

A Novel Nortriterpene from *Hedera rhombea*

Kyung-Sook Kim¹, Young-Hee Choi¹, Ihn-Rhan Lee¹, Byoung-Mog Kwon² and Seung-Ho Lee²

¹College of Pharmacy, Ewha Womans University, Seoul 120-750, Korea and ²Korea Research Institute of Bioscience & Biotechnology, Taejon 305-600, Korea

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A new nortriterpene, rhombenone (**1**) was isolated from the leaves of *Hedera rhombea* Bean (Araliaceae). The structure of this compound was established as 27-demethyl-20(*S*)-dammar-23-ene-6 α ,20-diol-3,25-dione on the basis of spectral analysis including HMQC and HMBC techniques. Rhombenone (**1**) was the first 27-demethyl nortriterpene of dammarane type isolated from natural sources.

Key words : Rhombenone, *Hedera rhombea*, Nortriterpene, 27-Demethyl-20(*S*)-dammar-23-ene-6 α ,20-diol-3,25-dione

INTRODUCTION

Hedera rhombea Bean (Araliaceae) has been used to treat hemorrhage, chronic catarrh, jaundice, lithiasis and convulsion as a folk medicine (Chung and Shin, 1990). In the previous paper, we reported the isolation of Kizuta saponin K₅, rutin, caffeic acid and 3,5-dicaffeoyl quinic acid from the leaves of *H. rhombea* (Lee *et al.*, 1993). Also, analgesic and anti-inflammatory activity of the leaves of this plant were published (Lee *et al.*, 1992).

In our continuing study, a novel nortriterpene, rhombenone (**1**), was isolated from the ethyl acetate extract of the leaves of *H. rhombea*. The structure of this compound was established as 27-demethyl-20(*S*)-dammar-23-ene-6 α ,20-diol-3,25-dione on the basis of spectral analysis. Rhombenone was the first 27-demethyl nortriterpene of dammarane type isolated from natural sources.

RESULTS AND DISCUSSION

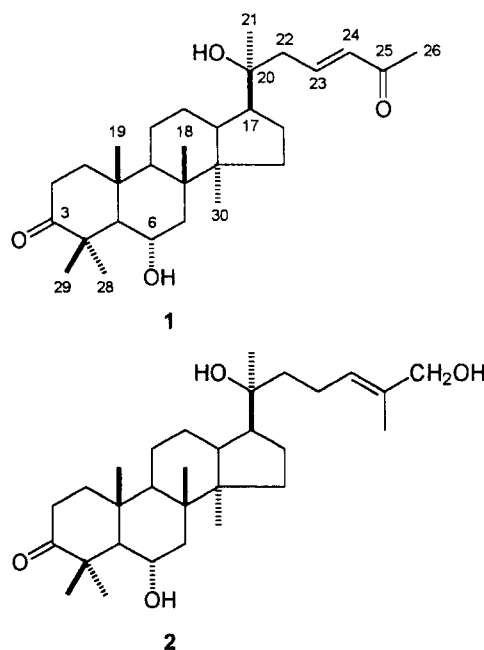
The molecular formula of rhombenone (**1**) was determined as C₂₉H₄₆O₄ by FAB mass (m/z 481, [M+Na]⁺) and ¹³C-NMR data. Absorption bands at 3460, 1710, 1680 cm⁻¹ suggested the presence of hydroxyl, carbonyl, and α,β -unsaturated carbonyl functionalities, respectively, in the IR spectrum.

One tertiary and one quaternary alcohol moiety were indicated by ¹³C-NMR signals at δ 68.3 and 75.9 ppm, respectively. The signal of a methine proton on the carbon bearing a tertiary hydroxyl group appear-

ed at δ 3.91 ppm (1H, m) in the ¹H-NMR spectrum. Also, seven methyl signals were observed at δ 2.19, 1.27, 1.24, 1.11, 0.95, 0.85 and 0.68 ppm as singlets.

Careful examination of ¹H- and ¹³C-NMR signals of compound **1** suggested that **1** possessed a dammarane-type triterpene skeleton with ketone moieties in addition to hydroxyl functionality. Detailed comparison of the ¹³C-NMR data of compound **1** with those of 3-oxo-20(*S*)-dammar-24-ene-6 α ,20,26-triol (**2**), the aglycone of Kizuta saponin K₅ (Kizu *et al.*, 1985), showed that most of ¹³C-NMR chemical shifts (C-1 to C-21, and C-28 to C-30) of **1** were very similar to those of **2** (Table I).

The remaining 5 carbon resonances appeared at δ



Correspondence to: Ihn-Rhan Lee, College of Pharmacy, Ewha Womans University, Seoul 120-750, Korea

Table I. Comparison of ^{13}C -NMR chemical shifts of rhombenone (**1**) and 3-oxo-20(*S*)-dammar-24-ene-6 α ,20,26-triol (**2**)

| carbon | 1* | 2** |
|--------|-------|-------|
| 1 | 40.4 | 40.2 |
| 2 | 33.6 | 33.4 |
| 3 | 219.9 | 218.5 |
| 4 | 47.8 | 47.8 |
| 5 | 59.7 | 59.6 |
| 6 | 68.3 | 66.9 |
| 7 | 46.0 | 45.9 |
| 8 | 41.6 | 41.4 |
| 9 | 49.5 | 49.7 |
| 10 | 38.7 | 38.4 |
| 11 | 22.9 | 22.9 |
| 12 | 25.5 | 25.3 |
| 13 | 42.8 | 42.4 |
| 14 | 50.7 | 50.6 |
| 15 | 31.7 | 31.6 |
| 16 | 28.0 | 28.1 |
| 17 | 50.9 | 50.4 |
| 18 | 18.2 | 17.7 |
| 19 | 16.4 | 16.1 |
| 20 | 75.9 | 74.3 |
| 21 | 27.0 | 26.1 |
| 22 | 44.3 | 41.7 |
| 23 | 144.9 | 22.9 |
| 24 | 134.5 | 125.8 |
| 25 | 199.0 | 136.2 |
| 26 | 27.7 | 68.3 |
| 27 | - | 13.9 |
| 28 | 32.6 | 32.2 |
| 29 | 20.2 | 20.0 |
| 30 | 16.9 | 16.7 |

Measured in *CDCl₃, and in **pyridine-d₅

199.0 (C=O), 144.9 (=CH), 134.5 (=CH), 44.3 (CH₂), 27.7 (CH₃) ppm were assigned to the terminal part of the side chain (C-22 to C-26). On the basis of ^1H - ^1H COSY and HMQC spectra, ^1H -NMR signals which were attached to the above carbons were assigned unequivocally. In the ^1H - ^1H COSY spectra, a olefinic proton signal at δ 6.82 (1H, dt, $J=15.9$, 7.3 Hz) was coupled with another olefinic proton at δ 6.04 (1H, d, $J=15.9$ Hz) and a methylene resonance at δ 2.32 (2H, m). The corresponding carbon signals were found at δ 144.9, 134.5 and 44.3 ppm, respectively, in the HMQC spectrum. The remaining carbon peak appearing at δ 27.7 showed cross peaks with corresponding methyl signal at δ 2.19 (3H, s) in the HMQC spectrum.

The connectivities of a methylene, two olefinic, a ketone, and a methyl carbons were established unambiguously by HMBC and HMQC techniques. The carbon signal at 144.9 (C-23) exhibited the connection to a methylene proton signal appeared at δ 2.32. Also, the quaternary carbon bearing a hydroxyl group at δ 75.9, which was assigned to C-20, showed a cross peak with the methylene at δ 2.32 (H-22). Also, α,β -unsaturated ketone moiety suggested by ^{13}C -NMR (δ 199.0 ppm) and IR (1680 cm⁻¹) were confirmed by

the downfield signals at δ 6.04 and 6.82 in the ^1H -NMR spectrum of compound **1**, and were assigned to the olefinic protons α and β to the carbonyl carbon, respectively. The stereochemistry of the olefinic protons were determined as *trans* by coupling constant ($J=15.9$ Hz). The carbon signal at δ 199.0 showed connection to the unusually downfield shifted methyl proton signal at δ 2.19 (H-26), and a olefinic proton at δ 6.82 (H-23) in the HMBC spectrum.

Based on the above findings, the structure of the new nortriterpene, rhombenone (**1**) was elucidated as 27-demethyl-20(*S*)-dammar-23-ene-6 α ,20-diol-3,25-dione. Rhombenone (**1**) was the first 27-demethyl nortriterpene of dammarane type isolated from natural sources.

EXPERIMENTAL

General experimental procedures

Melting points were determined using a Mettler FP 62 instrument and are uncorrected. The UV spectra were obtained on a Shimadzu UV-265 spectrophotometer, and FT-IR spectra were measured on a Perkin-Elmer 1710 spectrophotometer, and optical rotation were measured on a JASCO DIP 370 digital polarimeter. ^1H - and ^{13}C -NMR spectra were recorded on a Bruker ARX-400 spectrometer. FAB mass spectra were obtained with a JEOL HX 100 spectrometer and EI mass spectra were obtained with a Hewlett-Packard 5989A spectrometer. HPLC was conducted on a LKB-Bromma 2150 system with a Varian 400 UV detector at 245 nm.

Plant materials

The leaves of *Hedera rhombea* Bean (Araliaceae) were collected in Kohung, Chonnam, October, 1993.

Extraction and fractionation

The air-dried plant material (8 kg) were extracted with CHCl₃-MeOH-Acetone (1:1:1) three times in room temperature, and gave 300 g of a dried extract on removal of solvent in vacuo. The residue was extracted successively with *n*-hexane, ethyl acetate, and *n*-BuOH, and the ethyl acetates soluble portion was concentrated. The residue was purified by column chromatography with silica gel using *n*-hexane-EtOAc (80:20 \rightarrow 30:70). Fractions which were eluted by *n*-hexane-EtOAc (35:65) were collected and re-chromatographed with C₁₈ packing materials using MeOH-H₂O (50:50 \rightarrow 100:0). Fractions which were eluted by MeOH-H₂O (70:30) were collected, and separated by HPLC [Phenomenex Ultracarb 10 ODS column (2.12 id \times 25 cm)] eluted with MeOH-H₂O (78:22) and further purified by preparative thin layer chromatography using *n*-hexane-EtOAc (4:1) to afford compound **1**.

Compound **1** - colorless powders; mp 74-77°C; UV

(EtOH) λ_{\max} 225 nm (log ϵ 4.02); IR ν_{\max} (KBr) 3460 (OH), 1710 (C=O), 1680 (α,β unsaturated C=O) cm^{-1} ; $^1\text{H-NMR}$ (400 MHz, CDCl_3) δ 6.82 (1H, dt, $J_{2,3,24}=15.9$ Hz, $J_{22,23}=7.3$ Hz, 23-H), 6.04 (1H, d, $J_{23,24}=15.9$ Hz, 24-H), 3.91 (1H, m, 6-H), 2.32 (2H, m, 22-H₂), 2.19 (3H, s, 26-CH₃), 1.27 (3H, s, 28-CH₃), 1.24 (3H, s, 29-CH₃), 1.11 (3H, s, 21-CH₃), 0.95 (3H, s, 19-CH₃), 0.85 (3H, s, 30-CH₃), 0.68 (3H, s, 18-CH₃) ppm; $^{13}\text{C-NMR}$ (100 MHz, CDCl_3) see Table 1; FAB-MS m/z 481 $[\text{M}+\text{Na}]^+$; EI-MS (70 eV) m/z 440 ($\text{M}^+-\text{H}_2\text{O}$), 375 (10), 357 (6), 313 (8), 217 (4), 203 (7), 187 (5), 161 (6), 149 (7), 135 (9), 121 (13), 109 (35), 95 (30), 84 (23), 79 (14), 69 (21), 43 (100%).

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