

## 药用植物盆架树中的马钱子苷及其衍生物\*

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**摘要:** 从药用植物盆架树 (*Winchia calophylla* A. DC.) 的茎皮中分离得到 4 个环烯醚萜苷类化合物, 其结构经现代波谱技术鉴定为马钱子苷、7-*O*-甲酰基马钱子苷、6'-*O*-甲酰基马钱子苷和 6', 7-*O*-二甲酰基马钱子苷, 其中后 3 个化合物为新化合物。

**关键词:** 盆架树; 夹竹桃科; 马钱子苷; 环烯醚萜苷

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## Loganin Derivatives from *Winchia calophylla*\*

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**Abstract:** From the stem barks of *Winchia calophylla* A. DC., four iridoid glycosides were isolated. Their structures were elucidated as loganin, 7-*O*-formyl loganin, 6'-*O*-formyl loganin and 7, 6'-*O*-di-formyl loganin by means of spectroscopic methods. Three loganin derivatives were new compounds.

**Key words:** *Winchia calophylla*; Apocynaceae; Loganin derivatives; Iridoid glycosides

### 1 Results and Discussion

*Winchia calophylla* A. DC. (Apocynaceae), distributed in Yunnan and Hainan Province of China, India, Myanmar and Indonesia, is a traditional medicinal plant. Its stem barks were used in folk medicines for the treatment of chronic tracheitis (Delectis Florae Reipublicae Popularis Sinicae Agendae Academiae Sinicae, 1977). In order to research the bioactive components, the chemical constituents of this plant were systematically studied. Previously we reported the isolations and identi-

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fication of nine triterpenoids from this plants (Zhu *et al.*, 2001). This paper describes the isolation and structure elucidation of three new loganin derivatives, 7-*O*-formyl loganin (**1**), 6'-*O*-formyl loganin (**2**), 7, 6'-*O*-diformyl loganin (**3**), along with loganin (**4**) (Ikeshiro and Tomita, 1984). Their structures were determined by spectroscopic methods, especially 2D NMR experiments.

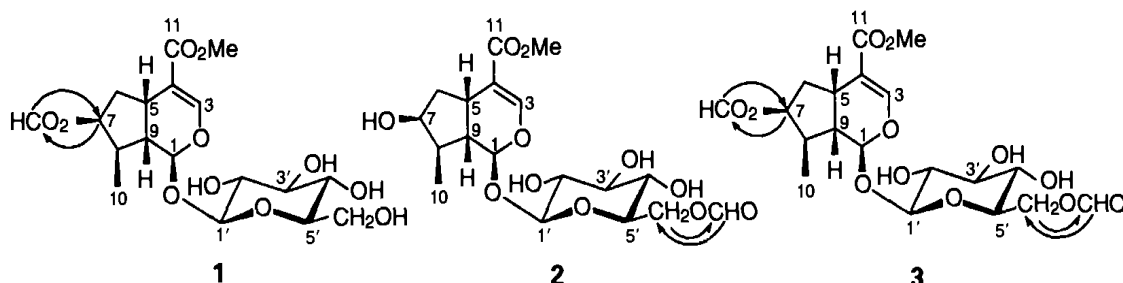


Fig. 1 The structures and key HMBC spectra of compounds 1-3

Compound **1** and **2** were determined to have the same molecular formula  $C_{18}H_{26}O_{12}$  based on the molecular ion peak at  $m/z$  417.1331 for **1** and 417.1428 for **2** (calcd. 417.1397 for  $[M-H]^-$ ) by the negative high resolution FABMS experiments. Similar to those of loganin (**4**), the EIMS of **1** and **2** gave the similar fragment ions at  $m/z$  256 ( $M^+ - 162$ ), 239 ( $256 - 17$ ), 225 ( $256 - 31$ ), 210 ( $256 - 46$ ) and 179, and 256 ( $M^+ - 162$ ), 210 ( $256 - 46$ ), 198 ( $229 - 31$ ), 192 ( $210 - 18$ ), 179, respectively. The  $^1H$  and  $^{13}C$  NMR were also roughly coincidence with those of loganin (Ikeshiro and Tomita, 1984), except for the additional signal of the formyl proton ( $\delta$  8.15, s, 1H in **1** and 8.14, s, 1H in **2**) and the down-field shifts of H-7, H-8 and C-7 (Table 1) for **1**, and the down-field shifts of H-6' and C-6' for **2**. Above mentioned data indicated that the 7-OH and 6'-OH in loganin was replaced by HCOO- in **1** and **2**, respectively. Furthermore, the following key  $^1H - ^{13}C$  long-range correlations in **1** and **2** were observed in HMBC experiments: between the formyl proton ( $\delta$  8.15, s, 1H) and C-7 ( $\delta$  78.0, d), between H-7 ( $\delta$  5.28, br.t, 1H,  $J = 5.0$  Hz) and formyl carbon ( $\delta$  162.6, d); and between formyl proton ( $\delta$  8.14, s, 1H) and C-6' ( $\delta$  63.9, t), between H-6' ( $\delta$  4.30, dd, 1H,  $J = 5.9, 12.0$  Hz & 4.51, dd, 1H,  $J = 1.5, 12.0$  Hz) and formyl carbon ( $\delta$  162.9, d), respectively (Fig. 1). Hence, the structure of **1** was elucidated as 7-*O*-formyl loganin, and **2** as 6'-*O*-formyl loganin.

The molecular formula of compound **3** was determined as  $C_{19}H_{26}O_{12}$  based on the molecular ion peak at  $m/z$  445.1290 (calcd. 445.1346 for  $[M-H]^-$ ) by the negative high resolution FABMS experiments. Its EIMS,  $^1H$  and  $^{13}C$  NMR were very similar to those of compounds **1** and **2**, except for the enhance 28 units in molecular weight, implying **3** was probably the double-formylation derivative of loganin. Comparison with those of loganin, the two additional signals of formyl protons ( $\delta$  8.14, s, 1H and 8.13, s, 1H), and the downfield shifts of H-7, H-8, H-6', C-7 and C-6' were observed in **3** (Table 1). All those data indicated that both 7-OH and 6'-OH in loganin were replaced by HCOO- in **3**. Furthermore, the key  $^1H - ^{13}C$  long-range correlations between the formyl proton ( $\delta$  8.14, s, 1H) and C-7 ( $\delta$  78.2, d), between H-7 ( $\delta$  5.27, br.t, 1H,  $J = 4.4$  Hz) and formyl carbon ( $\delta$  162.6, d), and between another formyl proton ( $\delta$  8.13, s, 1H) and C-6'

( $\delta$  63.8, t), between H-6' ( $\delta$  4.31, dd, 1H,  $J = 5.8, 12.0$  Hz & 4.51, dd, 1H,  $J = 1.5, 12.0$  Hz) and another formyl carbon ( $\delta$  162.9, d) were observed in HMBC experiments (Fig. 1). Hence, the structure of **3** was elucidated as 7, 6'-*O*-diformyl loganin.

Table 1 The NMR data for compounds 1-3<sup>a</sup>

position	1		2		3	
	<sup>1</sup> H	<sup>13</sup> C	<sup>1</sup> H	<sup>13</sup> C	<sup>1</sup> H	<sup>13</sup> C
1	5.27 (d, $J = 5.0$ )	97.6d	5.10 (d, $J = 5.0$ )	98.2d	5.10 (d, $J = 5.3$ )	97.9d
3	7.43 (s)	152.6d	7.38 (s)	152.2d	7.38 (s)	152.6d
4	/	113.0s	/	114.0s	/	113.0s
5	3.10 (t, $J = 8.1$ )	32.6d	3.10 (t, $J = 8.2$ )	32.3d	3.10 (t, $J = 8.2$ )	32.7d
6	1.77 (m)	40.4t	1.55 (m)	42.9t	1.71 (m)	40.6t
	2.30 (dd, $J = 7.8, 8.0$ )		2.23 (dd, $J = 7.7, 8.0$ )		2.31 (dd, $J = 7.7, 8.0$ )	
7	5.28 (brt, $J = 5.0$ )	78.0d	4.04 (brt, $J = 4.3$ )	75.0d	5.27 (brt, $J = 4.4$ )	78.2d
8	2.14 (m)	40.7d	1.84 (m)	42.3d	2.12 (m)	40.8d
9	2.05 (ddd, $J = 5.0, 5.0, 8.0$ )	47.0d	1.98 (ddd, $J = 4.9, 4.9, 8.7$ )	46.4d	2.40 (ddd, $J = 5.2, 5.2, 8.1$ )	46.8d
10	1.07 (d, $J = 6.6, 3H$ )	13.7q	1.07 (d, $J = 7.0, 3H$ )	13.5q	1.05 (d, $J = 6.9, 3H$ )	13.7q
11	/	169.2s	/	169.5s	/	169.2s
-OMe	3.69 (s, 3H)	51.7q	3.68 (s, 3H)	51.7q	3.69 (s, 3H)	51.7q
7-CHO	8.15 (s)	162.6d	/	/	8.14 (s)	162.6d
1'	4.66 (d, $J = 7.9$ )	100.2d	4.64 (d, $J = 8.0$ )	100.3d	4.66 (d, $J = 8.0$ )	100.4d
2'		74.7d		74.6d	74.6d	
3'		78.3d		77.8d		77.7d
4'	3.20-3.41 (m, 4H)	71.6d	3.20-3.50 (m, 4H)	71.4d	3.20-3.51 (m, 4H)	71.3d
5'		78.3d		75.4d	75.4d	
6'	3.66 (dd, $J = 6.0, 12.0$ )	62.8t	4.30 (dd, $J = 5.9, 12.0$ )	63.9t	4.31 (dd, $J = 5.8, 12.0$ )	63.8t
	3.90 (dd, $J = 1.0, 12.0$ )		4.51 (dd, $J = 1.5, 12.0$ )		4.51 (dd, $J = 1.5, 12.0$ )	
6'-CHO	/	/	8.14 (s)	162.9d	8.13 (s)	162.9d

<sup>a</sup> <sup>1</sup>H and <sup>13</sup>C NMR spectra were obtained at 400 MHz and 100 MHz, and recorded in CD<sub>3</sub>OD at room temperature, respectively. Unless otherwise indicated, all proton signals integrated to 1H. Coupling constants were presented in Hertz.

## 2 Experimental

### 2.1 General Experimental Procedures

Optical rotations were determined on a JASCO-20 polarimeter. The <sup>1</sup>H and <sup>13</sup>C NMR spectra were recorded on BRUKER AM-400 and / or DRX-500 with TMS as internal standard. The chemical shifts are reported in  $\delta$  units (ppm). EIMS and HRFABMS measurements were carried out on a VG Auto Spec-3000 spectrometer. TLC and column chromatography were performed on plates precoated with silica gel F<sub>254</sub> and over silica gel H (Qingdao Marine Chemical Ltd., P. R. China), respectively. Solvents were distilled prior to use.

### 2.2 Plant Material

The stem barks of *Winchia calophylla* A. DC. were collected in Xishuangbanna, Yunnan Province of China, in the July 2000 and were identified by Prof. Liu Hong-Mao and Mr. Cui Jing-Yun. The voucher specimen was deposited in the Xishuangbanna Garden of Tropical Plants, Chinese Academy of Sciences.

### 2.3 Extraction and Isolation

The dried and ground stem barks (10.5 kg) of *W. calophylla* were extracted four times with 95% EtOH under reflux. Removal of the solvents in vacuum produced a concentrated syrupy (600 g) which was partitioned between petroleum ether and water. The petroleum insoluble fraction was dissolved in 2% HCl (4 × 500 ml). The acidic solution was adjusted to pH 9-10 with concentrated ammonia and the obtained basic solution was then extracted with petroleum ether (3 × 600 ml), chloroform (3 × 600 ml), *n*-butanol (3 × 500 ml) in turns.

The butanol fraction (180 g) was subjected to flash column chromatography over silica gel H eluting with ethyl acetate and gradient EtOAc-MeOH to afford seven fractions. The residues BO-6 (~6 g) gave Compounds **1** (52 mg), **2** (64 mg), **3** (19 mg) and **4** (136 mg) by repeated column chromatography over silica gel H eluting with CHCl<sub>3</sub>-MeOH-HCO<sub>2</sub>H (900:100:0.5).

#### 2.4 Identification

7-*O*-formyl loganin (**1**) was obtained as white amorphous powder.  $[\alpha]_D^{24} - 56.6$  (*c* 2.60, MeOH). Negative FABMS *m/z* [M-H]<sup>-</sup> 417 (14), 255 (100). EIMS *m/z* (%): 256 (33), 239 (13), 225 (18), 210 (41), 193 (59), 179 (40), 150 (40), 139 (39), 127 (46), 109 (40), 97 (46), 85 (62), 81 (71), 7 (83), 55 (100). <sup>1</sup>H and <sup>13</sup>C NMR data see Table 1.

6'-*O*-formyl loganin (**2**) obtained as white amorphous powder.  $[\alpha]_D^{24} - 51.2$  (*c* 0.65, MeOH). Negative FABMS *m/z* [M-H]<sup>-</sup> 417 (5), 227 (100). EIMS *m/z* (%): 230 (50), 229 (45), 210 (65), 192 (27), 179 (100), 150 (49), 139 (76), 127 (26), 109 (34), 97 (43), 86 (50), 74 (46), 55 (42). <sup>1</sup>H and <sup>13</sup>C NMR data see Table 1.

7, 6'-*O*-diformyl loganin (**3**) obtained as white amorphous powder.  $[\alpha]_D^{24} - 58.3$  (*c* 0.75, MeOH). Negative FABMS *m/z* [M-H]<sup>-</sup> 445 (3), 417 (15), 255 (100). EIMS *m/z* (%): [M]<sup>+</sup> 446 (4), 415 (6), 387 (5), 256 (100), 239 (19), 228 (44), 210 (77), 193 (86), 179 (77), 161 (26), 150 (65), 139 (67), 127 (65), 109 (51), 97 (52), 85 (73), 73 (74), 57 (67). <sup>1</sup>H and <sup>13</sup>C NMR data see Table 1.

Loganin (**4**) obtained as white amorphous powder.  $[\alpha]_D^{24} - 37.5$  (*c* 1.10, MeOH). EI-MS *m/z* (%): 228 (73), 210 (76), 197 (34), 182 (86), 179 (100), 150 (66), 139 (87), 125 (48), 110 (61), 103 (62), 97 (73), 85 (80), 73 (74). <sup>1</sup>H-NMR (400 MHz, CD<sub>3</sub>OD)  $\delta$ : 5.27 (d, 1H, *J* = 4.5 Hz, H-1), 7.39 (s, 1H, H-3), 3.10 (t, 1H, *J* = 8.1 Hz, H-5), 1.61 (m, 1H, H-6), 2.22 (ddd, 1H, *J* = 4.9, 8.0, 13.1 Hz, H-6), 4.03 (t, 1H, *J* = 4.4 Hz, H-7), 1.86 (m, 1H, H-8), 2.03 (ddd, *J* = 4.5, 4.5, 8.1 Hz, H-9), 1.08 (d, 3H, *J* = 6.9 Hz, H-10), 3.68 (s, 3H, -OCH<sub>3</sub>), 4.64 (d, 1H, *J* = 8.0 Hz, H-1'), 3.12-3.40 (m, H-2' ~ H-5'), 3.66 (dd, 1H, *J* = 5.6, 12.0 Hz, H-6'), 3.89 (dd, 1H, *J* = 1.6, 12.0 Hz, H-6'). <sup>13</sup>C-NMR (100 MHz, CD<sub>3</sub>OD)  $\delta$ : 97.8 (d, C-1), 152.1 (d, C-3), 114.1 (s, C-4), 32.1 (d, C-5), 42.7 (t, C-6), 75.0 (d, C-7), 42.1 (d, C-8), 46.6 (d, C-9), 13.4 (q, C-10), 169.6 (s, C-11), 100.1 (d, C-1'), 74.8 (d, C-2'), 78.3 (d, C-3'), 71.6 (d, C-4'), 78.1 (d, C-5'), 62.8 (t, C-6'), 51.6 (q, OCH<sub>3</sub>).

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