaves (30 kg) were washed, dried, ground into powder (10 kg) and extracted by maceration with methanol at room temperature then the extracted solution was evaporated at reduced pressure to give a methanol residue (1,500 g). Approximately 1,200 g of this methanol residue was applied to the solid phase extraction eluted consecutively with petroleum ether – ethyl acetate (5 : 5), ethyl acetate, ethyl

acetate – methanol (9 : 1) and ethyl acetate – methanol (8 : 2). The extracted solutions were evaporated at reduced pressure to afford four types of extracts: A extract (50 g), B extract (50 g), C extract (48 g) and D extract (80 g), respectively. The C extract (48 g) was silica gel chromatographed (column 120 x 6 cm), eluted with petroleum ether–ethyl acetate (stepwise 1:1 and 0:1) and then ethyl acetate–methanol (stepwise, 9:1, 4:1, 1:1, 0:1) to give eight fractions (C1–C8). Fractions C3 and C4 were rechromatographed over Sephadex LH-20 and then on silica gel using $CHCl_3$–MeOH (1: 0 to 9 : 1) to afford (**1**) (30 mg) , (**2**) (15 mg), (**3**) (100 mg), (**4**) (30 mg) and (**5**) (15 mg). Fraction C8 (22 g) was subjected to a reversed phase chromatography (column 60 x 4 cm) eluted with with water - methanol (stepwise, 1:0, 9:1, 4:1, 1:1, 0:1) to obtain (**6**) (10 mg) and (**7**) (5 mg). 100 mg of the B extract was applied to Sephadex LH20 chromatography to obtain (**8**) (30 mg).

Myricetin (**1**). Yellow powder. HR-ESI-MS: *m/z* 317.0315 corresponded to the molecular formula of $C_{15}H_{10}O_8$ ($C_{15}H_{10}O_8$-H, 317.0336, error of 2.1 millimass). ^{1}H-NMR (DMSO-d_6), δ_H 6.18 (1H, *d*, 2.0 Hz), 6.36 (1H, *d*, 2.0 Hz), 7.24 (2H, *s*). ^{13}C-NMR (DMSO-d_6), δ_C 175.8 (C-4), 164.0 (C-7), 160.7 (C-5), 146.8 (C-2), 145.7 (C-3′, 5′), 135.9 (C-3, 4′), 107.2 (C-2′, 6′), 98.2 (C-6) and 93.2 (C-8).

Quercetin (**2**). Yellow powder. ^{1}H NMR, ($CDCl_3$), δ_H 6.18 (1H, *d*, 2.0 Hz), 6.40 (1H, *d*, 2.0 Hz), 7.67 (1H, *d*, 2.5 Hz), 6.88 (1H, *d*, 8.5 Hz), 7.53 (1H, *dd*, 8.5, 2.0 Hz). ^{13}C-NMR (DMSO-d_6), δ_C 175.8 (C-4), 163.9 (C-7), 160.7 (C-5), 156.1 (C-9), 147.7 (C-4′), 146.8 (C-2), 145.0 (C-3′), 135.7 (C-3), 121.9 (C-1′), 120.0 (C-6′), 115.6 (C-5′), 115.0 (C-2′), 103.0 (C-10), 98.2 (C-6) and 93.3 (C-8).

Myricetin 3-*O*-*α*-L-rhamnopyranoside (**3**). Yellow powder. NMR data, see Table 1.

Myricetin 3-*O*-(2′′-*O*-galloyl-α-L-rhamnopyranoside) (**4**). Yellow powder. HR-ESI-MS: *m/z* 615.0971 corresponded to the molecular formula of $C_{28}H_{24}O_{16}$ ($C_{28}H_{24}O_{16}$-H, 615.0986, error of 1.5 millimass). NMR data, see Table 1.

Myricetin 3-*O*-(3′′-*O*-galloyl-*α*-L-rhamnopyranoside) (**5**). Yellow powder. NMR data, see Table 1.

3-*O*-Methylellagic acid (**6**). Pale yellow powder. HR-ESI-MS: *m/z* 315.0120 is corresponded to molecular formula of $C_{15}H_8O_8$ ($C_{15}H_8O_8$–H, 315.0141, error of 2.1 millimass). ^{1}H-NMR (DMSO-d_6), δ_H 7.51 (1H, *s*), 7.42 (1H, *s*), 4.03 (3H, *s*). ^{13}C-NMR (DMSO-d_6), δ_C 159.1 (C-7), 158.9 (C-7′) 152.0 (C-4), 148.7 (C-4′), 141.6 (C-2), 141.0 (C-3′), 140.2 (C-3), 136.0 (C-2′), 112.6 (C-6), 112.4 (C-1), 112.1 (C-1′), 111.3 (C-5), 109.8 (C-5′), and 60.9 (OCH_3)

(*3S,5R,6S,7E*)-3,5,6-Trihydroxy-7-megastigmen-9-one (**7**). $[\propto]_D^{25}$ −199.9 (*c* 0.08, $CHCl_3$). ^{1}H-NMR (DMSO-d_6), δ_H 0.87 (3H, *s*), 1.11 (3H, s), 1.13 (3H, *s*), 1.25 (1H, *dd*, 13.0, 10.5 Hz), 1.62 (1H, *ddd*, 13.0, 3.5, 1.0 Hz), 1.73 (1H, *dd*, 14.5, 9.0 Hz), 2.25 (3H, *s*), 2.36 (1H, *ddd*, 14.5, 5.0, 1.0 Hz), 4.17 (1H, *m*), 6.03 (1H, *d*, 16.0 Hz), 7.07 (1H, *d*, 16.0 Hz). ^{13}C-NMR (DMSO-d_6), δ_C 197.4 (C-9), 143.0 (C-7), 132.4 (C-8), 68.9 (C-6), 68.7 (C-5), 68.3 (C-3), 43.2 (C-2), 37.7 (C-4), 34.5 (C-1), 28.7 (C-13), 27.4 (C-10), 25.0 (C-11), and 19.7 (C-12)

Gallic acid (**8**). White powder. ^{1}H-NMR (DMSO-d_6), δ_H 6.91 (2H, *s*). ^{13}C-NMR (DMSO-d_6), δ_C 167.5 (COOH), 145.4 (C-3, C-5), 138.0 (C-4), 120.5 (C-1), and 108.7 (C-2, C-6).

Bioassay

The inhibitory activity of α-glucosidase was determined according to the modified method of Kim *et al.* [2]. 3 mM *p*-nitrophenyl-*α*-D-glucopyranoside (25 µL) and 0.2 U/mL *α*-glucosidase (25 µL) in 0.01 M phosphate buffer (pH = 7.0) were added to the sample solution

(625 μL) to start the reaction. Each reaction was performed at 37 °C for 30 min and stopped by adding 0.1 M Na_2CO_3 (375 μL). Enzymatic activity was quantified by measuring the absorbance at 401 nm. One unit of α-glucosidase activity was defined as the amount of enzyme liberating *p*-nitrophenol (1.0 μM) per min. The IC_{50} value was defined as the concentration of *α*-glucosidase inhibitor that inhibited 50 % of *α*-glucosidase activity. Acarbose, a known *α*-glucosidase inhibitor, was used as a positive control. The result was presented in Table 2.

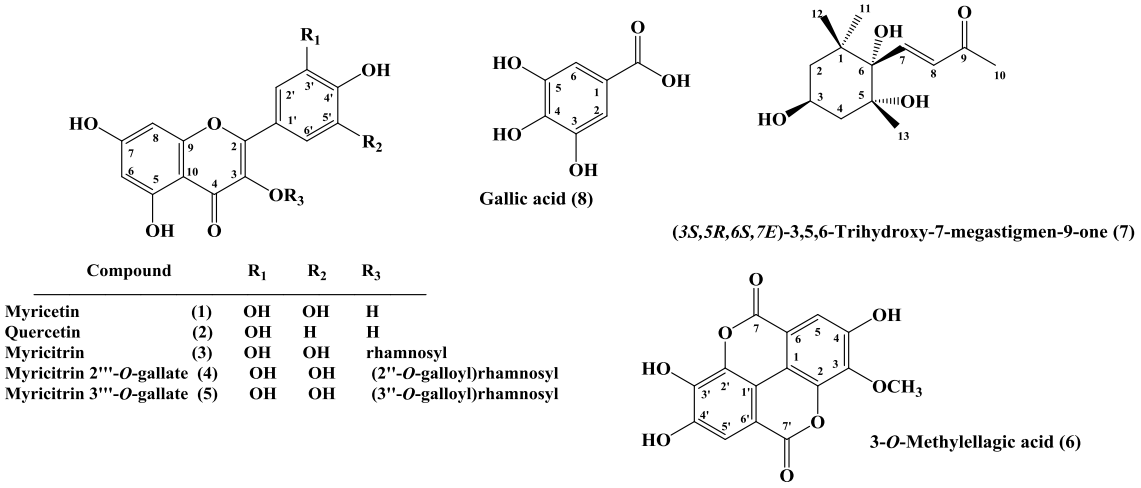
RESULTS AND DISCUSSION

Isolation and purification of compounds from *Lumnitzera racemosa* leaves were performed using combinations of chromatographic fractionation of some ethyl acetate extracts to afford eight compounds (**1–8**) (Fig. 3). Their structures were elucidated as the following.

The HR-ESI-MS spectrum of (**1**) gave a quasimolecular ion peak at *m*/*z* 317.0315 $[M–H]^–$ corresponding to the molecular formula of $C_{15}H_{10}O_8$. The ^{1}H-NMR spectrum of (**1**) in DMSO-*d6* showed a down field signal at δ_H 12.49 (1H, *s*) indicating the presence of a chelated hydroxyl at C-5 position. Two *meta*–coupled doublet proton signals at δ_H 6.18 (1H, *d*, 2.0 Hz) and 6.36 (1H, *d*, 2.0 Hz) were assigned to H–6 and H–8, respectively, of ring A of the 5,7-dihydroxyflavonoid. Moreover, a singlet signal at δ_H 7.24 (2H, *s*) was characteristic of a symmetric B ring. These spectral data revealed the presence of a myricetin skeleton. The good compatibility between these NMR data of (**1**) and those reported in the literature [6] confirmed its structure to be myricetin.

Table 1. NMR data of **3**, **4** and **5**

Pos.	**3** (DMSO-d_6)		**4** (DMSO-d_6)		**5** (DMSO-d_6)	
	δ_H, J (Hz)	δ_C	δ_H, J (Hz)	δ_C	δ_H, J (Hz)	δ_C
2		156.4		157.5		157.6
3		134.3		133.5		134.9
4		177.8		177.5		177.8
5		161.3		161.3		161.3
6	6.18 (1H, *d*, 2.0)	98.6	6.20 (1H, *d*, 1.5)	98.3	6.21 (1H, *d*, 2.0)	98.7
7		164.2		164.2		165.7
8	6.34 (1H, *d*, 2.0)	93.5	6.37 (1H, *d*, 1.5)	93.6	6.38 (1H, *d*, 2.0)	93.6
9		157.5		156.4		156.5
10		104.0		104.0		104.1
1’		119.6		119.4		119.6
2′, 6′	6.87 (2H, *s*)	107.9	6.92 (2H, *s*)	108.0	6.89 (2H, s)	107.9
3′, 5′		145.8		145.8		145.8
4′		136.4		136.6		136.8
1″	5.18 (1H, *d*, 1.5)	101.9	5.50 (1H, *d*, 1.5)	98.7	5.03 (1H, *brs*)	102.7
2″	3.96 (1H, *dd*, 1.5, 3.5)	70.0	5.48 (1H, *dd*, 1.5, 3.5)	71.7	4.30 (1H, *brs*)	67.8
3″	3.53 (1H, *dd*, 3.5, 9.5)	70.4	3.78–3.82 (1H, *m*)	68.6	5.04 (1H, *m*)	73.9
4″	3.14 (1H, *t*, 9.5)	71.3	3.78–3.82 (1H, *m*)	71.8	3.42 (1H, *t*, 6.5)	68.6
5″	3.34–3.37 (1H, *m*)	70.5	3.78–3.82 (1H, *m*)	70.7	3.83 (1H, *m*)	70.9
6″	0.84 (3H, *d*, 6.0)	17.5	0.93 (3H, *d*, 5.5)	17.6	0.96 (1H, *d*, 6.0)	17.4
C=O (galloyl)	-	-		165.0		165.7
1‴	-	-		119.3		119.6
2‴, 6‴	-	-	6.95 (2H, *s*)	108.9	7.05 (2H, *s*)	109.0
4‴	-	-		138.5		138.3
5‴	-	-		145.5		145.4
5-O**H**	12.81 (1H, *s*)		12.54 (1H, *s*)		12.66 (1H, *s*)	



Compound		R_1	R_2	R_3
Myricetin	(1)	OH	OH	H
Quercetin	(2)	OH	H	H
Myricitrin	(3)	OH	OH	rhamnosyl
Myricitrin 2'''-*O*-gallate	(4)	OH	OH	(2''-*O*-galloyl)rhamnosyl
Myricitrin 3'''-*O*-gallate	(5)	OH	OH	(3''-*O*-galloyl)rhamnosyl

Fig. 1. Isolated compounds from leaves of *Lumnitzera racemosa* Willd

Compounds (**2**) and (**1**) showed the similarities in proton signals at δ_H 12.5 (1H, *s*), 6.40 (1H, *d*, 2.0 Hz), 6.18 (1H, *d*, 2.0 Hz) indicating the ring A of 5,7-dihydroxyflavonoid. However, instead of a signal integrating for two protons, the presence of an ABX system at δ_H 7.67 (1H, *d*, 2.5 Hz), 7.53 (1H, *dd*, 8.5, 2.0 Hz) and 6.88 (1H, *d*, 8.5 Hz) corresponded to protons of the 1,3,4-trisubstituted phenyl group. The spectral data were compatible with those of quercetin [6].

Compound (**3**) and (**1**) showed similar spectral pattern but the former possessed a rhamnose moiety with proton signals at δ_H 5.18 (1H, *d*, 1.5 Hz, H-1′′) of an anomeric proton, 0.84 (3H, *d*, 6.0 Hz, H-6′′), and signals from δ_H 3.0 to 4.0 of an α-L-rhamnose moiety. In addition, this anomeric proton showed the HMBC cross-peak with carbon C-3 (δ_C 134.3) proving that the sugar moiety linking to the aglycone at its C-3. The good compatibility between these NMR data of (3) and those reported in the literature [5] confirmed its structure to be myricetin 3-*O*-α-L-rhamnopyranoside.

The HR-ESI-MS spectrum of compound (**4**) gave a quasimolecular ion peak at *m*/*z* 615.0971 $[M–H]^-$ corresponding to the molecular formula of $C_{28}H_{24}O_{16}$ ($C_{28}H_{24}O_{16}$–H, 615.0986, error of 1.5 millimass). Compounds (**4**) and (**3**) had similar spectral data (Table 1), however, the former had seven carbon signals more than the latter, including a carbonyl carbon, three oxygenated aromatic carbons, two aromatic methines and one substituted aromatic carbons. Those differences demonstrated that (**4**) was similar to (**3**) but further containing a galloyl moiety. In the HMBC spectrum of (4), the anomeric H-1″ signal at δ_H 5.50 (1H, *d*, 1.5 Hz) correlated with the myricetin C-3 resonance at δ_C 133.5, and the rhamnose H-2″ signal at δ_H 5.47 correlated with the galloyl ester carbon resonance at δ_C 165.0. Accordingly, the galloylrhamnosyl was determined to be attached to the myricetin C-3 position, and the galloyl moiety was attached to the rhamnose C-2 position (Fig. 1). Thus, (**4**) was determined as myricetin 3-*O*-(2″-*O*-galloyl)-α-L-rhamnopyranoside.

The spectral data of (**5**) were closely related to those of (**4**) with signals of a rhamnose unit, a myricetin skeleton and a galloyl group. The comparison of the ^{1}H NMR spectrum of (**5**) with that of (**4**) (Table 1) showed that the H-3″ was downfield shifted suggesting the galloyl group was located at the rhamnose C-3″ position, which was further confirmed by the HMBC cross-peak of the rhamnose proton signal H-3″ at δ_H 5.04

with the carbon signal at δ_C 165.7 (C=O of galloyl). Based on these findings, the structure of (**5**) was concluded to be myricetin 3-*O*-(3″-*O*-galloyl)-*α*-L-rhamnopyranoside (or myricitrin 3″-*O*-gallate).

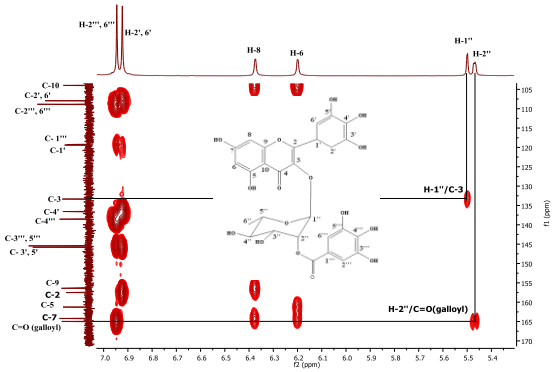


Fig. 2. The expanded HMBC spectrum of (4)

The HR-ESI-MS spectrum of (**6**) demonstrated a quasimolecular ion peak at *m*/*z* 315.0120 $[M–H]^-$ corresponding to the molecular formula of $C_{15}H_8O_8$ ($C_{15}H_8O_8$–H, 315.0141, error of 2.1 millimass). The ^{1}H NMR spectrum of (**6**) showed three proton signals at δ_H 7.51 (1H, *s*), 7.42 (1H, *s*) and 4.03 (3H, *s*). The ^{13}C NMR spectrum of (**6**) showed 15 carbon signals including a methoxy carbon at δ_C 60.9, 12 signals in the zone from δ_C 109–152, two carboxyl carbon signals at δ_C 158.9 and 159.1. Therefore, compound (**6**) had two gallic acid units. The comparison of spectral data of (**6**) with 3-*O*-methylellagic acid [7] showed good compatibility. Therefore, (**6**) was identified as 3-*O*-methylellagic acid.

The combination of ^{1}H NMR, DEPT and HSQC spectra of (**7**) showed the presence of four methyl singlets at δ_H 0.87, 1.11, 1.13 and 2.25, two non-equivalent methylenes at δ_H 1.25 (1H-2a, *dd*, 13.0, 10.5 Hz), 1.62 (1H-2b, *ddd*, 13.0, 3.5, 1.0 Hz) and 1.73 (1H-4a, *dd*, 14.5, 9.0 Hz), 2.36 (1H-4b, *ddd*, 14.5, 5.0, 1.0 Hz), an oxygenated methine at δ_H 4.17 (1H, *m*) and two olefinic protons at δ_H 6.03 (1H, *d*, 16.0 Hz) and 7.07 (1H, *d*, 16.0 Hz). The combination of ^{13}C NMR and DEPT spectra showed 13 carbon signals including four methyls (δ_C 19.7, 25.0, 27.4 and 28.7), two methylenes (δ_C 37.7 and 43.2), one oxymethine (δ_C 68.3), two olefinic carbons (δ_C 132.4 and 143.0), three quaternary carbons (δ_C 34.5, 68.7 and 68.9), and one carbonyl carbon (δ_C 197.4). The HMBC experiment showed cross-peaks of H-4b, H-13 with the oxygenated carbon C-5 (δ_C 68.7), and H-2a, H-2b, H-4a and H-4b with C-3 (δ_C 68.3). Meanwhile, the tertiary oxygenated carbon was attributed at C-6 (δ_C 68.9). Based on the HMBC cross-peaks of proton signals of H-2a, H-2b, H-4a, H-4b, H-7, H-8, H-11, H-12, H-13 with C-6 demonstrating that the side chain was attached to the six-membered ring at C-6. In addition, the HMBC cross-peaks of the *trans*-olefinic protons at δ_H 6.03 (H-8, *d*, 16.0 Hz) and 7.07 (H-7, *d*, 16.0 Hz) to C-6, as well as the carbonyl carbon (C-9), indicating the two conjugated olefinic carbons connected to the six-membered-ring and the carbonyl carbon, respectively. Therefore, (**7**) was 3,5,6-trihydroxy-7-megastigmen-9-one. The H-4a appeared as a double of doublets with J_{gem} 14.5 Hz and J_{aa} 9.0 Hz in the ^{1}H NMR spectrum indicating its axial position. In the NOESY spectrum (Fig. 2), correlations of H-2a and H4a with H-13 devulged that the hydroxyl group at C-5 was in axial position, whereas correlations of H-3 with H-11, of H-2b as well as H-4b with H-3 indicated the equatorial position of the hydroxyl group at C-3. The NOESY correlations of H-7 with CH_3-12 and CH_3-13 as well as of H-8 with C-13 indicated the equatorial position for 6-OH that was mentioned in a publication of stereostructure of (**7**) [8]. Therefore, the structure of (**7**) would be (*3S,5R,6S,7E*)- or (*3R,5S,6R,7E*)-3,5,6-trihydroxy-7-megastigmen-9-one.

Compound (**7**) was levorotatory ($[\propto]_D^{25}$ –199.9 (*c* 0.08, $CHCl_3$) corresponding with that

of *(3S,5R,6S,7E)*-3,5,6-trihydroxy-7-megastigmen-9-one in the literature [1]. Therefore, compound was identified as *(3S,5R,6S,7E)*-3,5,6-trihydroxy-7-megastigmen-9-one.

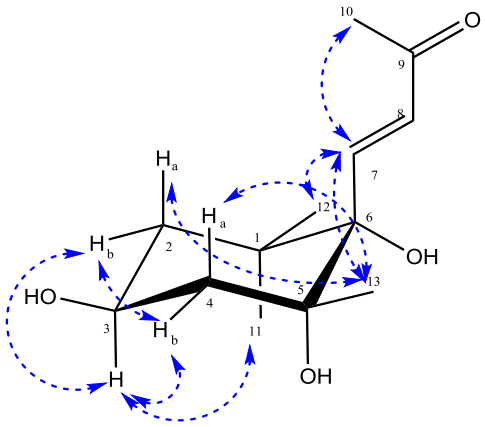


Fig. 3. Key NOESY correlations of (7)

The ^{13}C NMR spectrum of (**8**) disclosed a carboxyl carbon at δ_C 167.5, four carbon signals of one symmetrical aromatic ring including three oxygenated carbon signals at δ_C 145.4 (C–3, C–5), 138.0 (C–4), two aromatic methine signals at δ_C 108.7 (C–2, C–6), and a quaternary carbon signal at δ_C 120.5 (C–1). It corresponded to an aromatic proton signal at δ_H 6.91 (2H, *s*) in the ^{1}H NMR spectrum. Therefore, compound (**8**) was identified as gallic acid through the comparison of its NMR data with the published ones in the literature [4].

The glucosidase inhibition assay was applied on extracts and pure isolated compounds, and the result showed hat compounds (**1**), (**4**), (**5**), (**6**) and (**8**) exhibited good activities with the IC_{50} values in the range of 1.3–19.3 μM whereas extracts displayed strong activities.

Table 2. The result of *α*-glucosidase inhibition activity

	IC_{50} (μg/mL)						IC_{50} (μM)							
Extract/ compound	Methanol residue	**A**	**B**	**C**	**D**	**Acar**[b]	**1**	**2**	**3**	**4**	**5**	**6**	**8**	**Acarbose**
	< 0.1	11	< 0.1	0.3	2.2	138.2	1.3	179.5	>250	3.6	7.0	4.7	19.3	214.5

CONLUSION

From leaves of *Lumnitzera racemosa* Willd. eight compounds were isolated: myricetin (**1**), quercetin (**2**), myricetin 3-*O*-*α*-L-rhamnopyranoside (**3**), myricetin 3-*O*-(2″-galloyl)-*α*-L-rhamnopyranoside (**4**), myricetin 3-*O*-(3″-galloyl)-*α*- L-rhamnopyranoside (**5**), 3-*O*-methylellagic (**6**), *(3S,5R,6S,7E)*-3,5,6-trihydroxy-7-megastigmen-9-one (7) and gallic acid (**8**). Among them, (**3**), (**4**), (**5**), (**7**) were found for the first time in the *Lumnitzera* species.

The *α*-glucosidase inhibition was evaluated on isolated compounds. The result of *α*-glucosidase inhibitory activity showed that all extracts and most of isolated compounds exhibited good activities than the positive control acarbose. Among isolated compounds, (**1**), (**4**), (**5**) (**6**) and (**8**) displayed strong *α*-glucosidase inhibitory activities with the IC_{50} values in the range of 1.3–19.3 μM.

Acknowledgment: *This research is funded by Vietnam National University Ho Chi Minh City (VNU-HCM) under grant number A2015-18.02.*

Một số hợp chất cô lập từ lá cây Cóc trắng (*Lumnitzera racemosa* Willd.) mọc ở Việt Nam

- **Nguyễn Hoài Phương**
- **Nguyễn Thị Lệ Thủy**
- **Nguyễn Trung Đức**
- **Nguyễn Thị Thanh Mai**
- **Nguyễn Kim Phi Phụng**

Trường Đại học Khoa học Tự nhiên, ĐHQG-HCM

TÓM TẮT

*Từ lá cây L. racemosa, tám hợp chất đã được cô lập: myricetin (**1**), quercetin (**2**), myricetin 3-O-α-L-rhamnopyranoside (**3**), myricetin 3-O-(2″-O-galloyl- α-L-rhamnopyranoside) (**4**), myricetin 3-O-(3″-O-galloyl-α-rhamnopyranoside) (**5**), 3-O-methylellagic acid (**6**), (3S,5R,6S,7E)-3,5,6-trihydroxy-7-megastigmene-9-one (**7**) và gallic acid (8). Cấu trúc hoá học của các hợp chất cô lập được xác định bằng phổ cộng hưởng từ hạt nhân và khối phổ phân giải cao cũng như so sánh số liệu của chúng với tài liệu tham khảo. Ngoài ra các cao chiết và hợp chất cô lập được thử hoạt tính ức chế enzyme α-glucosidase. Kết quả cho thấy các hợp chất **1**, **4**, **5**, **6** và **8** có hoạt tính mạnh với giá trị IC_{50} trong khoảng 1.3–19.3 μM.*

Từ khóa: *Lumnitzera racemosa Willd., Chi lumnitzera, Flavonoid, Sesquiterpene khung megastigmane*

REFERENCES

[1]. J.H. Park, D.G. Lee, S.W. Yeon, H.S. Kwon, J.H. Ko, D.J. Shin, H. S. Park,Y.S. Kim, M.H. Bang, N.I. Baek, Isolation of megastigmane sesquiterpenes from the Silkworm (*Bombyx mori* L.) droppings and their promotion activity on HO-1 and SIRT1, *Arch Pharm. Res.*, 34, 4, 533–542 (2011).

[2]. K.Y. Kim, K.A. Nam, H. Kurihara, S.M. Kim, Potenta-glucosidase inhibitors purified from the red alga *Grateloupia elliptica*, *Phytochemistry*, 69, 2820–2825 (2008).

[3]. N.P. Thao, B.T.T. Luyen, C.N. Diep, B.H. Tai, E.J. Kim, H.K. Kang, S.H. Lee, H.D. Jang , N.T. Cuong, N.V. Thanh, N.X. Cuong, N.H. Nam, C.V. Minh, Y.H. Kim, *In vitro* evaluation of the antioxidant and cytotoxic activities of constituents of the mangrove *Lumnitzera racemosa* Willd., *Arch. Pharm. Res*., 38, 4, 446–455 (2015).

[4]. O.A. Eldahshan, Isolation and structure elucidation of phenolic compounds of Carob leaves grown in Egypt, *Curr. Res. J. Biol. Sci.*, 3, 1, 52–55 (2011).

[5]. S. Yaya, K.A.B. Benjamin, B. Fanté, S. Sorho, T.S. Amadou, C.J. Marie, Flavonoids and gallic acid from leaves *of Santaloides afzelii* (Connaraceae), *Rasãyan J. Chem*., 5, 3, 332–337 (2012).

[6]. T.J. Mabry, K.R. Markham and M.B. Thomas, The Systematic Identification of Flavonoids, Springer Verlag, New York-Heidelberg-Berlin (1970).

[7]. T. Tanaka, Z. Jiang, I. Kouno., Distribution of ellagic acid derivatives and a diarylheptanoid in wood of *Platycarya strobilacea*, *Phytochemistry*, 47, 5, 851–854 (1998).

[8]. Y. Sun, Y.C. Zhan, Y. Sha, Y.H.. Pei, Norisoprenoids from *Ulva lactuca*, *J. Asian Nat. Prod. Res.*, 9, 4, 321–325 (2007).