Isolation of Phenolics, Nucleosides, Saccharides and an Alkaloid from the root of *Aralia cordata*

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Abstract — Fourteen compounds were isolated from the n-BuOH fraction of the roots of *Aralia cordata* (syn. − *A. continentalis*). Through spectroscopic method, the chemical structures were elucidated as: caffeic acid (1), protocatechuic acid (2), thymidine (3), uridine (4), methyl-α-D-fructofuranoside (5), a mixture (3 : 1) of β-D-fructopyranoside and β-D-fructofuranoside (6), 1-methyl 1,2,3,4-tetrahydro-β-carboline-3-carboxylic acid (7), methyl-β-D-fructofuranoside (8), sucrose (9), 5-cafeoylquinic acid (chlorogenic acid) (10), 3-cafeoylquinic acid (neochlorogenic acid) (11), 4-cafeoylquinic acid (cryptochlorogenic acid) (12), 3,5-di-O-cafeoylquinic acid (13) and 1-kestose [β-D-fructofuranosyl-(2 → 1)]β-D-fructofuranosyl-(2 → 1)-α-D-glucopyranoside] (14). Among them, compounds 5, 7, 8, and 10–14 were isolated from this plant for the first time.

Keywords — *Aralia cordata*; Araliaceae; Phenolic acid; Nucleoside; Alkaloid; Saccharide

Introduction

*Aralia cordata* (Araliaceae), known as ‘Dokwhal’ in Korea, has been widely used in traditional Chinese medicine for analgesia and neuralgia, and as a cure for arthralgia, rheumatism, lumbago, and lameness (Perry, 1980). In previous phytochemical investigations, various diterpenes, flavonoids, saponins, and essential oils were isolated from the roots and leaves of this plant (Kang, 1997; Jung et al., 2009). In biological studies, a few essential oils, phenolic acid, and diterpenoid isolated from the roots have shown to have antioxidant (Kim et al., 1995; 1998), anti-inflammatory (Han et al., 1983a; 1983b, 1985; Park et al., 2005), analgesic (Okuyama et al., 1991), sedative (Wang et al., 1988), antiinflammatory (Jeong et al., 2006), anti-thrombotic (Han et al., 1986), anti-cancer (Kwon et al., 2008), and anti-Alzheimer activities (Jung et al., 2009).

However, limited studies on the polar fractions of this plant have been performed. Therefore, this works deals with the isolation and characterization of fourteen known compounds, including six phenolic acids (1, 2, 10–13), two nucleosides (3, 4), one alkaloid (7), and five saccharides (5, 6, 8, 9, 14) from the n-BuOH fraction of

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spray reagent.

**Plant material** – The root of *A. cordata* was purchased from Omni Herb Co. (Daeju, Korea), and authenticated by Prof. J. H. Lee (Dongguk University, Gyeongju, Korea). A voucher specimen (no. 20080320) was deposited in the laboratory of Prof. J. S. Choi (Pukyong National University, Busan, Korea).

**Extraction, fractionation, and isolation** – The roots of *A. cordata* (12 kg) were refluxed with MeOH for 3 hr, and the filtrates were concentrated to dryness in vacuo at 40°C to render the MeOH extract. The MeOH extract was suspended in distilled H2O and partitioned with n-hexane, CHCl3, EtOAc, n-BuOH and H2O in sequence, thus yielding five fractions. The n-BuOH fraction (160 g) obtained from the roots of *A. cordata* was then chromatographed over a silica gel column using CH2Cl2-MeOH (gradient), and generated 15 subfractions (Fr. 1 to 15). Fraction 3 (9.60 g) was chromatographed on a silica gel column using CH2Cl2-MeOH-H2O (15:1:0.1) to yield four subfractions (Fr. 3-1 to 3-4). Fraction 7-2 (2.55 g) was chromatographed on a Sephadex LH-20 and RP-18 gel column with H2O-MeOH (gradient) to obtain 1 (cafféic acid, 10 mg), 2 (protocatechuic acid, 200 mg), 3 (thymidine, 20 mg), 4 (uridine, 20 mg), and 5 (methyl-α-D-fructofuranoside, 210 mg), respectively. Fraction 7-2 (1.50 g) was subjected to column chromatography on a MCI gel using CH2Cl2-MeOH-H2O (10:1:0.1, gradient to MeOH), generating 15 subfractions (Fr. 7-2-1 to 7-2-15). Fraction 7-2-1 (8.49 g) was recrystallized using MeOH to yield 6 (1-Methyl 1,2,3,4-tetrahydro-β-carboline-3-carboxylic acid, 10 mg). Fraction 8 (24.6 g) was chromatographed on a MCI gel eluted with 40% MeOH to obtain 8 (methyl β-D-fructofuranoside, 30 mg). Fractions 12 and 13 (14.8 g) subjected to column chromatography on a silica gel column, with gradient elution using a CH3Cl2-MeOH-H2O (10:1:0.1, gradient to MeOH), generating 7 (1-methyl-1,2,3,4-tetrahydro-β-carboline-3-carboxylic acid, 6.5 mg). Fraction 9 (24.6 g) was chromatographed on a MCI gel eluted with 40% MeOH to obtain 9 (methyl β-D-fructofuranoside, 30 mg). Fractions 12 and 13 (14.8 g) subjected to column chromatography on a MCI gel column, using H2O as the eluent, to generate 10 (sucrose, 100 mg), 11 (3,5-di-O-cafëoylquinic acid, 10 mg), and 12 (l-kestose, 260 mg). Fractions 12 and 13 were consecutively purified, using a HPLC [column: symmetry C18 (4.6 × 250 mm, 5 μm, USA); flow rate: 1 ml/min; detector: UV (327 nm)], eluted with 0.1% phosphoric acid-CH3CN (89:11) to afford 10 (chlorogenic acid, 500 mg, tR 9.842 min), 11 (neochlorogenic acid, 10 mg, tR 6.092 min), and 12 (cryptochlorogenic acid, 10 mg, tR 11.177 min). The structures of compounds 5, 7, 8, and 10 - 14 are shown in Fig. 1.