



## A new norlignan from *Taxodium ascendens*

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### ABSTRACT

A new norlignan, (2*R*,3*R*,4*S*,5*S*)-2,4-bis(4-hydroxyphenyl)-3,5-dihydroxy-tetrahydropyran (**1**), together with 9 known compounds were isolated from the branches and leaves of *Taxodium ascendens*. Their structures were mainly determined on the basis of MS, IR, 1D and 2D NMR spectral evidences. Methanol extract showed inhibitory activity on carbonic anhydrase II with an IC<sub>50</sub> value of 4.27 µg/ml, acetone extract and methanol extract inhibited activity of cathepsin B with IC<sub>50</sub> values of 2.12 and 3.71 µg/ml, respectively.

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## 1. Introduction

*Taxodium ascendens* Brongn belongs to Taxodiaceae and distributes naturally in the south-east of North America [1], which can grow up to 25 m high. Several diterpenes and C-32 triterpenes have been reportedly isolated from its leaves [2,3]. As part of our systematic investigations on chemical and bioactive constituents from Taxodiaceae plants, we carried out extensive chemical studies on the branches and leaves of *T. ascendens*, and obtained ten phenolics including a new norlignan (**1**) and nine known compounds (**2–10**). Meanwhile, the petroleum, acetone, methanol extracts, and compounds **1–10** were tested on carbonic anhydrase II and cathepsin B bioassays. Results indicated that the methanol extract showed inhibitory activity on carbonic anhydrase II with an IC<sub>50</sub> value of 4.27 µg/ml, acetone and methanol extracts inhibited the activity of cathepsin B with IC<sub>50</sub> values of 2.12 and 3.71 µg/ml respectively. In this paper, the isolation and structural elucidation of these compounds are reported.

## 2. Experimental

### 2.1. Generals

Optical rotations: Horiba SEAP-300. IR: Bio-Red FTS-135. UV: 2401PC. NMR: Bruker AM-400 and DRX-500. MS: VG Autospec-3000.

### 2.2. Plant

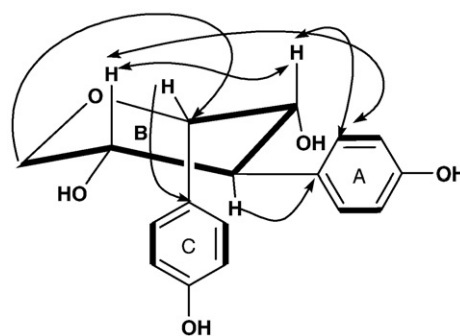
Branches and leaves of *T. ascendens* were collected in the Kunming Botanic Garden, Kunming Institute of Botany, Chinese Academy of Sciences, Kunming, Yunnan, PR China, in November 2003. A voucher specimen (No. 0040503) was deposited in the herbarium of Kunming Institute of Botany.

### 2.3. Extraction and isolation

The dried and powdered branches and leaves (11.5 kg) were respectively extracted with acetone and then with methanol at room temperature for three times. The extracts were concentrated under reduced pressure and afforded 220 g of acetone extract and 210 g of methanol extract. After degreasing by petroleum, the acetone extract (111 g) was purified by CC (2.3 kg SiO<sub>2</sub>; CHCl<sub>3</sub>/MeOH mixtures of increasing polarity), giving fractions (Fr.) 1–10. Fr.4 eluted

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**Fig. 2.** The key  $1\text{H}$ – $1\text{H}$  COSY, HMBC and ROESY correlation of **1**.

C	$\delta_{\text{H}}$	$\delta_{\text{C}}$	H–H COSY	HMBC (H→C)	ROESY
1'		127.5			
2', 6'	7.24 (d, 8.5)	127.6	3',5'	3',4,4',5'	3,5
3', 5'	6.73 (d, 8.5)	116.0	2',6'	1',2',4',6'	
4'		157.3			
4	3.48 (t, 6.4)	51.5	3,5	1',2,2',3,6,6'	3,5
5	4.58 (m)	84.0	4,6	1',3,4	2',3,6'
6	3.57 (dd, 11.7, 5.4), 3.53 (dd, 11.7, 3.7)	63.1	5	2,4,5	
1''		134.4			
2'', 6''	7.21 (d, 8.5)	132.5	3'',5''	2,3'',4'',5''	
3'', 5''	6.77 (d, 8.5)	116.2	2'',6''	1'',2'',4'',6''	
4''		157.9			
2	4.97 (d, 4.2)	88.1	3	1'',2'',3,4,6,6''	
3	4.29 (dd, 5.5, 4.4)	81.6	2,4	1'',2,5	2', 5, 6'

and H-2", 6", and the absolute configuration of C-2 was *R*. Thus, the structure of **1** was finally determined as (2*R*,3*R*,4*S*,5*S*)-2,4-bis(4-hydroxyphenyl)-3,5-dihydroxy-tetrahydropyran, named taxodascendin, the first norlignan whose C-3 on ring B was substituted by a hydroxy.

Nine known compounds **2**, **3**, **4**, **5**, **6**, **7**, **8**, **9** and **10** were respectively determined as: sequosemperverin B (**2**) [4], agatharesinol (**3**) [5], cryptoresinol (**4**) [6], 4-[3-hydroxy-2-[4-(3-hydroxypropyl)-2-methoxyphenoxy]propyl]-2-methoxyphenyl-1-*O*- $\beta$ -D-glucopyranside (**5**) [7] (7'*S*,8'*R*)-4,7'-epoxy-3,3'-dimethoxy-4,9,3',4',9'-lignanepentol (**6**) [8,9], (7'*R*, 8'*S*)-4,7'-epoxy-3,3'-dimethoxy-4,9,3',4',9'-lignanpentol-4'-*O*- $\beta$ -D-glucopyranside (**7**) [10], (2*R*,3*S*)-3,3',4',5,7-pentahydroxyflavane (**8**) [3], 1,2-dimethoxyphenyl-4-*O*- $\beta$ -D-glucoside (**9**) [11] and 1,2,3-trimethoxyphenyl-5-*O*- $\beta$ -D-glucoside (**10**) [12].

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### Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.fitote.2009.05.001.

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