Pergamon

PII: S0031-9422(96)00661-9

Phytochemistry, Vol. 44, No. 5, pp. 931–933, 1997

0031-9422/97 $17.00+0.00

A DAMMARANE GLYCOSIDE FROM KOREAN RED GINSENG

JAE-HA RYU,* JAE-HYUN PARK, JIN-HEE EUN, JEE-HYUNG JUNG† and DONG HWAN SOHN‡

College of Pharmacy, Sookmyung Women's University, Seoul 140-742, Korea; † Korea Ocean Research and Development Institute, Ansan 425-600, Korea; ‡ College of Pharmacy and Medicinal Resources Research Center, Wonkwang University, Iksan City, Cheonbuk 570-749, Korea

(*Received in revised form* 29 *August* 1996)

Key Word Index—*Panax ginseng*; Araliaceae; ginsenoside Rg_6; saponin.

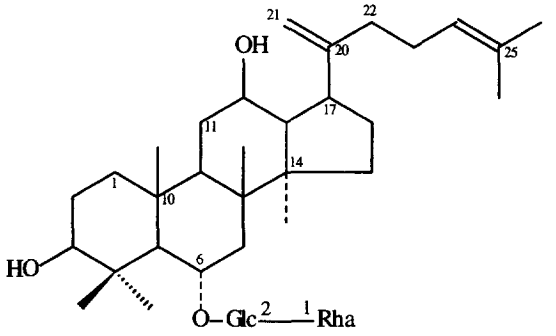
Abstract—A new dammarane glycoside, named ginsenoside Rg_6, was isolated from the Korean red ginseng (*Panax ginseng*). Its chemical structure was established to be 3β,6α,12β-trihydroxydammar-20 (21),24-diene-6-*O*-α-L-rhamnopyranosyl-(1→2)-β-D-glucopyranoside based on spectral analysis. Copyright © 1997 Elsevier Science Ltd

INTRODUCTION

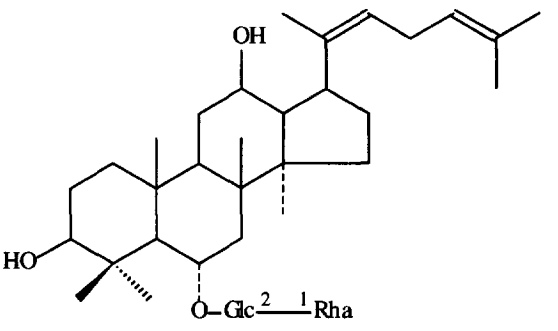
In recent years, several new saponin constituents have been reported from the Korean ginseng [1, 2]. The anti-tumour activity of the ginsenoside Rh family of compounds has been extensively studied [3]. In a previous paper [4], we reported the isolation of a new saponin, (20*E*)-ginsenoside F_4 from the Korean red ginseng. In this paper, we report the isolation and structure elucidation of a new dammarane glycoside from the Korean red ginseng. This is the first report on a ginseng saponin with a double bond at C-20 (21).

RESULTS AND DISCUSSION

The NMR spectra of **1** showed typical signals of the triol type ginsenosides, and their patterns are very similar to those of ginsenoside F_4 [2]. Saponin **1** showed a $[M + Na]^+$ peak at *m/z* 789 in the FAB-mass spectrum (molecular formula, $C_{42}H_{70}O_{12}$), which corresponds to the dehydrated structure of ginsenoside Rg_2 (molecular formula, $C_{42}H_{72}O_{13}$) such as ginsenoside F_4 (**2**). But the prominent difference from ginsenoside F_4 was found in the chemical shift of the olefinic carbons. Generally, double bonds of the ginsenosides were found at C-20 (22) and C-24 (25) in the side chain. The chemical shift values of C-20 and C-22 were dependent on the configuration of the double bond [5]. From the ^{13}C NMR data of **1**, one double bond was identified at C-24 (25), but the other olefinic carbons (δ108.1, δ155.5) cannot be assigned for C-20 and C-22 of ginsenoside F_4 (**2**). A methyl carbon signal corresponding to C-21 was not found in the ^{13}C NMR spectrum of **1**. The spectral pattern showed that compound **1** had a second double bond at the C-20 (21) position that might be formed by the dehydration of the C-20 hydroxyl group of ginsenoside Rg_2. One methylene carbon peak at δ108.1 was correlated with



1



2

two *exo*-methylene protons at δ5.17 and 4.95 in ^1H–^{13}C COSY and these two protons correlated together in ^1H–^1H COSY. The quaternary olefinic carbon at

* Author to whom correspondence should be addressed.

δ155.5 was assigned to C-20 and the chemical shift value was compatible with those of the other compounds having a similar side chain. The chemical shifts of C-20 in elabunin [6] and cycloeuphordenol [7] were reported as δ149.8 and 156.0, respectively. The proton peak at δ2.82 (H-9) was correlated with two protons at δ1.48 and 2.10 (H_2-11) in the ^1H–^1H COSY spectrum, and with carbon at δ48.23 (C-9) in ^1H–^{13}C COSY, respectively. The proton at δ3.97 (*m*, H-12) showed correlation with H-11 and δ2.10 (H-13) in ^1H–^1H COSY, and the peak at δ2.10 correlated with a carbon at δ52.2 (C-13) in ^1H–^{13}C COSY. From the correlations of protons at δ2.40 with δ5.35 and 2.01 in ^1H–^1H COSY, H-22 (δ2.01), H-23 (δ2.40) and H-24 (δ5.35) were identified. Other NMR signals were assigned based on the spectral analysis and comparison with those of ginsenoside F_4 (**2**) [2]. The NMR spectral data of **1** matched with the structure of $\Delta^{20(21)}$-ginsenoside Rg_2. This is the first report of a ginseng saponin with an *exo*-methylenic double bond at C-20 (21), and the saponin **1** has been named as ginsenoside Rg_6.

EXPERIMENTAL

The ^1H and ^{13}C NMR spectra were measured by Varian Unity 500 in pyridine-d_5 and chemical shifts were expressed in δ from TMS as int. standard.

The powder of Korean red ginseng (1 kg) prepared from six-year-old fresh ginseng (*Panax ginseng* C. A. Meyer) was extracted with MeOH (1 l × 3) with reflux. The MeOH extract (145 g) was partitioned between Et_2O and H_2O to remove a lipid soluble fr. The H_2O layer was partitioned again with EtOAc and *n*-BuOH sequentially. The EtOAc soluble fraction (19 g) was applied to a silica gel column with CH_2Cl_2–MeOH (7:1→5:1→3:1) as eluent to yield a subfr. containing **1** (2.3 g). It was further purified by HPLC using MeCN–H_2O (51:49) on a reverse phase column to yield **1** (16 mg) as an amorphous powder, mp 173–176°C; $[\alpha]_D^{23}$ −9.48 (MeOH: c = 0.28). IR $\nu_{max}^{KBr}cm^{-1}$: 3 400 (OH), 1 640 (C=C), 875 (=CH_2). Positive FAB-MS *m/z*: 789 [M + Na]$^+$. ^1H NMR (500 MHz, pyridine-d_5): δ1.86 (3H, *d*, J = 6.2 Hz, H-6 of Rha), 2.82 (1H, *m*, H-9), 3.55 (1H, *m*, H-3), 3.97 (1H, *m*, H-12), 4.05 (1H, *m*, H-3 of Glc), 4.27 (1H, *t*, J = 9.0 Hz, H-4 of Glc), 4.76 (2H, *m*, H-3 of Rha and H-6), 4.82 (1H, *brs*, H-2 of Rha), 4.95 and 5.17 (1H each, *s*, H-21), 5.33 (1H, *d*, J = 6.7 Hz, H-1 of Glc), 5.35 (1H, *t*, J = 6.5 Hz, H-24), 6.56 (1H, *s*, H-1 of Rha); ^{13}C NMR (125 MHz, pyridine-d_5): see Table 1.

Acknowledgement—This work was partially supported by the 1996 grants from Medicinal Resources Research Center.

Table 1. ^{13}C NMR chemical shifts of ginsenoside Rg_6 (**1**) and ginsenoside F_4 (**2**)*

C	1†	2‡
1	39.6	39.5
2	27.8	27.8
3	78.3	78.4
4	40.0	40.1
5	60.9	60.9
6	74.5	74.4
7	46.2	46.2
8	41.4	41.4
9	48.2	50.1
10	39.7	40.0
11	32.7	32.2
12	72.3	70.3
13	52.2	50.7
14	51.2	50.9
15	32.6	32.6
16	27.1	27.1
17	50.3	52.0
18	17.8	17.7
19	17.7	17.8
20	155.5	140.1
21	108.1	27.5
22	33.8	123.5
23	30.7	30.0
24	125.4	125.4
25	131.3	131.3
26	25.8	25.8
27	17.6	17.6
28	32.2	32.6
29	16.9	17.0
30	17.2	17.2
Sugar moieties		
Glc 1	101.9	101.8
2	79.4	79.5
3	78.4	78.4
4	72.7	72.6
5	78.7	78.4
6	63.2	63.2
Rha 1	101.9	102.0
2	72.4	72.3
3	72.4	72.4
4	74.2	74.2
5	69.5	69.5
6	18.7	18.8

* All spectra were recorded in pyridine-d_5, chemical shift in ppm relative to internal TMS.

† The spectra were recorded at 125 MHz.

‡ Data from ref. [2].

REFERENCES

1. Kim, D.-S., Chang, Y.-J., Zedk. U., Zhao, P., Liu, Y.-Q. and Yang, C.-R., *Phytochemistry*, 1995, **40**, 1493.
2. Zhang, S., Takeda, T., Zhu, T., Chen, Y., Yao, X., Tanaka, O. and Ogihara, Y., *Planta Medica*, 1990, **56**, 298.
3. Baek, N. I., Kim, D. S., Lee, Y. H., Park, J. D.,

Lee, C. B. and Kim, S. I., *Planta Medica*, 1996, **52**, 86.
4. Ryu, J.-H., Park, J.-H., Kim, D. H., Sohn, T. H., Kim, J. M. and Park, J. H., *Arch. Pharm. Res.*, 1996, **19**, 335.
5. Kim, D. S., Baek, N. I., Park, J. D., Lee, Y. H., Jeong, S. Y., Lee, C. B. and Kim, S. I., *Yakhak Hoeji*, 1995, **39**, 85.
6. Kubo, I. and Fukuhara, K., *Journal of Natural Products*, 1990, **53**, 968.
7. Khan, A. Q., Rasheed, T., Kazmi, S. N., Ahmed, Z. and Malik, A., *Phytochemistry*, 1988, **27**, 2279.