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LIGNANS AND NEOLIGNAN FROM THE STEMS OF *CANSJERA RHEEDEI* J.F.GMEL.

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Summary

Cansjera rheedei J.F.Gmel. belongs to the family Opiliaceae, which is distributed in the regions of southern Asia. Research on this plant's chemical constituents has been limited to the identification of several common phenolic compounds. This phytochemical study was conducted on the stems of *C. rheedei* to isolate five lignans and one neolignan. The chemical structures of six isolated compounds were elucidated by using spectral data analyses and comparison with those in references, leading to the determination of alyterinate A (**1**), alyterinate B (**2**), (+)-pinoresinol (**3**), (+)-medioresinol (**4**), (+)-syringaresinol (**5**), and balanophonin (**6**). All of them were reported for the first time from the genus *Cansjera*.

Keywords: *Cansjera rheedei; Lignan; Neolignan.*

1. Introduction

Cansjera is a small genus in the family Opiliaceae that consists of three species (*C. rheedei*, *C. leptostachya*, and *C. parvifolia*). *Cansjera rheedei* J.F.Gmel., a shrub or climbing shrub, is distributed from India and Nepal to southern China (Vietnam, Thailand, Laos, and Myanmar) and western Malaysia [1]. The ethanol extract of the aerial parts of *C. rheedei* showed a nontoxic effect through the evaluation of acute and sub-acute toxicity in animal trials [2]. Several investigations into the biological activities of this herb were performed to illustrate anthelminthic [3], hepatoprotective [4], hypoglycemic [5], and nephroprotective [6] effects. To date, only a single study has investigated the phytochemistry of *C. rheedii*, reporting several common phenolic and flavonoid compounds, including caffeic acid, ferulic acid, quercetin, quercetin-3-*O*-*β*-D-glucoside, and rutin [7]. Here, we report the isolation and structural elucidation of six compounds from the stems of *C. rheedei*, consisting of five lignans (alyterinate A (**1**), alyterinate B (**2**), (+)-pinoresinol (**3**), (+)-medioresinol (**4**), and (+)-syringaresinol (**5**)) and one neolignan (balanophonin (**6**)). All these chemical constituents were reported for the first time from this genus.

2. Materials and methods

2.1. Plant material

Stems of *C. rheedei* J.F.Gmel. were collected from Bac Giang province (June 2024) and authenticated by Dr. Vo Thanh Hoa (Department of Pharmacognosy, University of Health Sciences, Vietnam National University, Ho Chi Minh City). A voucher specimen of this sample (CRS2024-01) was deposited in the Department of Pharmacognosy, University of Health Sciences, Vietnam National University, Ho Chi Minh City.

2.2. General experimental procedures

Column chromatography was performed with *silica gel* (60 μm, Chromatorex MB70-40/75, Japan) and Sephadex LH-20 (GE Healthcare, Sweden). Thin-layer chromatography (TLC) was conducted on *silica gel* 60 F_{254} plates (Merck, Germany). The reversed-phase preparative HPLC was performed using an LC-40D instrument (Shimadzu, Japan) connected to a Cosmosil C_{18}-AR-II column (5 μm, 20 mm I.D. × 250 mm) with a UV detector. Optical rotations were recorded by a digital polarimeter (Jasco P-2000, Japan). HR-ESIMS data were obtained with the Shimadzu LCMS-9030 series Q-TOF mass spectrometer analyzer (Shimadzu, Japan). 1D and 2D NMR spectra were measured on a Bruker AVIII600 spectrometer (Bruker, Germany) using TMS as an internal standard. All reagents and solvents were of analytical grade.

2.3. Extraction and isolation

The plant samples were air-dried and ground to a raw powder before further processing. The dried powdered stems of *C. rheedei* (3.5 kg) were extracted with 95% ethanol (35 L, 3 times) at 50°C. The solvent was removed under reduced pressure to give the crude extract, which was then dispersed in distilled water (2 L) and partitioned with ethyl acetate (4 times, each 2 L) and continuously with *n*-butanol (3 times, each 2 L). The organic solvents were evaporated *in vacuum* to yield ethyl acetate extract (CR-A, 62 g) and *n*-butanol extract (CR-B, 40 g).

The CR-A extract was separated by *silica gel* column chromatography with elution of a gradient solvent mixture of *n*-hexane - ethyl acetate (9:1 to 0:10, *v/v*) to obtain 14 fractions (A.1 - A.14). The fraction A.7 was purified by preparative HPLC (40 % acetonitrile (ACN) in water, isocratic, 6 mL/min) to afford compounds **1** (32.6 mg, t_R 16.2 min) and **2** (14.1 mg, t_R 18.5 min). The fraction A.9 was chromatographed by *silica gel* column with gradient elution of chloroform - ethyl acetate (9:1 - 5:5, *v/v*) and applied subsequently on Sephadex LH-20 column to furnish compounds **3** (45.0 mg) and **4** (148.4 mg). The fraction A.10 was purified by preparative HPLC (25 % ACN in water, isocratic, 6 mL/min) to obtain compounds **5** (81.6 mg, t_R 12.5 min) and **6** (4.5 mg, t_R 14.8 min).

Compound 1 (alyterinate A): colorless needle crystals; $[\alpha]_D^{25}$ + 12.6 (*c* 0.1, MeOH); HR-ESIMS (+) *m/z* 371.1490 $[M\text{-}H_2O+H]^+$; ^{1}H-NMR (600 MHz, CD_3OD) δ_H (ppm): 6.90 (1H, d, *J* = 1.8 Hz, H-2), 6.75 (1H, m, H-5), 6.76 (1H, m, H-6), 5.15 (1H, d, *J* = 7.2 Hz, H-7), 3.11 (1H, dd, *J* = 8.4, 7.2 Hz, H-8), 6.76 (1H, m, H-2′), 6.71 (1H, d, *J* = 7.8 Hz, H-5′), 6.61 (1H, dd, *J* = 7.8, 1.8 Hz, H-6′), 2.74 (1H, dd, *J* = 13.8, 6.0 Hz, H-7′a), 2.54 (1H, dd, *J* = 13.8, 10.2 Hz, H-7′b), 2.97 (1H, m, H-8′), 4.07 (1H, dd, *J* = 8.4, 6.6 Hz, H-9′a), 3.76 (1H, dd, *J* = 8.4, 6.6 Hz, H-9′b), 3.65 (3H, s, 9-OCH_3), 3.83 (6H, s, 3/3′-OCH_3); ^{13}C-NMR (150 MHz, CD_3OD) δ_C (ppm): 134.2 (C-1), 110.6 (C-2), 149.0 (C-3), 147.4 (C-4), 116.1 (C-5), 119.8 (C-6), 84.0 (C-7), 57.1 (C-8), 174.0 (C-9), 132.3 (C-1′), 113.4 (C-2′), 149.0 (C-3′), 146.1 (C-4′), 116.2 (C-5′), 122.2 (C-6′), 35.4 (C-7′), 45.3 (C-8′), 74.0 (C-9′), 52.2 (9-OCH_3), 56.4 (3-OCH_3), 56.4 (3′-OCH_3).

Compound 2 (alyterinate B): colorless needle crystals; $[\alpha]_D^{25}$ + 15.1 (*c* 0.1, MeOH); HR-ESIMS (+) *m/z* 387.1435 $[M+H]^+$, 369.1339 $[M\text{-}H_2O+H]^+$; ^{1}H-NMR (600 MHz, CD_3OD) δ_H (ppm): 6.95 (1H, d, *J* = 1.8 Hz, H-2), 6.77 (1H, d, *J* = 7.8 Hz, H-5), 6.80 (1H, m, H-6), 5.12 (1H, d, *J* = 7.8 Hz, H-7), 3.70 (1H, dt, *J* = 7.8, 2.4 Hz, H-8), 6.75 (1H, d, *J* = 1.8, H-2′), 6.79 (1H, m, H-5′), 6.65 (1H, dd, *J* = 8.4, 1.8 Hz, H-6′), 6.43 (1H, q, *J* = 2.4 Hz, H-7′), 4.89 (1H, dd, *J* = 13.8, 3.0 Hz, H-9′a), 4.75 (1H, dt, *J* = 13.8, 3.0 Hz, H-9′b), 3.83 (3H, s, 3-OCH_3), 3.77 (3H, s, 9-OCH_3), 3.86 (3H, s, 3′-OCH_3); ^{13}C-NMR (150 MHz, CD_3OD) δ_C (ppm): 132.5 (C-1), 110.7 (C-2), 149.1 (C-3), 147.7 (C-4), 116.1 (C-5), 120.2 (C-6), 84.1 (C-7), 59.8 (C-8), 173.5 (C-9), 130.1 (C-1′), 113.1 (C-2′), 149.0 (C-3′), 147.3 (C-4′), 116.4 (C-5′), 122.5 (C-6′), 124.3 (C-7′), 137.7 (C-8′), 71.2 (C-9′), 52.8 (9-OCH_3), 56.4 (3-OCH_3), 56.4 (3′-OCH_3).

Compound 3 ((+)-pinoresinol): colorless needle crystals; $[\alpha]_D^{25}$ + 20.2 (*c* 0.1, MeOH); HR-ESIMS (+) *m/z* 359.1488 $[M+H]^+$, 341.1376 $[M\text{-}H_2O+H]^+$; ^{1}H-NMR (600 MHz, CD_3OD) δ_H (ppm): 6.93 (2H, d, *J* = 1.8 Hz, H-2/2′), 6.77 (2H, d, *J* = 8.4 Hz, H-5/5′), 6.79 (2H, dd, *J* = 8.4, 1.6 Hz, H-6/6′), 4.68 (2H, d, *J* = 4.2 Hz, H-7/7′), 3.10 (2H, q, *J* = 4.2 Hz, H-8/8′), 4.20 (2H, dd, *J* = 9.0, 6.6 Hz, H-9a/9′a), 3.81 (2H, dd, *J* = 9.0, 3.6 Hz, H-9b/9′b), 3.83 (6H, s, 3/3′-OCH_3); ^{13}C-NMR (150 MHz, CD_3OD) δ_C (ppm): 133.8 (C-1/1′), 111.0 (C-2/2′), 149.1 (C-3/3′), 147.2 (C-4/4′), 116.1 (C-5/5′), 120.0 (C-6/6′), 87.4 (C-7/7′), 55.3 (C-8/8′), 72.6 (C-9/9′), 56.4 (3/3′-OCH_3).

Compound 4 ((+)-medioresinol): amorphous white powder; $[\alpha]_D^{25}$ + 18.5 (*c* 0.1, MeOH); HR-ESIMS (+) *m/z* 389.1593 $[M+H]^+$, 371.1494 $[M\text{-}H_2O+H]^+$; ^{1}H-NMR (600 MHz, CD_3OD) δ_H (ppm): 6.66 (2H, s, H-2/6), 4.71 (1H, d, *J* = 4.2 Hz, H-7), 3.14 (1H, m, H-8), 4.25 (1H, m, H-9a), 3.88 (1H, m, H-9b), 6.95 (1H, d, *J* = 1.8 Hz, H-2′), 6.77 (1H, d, *J* = 7.8 Hz, H-5′), 6.81 (1H, dd, *J* = 7.8, 1.8 Hz, H-6′), 4.71 (1H, d, *J* = 4.2 Hz, H-7′), 3.14 (1H, m, H-8′), 4.25 (1H, m, H-9′a), 3.88 (1H, m, H-9′b), 3.85 (6H, s, 3/5-OCH_3), 3.86 (3H, s, 3′-OCH_3); ^{13}C-NMR (150 MHz, CD_3OD) δ_C (ppm): 133.2 (C-1), 104.5 (C-2/6), 149.4 (C-3/5), 136.2 (C-4), 87.7 (C-7), 55.6 (C-8), 72.7 (C-9), 133.8 (C-1′), 111.0 (C-2′), 149.1 (C-3′), 147.3 (C-4′), 116.1 (C-5′), 120.1 (C-6′), 87.5 (C-7′), 55.3 (C-8′), 72.6 (C-9′), 56.8 (3/5-OCH_3), 56.4 (3′-OCH_3).

Compound 5 ((+)-syringaresinol): colorless needle crystals; $[\alpha]_D^{25}$ + 23.9 (*c* 0.1, MeOH); HR-ESIMS (+) *m/z* 419.1701 $[M+H]^+$, 401.1602 $[M\text{-}H_2O+H]^+$; ^{1}H-NMR (600 MHz, CD_3OD) δ_H (ppm): 6.65 (4H, s, H-2/6/2′/6′), 4.71 (2H, d, *J* = 4.2 Hz, H-7/7′), 3.13 (2H, m, H-8/8′), 4.26 (2H, m, H-9a/9′a), 3.87 (2H, dd, *J* = 9.0, 3.6 Hz, H-9b/9′b), 3.84 (12H, s, 3/5/3′/5′-OCH_3); ^{13}C-NMR (150 MHz, CD_3OD) δ_C (ppm): 133.1 (C-1/1′), 104.5 (C-2/6/2′/6′), 149.3 (C-3/5/3′/5′), 136.2 (C-4/4′), 87.6 (C-7/7′), 55.5 (C-8/8′), 72.8 (C-9/9′), 56.8 (3/5/3′/5′-OCH_3).

Compound 6 (balanophonin): amorphous white powder; $[\alpha]_D^{25}$ + 10.0 (*c* 0.1, MeOH); HR-ESIMS (+) *m/z* 357.1330 $[M+H]^+$, 339.1228 $[M\text{-}H_2O+H]^+$; ^{1}H-NMR (600 MHz, CD_3OD) δ_H (ppm): 6.95 (1H, d, *J* = 1.8 Hz, H-2), 6.78 (1H, d, *J* = 8.4 Hz, H-5), 6.83 (1H, dd, *J* = 8.4, 1.8 Hz, H-6), 5.61 (1H, d, *J* = 6.6 Hz, H-7), 3.57 (1H, q, *J* = 6.0 Hz, H-8), 3.85 (2H, m, H-9), 7.24 (1H, d, *J* = 1.8 Hz, H-2′), 7.29 (1H, brs, H-6′), 7.63 (1H, d, *J* = 15.6 Hz, H-7′), 6.69 (1H, dd, *J* = 15.6, 7.8 Hz, H-8′), 9.59 (1H, d, *J* = 7.8 Hz, H-9′), 3.82 (3H, s, 3-OCH_3), 3.92 (3H, s, 3′-OCH_3); ^{13}C-NMR (150 MHz, CD_3OD) δ_C (ppm): 133.9 (C-1), 110.6 (C-2), 149.2 (C-3), 147.8 (C-4), 116.2 (C-

5), 119.8 (C-6), 90.1 (C-7), 54.7 (C-8), 64.6 (C-9), 129.6 (C-1′), 114.3 (C-2′), 146.0 (C-3′), 153.0 (C-4′), 131.3 (C-5′), 120.0 (C-6′), 156.1 (C-7′), 127.1 (C-8′), 196.1 (C-9′), 56.4 (3-OCH_3), 56.8 (3′-OCH_3).

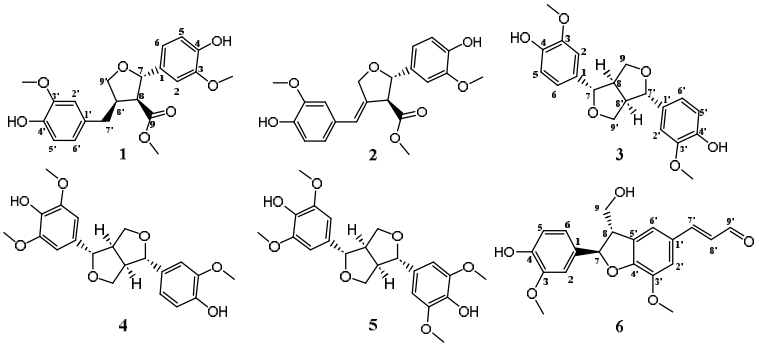

Fig.1. Chemical structures of the isolated compounds (**1**–**6**)

3. Results and discussion

The 95% ethanol extract from the stems of *C. rheedei* was partitioned and purified using various chromatographic methods to furnish six compounds (**1**-**6**). The chemical structures of the isolated compounds were determined by their spectral data and comparison with those in the corresponding references.

Compound **1** was obtained as colorless needle crystals. The molecular formula was identified to be $C_{21}H_{24}O_7$ by its HR-ESIMS data at *m/z* 371.1490 $[M\text{-}H_2O+H]^+$ (calcd. for $C_{21}H_{23}O_6^+$, 371.1495). The ^{1}H-NMR spectrum of **1** showed six protons of two ABX systems at the olefinic region (6.90 - 6.61 ppm); three methine proton signals at δ_H 5.15 (1H, d, 7.2 Hz), 3.11 (1H, dd, 8.4, 7.2 Hz), and 2.97 (1H, m); two methylene in the range of 4.07 - 2.54 ppm; and three methoxy groups at δ_H 3.83 (6H, s) and 3.65 (3H, s). The ^{13}C-NMR spectrum of **1** illustrated 21 signals, including one carbonyl carbon at δ_C 174.0; four oxygenated olefinic carbons (δ_C 149.0 - 146.1); two oxygenated methine and methylene groups at δ_C 84.0 and 74.0, respectively; and three methoxy signals (δ_C 56.4, 56.4, and 52.2). The proton at δ_H 3.11 (H-8) exhibited the COSY correlation with δ_H 2.97 (H-8′) and the HMBC interaction to δ_C 74.0 (C-9′) proved that compound **1** was a furan lignan. In the HMBC spectrum, correlations from the methylene proton (δ_H 2.74 and 2.54, H-7′) to δ_C 57.1 (C-8) and 74.0 (C-9′) were observed. Furthermore, three methoxy protons interacted with two aromatic carbons at δ_C 149.0 and the carbonyl group at δ_C 174.0. Spectral data analyses and optical rotation $[\alpha]_D^{25}$ + 12.6 led to the elucidation of compound **1** as alyterinate A, which showed similarity with those of the published literature [8].

Compound **2** was obtained as colorless needle crystals. The molecular formula was identified to be $C_{21}H_{22}O_7$ by its HR-ESIMS data at *m/z* 387.1435 $[M+H]^+$ (calcd. for $C_{21}H_{23}O_7^+$, 387.1438) and *m/z* 369.1339 $[M\text{-}H_2O+H]^+$ (calcd. for $C_{21}H_{21}O_6^+$, 369.1338). The ^{1}H-NMR spectrum of **2** showed six protons of two ABX systems at the olefinic region (6.95 - 6.65 ppm); another olefinic proton at δ_H 6.43 (1H, q, 2.4 Hz); two methine protons at δ_H 5.12 (1H, d, 7.8 Hz) and 3.70 (1H, dt, 7.8, 2.4 Hz); and three methoxy groups at δ_H 3.86 (3H, s), 3.83 (3H, s) and 3.77 (3H, s). The ^{13}C-NMR spectrum of **2** demonstrated 21 carbons with one carbonyl signal at δ_C 173.5; four hydroxyl aromatic carbons (δ_C 149.0 - 147.3); one oxygenated methine at δ_C 84.1; one oxygenated methylene at δ_C 71.2; and three methoxy groups (δ_C 56.4, 56.4, and 52.8). In the HMBC spectrum, the proton at δ_H 5.12 (H-7) showed the correlations with δ_C 137.7 (C-8′) and 71.2 (C-9′). The structure of compound **2** was a furan lignan similar to compound **1**. In addition, proton δ_H 6.43 (H-7′) correlated with δ_C 71.2 (C-9′) and 59.8 (C-8), indicating the appearance of one double bond at the C-7′ and C-8′ position. Carbon chemical shift values of C-7′ (δ_C 124.3) and C-8′ (δ_C 137.7) were consistent with literature values for *Z*-configured C-7′/C-8′ [8], suggesting the *Z* geometry of this double bond. This compound showed $[\alpha]_D^{25}$ + 15.1 (*c* 0.1, MeOH). Based on the spectral analyses and comparison with the reference [8], compound **2** was identified as alyterinate B.

Compound **3** was obtained as colorless needle crystals. The molecular formula was identified to be $C_{20}H_{22}O_6$ by its HR-ESIMS data at *m/z* 359.1488 $[M+H]^+$ (calcd. for $C_{20}H_{23}O_6^+$, 359.1489) and *m/z* 341.1376 $[M\text{-}H_2O+H]^+$ (calcd. for $C_{20}H_{21}O_5^+$, 341.1389). The ^{1}H-NMR spectrum of **3** showed three protons of an ABX system (6.93 - 6.77 ppm); two methine protons at δ_H 4.68

(1H, d, 4.2 Hz) and 3.10 (1H, q, 4.2 Hz); a methylene group at δ_H 4.20 (1H, dd, 9.0, 6.6 Hz) and 3.81 (1H, dd, 9.0, 3.6 Hz); and a methoxy group at δ_H 3.83 (3H, s). The ^{13}C-NMR spectrum of **3** exhibited 10 signals of a symmetrical structure, including two olefinic carbons connected with oxygen (δ_C 149.1 and 147.2); the oxygenated methine and methylene carbons at δ_C 87.4 and 72.6, respectively; and one methoxy group at δ_C 55.3. In the HMBC spectrum, proton δ_H 4.68 interacted with δ_C 72.6 and 55.3. In addition, the proton δ_H 3.10 had COSY correlations with the methine proton (δ_H 4.68) and the methylene group (δ_H 4.20 and 3.81) featured for a furofuran lignan derivative. The optical rotation of compound **3** was recorded as $[\alpha]_D^{25}$ + 20.2 (*c* 0.1, MeOH). In comparison with spectral data in the published literature [9], compound **3** was identified as (+)-pinoresinol.

Compound **4** was obtained as an amorphous white powder. The molecular formula was identified to be $C_{21}H_{24}O_7$ by its HR-ESIMS data at *m/z* 389.1593 $[M+H]^+$ (calcd. for $C_{21}H_{25}O_7^+$, 389.1595) and *m/z* 371.1494 $[M-H_2O+H]^+$ (calcd. for $C_{21}H_{23}O_6^+$, 371.1495). The ^{1}H-NMR spectrum of **4** showed three protons of an ABX system (6.95 - 6.77 ppm); two protons of the symmetrical trisubstituted aromatic ring at δ_H 6.66 (2H, s); two oxygenated methine protons at δ_H 4.71 (2H, d, 4.2 Hz); two oxygenated methylene groups at δ_H 4.25 (2H, m) and 3.88 (2H, m); and three methoxy groups at δ_H 3.86 (3H, s), and 3.85 (6H, s). The ^{13}C-NMR spectrum of **4** declared 18 signals consisting of 4 aromatic carbons linked with oxygen (149.4 - 136.2 ppm); two oxygenated methine at δ_C 87.7 and 87.5; two oxygenated methylene at δ_C 72.7 and 72.6; and three methoxy groups at δ_C 56.8 and 54.4. The NMR spectral data of compound **4** showed similar characteristics to those of compound **3**, suggesting a furofuran lignan derivative. The difference was the addition of a methoxy group to create the symmetrical 1,3,4,5-substituted phenolic unit. In addition, compound **4** indicated the optical rotation as $[\alpha]_D^{25}$ + 18.5 (*c* 0.1, MeOH). The structure of compound **4** was elucidated as (+)-medioresinol, which was confirmed by reference [10].

Compound **5** was obtained as colorless needle crystals. The molecular formula was identified to be $C_{22}H_{26}O_8$ by its HR-ESIMS data at *m/z* 419.1701 $[M+H]^+$ (calcd. for $C_{22}H_{27}O_8^+$, 419.1700) and *m/z* 401.1602 $[M-H_2O+H]^+$ (calcd. for $C_{22}H_{25}O_7^+$, 401.1600). The ^{1}H-NMR and ^{13}C-NMR spectra of **5** showed the characteristic of a furofuran lignan with a symmetrical structure like compound **3**. Furthermore, two aromatic ring units were all substituted by two methoxy groups (δ_C 56.8, δ_H 3.84 (6H, s)) and one hydroxyl group, combined with the observed optical rotation value of $[\alpha]_D^{25}$ + 23.9 (*c* 0.1, MeOH) suggested that the structure of compound **5** was identified to be (+)-syringaresinol [11].

Compound **6** was obtained as an amorphous white powder. The molecular formula was identified to be $C_{20}H_{20}O_6$ by its HR-ESIMS data at *m/z* 357.1330 $[M+H]^+$ (calcd. for $C_{20}H_{21}O_6^+$, 357.1333) and 339.1228 $[M-H_2O+H]^+$ (calcd. for $C_{20}H_{19}O_5^+$, 339.1233). The ^{1}H-NMR spectrum of **6** showed two olefinic protons at δ_H 7.63 and 6.69 with the coupling constant J = 15.6 Hz featured for a *trans* configuration double bond; two protons located in *meta* position at δ_H 7.29 (1H, brs) and 7.24 (1H, d, 1.8 Hz); three protons of an ABX system (6.95 - 6.78 ppm); two methine groups at δ_H 5.61 (1H, d, 6.6 Hz) and 3.57 (1H, q, 6.0 Hz); a methylene group at δ_H 3.85 (2H, m); and two methoxy groups at δ_H 3.92 (3H, s) and 3.82 (3H, s). The ^{13}C-NMR spectrum of **6** exhibited 20 carbons, including a carbonyl group at δ_C 196.1; four hydroxyl olefinic carbons (153.0 - 146.0 ppm); a double bond at δ_C 156.1 and δ_C 127.1; the oxygenated methine and methylene groups at δ_C 90.1 and 64.6, respectively; and two methoxy groups at δ_C 56.8 and 56.4. In the HMBC spectrum, proton δ_H 3.57 (H-8) illustrated correlations with δ_C 153.0 (C-4′) and 120.0 (C-6′), proving that two C_6-C_3 units were connected through C-8 and C-5′. In addition, proton δ_H 5.61 (H-7) interacted with δ_C 153.0 (C-4′) and 131.3 (C-5′), suggesting the formation of a furan ring. The optical rotation of compound **6** was measured to give $[\alpha]_D^{25}$ + 10.0 (*c* 0.1, MeOH). Detailed spectral data analyses and comparison with the published reference [12] led to the structure elucidation as balanophonin.

To the best of our knowledge, these six compounds were isolated and structure elucidated for the first time from the genus *Cansjera*. Two lignan esters, alyterinate A and B, were reported from *Alyxia schlechteri* and *Willughbeia coriacea*. Alyterinate A showed cytotoxic activity against HeLa cell line [13]. (+)-Pinoresinol, (+)-medioresinol, and (+)-syringaresinol were commonly found in foods and medicinal plants, which exhibited anti-inflammatory effects by influencing the NF-κB and MAPK pathways, demonstrated antitumor activities through the regulation of apoptosis, and alleviated the progression of osteoporosis [14]. Balanophonin, a dihydrobenzofuran neolignan, was investigated to

illustrate the anti-neuroinflammatory [15], anti-HIV-1 [16], and PTP1B inhibitory [12] activities. This study provides further information about the phytochemical composition of *C. rheedei*, which contributes to the scientific understanding of this herb in usage and quality control.

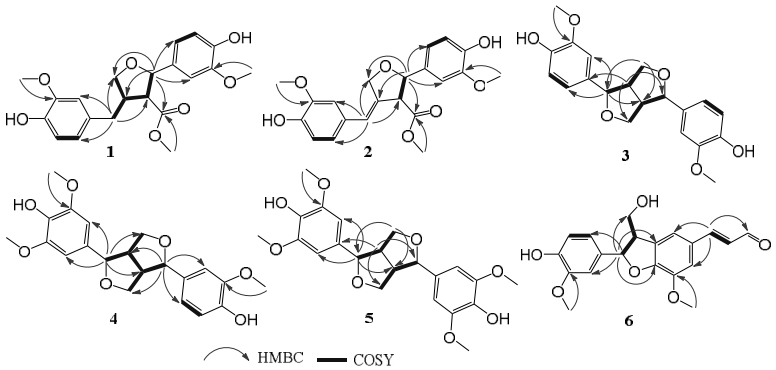

Fig.2. Key HMBC and COSY correlations of the isolated compounds (**1**–**6**)

4. Conclusion

Five lignans and one neolignan were isolated from the stems of *C. rheedei* J.F.Gmel.. The structures of these compounds were elucidated by spectral data analyses and by comparison with those in references as alyterinate A (**1**), alyterinate B (**2**), (+)-pinoresinol (**3**), (+)-medioresinol (**4**), (+)-syringaresinol (**5**), and balanophonin (**6**). All these chemical constituents were reported for the first time from the genus *Cansjera*.

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