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# CHEMICAL CONSTITUENTS OF THE LEAVES OF *Cinnamomum insulari-montanum*

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*Cinnamomum insulari-montanum* (Lauraceae) is an endemic tree that grows in Taiwan′s natural hardwood forests at elevations between 400 and 1500 m [1]. In the course of screening for biologically and chemically novel agents from Formosan Lauraceous plants [2–15], *C. insulari-montanum* was chosen for further phytochemical investigation. In this paper, we reinvestigated the constituents of the leaves of *C. insulari-montanum*. The MeOH extract of its stems was subjected to solvent partitioning and chromatographic separation to afford nine pure substances. The chemical constituents of the leaves of *C. insulari-montanum* were separated by column chromatography. A chemical investigation of the leaves of *C. insulari-montanum* afforded nine phytochemicals, including two butanolides, obtusilactone A (**1**) [13] and isoobtusilactone A (**2**) [13]; three lignans, (+)-sesamin (**3**) [12], (+)-diasesamin (**4**) [12], and (+)-episesamin (**5**) [12]; two steroids, *β*-sitostenone (**6**) [16] and *β*-sitosterol (**7**) [17]; two benzenoids, cinnamic acid (**8**) [17] and eugenol (**9**) [17]. All of these compounds were found for the first time from this plant.

The specimen of *C. insulari-montanum* was collected from Pingtung County, Taiwan, February 2006. A voucher specimen (Cinnamo. 3) was identified by Dr. Fu-Yuan Lu (Department of Forestry and Natural Resources College of Agriculture, National Chiayi University) and was deposited in the School of Medical and Heath Science, Fooyin University, Kaohsiung, Taiwan. The leaves (3.0 kg) of *C. insulari-montanum* were extracted repeatedly with MeOH at room temperature for 24–48 hrs. The MeOH extract was dried and evaporated to leave a viscous residue (43.8 g). The residue was placed on a silica gel column and eluted with $CH_2Cl_2$ gradually enriched with MeOH to afford five fractions. Fraction 1 (3.2 g) eluted with *n*-hexane–acetone (30:1) was further purified by silica gel column chromatography using the same solvent system to obtain obtusilactone A (**1**) (8 mg), and isoobtusilactone A (**2**) (17 mg). Fraction 2 (13.3 g) eluted with *n*-hexane–acetone (20:1) was further separated using silica gel column chromatography and purified by preparative TLC (thin layer chromatography) to yield *β*-sitostenone (**6**) (24 mg) and *β*-sitosterol (**7**) (29 mg). Fraction 3 (15.5 g) was purified by silica gel chromatography ($CH_2Cl_2$–MeOH, 15:1) to give (+)-sesamin (**3**) (37 mg), (+)-diasesamin (**4**) (6 mg), and (+)-episesamin (**5**) (2 mg). Fraction 5 (7.3 g), eluted from *n*-hexane–EtOAc (1:2), was further chromatographed on silica gel elution with EtOAc–MeOH (15:1) and recrystallized from acetone to give cinnamic acid (**8**) (3 mg) and eugenol (**9**) (15 mg), respectively.

**Obtusilactone A (1)**, pale yellowish liquid; $[\alpha]_D^{25}$–11.3° (*c* 0.05, $CHCl_3$). UV (MeCN, $\lambda_{max}$, nm) (log ε): 225 (4.11). IR (neat, $\nu_{max}$, $cm^{-1}$): 3400 (br, OH), 1770, 1670 (*α,β*-unsaturated *γ*-lactone), 1465, 1365, 1090. $^1$H NMR (400 MHz, $CDCl_3$, δ, ppm, J/Hz): 0.88 (3H, t, J = 7.2, H-19), 1.25 (20H, br.s, H-9–18), 1.48 (2H, m, H-8), 2.77 (2H, m, H-7), 4.67 (1H, dd, J = 2.8, 1.6, H-5a), 4.89, (1H, dd, J = 2.8, 1.6, H-5b), 5.11 (1H, br.s, H-3), 6.68 (1H, td, J = 7.6, 2.0, H-6).

**Isoobtusilactone A (2)**, pale yellowish liquid; $[\alpha]_D^{25}$ –24.6° (*c* 0.05, $CHCl_3$). UV (MeCN, $\lambda_{max}$, nm) (log ε): 225 (4.12). IR (neat, $\nu_{max}$, $cm^{-1}$): 3450 (br, OH), 1770, 1670 (*α,β*-unsaturated *γ*-lactone), 1465, 1360, 1090. $^1$H NMR (400 MHz, $CDCl_3$, δ, ppm, J/Hz): 0.88 (3H, t, J = 6.8, H-19), 1.25 (20H, br.s, H-9–18), 1.52 (2H, m, H-8), 2.45 (2H, m, H-7), 4.72 (1H, dd, J = 2.8, 1.2, H-5a), 4.94, (1H, dd, J = 2.8, 1.2, H-5b), 5.24 (1H, br.s, H-3), 7.07 (1H, td, J = 7.6, 2.4, H-6).

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**(+)-Sesamin (3)**, colorless needles; $[\alpha]_D^{25}$ +34.4° (*c* 0.45, $CHCl_3$). UV (MeCN, $\lambda_{max}$, nm) (log ε): 205 (4.11), 233 (4.18), 287 (4.11). IR (neat, $\nu_{max}$, $cm^{-1}$): 1040 (methylenedioxy), 950. $^1H$ NMR (400 MHz, $CDCl_3$, δ, ppm, J/Hz): 3.04 (2H, m, H-1, 5), 3.88 (2H, dd, J = 9.2, 3.6, H-4ax, 8ax), 4.23 (2H, dd, J = 9.2, 6.6, H-4eq, 8 eq), 4.72 (2H, d, J = 4.3, H-2, 6), 5.94 (4H, s, $OCH_2O$), 6.78 (2H, d, J = 8.4, H-5′, 5″), 6.80 (2H, dd, J = 8.4, 1.2, H-6′, 6″), 6.85 (2H, d, J = 1.2, H-2′, 2″).

**(+)-Diasesamin (4)**, colorless needles; $[\alpha]_D^{25}$ +104.9° (*c* 0.45, $CHCl_3$). UV (MeCN, $\lambda_{max}$, nm) (log ε): 212 (4.10), 238 (4.15), 285 (4.05). IR (neat, $\nu_{max}$, $cm^{-1}$): 1040 (methylenedioxy), 950. $^1H$ NMR (400 MHz, $CDCl_3$, δ, ppm, J/Hz): 3.21 (2H, m, H-1, 5), 4.01 (2H, dd, J = 9.2, 3.6, H-4ax, 8ax), 4.21 (2H, dd, J = 9.2, 6.8, H-4eq, 8eq), 4.96 (2H, d, J = 5.2, H-2, 6), 5.94 (4H, s, $OCH_2O$), 6.77 (2H, d, J = 8.4, H-5′, 5″), 6.80 (2H, dd, J = 8.4, 1.2, H-6′, 6″), 6.91 (2H, d, J = 1.2, H-2′, 2″).

**(+)-Episesamin (5)**, colorless needles; $[\alpha]_D^{25}$ +77.8° (*c* 0.45, $CHCl_3$). UV (MeCN, $\lambda_{max}$, nm) (log ε): 211 (4.14), 236 (4.16), 285 (4.10). IR (neat, $\nu_{max}$, $cm^{-1}$): 1040 (methylenedioxy), 950. $^1H$ NMR (400 MHz, $CDCl_3$, δ, ppm, J/Hz): 2.88 (1H, m, H-1), 3.25 (1H, m, H-5), 3.38 (1H, m, H-4ax), 3.85 (1H, m, H-8ax), 3.86 (1H, m, H-4eq), 4.12 (1H, m, H-8eq), 4.41 (1H, d, J = 6.8, H-6), 4.84 (1H, d, J = 5.2, H-2), 5.92 (2H, s, $OCH_2O$), 5.94 (2H, s, $OCH_2O$), 6.76 (1H, d, J = 8.4, H-5″), 6.78 (1H, d, J = 8.4, H-5′), 6.79 (1H, dd, J = 8.4, 1.2, H-6′), 6.80 (2H, dd, J = 8.4, 1.2, H-6″), 6.85 (1H, d, J = 1.2, H-2′), 6.87 (1H, d, J = 1.2, H-2″).

***β*-Sitostenone (6)**, white needles ($CH_2Cl_2$), mp 85–86°C. IR ($\nu_{max}$, $cm^{-1}$): 1675, 1620, 1450, 1375. $^1H$ NMR (400 MHz, $CDCl_3$, δ, ppm, J/Hz): 0.68 (3H, s, H-18), 0.81 (3H, d, J = 6.7, H-26), 0.84 (3H, s, H-27), 0.86 (3H, d, J = 7.0, H-29), 0.94 (3H, d, J = 6.0, H-21), 1.02 (3H, s, H-19), 5.72 (1H, d, J = 1.4, H-3).

***β*-Sitosterol (7)**, white needles (MeOH), mp 138–140°C [16].

**Cinnamic acid (8)**, yellowish needles ($CH_2Cl_2$), mp 208–210°C. UV (MeCN, $\lambda_{max}$, nm): 260, 315. IR (neat, $\nu_{max}$, $cm^{-1}$): 1700, 1680, 1650, 980, 770. $^1H$ NMR (400 MHz, $CDCl_3$, δ, ppm, J/Hz): 6.63 (1H, d, J = 16.0, H-2), 7.38 (3H, m, H-6, 7, 8), 7.56 (1H, d, J = 16.0, H-3), 7.58 (2H, m, H-5, 9).

**Eugenol (9)**, colorless oil. UV (MeCN, $\lambda_{max}$, nm): 230, 285. IR (neat, $\nu_{max}$, $cm^{-1}$): 3500 (OH), 1630, 1500, 1430. $^1H$ NMR (400 MHz, $CDCl_3$, δ, ppm, J/Hz): 3.38 (2H, d, J = 6.8, H-1′), 3.89 (3H, s, $OCH_3$), 5.13 (2H, m, H-3′), 5.88 (1H, s, OH), 6.03 (1H, m, H-2′), 6.75 (1H, dd, J = 8.8, 2.0, H-5), 6.76 (1H, d, J = 2.0, H-3), 6.93 (1H, d, J = 8.8, H-6).

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