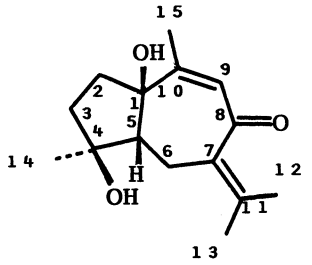
CHEMISTRY LETTERS, pp. 1625 - 1628, 1991.

Structure of Aerugidiol, a New Bridge-head Oxygenated Guaiane Sesquiterpene

Toshiya MASUDA,* Akiko JITOE, and Nobuji NAKATANI
Laboratory of Food Chemistry, Faculty of Science of Living,
Osaka City University, Sumiyoshi, Osaka 558

The structure elucidation of aerugidiol, a new bridge-head oxygenated sesquiterpene isolated from the rhizomes of Curcuma aeruginosa, is described.

Aerugidiol (**1**) was isolated from the fresh rhizomes of Curcuma aeruginosa (Zingiberaceae) collected in Bali, Indonesia, April 1990, in the course of our researches to find new substances in tropical medicinal plants.[1] Aerugidiol (**1**),[2] colorless plates (H_2O-MeOH), mp 150.0-150.5 °C, has $C_{15}H_{22}O_3$ as the molecular formula based on high resolution EI-MS (m/z 250.1632, Calcd for $C_{15}H_{22}O_3$: 250.1568). The IR spectrum of **1** revealed the presence of hydroxyl group (3368 cm^{-1}) and conjugated carbonyl group (1645 cm^{-1}). In the ^{13}C-NMR of **1**, one carbonyl carbon, four olefinic carbons, two oxygenated carbons, and eight aliphatic carbons were observed. Segments of proton coupling networks of **1** were



Aerugidiol (1)

obtained by HH-COSY spectrum and the other segments were obtained by IR and ^{1}H-NMR spectra as shown in Fig. 1. All segments were coupled by the data in COLOC spectrum[3] to reveal **1** has a new bridge-head oxygenated guaiane structure (Fig. 2). Although this structure has been reported by Kuroyanagi *et al.*, they did not mention the stereochemistry of **1**.[4] We determined the stereochemistry of **1**. At first, the orientation of hydroxyl group at 4-position was determined as follows. In the NOESY spectrum of **1**, cross peaks were observed between the methyl signal at 14-position and two protons signals at 6-position. By the way, no cross peak was obtained between the methyl signal at 14-position and the proton signal at 5-position to indicate the stereochemistry of the methyl group and 5-proton is trans. Thus, the hydroxyl group at 4-position has cis stereochemistry to the 5-proton (Fig. 3). This result was supported by a biosynthetic aspect, because we could obtain structually confirmed 1-deoxy derivatives of **1** (**2** and **3**), which have the same stereochemistry at 4- and 5-position as that of **1**,[8,9] from this rhizomes.

Determination of stereochemistry of bridge-head hydroxyl group is a difficult process. Many studies to determine the stereochemistry of such compounds were solved by X-ray analysis, generally, or by NOE method in some structurally rigid case.[5] Unfortunately, we could not obtain suitable crystals for X-ray analysis, and **1** has also a conformationaly unidentified 7-membered ring to prevent the determination of stereochemistry of **1** by NOE. Thus, we investigate a CD method, because **1** has a crossed conjugated carbonyl group in the 7-membered ring and the conformation was thought to depend on the stereochemistry of the ring junction. As abovementioned, we could isolate trans and cis 1-deoxy derivatives (**2**[6] and **3**,[7] respectively) of **1** from this plant, whose structures were established absolutely based on NOEs of **2** and X-ray analysis of the derivative of **2** by Kitagawa *et al.*[8] and by Kuroyanagi *et al.*[9] We measured and compared the CD spectra of **1** and deoxy derivatives (**2** and **3**) as shown in Fig. 4. **1** showed very similar CD

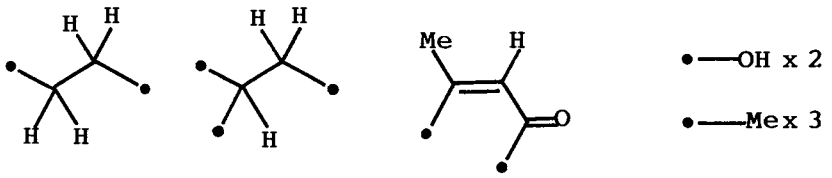


Fig.1. Segments of 1.

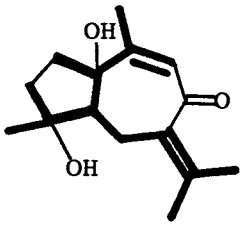


Fig.2. Carbon skeleton obtained by COLOC spectrum (heavy lines).

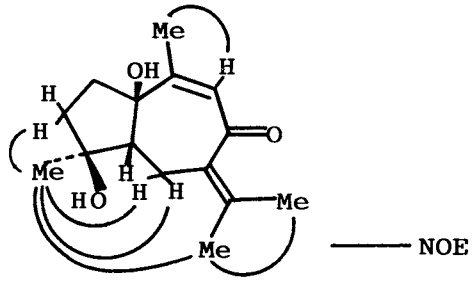
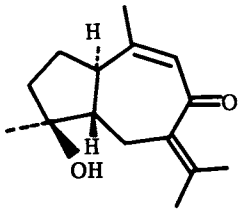
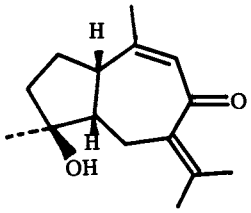


Fig.3. NOEs obtained by NOESY and NOE difference spectra.



2



3

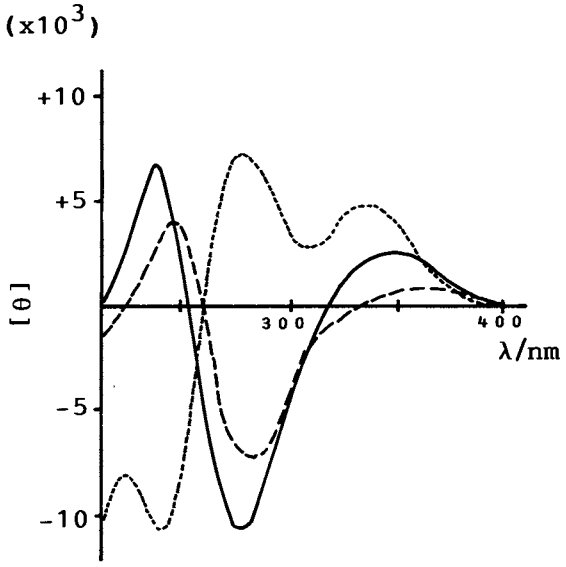


Fig.4. CD spectra of 1, 2, and 3 in MeOH. 1, ——; 2, ------; 3, ---.

spectrum to that of **3**, indicating **1** has cis junction on bridge-head and has also the same absolute configuration as that of **3**.

We thank Dr. Tadao Kondo and Dr. Kumi Yoshida (Nagoya University) for CD measurement. We also thank Dr. G. P. Tengah, Dr. D. N. Suprapta, and Dr. I. W. Gara (Udayana University, Indonesia) for the plant collection and Identification.

References

1) T. Masuda, A. Jitoe, S. Kato, and N. Nakatani, Phytochemistry, **30**, 2391 (1991).

2) **1:** ^{1}H-NMR ($CDCl_3$:C_6D_6=1:1)δ 1.24 (3H, s, H-14), 1.45 (1H, ddd, J=11.6, 5.5, 2.4 Hz, H-3), 1.61 (1H, dd, J=15.3 and 10.4 Hz, H-6), 1.61 (3H, s, H-13), 1.75 (1H, m, H-2), 1.85 (3H, d, J=1.2 Hz, H-15), 1.86 (1H, m, H-3), 1.88 (1H, d, J=10.4 Hz, H-5), 2.02 (1H, m, H-2), 2.04 (3H, s, H-12), 2.38 (1H, d, J=15.3 Hz, H-6), 4.18 (1H, brs, OH), 4.38 (1H, brs, OH), 5.80 (1H, d, J=1.2 Hz, H-9). ^{13}C-NMR ($CDCl_3$:C_6D_6=1:1) δ22.2 (15), 22.6 (13), 23.5 (12), 24.5 (14), 27.8 (6), 37.5 (3), 37.6 (2), 61.2 (5), 83.5 (4), 87.0 (1), 128.6 (9), 133.9 (7), 143.6 (11), 151.3 (10), 195.5 (8). EI-MS m/z (%) 250 (M^+, 1), 232 (M^+-H_2O, 10), 214 (M^+-2H_2O, 8), 174 (100). $[\alpha]_D^{26}$ -17.0°(C 1.0 MeOH).

3) COLOC correlations of **1:** C-1/H-6 , H-9, H-15, C-3/H-14, C-4/H-6 ,H-14, C-5/H-6 , H-14, C-6/H-13, C-7/H-6 , H-12, H-13, C-8/H-6 , C-9/H-15, C-10/H-15, C-11/H-12, H-13, C-12/H-13, C-13/H-12, C-15/H-9.

4) M. Kuroyanagi, K. Ujiie, A. Ueno, and S. Sato, Symposium Paper of 29th Symposium on the Chemistry of Natural Products, **1987**, 528.

5) B. Tursch, J. C. Braekman, D. Daloze, P. Fritz, and A. Kelecom, Tetrahedron Lett., **9**, 747 (1974).

6) **2:** $[\alpha]_D^{26}$ +188.1° (c 0.67, $CHCl_3$). EI-MS m/z 234 (M^+). ^{13}C-NMR ($CDCl_3$) δ21.2 (12), 22.4 (13). 23.4 (14), 24.3 (15), 26.9 (2), 28.6 (3), 39.9 (6), 50.5 (1), 54.0 (5), 80.3 (4), 129.2 (9), 136.3 (11), 136.8 (7), 155.0 (10), 199.1 (8).

7) **3:** $[\alpha]_D^{26}$ -39.1° (c 0.23 MeOH). EI-MS m/z 234 (M^+). ^{13}C-NMR ($CDCl_3$) δ21.6 (12), 22.7 (13), 24.8 (14), 26.5 (15), 26.6 (2), 28.4 (3), 38.1 (6), 46.8 (1), 54.5 (5), 82.0 (4), 129.0 (9), 134.4 (7), 140.8 (11), 154.9 (10), 196.2 (8).

8) M. Yoshihara, C. Yang, C. Zheng, H. Shibuya, Y. Hamamoto, N. Tanaka, and I. Kitagawa, Chem. Pharm. Bull., **34**, 434 (1986).

9) M. Kuroyanagi, A. Ueno, K. Koyama, and S. Natori, Chem. Pharm. Bull., **38**, 55 (1990).

(Received July 1, 1991)