A NEW ALKALOID FROM *Lysimachia patungensis*

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A new pyridine alkaloid and six known compounds were isolated from the whole plant of Lysimachia patungensis *Hand.-Mazz. The structure of the new alkaloid, named patungensin, was characterized as (17*R, E*)-2-hydroxy-4,6-dimethoxy-17-acetoxy-cyclopentadeca-1, 3-diene[1,2-*b*]pyridine, and the six known compounds were identified as octacosanoic acid (**1**), palmic acid (**2**), stigmasterol (**3**), ardisiacrispin A (**5**), isorhamnetin 3-β-D-galactopyranoside (**6**), and isorhamnetin 3-robinobioside (**7**), respectively.*

Key words: Primulaceae, *Lysimachia patungensis*, patungensin.

Lysimachia patungensis Hand.-Mazz (Primulaceae), a shrub species occurring in China [1], is a substitute for *L. christinae* Hance in treating heptatitis, strangury due to heat, and stranguria due to urinary stone in Zhejiang province [2]. No phytochemical investigation have been carried out to elucidate the chemical differences between *L. patungensis* and *L. christinae* previously. In order to find the chemical differences, we conducted a chemical investigation on *L. patungensis* for the first time. This paper reports the isolation and characterization of one new alkaloid and six other known compounds in *L. patungensis*.

Six known compounds were identified as octacosanoic acid (**1**) [3], palmic acid (**2**) [4], stigmasterol (**3**) [5], ardisiacrispin A (**5**) [6], isorhamnetin 3-*β*-D-galactopyranoside (**6**) [7, 8], and isorhamnetin 3-robinobioside (**7**) [9] by spectroscopic analyses and by comparison of data with those reported.

Patungensin (**4**) was obtained as colorless needles; its molecular formula was found to be $C_{22}H_{33}O_5N$ by HRESIMS. Absorption bands at 1612, 1546, 1496, and 836 cm^{-1} for the four-substituted pyridine ring, 3444 and 3288 cm^{-1} for the hydroxyl group, and 1762 cm^{-1} for the ester carbonyl group in the IR spectrum were observed. The connectivity of proton and carbon atoms was confirmed by the HMQC spectrum. Extensive analysis of the ^1H and ^{13}C NMR spectra indicated the presence of two methoxyl, one hydroxyl, one acetoxyl, and one aliphatic chain structure. The aliphatic chain structure was identified as $-(CH_2)_{10}-$, which was supported by the ion peaks at *m*/*z* 308 and 207 for $[M-CH_3CO]^+$ and $[M-CH_3CO-(CH_2)_{10}-H]^+$, respectively. One terminal of the $-(CH_2)_{10}-$ structure was connected to the methane carbon at δ 79.8, according to the long-rang couplings from H-17 (δ 5.277) to C-2 (δ 168.5), C-4 (δ 166.6), C-17a (δ 155.0), C-4a (δ 106.5), and C-16 (δ 34.5). The gross structure of **4** was deduced according to the long-rang correlations from H-5 (δ 6.383) to C-4 (δ 166.6), C-6 (δ 159.3), C-4a (δ 106.5), and C-3 (δ 97.3); and the proton (δ 6.39) of the hydroxyl group to C-2 (δ 168.5), C-4 (δ 166.5), C-4a (δ 106.5), and C-5 (δ 98.4) (Fig. 1). The *Z*-form configuration of the trisubstituted double bond at C-6 was determined by the correlation between the olefinic methoxyl (δ 3.92) and the olefinic proton (H-5) in the NOESY spectrum, as shown by the double-head arrow in Fig. 1. According to the relationship of the optical rotation and the configuration of the analogous asymmetric center of colchicine [10, 11], the chiral center in **4** was deduced to be the (*R*)-form steric configuration, on the basis of its optical rotation observed as [α] +12.8° (*c* 0.20; MeOH). The structure was identified as (17*R*, *E*)-2-hydroxy-4, 6-dimethoxy-17-acetoxy-cyclopentadeca-1, 3-diene[1, 2-*b*]pyridine and named patungensin.

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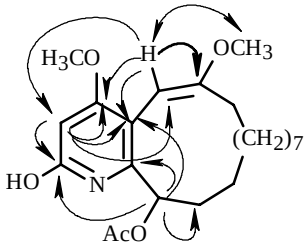

Fig. 1. Selected long-range correlations of compound **4**[a]
a: Single-head arrow represents the long-range correlations in the HMBC spectrum; double-head arrow demonstrates the correlation of ^{1}H and ^{1}H in the NOESY spectrum.

EXPERIMENTAL

General Experimental Procedures. NMR spectra were measured on a Bruker DRX-400 (400 MHz for ^{1}H and 100 MHz for ^{13}C spectra) or a Bruker AVANCE -500 (500 MHz for ^{1}H and 125 MHz for ^{13}C spectra) spectrometer. Chemical shifts are expressed in δ values with reference to TMS as internal standard, and coupling constants (J) are given in Hz. HRESIMS, EI-MS, and ESI-MS were recorded on Bruker Bio TOF-Q, Micromass Platform, and API2000 LC/MS/MS spectrometers, respectively. IR spectra were obtained on an Analect RFX-65A spectrometer. Melting points were determined using a SGW X-4 micromelting point meter. Optical rotations were measured on a WZZ-1S polarimeter. UV absorption spectra were measured on a TU-1900 UV spectrophotometer.

Plant Material. *L. patungensis* were collected from the Wuzhishan Mountains of Guangdong province in July 2003. The voucher specimen (Hao, 385) was deposited at the Herbarium of the South China Botanical Garden, Chinese Academy of Sciences, and authenticated by Prof. Gang Hao, South China Botanical Garden.

Extraction and Isolation. The powder of the whole plant of *L. patungensis* (1.2 kg) was extracted with EtOH–H_2O (95:5, V/V). The concentrated mixture was extracted successively by EtOAc and *n*-butanol, and the EtOAc-soluble part (13 g) was subjected to silica gel column eluting with petroleum ether–acetone gradient solvent. Combination of similar fractions on the basis of TLC analysis afforded 3 fractions. Fraction 1 was chromatographed over silica gel with petroleum ether–acetone (99:1) to give octacosanoic acid (**1**) (83 mg) and palmic acid (**2**) (91 mg). Fraction 2 was chromatographed over silica gel with petroleum ether–acetone (90:10) to afford stigmasterol (**3**) (39 mg), and fraction 3 was chromatographed over silica gel with petroleum ether–acetone (70:30) to afford compound **4** (907 mg). The *n*-butanol-soluble part (9 g) was subjected to Dianon HP-20 resin column eluting with H_2O, 20% MeOH, 50% MeOH, 70% MeOH, 80% MeOH, and MeOH, respectively. The 70% MeOH eluted part was dissolved with MeOH, and the soluble part was subjected to a silica gel column and eluted with $CHCl_3$–MeOH (70:30) to obtain ardisiacrispin A (**5**) (50 mg). The 80% MeOH eluted part was dissolved with MeOH, and the soluble part was subjected to a silica gel column and eluted with $CHCl_3$–MeOH gradient solvent to give fraction 4 and 5. Fraction 4 was chromatographed over silica gel with $CHCl_3$–MeOH (88:12) to give isorhamnetin 3-β-D-galactopyranoside (**6**) (14 mg). Fraction 5 was chromatographed over silica gel with $CHCl_3$–MeOH (85:15) to give isorhamnetin 3-robinobioside (**7**) (20 mg).

Patungensin (4): $C_{22}H_{33}O_5N$, colorless needles (MeOH), mp 111.5–112.5° C (MeOH); UV spectrum (EtOH, λ_{max}, nm): 221, 257, 290 (log ε 4.40, 4.27, 3.85); IR spectrum (KBr, ν, cm^{-1}): 3444, 3288 (OH), 2925, 2852, 2364, 1762 (C=O), 1637, 1612, 1546, 1496 (Ar), 1469; ^{1}HMR (400 Hz, $CDCl_3$, d, ppm, J/Hz): 1.24 (12H, m, H-9~14), 1.46 (4H, m, H-8, 15), 1.67 (1H, m, H-16b), 1.93 (1H, m, H-16a), 1.97 (3H, s, CH_3COO-17), 3.20 (2H, m, H-7), 3.87 (3H, s, CH_3O-4), 3.92 (3H, s, CH_3O-6), 5.27 (1H, m, H-17), 5.67 (1H, s, HO-2), 6.38 (1H, s, H-5), 6.39 (1H, s, H-3); ^{13}C NMR (100 MHz, $CDCl_3$): 168.5 (C-2), 97.3 (C-3), 166.5 (C-4), 106.5(C-4a), 98.4 (C-5), 159.3 (C-6), 39.4 (C-7), 24.3 (C-8), 26.7 (C-9), 29.1 (C-10~15), 34.5 (C-16), 79.8 (C-17), 155.0 (C-17a), 55.8 (CH_3O-4, 6), 170.1 (CH_3COO-17), 23.0 (CH_3COO-17); HRESIMS *m/z*: 414.2254 $[M+Na]^+$ (calcd for $C_{22}H_{33}O_5N_1Na$, 414.2251); Mass spectrum (EI, 70 eV), *m/z* (I_{rel}, %): 391 $[M]^+$ (41), 348 (17), 371 (2.4), 207 (100), 193 (90), 177 (11), 165 (17), 135 (7.3), 86 (24), 77 (30), 72 (41), 55 (42).

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