

## 橙黄网孢盘菌中的新没药烷倍半萜\*

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**摘要:** 从橙黄网孢盘菌 (*Aleuria aurantia*) 中分离得到一个新的没药烷型倍半萜, 其化学结构通过波谱方法鉴定为: (1*R*, 7*S*)-15-hydroxy-1- $\alpha$ -bisabolol, 命名为 aleuriol (**1**)。没药烷型倍半萜在盘菌科中为首次报道。

**关键词:** 橙黄网孢盘菌; 没药烷倍半萜; Aleuriol

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## New Bisabolane Sesquiterpene from Culture Broth of the Fungus *Aleuria aurantia* (Pezizaceae)

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**Abstract:** A new bisabolane-type sesquiterpene: (1*R*, 7*S*)-15-hydroxy-1- $\alpha$ -bisabolol, named aleuriol (**1**) was isolated from culture broth of the fungus *Aleuria aurantia* (Pezizaceae). The structure of **1** was elucidated on the basis of extensive spectroscopic analysis. This is the first example of bisabolane isolated from the family.

**Key words:** *Aleuria aurantia*; Bisabolane sesquiterpene; Aleuriol

*Aleuria aurantia* of the family Pezizaceae is a widespread ascomycete and easily recognized by the sizable orange cups from disturbed ground. This orange peel fungus grows on bare clay or disturbed soil, which fruits mainly in late summer and autumn. The chemical investigation of *A. aurantia* began in 1938, and then a series of carotenoids were isolated from this fungus (Lederer, 1938; Valadon, 1964; Liaaen-Jensen, 1965; Arpin *et al.*, 1973). One of our efforts to discover bioactive substances from higher fungi in Southwestern China (Liu, 2005, 2006; Zhang *et al.*, 2006; Yang *et al.*, 2007) has led to the isolation of a new sesquiterpene named aleuriol (**1**) from the culture

broth of *A. aurantia*. This is the first representative of bisabolane sesquiterpene in the family. Herein, details of the isolation and structure elucidation of aleuriol (**1**) are described.

### Results and discussion

Compound **1**, obtained as colorless needles, has a molecular formula of C<sub>15</sub>H<sub>26</sub>O<sub>2</sub> based on HRESF-MS (pos.), showing a quasi-molecular ion at *m/z* 261.1835 (calcd. for C<sub>15</sub>H<sub>26</sub>O<sub>2</sub>Na, 261.1830), requiring three degrees of unsaturation. The IR spectrum displayed absorption bands of hydroxyl (3260 cm<sup>-1</sup>) and double bond (3029, 1638 cm<sup>-1</sup>) groups. The <sup>13</sup>C NMR

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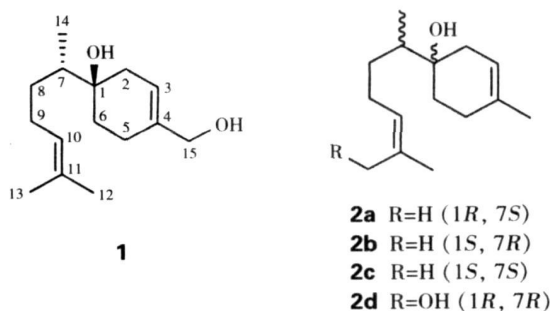
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(DEPT) spectrum (Table 1) exhibited 15 carbon signals, including a set of double bond at  $\delta$  137.1 (s), 120.2 (d), an oxygen-bearing quaternary carbon at  $\delta$  72.5 (s), as well as characteristic signals at  $\delta$  131.5 (s), 124.6 (d), 26.4 (t), 25.7 (q), 17.6 (q) contributed to an isopentenyl unit. The above NMR character allowed us to conclude that compound **1** possessed a skeleton of sesquiterpene containing only one alicyclic ring.

Table 1 NMR data for **1** in CDCl<sub>3</sub>

No.	$\delta_C$	$\delta_H$	HMBC
1	72.5 (s)		
2	34.2 (t)	1.97 (br d, 16.0); 2.17 (br d, 16.0)	G-3, G-4, G-6
3	120.2 (d)	5.57 (br s)	G-1, G-2, G-5, G-15
4	137.1 (s)		
5	22.6 (t)	2.02 (m); 2.22 (m)	G-1, G-3, G-4, G-15
6	30.3 (t)	1.59-1.65 (m)	G-2, G-4, G-7
7	42.1 (d)	1.44 (m)	G-1, G-2, G-14
8	30.8 (t)	1.05 (m); 1.58 (m)	G-1, G-10, G-14
9	26.4 (t)	1.88 (m); 2.08 (m)	G-7, G-10, G-11
10	124.6 (d)	5.08 (br t, 7.1)	G-8, G-12, G-13
11	131.5 (s)		
12	25.7 (q)	1.67 (s)	G-10, G-11, G-13
13	17.7 (q)	1.59 (s)	G-10, G-11, G-12
14	13.5 (q)	0.94 (d, 6.8)	G-1, G-7, G-8
15	66.9 (t)	3.99 (s)	G-3, G-4, G-5

The NMR spectra were similar to those of (1*S*, 7*S*)- $\beta$ -bisabolol (**2c**) (Fr ter and M ller, 1989), and the obvious NMR differences were as follows: Me-15 signals at  $\delta_C$  23.3 (q),  $\delta_H$  1.69 (3H, s) of **2c** were absent and replaced by newly arising down-field resonances at  $\delta_C$  66.9 (t),  $\delta_H$  3.99 (2H, s) in **1**, indicating that the methyl must be substituted by a hydroxyl group in **1**. This conclusion was further supported by the fact that the following significant HMBC correlations (Table 1) were observed: from H-3 to C-1, C-5, C-15; from H-15 to C-3, C-5. Therefore, the gross structure of **1** was elucidated as 15-hydroxy- $\beta$ -bisabolol, shown in Fig. 1, named aleuriol. The absolute configuration of **1** was deduced to be (1*R*, 7*S*) by comparison of its optical rotation value with those of reported analogues of  $\beta$ -bisabolol (Table 2) (Ohloff *et al.*, 1986; Kim *et al.*, 2005). Consequently, the ultimate structure of **1** was established to be (1*R*, 7*S*)-15-hydroxy-1-*epi*- $\beta$ -bisabolol.

Fig. 1 Structures of compounds **1** and **2a-2d**Table 2 The optical rotation values of **1** and its analogues

Compound	Configuration	Value	Solvent
<b>1</b>	1 <i>R</i> , 7 <i>S</i>	-48.7	<i>c</i> 0.20, CHCl <sub>3</sub>
<b>2a</b>	1 <i>R</i> , 7 <i>S</i>	-57°	<i>c</i> 0.1, CHCl <sub>3</sub>
<b>2b</b>	1 <i>S</i> , 7 <i>R</i>	+49°	<i>c</i> 0.49, CHCl <sub>3</sub>
<b>2c</b>	1 <i>S</i> , 7 <i>S</i>	+7.2°	<i>c</i> 0.28, CHCl <sub>3</sub>
<b>2d</b>	1 <i>R</i> , 7 <i>R</i>	-5.2**	<i>c</i> 1.0, CHCl <sub>3</sub>

\*/\*\* These data were cited from Ohloff *et al.*, 1986 and Kim *et al.*, 2005, respectively

## Experimental

**General** Optical rotation was measured on a Horiba SE-PA-300 polarimeter. IR spectrum was obtained with a Bruker Tensor 27 FT-IR spectrometer with KBr pellets. NMR spectra were recorded with a Bruker DRX-500 spectrometer in CDCl<sub>3</sub> ( $\delta_H$  = 7.26 ppm,  $\delta_C$  = 77.00 ppm) at room temperature. EIMS was taken on a Finnigan MAT 90 instrument and HRESIMS recorded with API QSTAR Pulsar i spectrometer. Silica gel (200-300 mesh) and LiChroprep RP-18 silica gel (40-63  $\mu$ m, Merck, Darmstadt, Germany) were used for column chromatography. Fractions were monitored by TLC and spots were visualized by heating silica gel plates immersed with vanillin-H<sub>2</sub>SO<sub>4</sub> in ethanol.

**Fungal material and fermentation** The fresh fruiting bodies of *A. aurantia* were collected at the southern part of Gaoligong Mountains in Yunnan Province, China, in July 2007 and identified by Prof. ZANG Mu. The voucher specimen was deposited at the Herbarium of Kunming Institute of Botany, Chinese Academy of Sciences. The culture medium consisted of potato (peel off) 200 g, glucose 20 g, KH<sub>2</sub>PO<sub>4</sub> 3 g, MgSO<sub>4</sub> 1.5 g, citric acid 0.1 g and thiamin hydrochloride 10 mg in 1 L of sterilized water. Reagent bottles were used as flask (size: 500 ml; volume of media: 380 ml). The pH value was adjusted to 6.5 before autoclaving. Fermentation was carried out on a shaker at 22°C and 140 r/min for 26 days.

**Extraction and isolation** The culture broth (22 L) was

extracted by EtOAc for three times. The EtOAc extract (6.2 g) was applied on a silica gel column, which eluted stepwise with petroleum ether/acetone solvent system. Fraction **3** (220 mg) from petroleum ether/acetone (10/1, v/v) was repeatedly isolated by silica gel to get a target portion (40.6 mg) mainly containing **1**, which was further purified by RP-18 column (90% MeOH in H<sub>2</sub>O) to afford aleuriol (**1**; 26.8 mg).

**Aleuriol** (**1**, 1*R*, 7*S*-15-hydroxy-1-*epi*- $\beta$ -bisabolol): colorless needles.  $[\alpha]_D^{25} = -48.7$  (c 0.20, CHCl<sub>3</sub>). IR (KBr):  $\nu = 3260, 3029, 1638, 1375, 1073, 890 \text{ cm}^{-1}$ . <sup>1</sup>H- and <sup>13</sup>C-NMR: see Table 1. EIMS:  $m/z$  (%) = 220 (30) [M-H<sub>2</sub>O]<sup>+</sup>, 189 (15), 177 (16), 138 (43), 123 (30), 109 (68), 107 (60), 96 (48), 82 (100). HRESIMS (pos.): 261.1835 (calcd. for C<sub>15</sub>H<sub>26</sub>O<sub>2</sub>Na, 261.1830).

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