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Isolation and Identification of Phytochemical Constituents from *Taraxacum coreanum*

Sullim Lee, Saem Han, Hye Min Kim, Jeong Min Lee, So-Youn Mok, and Sanghyun Lee*

Department of Applied Plant Science, Chung-Ang University, Anseong 456-756, Republic of Korea

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Phytochemical constituents were isolated from the aerial parts of *Taraxacum coreanum* (Asteraceae) by repeated column chromatography and prep-HPLC. Their structures were identified as β-sitosterol (1), daucosterol (2), taraxasteryl acetate (3), chrysoeriol (4), diosmetin (5), luteolin (6), luteolin-7-*O*-glucoside (7), esculetin (8), and 5-hydroxypyrrolidin-2-one (9) by the interpretation of spectroscopic analyses including MS, ^{1}H-, and ^{13}C-NMR. This is the first report on the isolation of compounds 1-9 from *T. coreanum*. Among the compounds, 5 and 9 were isolated for the first time from *Taraxacum*.

Key words: *Taraxacum coreanum*, constituent, diosmetin, 5-hydroxypyrrolidin-2-one

The genus *Taraxacum* (dandelions; Asteraceae) is widely distributed in warm temperate zones of the northern hemisphere, inhabiting fields, roadsides, and rural sites. *Taraxacum* includes 30 to 57 varieties with many microspecies, divided into nine sections. *Taraxacum* is made up of perennial herbs that produce stout taproots, which reach length of 15-100 cm. The roots are capable of producing new plants, even when the plant is cut at or below the soil surface. The large, green leaves (5-40 cm long) are clustered in a rosette pattern and are deeply serrated [Kirchner, 1955; Faber, 1958]. The fruits are conical achenes, brown and crowned by a hairy pappus, which allows the seeds to be distributed by the wind [Hiermann, 1992; Hock, 1994]. Plants of *Taraxacum* have long been used as medicinal herbs. The name is derived from the Greek words "taraxis", for inflammation, and "akeomai", for curative. In English, the common name "dandelion" is derived from the French word "dent-de-lion", referring to the serrated leaves of the plant.

Pogongyoung (Korean name for dandelion), an aspect of Traditional Chinese Medicine, is sometimes used in combination with other medicinal plants to treat hepatitis, to enhance the immune response to upper respiratory tract infections such as bronchitis or pneumonia, and as a compress for its anti-mastopathy activity [Leu *et al*., 2005; Sweeney *et al*., 2005]. Although dandelion is a well-known traditional herbal remedy with a long history, until recently, only limited scientific information was available to justify its reputed uses [Gurib-Fakim, 2006]. In previous studies, phytochemical constituents isolated from *T. officinale* included various sesquiterpenes such as eudesmanolides [Hänsel *et al*., 1980], guaianolides, and germacranolide esters [Kisiel and Barszcz, 2000]. Sesquiterpene lactones were isolated from several *Taraxacum* species [Ho *et al*., 1998; Michalska and Kisiel, 2003; Kisiel and Michalska, 2006]. Furthermore, the presence of various triterpenes and phytosterols in *T. officinale* was demonstrated [Hänsel *et al*., 1980; Akashi *et al*., 1994]. Recent reports showed the presence of such flavonoids as well as flavonoid glycosides in *T. officinale* [Wolbis *et al*., 1993; Williams *et al*., 1996].

According to Lee and Lee [2008], extracts of *T. coreanum,* a plant native to Korea, exhibited higher content of phenolic compounds and antioxidant activity than *T. officinale.* This finding provides a logical basis for the use of information for *T. coreanum* in the areas of functional foods and nutraceuticals. However, the chemical constituents of *T. coreanum* have not been investigated. Our paper describes a procedure for the isolation of phytochemical constituents from *T. coreanum* by repeated column chromatography and prep-HPLC, and structure determination by spectral analyses. This is the first report on the isolation of phytochemical constituents from *T. coreanum*.

Materials and Methods

Plant materials. The aerial parts of *T. coreanum* were

*Corresponding author
Phone: +82-31-670-4688; Fax: +82-31-676-4686
E-mail: slee@cau.ac.kr

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collected in 2007 near the Westcoast Express Highway, Korea and authenticated by Prof. Young-Hee Ahn, Chung-Ang University, Korea. A voucher specimen (No. LEE 2007-01) was deposited at the Herbarium of Department of Applied Plant Science, Chung-Ang University, Korea.

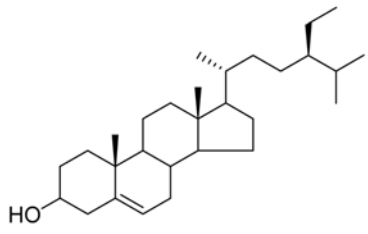
General instruments. EI-MS was measured with a JEOL JMS-600W (Yamagata, Japan) mass spectrometer and FAB-MS was measured with a JEOL JMS-AX505WA mass spectrometer. ^{1}H- and ^{13}C-NMR spectra were recorded with a Bruker AVANCE 300 NMR (Rheinstetten, Germany) spectrometer using TMS as an internal standard. Chemical shifts were reported in parts per million (δ), and coupling constants (*J*) were expressed in hertz. Evaporation was conducted by an EYELA rotary evaporator system (Tokyo, Japan) under reflux *in vacuo*. Thin layer chromatography (TLC) was conducted with Kiesel gel 60 F_{254} (Art. 5715, Merck Co., Darmstadt, Germany) plates (silica gel, 0.25 mm layer thickness). Recycling preparative high performance liquid chromatography (HPLC) was conducted by a JAI LC-9014 system, and determination was performed by an L-6050 system pump with a UV-3702 system UV/VIS detector. The auto collector was measured with an FC-339 fraction collector.

Extraction and isolation. Dried and finely powdered aerial parts of *T. coreanum* (1970.2 g) were extracted with MeOH for 3 h (4 L×8) under reflux at 65-75, and the solvent was evaporated *in vacuo* to isolate the MeOH extract (692.8 g), which was suspended in distilled water and successively partitioned with *n*-hexane (98.8 g), $CHCl_3$ (11.8 g), EtOAc (23.2 g), and *n*-BuOH (25.2 g). Among them, the *n*-hexane fraction (5.8 g) was subjected to a silica gel column chromatography (6×80 cm, No. 7734), with a gradient of *n*-hexane–EtOAc (100% *n*-hexane up to 100% EtOAc) and EtOAc–MeOH (EtOAc–MeOH mixture of increasing polarity), to yield 15 subfractions (subfrs). Of these, subfr 2 (*n*-hexane:EtOAc=99:1) and subfr 7 (60% EtOAC in *n*-hexane) yielded compounds **1** and **2**, respectively. Subfr 1 was separated by recycling preparative HPLC. Recycle processing was repeated three times, and subsequently the last peaks were classified into five sections: A-E, among which E was recrystallized to afford compound **3**. A portion of the $CHCl_3$ fraction (6.0 g) was subjected to a silica gel column chromatography (6×80 cm, No. 7734), with a gradient of *n*-hexane–EtOAc (100% *n*-hexane up to 100% EtOAc) and $CHCl_3$–MeOH ($CHCl_3$–MeOH mixture of increasing polarity) to yield 22 subfrs. Of these, subfr 9 (*n*-hexane:EtOAc=7:3) yielded compound **4**. A portion of the EtOAc fraction (7.0 g) was subjected to a silica gel column chromatography (6×80 cm, No. 7734), with a gradient of *n*-hexane–EtOAc (100% *n*-hexane up to 100% EtOAc) and EtOAc–MeOH (EtOAc–MeOH mixture of increasing polarity) to yield 16 subfrs. Subfrs 6, 7, and 12 (20, 30, and 100% EtOAC in *n*-hexane, respectively) yielded compounds **5**, **6**, and **7**, respectively. A portion of the EtOAc subfr 7 (2.3 g) was to a silica gel column chromatography (3×50 cm, No. 7734), with a gradient of $CHCl_3$–MeOH (100% $CHCl_3$ up to 100% MeOH) to yield 14 subfrs. Of these, subfr. 7 ($CHCl_3$: MeOH=20:1) yielded compound **8**. A portion of the *n*-BuOH fraction (5.7 g) was subjected to a silica gel column chromatography (6×80 cm, No. 7734), with a gradient of $CHCl_3$–MeOH (100% $CHCl_3$ up to 100% MeOH) to yield 12 subfrs. Subfr 2 (1% MeOH in $CHCl_3$) yielded compound **9**.

Compound **1**: White crystals; electron ionization mass spectrometry (EI-MS) (rel. int., %): *m/z* 414 $[M]^+$ (100), 396 (49.9), 381 (24.3), 329 (28.0), 303 (32.3), 273 (32.7), 255 (69.3), 213 (37.9), 159 (42.9), 145 (45.1); ^{1}H-NMR (300 MHz, $CDCl_3$): δ 3.53 (m, 3-H), 5.35 (d, *J*=4.8 Hz, 6-H), 0.70 (s, 18-H), 1.00 (s, 19-H), 0.92 (d, *J*=6.3 Hz, 21-H), 0.85 (d, *J*=6.3 Hz, 26-H), 0.88 (d, *J*=6.3 Hz, 27-H), 0.79 (t, *J*=6.0 Hz, 29-H); ^{13}C-NMR (75 MHz, $CDCl_3$): δ 37.4 (C-1), 29.8 (C-2), 72.0 (C-3), 39.9 (C-4), 141.1 (C-5), 122.2 (C-6), 32.0 (C-7), 31.8 (C-8), 50.3 (C-9), 36.6 (C-10), 21.2(C-11), 40.7 (C-12), 42.4 (C-13), 56.9 (C-14), 24.4 (C-15), 28.4 (C-16), 56.2 (C-17), 11.9 (C-18), 19.1 (C-19), 36.3 (C-20), 18.9 (C-21), 34.1 (C-22), 26.2 (C-23), 46.0 (C-24), 29.3 (C-25), 19.9 (C-26), 19.5 (C-27), 23.2 (C-28), 12.1 (C-29)

Compound **2**: White powder; fast atom bombardment mass spectrometry (FAB-MS): *m/z* 577 $[M+H]^+$; ^{1}H-NMR (300 MHz, $CDCl_3$): δ 3.59 (m, 3-H), 5.26 (d, *J*=4.8 Hz, 6-H), 0.66 (s, 18-H), 0.99 (s, 19-H), 1.00 (d, *J*=5.6 Hz, 21-H), 0.86 (d, *J*=7.1 Hz, 26-H), 0.84 (s, 27-H), 0.91 (t, *J*=8.0 Hz, 29-H), 4.22 (d, *J*=7.8 Hz, H-1'); ^{13}C-NMR (75 MHz, $CDCl_3$): δ 36.8 (C-1), 29.3 (C-2), 78.7 (C-3), 38.3 (C-4), 140.4 (C-5), 121.2 (C-6), 31.4 (C-7), 31.3 (C-8), 49.6 (C-9), 36.2 (C-10), 20.6 (C-11), 40.1 (C-12), 41.8 (C-13), 56.2 (C-14), 23.9 (C-15), 27.8 (C-16), 55.1 (C-17), 11.7 (C-18), 19.1 (C-19), 35.5 (C-20), 18.6 (C-21), 33.3 (C-22), 25.4 (C-23), 45.1 (C-24), 28.7 (C-25), 18.9 (C-26), 19.7 (C-27), 22.6 (C-28), 11.8 (C-29), 100.8 (C-1'), 73.5 (C-2'), 76.9 (C-3'), 70.1 (C-4'), 76.7 (C-5'), 61.1 (C-6')

Compound **3**: White powder; EI-MS (rel. int., %): *m/z* 468 $[M]^+$ (81.5), 408 (29.9), 393 (15.1), 249 (24.8), 218 (79.9), 203 (30.5), 189 (100), 175 (17.8), 135 (28.8), 121 (30.6), 95 (27.6), 81 (17.2); ^{1}H-NMR (300 MHz, $CDCl_3$): δ 1.02 (1a-H), 1.75 (1b-H), 1.67 (2-H), 4.48 (3-H), 1.39 (6a-H), 1.56 (6b-H), 1.36 (7-H), 1.30 (9-H), 1.17 (11a-H), 1.56 (11b-H), 1.17 (12a-H), 1.67 (12b-H), 1.61 (13-H), 0.95 (15a-H), 1.69 (15b-H), 1.17 (16a-H), 1.25 (16b-H), 0.97 (18-H), 2.05 (19-H), 2.23 (21a-H), 2.40 (21b-H),



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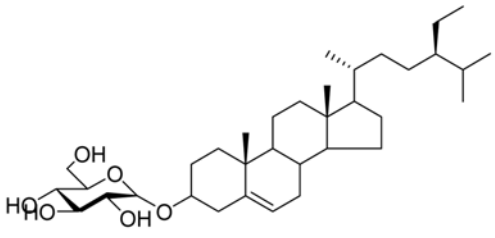

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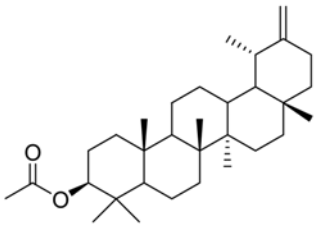

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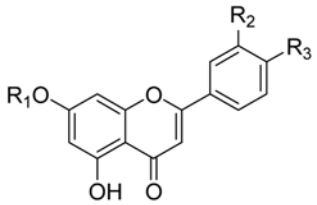
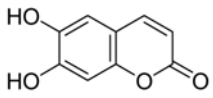


4: $R_1 = H$ $R_2 = OMe$ $R_3 = OH$

5: $R_1 = H$ $R_2 = OH$ $R_3 = OMe$

6: $R_1 = H$ $R_2 = OH$ $R_3 = OH$

7: $R_1 = Glc$ $R_2 = OH$ $R_3 = OH$



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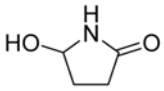

9

Fig. 1. Structures of compounds 1-9.

1.36 (22a-H), 1.42 (22b-H), 0.88 (23-H), 0.84 (24-H), 0.87 (25-H), 1.09 (26-H), 0.94 (27-H), 0.85 (28-H), 1.02 (29-H), 4.51 (30-H), 2.05 ($COOCH_3$); ^{13}C-NMR (75 MHz, $CDCl_3$): δ 38.4 (C-1), 23.7 (C-2), 80.7 (C-3), 37.8 (C-4), 55.3 (C-5), 18.2 (C-6), 33.8 (C-7), 40.7 (C-8), 50.2 (C-9), 37.8 (C-10), 21.3 (C-11), 23.7 (C-12), 38.1 (C-13), 41.8 (C-14), 26.5 (C-15), 39.2 (C-16), 34.3 (C-17), 48.5 (C-18), 38.2 (C-19), 154.2 (C-20), 25.3 (C-21), 39.0 (C-22), 27.7 (C-23), 16.1 (C-24), 15.7 (C-25), 16.1 (C-26), 14.5 (C-27), 25.0 (C-28), 18.2 (C-29), 110.2 (C-30), 201.5 ($\underline{C}OOCH_3$), 55.1 ($COO\underline{C}H_3$)

Compound **4**: Yellow powder; EI-MS (rel. int., %): *m/z* 300 $[M]^+$ (100), 257 (4.9), 229 (4.2), 153 (9.5), 136 (5.0), 115 (3.8), 69 (2.3); ^{1}H- and ^{13}C-NMR (300 MHz, DMSO-d_6): see Table 1.

Compound **5**: Yellow powder; EI-MS (rel. int., %): *m/z* 300 $[M]^+$ (100), 270 (8.5), 257 (9.0), 229 (5.0), 153 (12.0), 136 (5.6), 115 (4.4), 69 (2.0); ^{1}H- and ^{13}C-NMR (300 MHz, DMSO-d_6): see Table 1.

Compound **6**: Yellow powder; EI-MS (rel. int., %): *m/z* 286 $[M]^+$ (100), 258 (12.2), 229 (4.1), 153 (18.5), 129 (9.4); ^{1}H- and ^{13}C-NMR (300 MHz, DMSO-d_6): see Table 1.

Compound **7**: Yellow powder; EI-MS (rel. int., %): *m/z* 286 $[M\text{-Glc}]^+$; ^{1}H- and ^{13}C-NMR (300 MHz, DMSO-d_6): see Table 1.

Compound **8**: Yellow crystals; EI-MS (rel. int., %): *m/z* 179 $[M+H]^+$ (100), 178 (8.5), 163 (10.6), 115 (27.1), 93 (73.4), 75 (27.4), 57 (20.3), 45 (16.2); ^{1}H- NMR (300 MHz, DMSO-d_6): δ 6.16 (d, *J*=9.4 Hz, 3-H), 7.86 (d, *J*= 9.4 Hz, 4-H), 6.97 (s, 5-H), 6.73 (s, 8-H); ^{13}C-NMR (75 MHz, DMSO-d_6): δ 160.8 (C-2), 110.8 (C-3), 144.1 (C-4), 112.3 (C-5), 142.9 (C-6), 150.4 (C-7), 102.5 (C-8), 111.3 (C-9), 148.5 (C-10)

Table 1. ^{1}H- and ^{13}C-NMR spectral data of compounds 4-7 in DMSO-d_6

No.	4		5		6		7	
	δ_H	δ_C	δ_H	δ_C	δ_H	δ_C	δ_H	δ_C
2	-	164.7	-	164.1	-	163.9	-	164.5
3	6.89 s	103.9	6.89 s	103.7	6.67 s	102.9	6.76 s	103.2
4	-	184.2	-	182.2	-	181.6	-	181.9
5	-	161.7	-	161.9	-	161.4	-	161.2
6	6.17 d (2.0)	99.1	6.19 d (1.9)	99.3	6.18 d (2.0)	98.8	6.48 d (2.1)	99.6
7	-	164.7	-	164.6	-	164.1	-	163.0
8	6.49 d (2.0)	94.4	6.50 d (1.9)	94.5	6.37 d (2.0)	93.8	6.79 d (2.1)	94.8
9	-	157.3	-	157.8	-	157.3	-	157.0
10	-	103.4	-	103.6	-	103.7	-	105.4
1'	-	121.7	-	120.0	-	119.0	-	121.4
2'	7.54 d (2.0)	110.4	7.55 d (2.0)	110.7	7.39 d (1.7)	113.4	7.42 d (2.4)	113.6
3'	-	151.0	-	151.2	-	145.7	-	145.8
4'	-	148.3	-	148.5	-	149.7	-	150.0
5'	6.92 d (9.0)	116.0	6.93 d (9.0)	112.6	6.88 d (8.5)	116.0	6.91 d (8.4)	116.0
6'	7.56 dd (2.0, 9.0)	120.1	7.57 dd (2.0, 9.0)	119.0	7.40 dd (1.7, 8.5)	121.5	7.44 dd (2.4, 8.4)	121.4
5-OH	12.96 s	-	12.97 s	-	12.98 s	-	12.98 s	-
OCH_3	3.87 s	56.2	3.89 s	56.7	-	-	-	-
G-1							5.08 d (7.2)	99.9
G-2							-	73.1
G-3							-	77.2
G-4							-	69.6
G-5							-	76.4
G-6							-	60.6

Compound **9**: Colorless crystals; EI-MS (rel. int., %): *m/z* 101 $[M]^+$ (22.1), 84 (100); ^{1}H-NMR (300 MHz, DMSO-d_6): δ 8.59 (br s, NH), 2.23 (m, 3_{ax} and $_{eq}$-H), 2.03 (m, 4_{ax}-H), 1.81 (s, 4_{eq}-H), 5.04 (d, *J*=9.4 Hz, 5-H); ^{13}C-NMR (75 MHz, DMSO-d_6): δ 177.4 (C-2), 27.9 (C-3), 28.1 (C-4), 82.6 (C-5)

Results and Discussion

Chromatographic separation of the MeOH extract of *T. coreanum* led to the isolation of compounds **1-9** by repeated column chromatography and prep-HPLC.

Compounds **1** and **2** were obtained as white crystals. Compound **1** showed a molecular ion peak at *m/z* 414 $[M]^+$ in the EI-MS, which corresponds to a molecular formula of $C_{29}H_{50}O$. Compound **2** showed a quasimolecular ion peak at *m/z* 577 $[M+H]^+$ in the FAB-MS, corresponding to the molecular formula $C_{35}H_{60}O_6$. In the ^{1}H-NMR spectra of **1** and **2**, typical phytosterol signals were observed, as well as two angular methyl singlet signals of the 18- and 19-position methyl groups, and the doublet of the 21-, 26-, and 27-position methyl groups were observed on both sides. The broad doublet at δ 5.26-5.35 showed an olefinic proton (H-6). In the ^{1}H-NMR spectrum of **2**, the signals at δ 3.00-5.00 indicated glycoside. The ^{13}C-NMR spectrum of **1** exhibited 27 resonances, whereas the aglycon of **2** by acid hydrolysis was **1**. Due to the change in chemical shift at C-3 of **2** from δ 72.0 to 78.7, and the anomeric proton of glucose at δ 4.22 (d, *J*=7.8 Hz), the glucose position of **2** was at C-3 (β-linkage) of the aglycon. Accordingly, the structures of **1** and **2** were elucidated as β-sitosterol (stigmast-5-en-3-ol) and daucosterol (β-sitosterol-3-*O*-glucoside), respectively, by the interpretation of spectroscopic analysis including MS, ^{1}H-, and ^{13}C-NMR [Rubinstein *et al*., 1976; Chang *et al*., 1981; Xiong *et al*., 1992].

Compound **3** showed a molecular ion peak at *m/z* 468 $[M]^+$ in the EI-MS, corresponding to the molecular formula of $C_{32}H_{52}O_2$. In the ^{1}H-NMR spectrum of **3**, typical triterpene signals were observed, and the presence of methyl signals was shown at δ 0.84, 0.85, 0.87, 0.88, 0.94, 1.02, and 1.09. Additionally, a signal at δ 2.05 (1H, s) indicated the acetyl group in the structure. The ^{13}C-NMR spectrum of **3** showed 32 resonances. Accordingly, the structure of **3** was elucidated as taraxasteryl acetate by the interpretation of spectroscopic analyses including MS, ^{1}H-, and ^{13}C-NMR [Chow and Quon, 1970; Domínguez *et al*., 1973].

Compounds **4-7** were obtained as yellow powders. In the ^{1}H-NMR spectra, typical flavonoid signals were observed. They showed the presence of two singlet signals at δ 6.67-6.89 (s, H-3) and 12.96-12.98 (s, 5-OH), and two signals at δ 6.17-6.48 (1H, d, *J*=1.9-2.1 Hz, H-6) and 6.37-6.79 (1H, d, *J*=1.9-2.1 Hz, H-8) indicated the methine signals. Furthermore, the proton resonances at δ 6.88-6.93 (1H, d, *J*=8.4-9.0 Hz, H-5'), 7.39-7.55 (1H, d, *J*=1.7-2.4 Hz, H-2'), and 7.40-7.57 (1H, dd, *J*=1.7-2.4, 8.4-9.0 Hz, H-6') were aromatic protons, suggesting the ABX splitting signals of the skeleton in the B-ring structure. Compounds **4** and **5** exhibited the methoxy signals at δ 3.87 and 3.89 in the ^{1}H-NMR spectra, respectively, as revealed by heteronuclear multiple bond correlation analysis. The ^{13}C-NMR spectra of **4** and **5** showed 16 carbon resonances including five aromatic, six methines, and ten quaternary carbons (including four oxygenated aromatic carbons, one carboxyl group, and one methoxy group). The carbonyl carbon signals of the C-ring in **4** and **5** were observed at δ 184.2 and 182.2, respectively, whereas the methoxy signals were observed at δ 56.2 and 56.7 in **4** and **5**, respectively. Compounds **4** and **5** showed a molecular ion peak at *m/z* 300 $[M]^+$ in the EI-MS, corresponding to a molecular formula of $C_{16}H_{12}O_6$. Accordingly, **4** and **5** were identified as chrysoeriol (4',5,7-trihydroxy-3'-methoxyflavone) and diosmetin (3',5,7-trihydroxy-4'-methoxyflavone), respectively, by the interpretation of spectroscopic analysis including MS, ^{1}H-, and ^{13}C-NMR [Ockendon *et al*., 1966; Subramanian and Nair, 1972; Williams *et al.*, 1976; Hartwig *et al.*, 1990]. Compounds **6** and **7** had similar structural signals. Compound **7** was analogous to the signals of **6**; however, one signal was different by virtue of glucoside. In the ^{1}H-NMR spectrum of **7**, due to the anomeric proton of glucose shown at δ 5.08 (d, *J*=7.2 Hz), the glucose position was at C-7 (β-linkage) of the aglycon. In addition, the ^{13}C-NMR spectrum of **7** was analogous to the signals of **6**; however, six carbon signals were different due to a glucosyl residue. The EI-MS spectrum of **6** showed a molecular ion peak at *m/z* 286, corresponding to the molecular formula of $C_{15}H_{10}O_6$. Accordingly, **6** and **7** were identified as luteolin (5,7,3',4'-tetrahydroxyflavone) and luteolin-7-*O*-glucoside (5,7,3',4'-tetrahydroxyflavone-7-*O*-glucoside), respectively, by the interpretation of spectroscopic analysis including MS, ^{1}H-, and ^{13}C-NMR [Hartwig *et al.*, 1990; Wolbis *et al.*, 1993; Jung *et al.*, 2004].

Compound **8** showed a molecular ion peak at *m/z* 179 $[M+H]^+$ in the EI-MS, corresponding to the molecular formula of $C_9H_6O_4$. In the ^{1}H-NMR spectrum of **8**, typical coumarin signals were observed with the presence of two singlet signals at δ 6.97 (s, H-5) and 6.73 (s, H-8). Additionally, the proton resonances at δ 6.16 (1H, d, *J*= 9.4 Hz, H-3) and 7.86 (1H, d, *J*=9.4 Hz, H-4) were aromatic protons. The ^{13}C-NMR spectrum showed 9 carbon resonances including four aromatic methines and five quaternary carbons (including two oxygenated aromatic carbons and one carboxyl group). Furthermore, one of the characteristic carbonyl carbon signals was observed at δ 160.8. Accordingly, **8** was elucidated as esculetin (6,7-dihydroxycoumarin) by the interpretation of spectroscopic analyses including MS, ^{1}H-, and ^{13}C-NMR [Cussans and Huckerby, 1975; Razdan *et al*., 1987].

Compound **9** showed a molecular ion peak at *m/z* 101 $[M]^+$ in the EI-MS, corresponding to the molecular formula of $C_4H_7NO_2$. In the ^{1}H-NMR spectrum of **9**, an amide (NH) broad singlet at δ 8.59 and a methine doublet at δ 5.04 were observed. A methylene at δ 2.03 (2H, m, H-3_{ax}, and 3_{eq}), and other methylenes at δ 2.03 (1H, m, H-4_{ax}) and δ 1.81 (1H, m, 4_{eq}) were observed. The ^{13}C-NMR spectrum showed four carbon resonances including one methane, two methylenes, and one quaternary carbon. The quaternary carbon at δ 177.4, attributed to an amide carbonyl carbon, and a methyl carbon at δ 82.6, assigned to a hemiaminoacetal carbon, were recognized. Accordingly, **9** was elucidated as 5-hydroxypyrrolidin-2-one by the interpretation of spectroscopic analyses including MS, ^{1}H-, and ^{13}C-NMR [Staubmann *et al*., 1999; Zhang *et al*., 2007].

There are many reports on the phytochemical constituents and biological activities of *Taraxacum* species [Hänsel *et al*., 1980; Wolbis *et al*., 1993; Williams *et al*., 1996; Ho *et al*., 1998; Kisiel and Barszcz, 2000; Michalska and Kisiel, 2003; Leu *et al*., 2005; Sweeney *et al*., 2005; Kisiel and Michalska, 2006]. However, there were no previous reports describing the isolation of phytochemical constituents from *T. coreanum*. To the best of our knowledge, this is the first report on the isolation of compounds **1-9** from *T. coreanum*. The structures were identified as β-sitosterol (**1**), daucosterol (**2**), taraxasteryl acetate (**3**), chrysoeriol (**4**), diosmetin (**5**), luteolin (**6**), luteolin-7-*O*-glucoside (**7**), esculetin (**8**), and 5-hydroxypyrrolidin-2-one (**9**).

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