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A Novel Protoilludane Sesquiterpene from the Wood of *Xanthoceras sorbifolia*

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Abstract: A protoilludane sesquiterpene (named xanthocerapene) was isolated from the wood of *Xanthoceras sorbifolia* Bunge. Its structure, including the relative configuration was established by spectroscopic and chemical methods.

Keywords: *Xanthoceras sorbifolia*, Sapindaceae, sesquiterpene, protoilludane, xanthocerapene.

In the course of our searching for anti-HIV agents from natural sources, we have isolated a triterpene and a doubly linked proanthocyanidin dimer as HIV-1 protease inhibitors from the wood of *Xanthoceras sorbifolia* Bunge (Sapindaceae)[1]. Further investigation of this plant has led to the isolation of a protoilludane sesquiterpene (**1**). The present paper describes the isolation and structural determination of this novel sesquiterpene.

The EtOH eluate of a MeOH extract of the wood of *X. sorbifolia* from a Sephadex LH-20 column was further chromatographed on a RP-2 column. The 60% MeOH eluate of the RP-2 column was repeatedly chromotographed on ODS and SiO_2 column to afford compound **1** (8 mg). The molecular weight of **1** was found to be 270 by FABMS. In the EIMS, compound **1** did not exhibit molecular ion but a fragment of that lost one molecule of H_2O. The formula of this fragment was established as $C_{15}H_{24}O_3$ from HREIMS. The molecular formula of **1** was deduced to be $C_{15}H_{26}O_4$ from the above evidence and by analyzing its ^{1}H-NMR where four hydroxyl signals were observed. The signals in the ^{13}C-NMR spectrum of **1** could be assigned with the aid of the DEPT spectrum. Three methyls, five methylenes, three methines and four nonprotonated carbons were showed. Since **1** exhibited neither carbonyl nor olefinic carbon signals, its structure was deduced to be tricyclic.

By analyzing its ^{1}H-^{1}H COSY, HMQC and HMBC spectra, the planar structure of **1** was determined step by step as followings:

A methyl signal at δ 1.03 (s, H-12) was correlated with carbon signals at δ 53.4 (C-2, CH), 46.0 (C-6, CH), 37.7 (C-3, C) and 33.2 (C-4, CH_2) in HMBC. Because of

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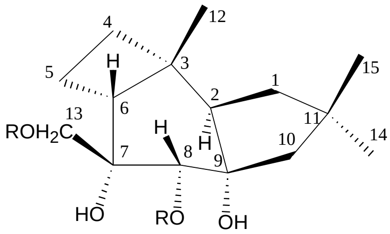
the singlet nature of this methyl, it must connect directly to the quaternary carbon (C-3),

Figure 1 structures of **1** and **2**



compound **1** R=H

compound **2** R=CH_3CO-

Table 1 NMR spectral data of compounds **1** and **2** (δ ppm, $CDCl_3$, 500 MHz)

	1		**2**	
position	δ H	δC	δ H	δC
1	β 1.41 (dd, *J*=8.5, 14.0 Hz)	41.8	β 1.45 (dd, *J*=8.5, 13.5 Hz)	42.6
	α 1.85 (dd, *J*=8.5, 14.0 Hz)		α 1.80 (dd, *J*=8.5, 13.5 Hz)	
2	2.60 (t, *J*=8.5 Hz)	53.4	2.63 (t, *J*=8.5 Hz)	53.4
3		37.7		37.7
4	1.61 (br. t, *J*=9.0 Hz), 1.77 (overlapped)	33.2	β 1.63 (m), α 1.88 (m)	33.6
5	β 1.86 (m), α 2.28 (m)	15.9	β 1.95 (m), α 2.23 (m)	17.1
6	1.75 (overlapped)	46.0	2.24 (overlapped)	47.2
7		73.2		74.0
8	3.34 (s)	77.4	4.80 (s)	74.2
9		84.9		84.8
10	1.56 (d, *J*=14.5 Hz)	53.0	α 1.52 (d, *J*=14.5 Hz)	54.2
	1.73 (d, *J*=14.5 Hz)		β 1.60 (d, *J*=14.5 Hz)	
11		37.4		36.9
12	1.03 (s, 3H)	26.3	1.23 (s, 3H)	26.8
13	3.33 (d, *J*=11.0 Hz)	69.1	3.74 (d, *J*=11.0 Hz)	67.8
	3.61 (d, *J*=11.0 Hz)		3.99 (d, *J*=11.0 Hz)	
14	1.22 (s, 3H)	31.8	1.18 (s, 3H)	31.7
15	1.05 (s, 3H)	31.2	1.03 (s, 3H)	31.3
OH x 4	3.56 (s), 3.62 (s), 3.81 (s), 3.94 (s)		3.19 (s), 4.12 (s)	
8-Ac			2.18 (s, 3H)	21.3, 170.5
13-Ac			2.05 (s, 3H)	21.2, 171.1

and the other three carbons (C-2, C-6, C-4) should be next to this quaternary carbon.

Two singlet methyl groups at δ1.05 (CH_3-15) and 1.22 (CH_3-14) were found to correlate with each other, and both correlate with 37.4 (C-11, C), 53.0 (C-10, CH_2) and 41.8 (C-1, CH_2) in HMBC. These data indicated that they were two germinal methyls connected with the methylene carbons (C-10, C-1) through the quaternary carbon (C-11).

The ^1H-^1H COSY spectrum clearly indicated that a methyne group at δ 2.60 (H-2) was next to a methylene group at δ 1.41 and 1.85 (H-1), and a methylene group at δ 1.61 and 1.77 (H-4) was next to another methylene at δ 2.28 and 1.86 (H-5).

Methylene proton signals at δ 1.56 and 1.73 (H-10) were found correlated with a quaternary carbon signal at δ 84.9 (C-9), and with two tertiary carbon signals at δ 77.4 (C-8) and δ 53.4 (C-2) in HMBC. Because of the characteristic AB spinning system of this methylene, it should be next to the quaternary carbon (C-9). The quite low-field chemical shift of C-9 (δ 84.9) suggested that it connected with an oxygen atom.

A methyne proton signal at δ 3.34 (H-8) was found correlated with a quaternary carbon signal at δ 73.2 (C-7) and a tertiary carbon signal at δ 46.0 (C-6) in HMBC. The singlet nature of H-8 suggested it to be next to the quaternary carbon (C-7). The low-field chemical shifts of C-8 (77.4) and C-7 suggested that they were both connected with oxygen atoms.

The methylene proton signals at δ 3.61, 3.33 (H-13) was a double-doublet which correlated with C-7 and C-8 in HMBC, so it must connect with the quaternary carbon, C-7. The low-field chemical shift (C-13, δ 69.1) suggested it was oxygenated. The correlation H-5 and C-7 in HMBC suggested that C-6 bonded with C-5. Thus, the skeleton of **1** was determined as protoilludane with 7, 8, 9 and 13 positions oxygenated.

Treatment of **1** (2 mg) with acetic anhydride in pyridine at room temperature yielded compound **2** (2 mg), the primary (OH-13) and secondary (OH-8) hydroxyl groups were acetylated and the two tertiary hydroxyls (OH-7 and 9) were unaffected.

The relative stereochemistry of **1** was determined by NOESY experiments. In the spectrum of **1**, correlations between H-12 and H-8, H-12 and H-1 at δ 1.41 were observed, therefore, these protons must locate at the same face (it was assumed to be β). One of the methyl groups on C-11 was assigned to be β-orientated (CH_3-15) since its correlation with 1β-H. H-2 was found to have NOE correlation with CH_3-14, but not with CH_3-15, thus it was assigned to be α orientation.

In the NOESY spectrum of **2**, CH_2OAc-13 showed significant cross peak with H-8 but little cross peak with AcO-8, so it was β orientated. From HMQC of **2**, it was known that the signal of H-6 was overlapped with one of H-5 signals. The other H-5 was determined to be β orientated because it was correlated with H-12 in NOESY. Therefore, the overlapped H-5 was deduced to be α orientated. The overlapped signals of H-5α and H-6 were found correlation not only with other α orientated protons(such as H-2) due to H-5α, but also with β orientated protons, such as H-8, therefore, H-6 was determined to be β-orientated. Based on the above evidence, the structure of compound **1** was determined as shown in **Figure 1** and was named xanthocerapene.

Compound **1** is the first example of a protoilludane type sesquiterpene from the plant family of Sapindaceae.

Reference

1. C. M. Ma, N. Nakamura, M. Hattori, *et al*., *J. Nat. Prod*., **2000**, *63*, (2), 238.

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