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NEOLIGNAN, PHENOLS, AND GLYCOSYL COMPOUNDS FROM THE LEAVES OF *BOEHMERIA NIVEA* (L.) GAUDICH

Nguyen Thi Thu Thao[1, 2], Do Thi Ha[3], Tran Dinh Nghia[4], Truong Quoc Ky[5], Le Thi Hong Van[1,*]

[1]*Faculty of Pharmacy, University of Medicine and Pharmacy at Ho Chi Minh City, Vietnam;*

[2]*School of Medicine, Vietnam National University Ho Chi Minh City, Vietnam;*

[3]*National Institute of Medical Materials (NIMM), Hanoi, Vietnam;* [4]*Hanoi University of Pharmacy, Vietnam;*

[5]*Faculty of Pharmacy, Pham Ngoc Thach University of Medicine, Vietnam*

*Corresponding author: levan@ump.edu.vn

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Summary

Neolignan, Phenol, and Glycosyl Compounds from the Leaves of *Boehmeria nivea* (L.) Gaudich

Seven compounds belonging to the structures of neolignan, phenols, and glycosyl compounds were isolated from the *n*-butanol extract of *Boehmeria nivea* leaves. Their chemical structures were elucidated as glochidioboside (**BNL9**), protocatechuic acid (**BNL1**), ethyl *β*-fructopyranoside (**BNL3**), eugenyl *O*-*β*-apiofuranosyl-(1″→6′)-*O*-*β*-glucopyranoside (**BNL10**), ethyl *α*-D-glucopyranoside (**BNL11**), hydroxytyrosol 4-*β*-*D*-glucoside (**BNL16**), and cimidahurinine (**BNL17**) on the basis of detailed analysis of the 1D and 2D NMR spectroscopic data in comparison with the literature data. Among them, 6 compounds **BNL3**, **BNL9**, **BNL10**, **BNL11**, **BNL16**, and **BNL17** were reported for the first time in *Boehmeria* genus.

Keywords: *Boehmeria nivea,* Urticaceae, *Neolignan, Phenolic glycoside.*

1. Introduction

Boehmeria nivea (L.) Gaudich, Urticeace is a versatile plant utilized for many purposes such as food, animal feed, medicinal applications, and fiber production. The root of this plant is used in traditional Chinese herbal medicine for the treatment of common cold, edema, fever, fetal irritability, urinary tract infections, nephritis, and abortion risk, and it possesses various pharmacological properties. Its leaves have antibiotic and anti-inflammatory effects [1]. Numerous studies have shown that the extract of *B. nivea* leaves (BNL) exerts many biological activities, such as anti-proliferative, antitumor, anti-inflammatory, antibacterial, antioxidant, glucose-lowering, and anti-hepatitis B virus effects [2]. Nevertheless, *B. nivea* leaves contain several common ingredients, including flavonoids, simple phenols, sterols, terpenoids, coumarins, anthraquinones, glycosides, fatty acids, and polysaccharides [3],[4]. In our ongoing study to determine the immune-inducing activity of some Vietnamese medicinal plants, the result showed that 70% ethanol of BNL extract had immunomodulatory activity on IL-1*β* and IL-10 cytokines production in RAW 264.7 murine macrophage (unpublished data), therefore it was selected for further study. In this article, we report on the isolation and structure identification of seven compounds belonging to the structures of neolignan, phenols, and glycosyl compounds from the leaves of *B. nivea.*

2. Subject and Methods

2.1. Plant materials

The leaves of *B. nivea* were collected in Chiem Hoa district, Tuyen Quang province, Vietnam in June 2022. The plant material was identified by Prof. Dr. Pham Thanh Huyen at the Medicinal Material Resources Center, Vietnam National Insititute of Medicinal Materials (NIMM), and deposited at NIMM with voucher specimen number (**BNL-06/2022-TQ**). After collection, samples were dried in the shade at 45-50 °C and then coarsely ground into powder (12.5 kg).

2.2. Apparatus and chemicals

NMR spectra were recorded on Bruker Avance Digital 500 and 600 MHz NMR spectrometers (Karlsruhe, Germany) using tetramethylsilane internal standard. ESI low-resolution LC-MS data were recorded using an Agilent Technologies 6130 Quadrupole mass spectrometer (Agilent Technologies, Santa Clara, CA, USA), and ESI high resolution LC-MS/MS data were recorded using Xevo G2-XS QToF (WATERS, USA). Solvents were purchased from RCI Labscan Ltd, (Thailand). Compounds were isolated by column chromatography (CC) with *silica gel* (Merck, particle size 63-200 mm), RP-C_{18} (Merck, particle size 40-63 mm), Sephadex LH-20 (25-100 μm), and MCI gel (75-150 μm). Thin-layer chromatography (TLC) was performed on precoated Kieselgel 60_{F254} and RP-18_{F254S}, and spots were detected under a UV lamp or were visualized by spraying with vanillin-sulphuric acid reagent (VIS), followed by heating.

2.3. Extraction, fractionation, and isolation

The air-dried powder of material (12.0 kg) was refluxed macerated with 70% EtOH (ratio 1 :10, 3 times). The extract was filtered, and the solvent was removed by evaporation under low pressure to obtain 70% EtOH extract (BNL, 1.5 kg). Then, water was added to this crude extract and successively partitioned into hexane, $CHCl_3$, EtOAc, and *n*-butanol solvents. Finally, five fractions extracted from BNL include *n*-hexane extract (250 g), chloroform extract (125.42 g), ethyl acetate extract (18.23 g), *n*-butanol extract (92.57 g) and water extract (1013.78 g).

The *n*-butanol extract (70 g) was subjected to column chromatography (CC) with *silica gel* and eluted with a gradient mixture of $CHCl_3$ - MeOH - H_2O solvent (9:1:1 - 6:4:1, v/v) to obtain 19 fractions (Bu1 - 19). Two fractions Bu9 (2.3 g) and Bu10 (4.5 g) were CC separated with a saturated EtOAc - MeOH solvent system (95:5 - 85:15 v/v) to obtain 10 fractions (Bu9.1 - 9.10) and 15 fractions (Bu10.1 - 10.15), respectively. Fraction Bu9.7 (400 mg) was separated by *silica gel* RP-C_{18} CC with a mixture of H_2O - ACN (78:22, v/v) to obtain compound **BNL1** (10.1 mg). Fractions Bu10.7 (938 mg) and Bu10.8 (900 mg) were separated by Sephadex LH-20 with 100% MeOH to obtain 6 fractions (Bu10.7.1 - 10.7.6) and 8 fractions (Bu10.8.1 - 10.8.8). Compounds **BNL3** (15.9 mg), **BNL9** (10.4 mg), and **BNL10** (8 mg) were purified from fractions Bu10.7.2 (7.2 mg) and Bu10.8.5 (430 mg) using *silica gel* RP-C_{18} CC eluted with H_2O-MeOH (4:1 - 3:2, v/v), respectively. Fraction Bu10.10 (189 mg) was isolated by *silica gel* RP-C_{18} CC eluted with a gradient mixture of H_2O - MeOH (3:1 - 3:2, v/v) to obtain **BNL11** (7.2 mg). Fraction Bu14 (2.9 g) was applied to Sephadex LH-20 with 100% MeOH to obtain 6 fractions (Bu14.1 - 14.6). Fraction Bu14.4 (190 mg) was isolated by *silica gel* RP-C_{18} CC eluted with H_2O - MeOH (4:1, v/v) to obtain compound **BNL16** (10.4 mg) and **BNL17** (3.5 mg).

Glochidioboside (BNL9) - Yellow color gum. Q-Tof_MS spectrum (mode$^-$) *m/z* 567.2144 $[M+HCOO]^-$. 1D and 2D-NMR (CD_3OD) see Table 1.

Eugenyl O-*β*-apiofuranosyl-(1′′→6′)-O-*β*-glucopyranoside (BNL10) – Colorless gum. Q-Tof_MS spectrum (mode$^-$) *m/z* 503.1833 $[M+HCOO]^-$. ^{1}H-NMR (500 MHz, CD_3OD) and ^{13}C-NMR (125 MHz, CD_3OD) see Table 2.

Hydroxytyrosol 4-*β*-D-glucoside (BNL16) – Pale yellow oil. ESI-MS spectrum (mode$^+$) *m/z* 339.0 $[M+Na]^+$. ^{1}H-NMR (600 MHz, CD_3OD), ^{13}C-NMR (150 MHz, CD_3OD) see Table 2.

Cimidahurinine (BNL17) – Pale yellow oil. ESI-MS spectrum (mode$^+$) *m/z* 338.8 $[M+Na]^+$ ^{1}H-NMR (600 MHz, CD_3OD) and ^{13}C-NMR (150 MHz, CD_3OD) see Table 2.

Protocatechuic acid (BNL1) – Pale yellow powder. Q-Tof_MS (mode$^-$): *m/z* 153.0180 $[M-H]^-$. ^{1}H-NMR (600 MHz, CD_3OD): δ_H 7.46 (1H, d, 1.8, H-2), 7.44 (1H, d, J = 7.8; 1.8 Hz, H-2), 6.82 (1H, d, J = 7.8 Hz, H-5). ^{13}C-NMR (150 MHz, CD_3OD): δ_C 170.3 (C-7), 151.5 (C-4), 146.0 (C-3), 123.9 (C-6), 123.2 (C-1), 117.8 (C-5), 115.8 (C-2).

Ethyl *β*-fructopyranoside (BNL3) – Colorless gum. Q-Tof_MS spectrum (mode$^+$) *m/z* 231.0844 $[M+Na]^+$. ^{1}H-NMR (CD_3OD, 500 MHz): 4.08 (1H, d, J = 8.0, H-2), 3.92 (1H, dd, J = 8.0, 7.5, H-3), 3.72 (1H, m, H-4), 3.70 (1H, m, H-5a), 3.56 (1H, m, H-5b), 3.63 (1H, m, H-6a), 3.51 (1H, m, H-6b), 3.73 (1H, m, H-7a), 3.52 (1H, m, H-7b), 1.11 (3H, t, J = 7.0, H-8). ^{13}C-NMR (125 MHz, CD_3OD): 104.0 (C-1), 82.1 (C-4), 77.1 (C-2), 76.0 (C-3), 63.6 (C-5), 60.6 (C-6), 56.5 (C-7), 14.7 (C-8).

Ethyl *β*-fructopyranoside (BNL3) – Colorless gum. Q-Tof_MS spectrum (mode$^+$) *m/z* 231.0844 $[M+Na]^+$. ^{1}H-NMR (CD_3OD, 500 MHz): 4.08 (1H, d, J = 8.0, H-2), 3.92 (1H, dd, J = 8.0, 7.5, H-3), 3.72 (1H, m, H-4), 3.70 (1H, m, H-5a), 3.56 (1H, m, H-5b), 3.63 (1H, m, H-6a), 3.51 (1H, m, H-6b), 3.73 (1H, m, H-7a), 3.52 (1H, m, H-7b), 1.11 (3H, t, J = 7.0, H-8). ^{13}C-NMR (125 MHz, CD_3OD): 104.0 (C-1′), 82.1 (C-4′), 77.1 (C-2′), 76.0 (C-3′), 63.6 (C-5′), 60.6 (C-6′), 56.5 (C-1), 14.7 (C-2).

3. Results and Discussion

Structure elucidation of lignan compound

Table 1. 1D and 2D NMR data of **BNL9** (^{1}H: 500 MHz, ^{13}C: 125 MHz, CD_3OD)

C	CH_n	δ_C	δ_H (nH, m, J = Hz)	HMBC	COSY
1	C	133.5	-		
2	CH	109.2	6.93 (1H, d, J = 2.0)	1, 6, 7	
3	C	147.8	-		
3-Ome	CH_3	55.1	3.79 (3H, s)	3	
4	C	146.17	-		
5	CH	114.8	6.74 (1H, d, J= 8.0)	1, 3	6
6	CH	118.4	6.80 (1H, dd, J =8.0, 2.0)	2, 4, 7	5
7	CH	87.7	5.46 (1H, d, J = 6.5)	1, 2, 6, 8, 9, 4', 5'	

C	CH_n	δ_C	δ_H (nH, m, J = Hz)	HMBC	COSY
8	CH	54.1	3.44 (1H, m)	1, 7, 9, 5′, 6′	
9	CH_2	63.7	3.80 (1H, t, J = 1.5)		
			3.73 (1H, dd, J = 11.0, 7.0)	7, 8, 5′	
1’	C	135.5	-		
2’	CH	112.9	6.72 (1H, m)	3′, 4′, 6′	
3’	C	143.9	-		
3’-Ome	CH_3	55.5	3.83 (3H, s)	3′	
4’	C	146.2	-		
5’	C	128.5	-		
6’	CH	116.8	6.73 (1H, m)	8, 2′	
7’	CH_2	31.55	2.65 (2H, t, J = 7.5)	1′, 2′, 6′, 8′, 9′	8′
8’	CH_2	31.6	1.88 (2H, m)	1′, 7′, 9′	7′
9’	CH_2	68.6	3.90 (1H, dt, J = 9.5, 6.5)	7′, 1″	
			3.51 (1H, m)	7′, 1″	
1”	CH	103.2	4.23 (1H, d, J = 8.0)	9′, 2″, 5″	2″
2”	CH	73.9	3.18 (1H, dd, J = 9.0, 8.0)	1″, 3″	
3”	CH	76.8	3.32 (1H, t, J = 4.5)	4″	
4”	CH	70.4	3.26 (1H, m)	2″, 5″	
5”	CH	76.6	3.23 (1H, m)	4″	
6”	CH_2	61.4	3.83 (1H, m)	4″	
			3.64 (1H, dd, J = 12.0, 5.5)	5″	5″

Compound BNL9 was obtained as yellow color gum. The molecular formula was determined to be $C_{26}H_{34}O_{11}$ from the HR-ESI-MS (*m/z* 567.2144 $[M+HCOO]^-$, calcd. for $[C_{27}H_{35}O_{13}]^-$: 567.2131, with an error between these values Δ = 2.31 ppm; and *m/z* 521.2056 $[M-H]^-$ calcd. for $[C_{26}H_{33}O_{11}]^-$: 521.2028, with Δ = 5.3 ppm). The ^{13}C-NMR spectrum showed signals of 26 carbons, including the signals at δ_C 103.2, 73.9, 76.8, 70.4, 76.6, and 61.4 belonging to the glucose moiety. The carbon signal at δ_C 55.1 and 55.5 were attributed to 2 methoxy groups. Signals of the remaining carbons belonging to 2 systems C6-C3 suggested a lignan. Furthermore, the appearance of 2 methylene carbon signals at δ_C 31.55 and 31.6, 2 oxymethylene carbon signals at δ_C 63.7 and 68.6, 1 oxymethine carbon signal at δ_C 87.7 (C-7), and a methine carbon signal at δ_C 54.1 (C-8) suggesting an 8,3'-neolignan glycoside. The ^{1}H-NMR spectrum showed signals of 5 aromatic protons belonging to an ABX spin-spin interaction system [at δ_H 6.93 (1H, d, J = 2.0 Hz, H-2), 6.74 (1H, d, J = 8.1 Hz, H-5), 6.80 (1H, dd, J = 8.1, 2.0 Hz, H-6)] and an AX system [6.72 (1H, m, H-2'), 6.73 (1H, m, H-6')], 4 methylene groups, 2 methine protons, 2 methoxy groups at δ_H 3.79 (3H, s) and 3.83 (3H, s), the signal of an anomer proton at δ_H 4.23 (1H, d, J = 8.0 Hz), suggesting the presence of a sugar unit with a β configuration. From the above data, an epoxy ring was suggested to be formed between C-7 (δ_C 87.7) and C-4′ (δ_C 146.2), which was further confirmed by HMBC correlation from H-7 to C-4′, C-5′. Based on the above evidence, the structure of **BNL9** was determined as dihydrodehydrodiconiferyl alcohol-9'-*O*-β-glucoside. The coupling constant (J = 6.5 Hz) between H-7 and H-8 indicated the relative *trans*-vicinal coupling of 7-aryl and 8-hydroxymethyl to the dihydrobenzofuran ring. Although the stereochemistry at C-7 and C-8 could not be established from the available data, the similarity between all the NMR data suggested that **BNL9** may have the same stereoisomeric structure as (7*S*,8*R*)-dihydrodehydrodiconiferyl alcohol-9'-*O*-β-glucoside, reported in references [5],[6]. Consequently, compound **BNL9** was identified as (7*S*,8*R*)-dehydrodiconiferyl alcohol-4-*O*-β-D-glucopyranoside or **glochidioboside (Fig. 1).**

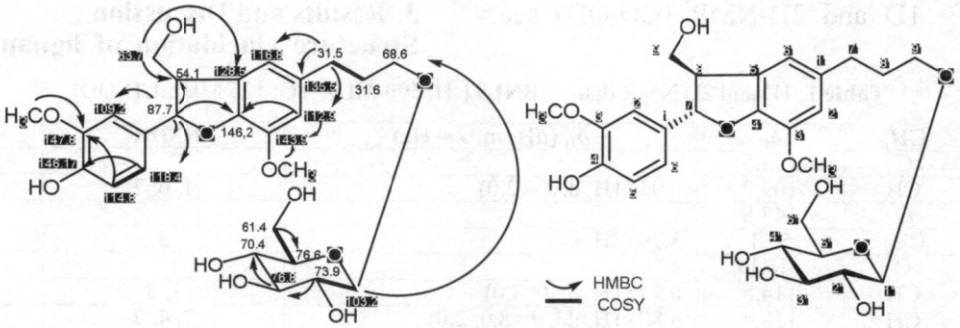

Fig. 1. COSY and HMBC correlations of **BNL9**

Table 2. ^{1}H and ^{13}C NMR data of compounds **BNL16**, **BNL17**, and **BNL10**

Position	BNL16		BNL17		BNL10	
	δ_C ppm, type	δ_H ppm, J (Hz)	δ_C ppm, type	δ_H ppm, J (Hz)	δ_C ppm, type	δ_H ppm, J (Hz)
1	136.2, C	-	132.1, C	-	145.0, C	-
2	117.7, CH	6.76 (1H, d, J = 2.0)	119.7, CH	7.10 (1H, d, J = 2.0)	149.5, C	-
3	148.4, C	-	146.6, C	-	112.9, CH	6.80 (1H, d, J = 2.0)
4	145.3, C	-	146.8, C	-	135.2, C	-
5	119.2, CH	7.12 (1H, d, J = 8.2)	116.9, CH	6.78 (1H, d, J = 8.0)	120.9, CH	6.72 (1H, dd, J = 8.0, 2.0)
6	121.4, CH	6.67 (1H, dd, J = 8.2, 2.0)	125.2, CH	6.8 (1H, dd, J = 8.0, 2.0)	117.1, CH	7.05 (1H, d, J = 8.0)
7	39.7, CH_2	2.73 (2H, t, J = 7.0)	39.5, CH_2	2.74 (2H, t, J = 7.0)	39.4, CH_2	3.31 (2H, m)
8	64.3, CH_2	3.7 (2H, m)	64.3, CH_2	3.73 (2H, m)	137.7, CH	5.93 (1H, ddt, J = 17.0, 10.0, 6.5)
9	-	-	-	-	114.5, CH_2	5.00 (1H, dm, J = 11.0, H9a) 5.04 (1H, dm, J = 17.0, H9b)
OMe	-	-	-	-	55.4, CH_3	3.82 (3H, s)
1′	104.8, CH	4.72 (1H, d, J = 7.8)	104.5, CH	4.77 (1H, d, J = 7.4)	101.9, CH	4.77 (1H, d, J = 7.5)
2′	74.9, CH	3.49 (1H, m)	74.9, CH	3.5 (1H, m)	73.6, CH	3.44(1H, m)
3′	78.3, CH	3.40 (1H, m)	78.3, CH	3.43 (1H, m)	76.5, CH	3.41 (1H, m)
4′	71.3, CH	3.42 (1H, m)	71.4, CH	3.42 (1H, m)	70.3, CH	3.31 (1H, m)
5′	77.7, CH	3.44 (1H, m)	77.7, CH	3.48 (1H, m)	75.7, CH	3.50 (1H, ddd, J = 9.5, 6.5, 2.0)
6′	62.4, CH_2	3.74 (1H, m)	62.5, CH_2	3.92 (1H, dd, J = 12.0, 1.8)	67.3, CH_2	3.96 (1H, dd, J = 11.0, 2.0)
	-	-	-	-		3.59 (1H, dd, J = 1.0, 6.5)
1″	-	-	-	-	109.7, CH	4.94 (1H, d, J = 2.5)
2″	-	-	-	-	76.7, CH	3.86 (1H, d, J = 2.5)
3″	-	-	-	-	79.2, C	-
4″	-	-	-	-	73.7, CH_2	3.71 (1H, d, J = 9.5)
	-	-	-	-		3.92 (1H, d, J = 9.5)
5″	-	-	-	-	64.3, CH_2	3.54 (2H, s)

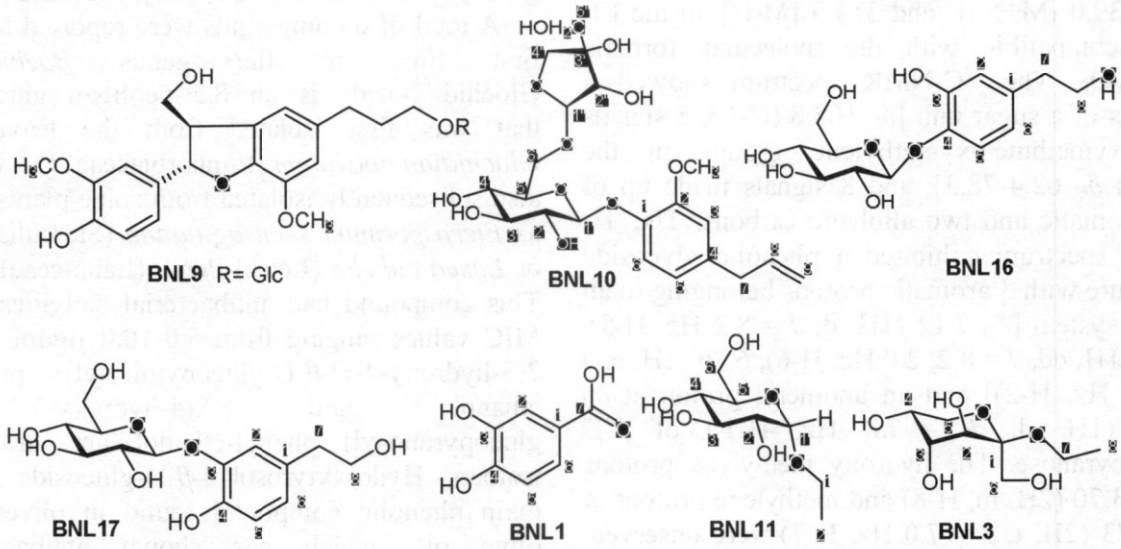

Fig. 2. Compounds isolated from *B. nivea* leaves

Compound BNL10 was isolated as a colorless gum. Its molecular formula was determined to be $C_{21}H_{30}O_{11}$ (M=458.1788) from the HR-ESI-MS spectrum (*m/z* 503.1833 $[M+HCOO]^-$ calcd. for $[C_{22}H_{31}O_{13}]^-$: 503.1853, Δ= 3.98 ppm). The ^{1}H-NMR spectrum showed 3 aromatic proton signals belonging to an ABX system [δ_H 6.80 (1H, d, J = 2.0 Hz, H-3), 6.72 (1H, dd, J = 8.0, 2.0 Hz, H-5), and 7.05 (1H, d, J = 8.0 Hz, H-6). Furthermore, a methoxy (δ_H 3.82) and an allylic moiety [δ_H 3.31 (2H, m, H-7), 5.93 (1H, ddt, J = 17.0, 10.0, 6.5 Hz, H-8), 5.00 (1H, dm, J = 11.0 Hz, H9a), and 5.04 (1H, dm, J = 17.0 Hz, H9b)] were identified. In addition, 2 anomeric protons appeared at δ_H 4.77 (1H, d, J = 7.5 Hz, H-1') and 4.94 (1H, d, J = 2.5 Hz, H-1") suggesting the glucose and apiose units. The ^{13}C-NMR spectrum appeared with 21 carbons with 10 carbons of the aglycon and 11 signals of 2 sugar units. The spectrum supported the presence of a phenylpropanoid skeleton, having 3 quaternary carbons of the aromatic ring with 1 signal upfield

at δ_C 135.2 (C-4), 3 aromatic methine groups at δ_C 112.9 (C-3), 120.9 (C-5), 117.1 (C-6) and an olefin group at δ_C 137.7 (C-8), 2 methylene groups at 39.4 (C-7) and 114.5 (C-9) in the allylic moiety. The biglycoside included 6 signals of a β-D-glucopyranose unit [δ_C 101.9 (C-1'), 5 signals of oxymethine/oxymethylene groups in the region δ_C 67.3-76.5] and a β-D-apiofuranose unit [δ_C 109.7 (C-1"), 3 signals of oxymethine/oxymethylene groups in the region from δ_C 64.3 - 76.7 and a quaternary carbon signal at δ_C 79.2 (C-3")]. The HMBC spectrum showed the correlations of δ_H 4.77 (1H, d, J = 7.5 Hz, Glc-H-1') with δ_C 145.0 (C-1) and of δ_H 4.94 (1H, d, J = 2.5 Hz, api H-1") with δ_C 67.3 (C-6'), supporting this suggestion and designating the glycosidic linkage of apiofuranose (1"→6')-glucopyranose -O-C-1. Based on the above analysis and comparison with spectral data in the literature [7], compound **BNL10** was assigned eugenyl *O*-β-apiofuranosyl-(1"→6')-*O*-β-glucopyranoside (**Fig 2**).

Compound BNL16 was obtained as a pale-yellow oil, that showed a molecular ion peak at *m/z* 339.0 $[M+Na]^+$ and 314.9 $[M-H]^-$ in the EI-MS, compatible with the molecular formula $C_{14}H_{20}O_8$. The ^{13}C-NMR spectrum showed 6 signals of a sugar unit [δ_C 104.8 (C-1'), 5 signals of oxymethine/oxymethylene groups in the region δ_C 62.4-78.3], and 8 signals made up of six aromatic and two aliphatic carbons. The ^{1}H-NMR spectrum exhibited a phenolic glycoside structure with 3 aromatic protons belonging to an ABX system [δ_H 7.12 (1H, d, J = 8.2 Hz, H-5), 6.67 (1H, dd, J = 8.2, 2.0 Hz, H-6), 6.76 (1H, d, J = 2.0 Hz, H-2)] and an anomeric proton at δ_H 4.72 (1H, d, J = 7.8 Hz, H-1') of β-D glucopyranose. The hydroxy methylene protons at δ_H 3.70 (2H, m, H-8) and methylene protons at δ_H 2.73 (2H, t, J = 7.0 Hz, H-7) were observed. From the COSY spectrum, we determined two structural moieties including A (hydroxyethyl): -C(7)H_2- H_2C(8)OH and B: -C(5)H=HC(6). The HMBC spectrum showed the correlations of the proton anomer at δ_H 4.72 (1H, d, J = 7.8 Hz, H-1') with δ_C 145.0 (C-4) and of δ_H 2.73 (H-7) with δ_C 136.2 (C-1), 121.4 (C-6), which identified the position of the sugar at C-4 and the hydroxyethyl moiety at C-1, respectively. All the NMR data of **BNL16** were compared to those of 2(3-hydroxy-4-*O*-β-D-glucopyranosyl) phenyl-ethanol, namely hydroxytyrosol 4-β-D-glucoside, and a matching was found in the literature [8] (See in **Fig 2**).

Compound BNL17 was also isolated as a pale-yellow oil. **BNL17** showed a molecular ion peak at *m/z* 338.8 $[M+Na]^+$ and 314.7 $[M-H]^-$ in the EI-MS spectrum, compatible with the molecular formula $C_{14}H_{20}O_8$. The 1D-NMR data of this compound was similar to that of **BNL16**, with the appearance of a hydroxyethyl moiety, an aromatic ring, and a β-D glucopyranose unit. The difference between those compounds was only in the sugar position. The HMBC spectrum showed the correlations of the proton anomer at δ_H 4.77 (1H, d, J = 7.4 Hz, H-1') with δ_C 146.6 (C-3), identifying the position of the sugar at C-3. Consequently, compound **BNL17** was identified to be 2(4-hydroxy-3-*O*-β-D-glucopyranosyl) phenyl-ethanol, namely cimidahurinine [9]. Other known compounds were elucidated by comparing their NMR data to the previous reports including protocatechuic acid (**BNL1**) [10], ethyl β-fructopyranoside (**BNL3**) [11], and ethyl α-D-glucopyranoside (**BNL11**) [12]. (See in **Fig 2**).

A total of 6 compounds were reported for the first time in the genus *Boehmeria*. Glochidioboside is an 8,3'-neoligan glucoside that was first isolated from the leaves of *Glochidion obovatum* (Euphorbiaceae) [5]. It was also subsequently isolated from some plants such as *Pterospermum semisagittatum* (Sterculiaceae) or *Litsea cubeba* (Lour.) Pers., (Lauraceae) [13]. This compound had antibacterial activities with MIC values ranging from 5.0-10.0 µg/mL [14]. 2(3-hydroxy-4-*O*-β-D-glucopyranosyl) phenyl-ethanol and 2(4-hydroxy-3-*O*-β-D-glucopyranosyl) phenyl-ethanol are structural isomers. Hydroxytyrosol 4-β-D-glucoside is the main phenolic compound found in olives and olive oil, which has shown antibacterial, hypoglycemic, hyponatremic, and cholesterol-lowering properties [15]. Cimidahurinine was reported to reduce cardiotoxicity dose-dependent caused by doxorubicin (EC_{50} 45.79 µM) and have a strong inhibitory effect on melanin production, tyrosinase enzyme activity, and antioxidant capacity in the DPPH model [16].

4. Conclusion

From the *n*-butanol extract of *B. nivea* leaves, 7 compounds were isolated and identified, including protocatechuic acid (**BNL1**), ethyl β-fructopyranoside (**BNL3**), glochidioboside (**BNL9**), eugenyl *O*-β-apiofuranosyl-(1"→6')-*O*-

β-glucopyranoside (**BNL10**), ethyl α-D-glucopyranoside (**BNL11**), hydroxytyrosol 4-β-D-glucoside (**BNL16**), and cimidahurinine (**BNL17**). Among them, **BNL3**, **BNL9**, **BNL10**, **BNL11**, **BNL16**, and **BNL17** were first isolated from the *Boehmeria*.

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MEGASTIGMANE, ALKALOID, FLAVONOID, AND PHENOLIC COMPOUNDS FROM *CISSUS TRILOBUS* (LOUR.) MERR.

Ho Duc Tai, Tran Duy Hien, Tran Thi Van Anh*

Faculty of Pharmacy, University of Medicine and Pharmacy at Ho Chi Minh City, Vietnam

*Corresponding author: ttvananh@ump.edu.vn

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Summary

Megastigmane, Alkaloid, Flavonoid, and Phenolic Compounds from *Cissus trilobus* (Lour.) Merr.

From the dichloromethane and ethyl acetate extracts of *Cissus trilobus* seven compounds were isolated and identified as blumenol B (**1**), blumenol A (**2**), indole-3-carboxylic acid (**3**), vitexin (**4**), cytisoside (**5**), acacetin-8-*C*-neohesperidoside (**6**), and 4-hydroxybenzoic acid (**7**). These structures were determined through the analysis of NMR and MS spectroscopic data and comparison with the reported literature. These compounds were isolated for the first time from *C.trilobus*.

Keywords: *C.trilobus, Megastismane, Alkaloid, Flavonoid.*

1. Introduction

Cissus trilobus (Lour.) Merr. (synonym: *Cissus modeccoides* Planch.) is a vine belonging to the Vitaceae family and is naturally distributed throughout many regions of Vietnam, Cambodia, Thailand, and China. In folk medicine, the tuberous root and the aerial part of this plant have been used for the treatment of bone and joint pain, swelling, snakebite… [1]. Although this plant has been used commonly, there are very few studies on its chemical composition. A previous study revealed the presence of three anthraquinones (chrysophanol, emodin, and physcione) and two phenolic compounds (lasiodiplodin and *trans*-4-hydroxymellein) from the aerial part of *C. trilobus* [2]. In a pharmacological study, the hot aqueous extract of *C. trilobus* did not have a hypoglycemic effect on