Chinese Chemical Letters Vol. 16, No. 6, pp 774-776, 2005
http://www.imm.ac.cn/journal/ccl.html

Two Novel Epimeric Eremophilane Sesquiterpenes from the Flower of *Cacalia tangutica*

Xia LIU, Yan Ping SHI*

Key Laboratory for Natural Medicine of Gansu Province, Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, Lanzhou 730000

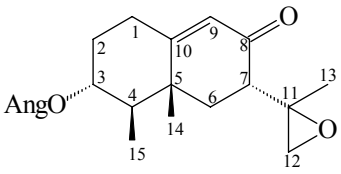
Abstract: Two novel epimeric eremophilane sesquiterpenes, 7β-H-3α-angeloyl-9(10)-ene-11, 12-epoxy-8-oxoeremophilane (**1**) and 7β-H-3α-angeloyl-9(10)-ene-11, 12-epoxy-8-oxoeremophilane (**2**) were isolated from the methanol extract of the flower of *Cacalia tangutica* (Franch.) Hand-Mazz. Their structures were characterized by 1D-, 2D-NMR (^{1}H-^{1}H COSY, HMQC, HMBC, ^{1}H-^{1}H NOESY) and HRESI-MS techniques.

Keywords: *Cacalia tangutica*, Compositae, eremophilane, sesquiterpene.

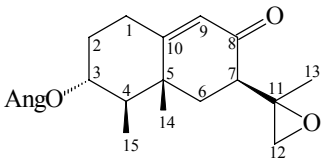
The genus *Cacalia* (Compositae) consists of about 60 species grown in northwest and southwest of China, and one half of them have been used as folk medicines to treat many kinds of diseases[1]. In order to find active constituents, the phytochemistry of the flower of *Cacalia tangutica* was studied for the first time, and two novel epimeric eremophilane sesquiterpenes **1** and **2** were isolated from the methanol extract of the flower. We describe herein the structural elucidation of **1** and **2**.

Compound **1** was obtained as colorless gum, $[\alpha]_D^{20}$ +40 (*c* 0.34, $CHCl_3$). The molecular formula was assigned as $C_{20}H_{28}O_4$ on the basis of the HRESI-MS (M+Na = 355.1887; calcd. for $C_{20}H_{28}O_4Na$ 355.1880), and that could be supported by evidences from ^{13}C-NMR combined the DEPT experiment (20 carbons as 5×CH_3, 4×CH_2, 5×CH, 6×C). Its UV spectrum showed a band at 232 nm (logε 4.32) due to α,β-unsaturated ketone. The IR spectrum (film) indicated the presences of carbonyl groups (1715, 1677 cm^{-1}) and double bonds (1628 cm^{-1}). The NMR spectra showed the presences of several typical functions, such as an angeloyl group (**Table 1**), a double bond (δ_C 124.54, 166.81 and δ_H 5.74), an α,β-unsaturated ketone (δ_C 197.82) and an epoxy (δ_C 56.18, C; 50.80, CH_2 and δ_H 2.60, d, 1H, *J*=4.4Hz, 2.50, d, 1H, *J*=4.4Hz) groups. Taking into account above results, compound **1** considered to be a sesquiterpene with an α,β-unsaturated ketone, an angeloyl and an epoxy group. By detailed inspection of the ^{1}H- and ^{13}C-NMR and comparison of its spectral data with those of reported eremophilane sesquiterpenes[2-4], **1** was further confirmed as eremophilane sesquiterpene, particularly, with typical eremophilane methyl groups: δ_H 1.42 (s, 3H) and

* E-mail: shiyp@ns.lzb.ac.cn



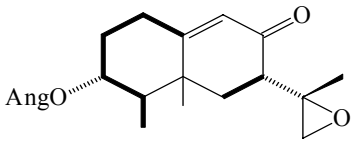
1

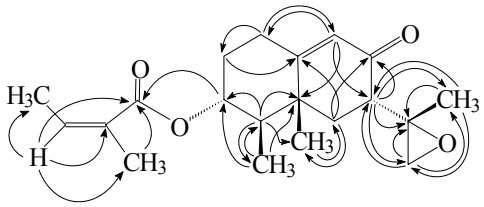


2

Figure 1 Structural parts of ^{1}H-^{1}H COSY in **1** (Bold bonds)

Figure 2 Relative peaks of HMBC in **1**





δ_C 21.13, δ_H 1.17 (s, 3H) and δ_C 17.05, δ_H 0.95 (d, 3H, *J*=6.8Hz) and δ_C 10.52. The location of the angeloyl group at C-3 and 11,12-epoxy was assigned by ^{1}H-^{1}H COSY (**Figure 1**) and HMBC (**Figure 2**) with correlations of H-3 (δ_H 4.92) with C-1′ (δ_C 167.56), H-12a (δ_H 2.60) with C-11 (δ_C 56.18) and C-13 (δ_C 21.13), and H-12b (δ_H 2.50) with C-11. The NOESY cross-peaks between H-3 with H-14, and H-7 with H-14 showed that the angeloyl group was in α-orientation if H-7 was in β-orientation. Assignments of the ^{13}C-NMR data were based on HMQC experiment. Thus, the compound **1** was identified as 7β-H-3α-angeloyl-9(10)-ene-11, 12-epoxy-8-oxoeremophilane.

Compound **2** was obtained as colorless gum, $[\alpha]_D^{20}$ +15 (*c* 0.20, $CHCl_3$). Its molecular formula, $C_{20}H_{28}O_4$ was assigned by the HRESI-MS (M+Na=355.1893; calcd. for $C_{20}H_{28}O_4Na$ 355.1880) and evidences from ^{13}C-NMR combined the DEPT experiment (20 carbons including 5×CH_3, 4×CH_2, 5×CH, 6×C). The similar molecular formulas of **1** and **2** showed that they are isomers. The UV spectrum of **2** showed a band at 234 nm (logε 4.19) described α,β-unsaturated ketone. The NMR spectra data were very similar to those of **1** except for the signals of H-7, H-12 and H-13 and corresponding carbons (C-7, C-12 and C-13), such as H-7, H-12 and H-13 of **2** shifted from δ 2.42, 2.60. 2.50, 1.42 in **1** to δ 2.30, 2.84, 2.76, 1.27; C-7, C-12 and C-13 of **2** shifted from δ 47.39, 50.80 and 21.13 in **1** to δ 49.72, 56.21 and 17.17. The changes of chemical shifts preliminary suggested that compound **2** was an epimer of **1** at C-7, which can be confirmed by its NOESY correlation of H-7 and H_α-6. Consequently, the compound **2** was identified as 7α-H-3α-angeloyl-9(10)-ene-11,12-epoxy-8-oxoeremophilane.

Table 1 ^{1}H, ^{13}C NMR (DEPT) data of **1** and **2** ($CDCl_3$, TMS, δ ppm)*

No.	**1** δ_H	**1** δ_C	**2** δ_H	**2** δ_C
1α	2.43 m	30.54 t	2.51 m	30.76 t
1β	2.27 m		2.38 m	
2α	1.44 m	31.55 t	1.84 m	31.60 t
2β	2.21 m		2.20 m	
3	4.92 ddd (4.4, 11.2, 10.8)	72.85 d	4.96 ddd (4.4, 11.2, 10.8)	72.91 d
4	1.58 dq (10.8, 6.8)	47.92 d	1.54 dq (10.8, 6.8)	47.41 d
5	-	39.85 s	-	39.91 s
6α	1.41 dd (14.8, 13.2)	38.08 t	1.82 m	38.18 t
6β	2.10 dd (4.4, 13.2)		2.38 m	
7	2.42 dd (4.4, 14.8)	47.39 d	2.10 dd (4.4, 14.4)	49.72 d
8	-	197.82 s	-	197.57 s
9	5.74 s	124.54 d	5.77 s	124.36 d
10	-	166.81 s	-	167.60 s
11	-	56.18 s	-	56.27 s
12a	2.60 d (4.4)	50.80 t	2.84 d (4.4)	56.21 t
12b	2.50 d (4.4)		2.76 d (4.4)	
13	1.42 s	21.13 q	1.27 s	17.17 q
14	1.17 s	17.05 q	1.19 s	17.12 q
15	0.95 d (6.8)	10.52 q	0.99 d (6.8)	10.59 q
Angeloyl				
group	-	167.56 s	-	167.75 s
	-	127.82 s	-	127.89 s
	6.06 qq (7.2, 1.6)	138.16 d	6.08 qq (7.2, 1.4)	138.15 d
	1.95 dq (7.2, 1.6)	15.74 q	2.00 dq (7.2, 1.4)	15.77 q
	1.86 br s	20.57 q	1.92 br s	20.58 q

*Assignments of **1** and **2** were aided by spin splitting pattern, DEPT, COSY, HMQC and HMBC experiments. Multiplication by DEPT experiments.

Acknowledgments

We are grateful to Dr Ji Ma for identification of the plant material. The research project was supported by Foundation of "Bairen Jihua" of CAS in 2000 and NNSFC (No. 20372029 and 20475057).

References

1. Jiangsu college of new medicine, *A dictionary of traditional Chinese medicine*, Shanghai Science and Technology press, Shanghai, **1977**, p.22.
2. Y.L. Lin, J.C. OU, C.F. Chrn, *et al.*, *Chem. Pharm. Bull.*, **1998**, *46*(11), 1807.
3. Y. Zhao, H.R. Peng, Z.J. Jia, *J. Nat. Prod.*, **1994**, *57*(12), 1626.
4. K. Sugama, K. Hayashi, T. Nakagawa, *et al.*, *Phytochemistry*, **1983**, *22*(7), 1619.

Received 21 June, 2004