CHEMISTRY LETTERS, pp. 1383-1384, 1979. © The Chemical Society of Japan 1979

(-)-ISOBICYCLOGERMACRENAL, A NOVEL SESQUITERPENOID OF *ENT*-ISOBICYCLOGERMACRENE GROUP FROM THE LIVERWORT *LEPIDOZIA VITREA*

Akihiko MATSUO,* Naoji KUBOTA, Seiryû UTO, Mitsuru NAKAYAMA,
Shûichi HAYASHI,1) and Kazuo YAMASAKI#
Department of Chemistry, Faculty of Science, Hiroshima
University, Higashisenda-machi, Hiroshima 730
Institute of Pharmaceutical Sciences, School of Medicine,
Hiroshima University, Kasumi, Hiroshima 734

A novel sesquiterpene aldehyde, (-)-isobicyclogermacrenal, was isolated from *Lepidozia vitrea*, and its structure and absolute configuration were shown to be *ent*-isobicyclogermacren-14-al on the basis of the chemical and spectral evidence.

In the course of our investigation on terpenoids from the liverworts (Hepaticae),2) a novel sesquiterpene aldehyde named (-)-isobicyclogermacrenal was isolated from a methanol extract of the leafy liverwort *Lepidozia vitrea* Steph. The structure and absolute configuration was determined as the formula(**1**), and we here describe the chemical and spectral evidence for the proposed structure.

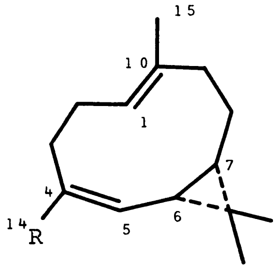
(-)-Isobicyclogermacrenal(**1**), $C_{15}H_{22}O$(M^+ 218); $[\alpha]_D$ -168°(c 1.0, $CHCl_3$), was characterized to be a bicyclic sesquiterpenoid containing an aldehyde conjugated with a trisubstituted double bond[λ(EtOH) 261 nm(ε 11600); ν(CCl_4) 2810, 2705, 1685, 1624 cm^{-1}; δ($CDCl_3$) 6.28(1H, d, J=9.0 Hz), 9.25(1H, s)], a trisubstituted double bond[ν 860 cm^{-1}; δ 5.06(1H, m)] bearing a methyl group[δ 1.25(3H, d, J=1.5 Hz)], a cyclopropane ring[δ 0.5-0.9(2H, complex)] and a gem-dimethyl[ν 1387, 1380 cm^{-1}; δ 1.18, 1.21(each 3H, s)]. The spectra resembled those of bicyclogermacrene3) and isobicyclogermacrene4) prepared by isomerization of the former, apart from the presence of an aldehyde group.

Now, **1** was reduced with $LiAlH_4$ in ether to give an alcohol(**2**), $C_{15}H_{24}O$(M^+ 220); mp 86.5-88 °C; $[\alpha]_D$ +21°(c 1.1, $CHCl_3$), whose structure was supported by the off-resonance ^{13}C-NMR spectrum(3 singlets, 4 doublets, 5 triplets and 3 quartets).5) By treatment of **2** with C_5H_5N-SO_3 and followed by $LiAlH_4$ in ether it was then transformed into a polar hydrocarbon(**3**), $C_{15}H_{24}$(M^+ 204); $[\alpha]_D$ +15°(c 1.0, $CHCl_3$), as well as a less polar hydrocarbon(**4**), $C_{15}H_{24}$(M^+ 204); $[\alpha]_D$ +4.0°(c 1.0, $CHCl_3$), in a ratio of 2 : 1. The major sesquiterpene hydrocarbon was identified as isobicyclogermacrene, excluding the absolute configuration, by a comparison of the IR and ^1H-NMR spectra with those of the authentic specimen.4) The geometries of two double bonds were also confirmed to be 4-*cis* and 1(10)-*trans* on the basis of NOE of the original aldehyde(**1**); when the signal of the aldehyde proton(δ 9.25) was saturated by double irradiation, the integrated intensity of the 5-H signal (δ 6.28) increased and the value was measured as about 14 %. However, saturation of the 10-Me(δ 1.25) caused no increase in the intensity of the 1-H signal(δ 5.06).

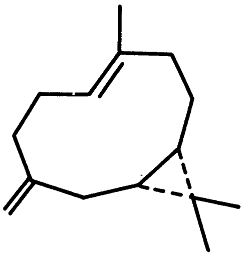
In order to establish the absolute configuration, 2 was submitted to ozonolysis in EtOAc and the resulting ozonide was oxidatively decomposed with H_2O_2 to afford an acid(5), $C_{10}H_{16}O_3$([M-58]$^+$ 126); $[\alpha]_D$ -18°(c 1.2, $CHCl_3$), which was then converted into a methyl ester(6), $C_{11}H_{18}O_3$(M^+ 198); $[\alpha]_D$ -23°(c 1.7, $CHCl_3$). The spectroscopic properties and signs of the optical rotations of both compounds (5 and 6) coincided with those of the corresponding acid and ester derived from (-)-taylorione, *ent*-1,10-seco-aromadendra-1(5),4(15)-dien-10-one, respectively.$^{6)}$

Accordingly, the structure and absolute configuration of (-)-isobicyclogermacrenal should be represented by *ent*-isobicyclogermacren-14-al or (1*E*,4*E*)-*ent*-bicyclogermacra-1(10),4-dien-14-al(1). This is the first example of the naturally occurring isobicyclogermacrene sesquiterpenoid, and the compound inhibits the growth of rice at concentration of 50 ppm.

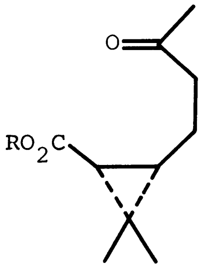
The authors thank Dr. Kiichi Nishimura, The Central Research Institute, Suntory LTD., for providing the IR spectra of the hydrocarbons.



1 R=CHO
2 R=CH_2OH
3 R=CH_3



4



5 R=H
6 R=CH_3

References and Notes

1) The present address: Department of Chemistry, Faculty of Science, Okayama University of Science, Ridai-cho, Okayama 700.

2) The previous paper: A. Matsuo, H. Nozaki, K. Atsumi, H. Kataoka, M. Nakayama, Y. Kushi, and S. Hayashi, J. Chem. Soc., Chem. Commun., 1979, in press.

3) K. Nishimura, N. Shinoda, and Y. Hirose, Tetrahedron Lett., 1969, 3097.

4) K. Nishimura, I. Horibe, and K. Tori, Tetrahedron, 29, 271 (1973).

5) The spectral data of the new compounds(2 and 4) derived from 1 were as follows. 2: ν(CCl_4) 3620, 3400, 1670, 1390, 1380, 1218, 1080, 992, 860 cm^{-1}; δ($CDCl_3$) 1.03, 1.07(each 3H, s), 1.36(3H, d, J=1.5 Hz), 3.99(2H, br.s), 5.12(1H, m), 5.22(1H, d, J=8.0 Hz); δ_C($CDCl_3$) 15.8(q), 17.1(q), 17.7(s), 23.3(t), 27.6(q), 27.6(t), 27.6(t), 29.2(d), 33.6(d), 40.6(t), 67.3(t), 123.7(d), 126.0(d), 134.4 (s), 139.0(s). 4: ν(CCl_4) 3060, 1635, 1390, 1380, 1220, 890 cm^{-1}; δ($CDCl_3$) 0.79, 1.04(each 3H, s), 1.66(3H, d, J=1.5 Hz), 4.83(2H, br.s), 5.28(1H, m).

6) A. Matsuo, S. Sato, M. Nakayama, and S. Hayashi, Symposium Papers on the Chemistry of Natural Products, 18, 69 (1974); idem, J. Chem. Soc., Perkin I, 1979, in press.

(Received September 17, 1979)