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灯盏细辛中两个新四氢吡喃类化合物

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摘　要:采用硅胶柱色谱、葡聚糖凝胶和高效液相色谱仪从灯盏细辛全草中分离等到2个化合物,根据波谱数据鉴定结构为反式乙酰化灯盏细辛酸甲酯(**1**)和顺式乙酰化灯盏细辛酸甲酯(**2**)。两个化合物皆为新四氢吡喃类化合物。

关键词:灯盏细辛;化学成分;四氢吡喃类化合物

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Two New Tetrahydropyranoids from *Erigeron brevicapus*

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Abstract: Two compounds were isolated from the whole plant of *Erigeron brevicapus* by silica gel column, Sephadex LH-20 column chromatography and HPLC. Their structures were elucidated on the basis of spectral analysis as trans-methyl brevicatoacetate (**1**) and cis-methyl brevicatoacetate (**2**). These compounds were two new tetrahydropyranoids.

Key words: *Erigeron brevicapus*; chemical constituents; tetrahydropyranoids

Erigeron brevicapus is a well known traditional Chinese medicine, used to treat a variety of paralysis and its sequelae originated from apoplexy and atherothrombotic of brain[1]. Flavonoids, caffeoylquinic acids, phenolic compounds and γ-pyrones were previously isolated from this species[2-4]. In order to further study the chemical constituents of *E. brevicapus*, two new tetrahydropyranoids, namely trans-methyl brevicatoacetate (**1**) and cis-methyl brevicatoacetate (**2**) were isolated from it (Fig. 1).

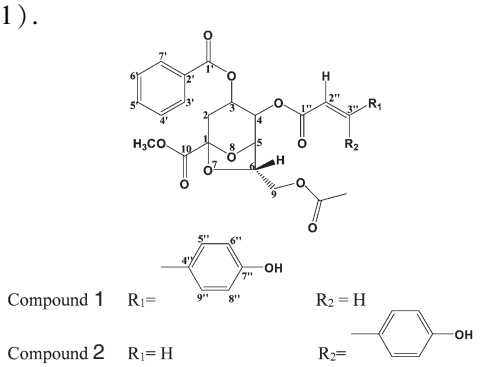

Fig. 1　Chemical structures of compounds 1 and 2

Instruments and Materials

Bruker AV-400 NMR spectrometer; Agilent 1200 LC/MSD Trap SL Mass spectrometer; Shimadzu LC 8A liquid chromatograph; Sephadex LH-20 (GE Healthcare); Silica gel (200-300 mesh, Qingdao, China); The reagents used were of analytical grade or HPLC grade. *Erigeron brevicapus*, collected in Luxi, Yunnan Province of China, was identified by Prof. S. P. Li, Institute of medicinal Plants, Yunnan Agricultural Academy. A voucher specimen (20050291) was deposited at the Research Institute of Yunnan Biovalley Pharmaceutical Company.

Extraction and Isolation

The dried whole plants of *E. breviscapus* (20.0 kg) were extracted with EtOH three times under reflux. After removal of the solvent *in vacuo* to yield a residue (1.8 kg), which was partitioned between H_2O and EtOAc. The EtOAc extract (950 g) was chromatographed on silica gel (200-300 mesh), eluted with a gradient $CHCl_3$/MeOH (10∶1-1∶10) to afford fractions F1-F10. Fraction F2 (60 g) was subjected to Sephadex

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LH-20 column chromatography (methanol) to afford subfractions F11-F19. Fraction 15 (12 g) was purified repeatedly by preparative and semi-preparative HPLC (95% CH_3OH-H_2O) to give **1** (12.7 mg) and **2** (8.5 mg).

Structural identification

Compound (1) was obtained as a yellow oil. HR-ESI-MS *m/z*:549.1379 $[M+Na]^+$ (calcd for $C_{27}H_{26}O_{11}$, 549.1372), indicating 15 degrees of unsaturation. The ^1H NMR, ^{13}C NMR spectra (Table 1) indicated the presence of four ester carbonyl groups at (C 170.9 (s), 167.1 (s), 165.9 (s) and 165.2 (s), one methoxyl group at (C 53.2 (q) and (H 3.88 (s, 3H), one methyl at (C 20.7 (q) and (H 2.04 (s, 3H), a methylene (C 38.2 (t) and (H 2.57 (m, 2H), and at least five oxygenated carbons. The methylene (C-2) was analyzed as the starting point. In the COSY spectrum, five strong cross peak was found from 2H-2/H-3, H-3/H-4, H-4/H-5, H-5/H-6, H-6/2H-9, it proved the existence of a partial structure $-CH_2$-CH-CH-CH-CH-CH_2-. In addition, the carbon and proton chemical shifts pointed out that the back five carbons bear oxygen group, except C-2. Compared the spectral data of erigoster A [5] with compound **1**, both have the same mother nucleus.

Table 1 ^1H NMR and ^{13}C NMR of compound 1 and 2 in CD_3Cl (400 MHz. (in ppm)

C	δ_H		δ_C	
	1	2	1	2
1	–	–	103.5 (s)	103.4 (s)
2	2.60 (2H. m)	2.57 (2H. m)	38.2 (t)	38.2 (t)
3	5.83 (1H. *J* = 4.8 Hz. t)	5.81 (1H. m)	64.7 (d)	64.7 (d)
4	5.59 (1H, *J* = 5.2 Hz. t)	5.48 (1H. *J* = 5.2 Hz. t)	66.7 (d)	66.7 (d)
5	4.81 (1H. m)	4.69 (1H. m)	74.8 (d)	74.8 (d)
6	4.59 (1H, *J* = 5.2 Hz. t)	4.53 (1H, *J* = 6.0 Hz. t)	78.8 (d)	79.1 (d)
9	4.59 (2H. m)	4.71 (2H. m)	62.4 (t)	61.9 (t)
10	–	–	167.1 (s)	167.1 (s)
9-OAc	–	–	170.9 (s)	170.5 (s)
	2.04 (3H. s)	2.07 (3H. s)	20.7 (q)	20.8 (q)
10-OCH3	3.88 (3H. s)	3.87 (3H. s)	53.2 (q)	53.1 (q)
1′	–	–	165.9 (s)	166.0 (s)
2′	–	–	129.6 (s)	129.6 (s)
3′,7′	8.07 (2H, *J* = 7.2 Hz. d)	8.06 (2H, *J* = 7.2 Hz. d)	129.9 (d)	129.8 (d)
4′,6′	7.45 (2H, *J* = 7.6 Hz. d)	7.47(2H, *J* = 7.6 Hz. d)	128.6 (d)	128.6 (d)
5′	7.58 (1H, *J* = 7.2 Hz. t)	7.60(1H, *J* = 7.2 Hz. t)	133.4 (d)	133.4 (d)
1″	–	–	165.2 (s)	164.2 (s)
2″	7.44 (1H. *J* = 16.0 Hz. d)	6.86(1H, *J* = 12.8 Hz. d)	146.4 (d)	146.4 (d)
3″	6.12 (1H. *J* = 16.0 Hz. d)	5.64(1H, *J* = 12.8 Hz. d)	113.3 (d)	114.7 (d)
4″	–	–	126.5 (s)	127.0 (s)
5″.9″	7.24 (2H, *J* = 8.4 Hz. d)	7.65 (2H. *J* = 8.8 Hz. d)	130.2 (d)	132.8 (d)
6″,8″	6.76 (2H. *J* = 8.4 Hz. d)	6.79 (2H, *J* = 8.8 Hz. d)	115.9 (d)	115.1 (d)
7″	–	–	158.3 (s)	157.1 (s)

The HMBC correlations (Fig. 2) of 3H-methyl, 2H-9 with the carbonyl group δC 170.9 (s), indicated that an acetoxy located at C-9. The HMBC correlations of 3H-methoxy group with C-10(167.1, s) showed that a

methyl ester could be positioned C-1[6]. The benzoyloxy group was assigned to C-3 by the HMBC correlations from H-3, and 2H-3′,7′ to the corresponding C-1′ (165.9, s). The phenacryloyloxy group was attached to C-4 by HMBC the correlations of H-4, H-2″ and H-3″ with C-1″(165.2, s), of H-3″ with C-4″(Fig. 2). For the above mentioned groups occupied 10 oxygenes in the molecular formula, the remaining oxygen as a hydroxyl group was attributed to a benzene ring carbon in downfield from the phenacryloyloxy group, the location of the hydroxyl group at C-7″ was deduced from the HMBC correlations of 2H-5″,9″, and 2H-6″,8″ with C-7″(158.3, s). In addition, the coupling constant of the double bond between C-2″ and C-3″ in **1** was 16 Hz, it belonged to the trans coupling in olefines. On the basis of the above evidence, the structure of **1** was determined as shown, and this compound has been given the name trans-methyl brevicatoacetate. The coupling constant between H-5β and H-6β indicated a preferred α-orientation for the substituent group at C-6 position[7]. NMR spectra and detailed experimental data of 1 is available free of charge via the Internet at http://www.trcw.ac.cn.

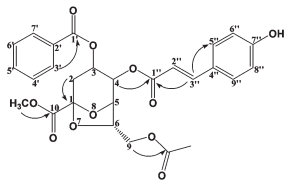

Fig. 2 Key HMBC correlations of compound 1

Compound (**2**) was isolated as a yellow oil. The molecular formula was established as $C_{27}H_{28}O_{11}$ by HR-ESI-MS *m/z*:549.1378 $[M+Na]^+$ (calcd. 549.1372), including fifteen degrees of unsaturation. The ^1H NMR and ^{13}C NMR (Table 1) exhibited the presence of one acetate system [(H 2.07 (3H, s), (C 20.8 (q) and (C 170.5 (s)], a methyl ester moiety [(H 3.87 (3H, s), (C 53.2 (q) and 167.1 (s)], a benzoyloxy group, a phenacryloyloxy group, These spectral features suggested **2** had the same structure as **1**, the only significant difference of **1** and **2** was the coupling constant of the double bond between C-2″ and C-3″. The coupling constant of **2** was 12.8 Hz, in the range of the cis coupling 6 ~ 12 Hz. Consequently, the structure of **2** was established, and it has been accorded the name cis-methyl brevicatoacetate. NMR spectra and detailed experimental data of **2** is available free of charge via the Internet at http://www.trcw.ac.cn.

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