CHEMISTRY LETTERS, pp. 1535-1536, 1988.

Isolation and Structure of a New Natural Cyclopentenone Derivative from Potato Culture Solution of Phoma wasabiae Yokogi

Osamu SOGA,* Hidetoshi IWAMOTO, Akio TAKUWA, Tamayo TAKATA, Yuko TSUGIYAMA, Kensaku HAMADA, Takaji FUJIWARA, and Mitsuru NAKAYAMA*†

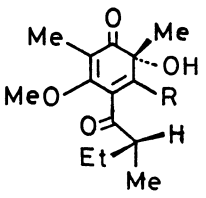
Department of Chemistry, Faculty of Science, Shimane University, Nishikawatsu-cho, Matsue 690

†Department of Agricultural Chemistry, College of Agriculture, University of Osaka Prefecture, Sakai, Osaka 591

A new natural cyclopentenone derivative has been isolated from the potato culture solution of Phoma wasabiae, and its structure was determined to be (5S*)-5-acetyl-3,5-dimethoxy-2-methyl-(4R*)-4-[(2R*)-2-methylbutanoyl]-2-cyclopenten-1-one by spectroscopic and single crystal X-ray diffraction analyses.

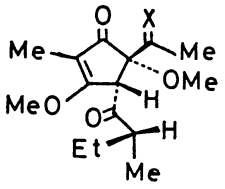
In the previous papers,[1,2] we have reported the isolation and the structural elucidation of wasabidienone A (WA) and wasabidienone E (WE) as new natural cyclohexadienone derivatives from the potato culture solution of Phoma wasabiae Yokogi. Phoma wasabiae was incubated on the stationary potato culture solution containing 2% glucose at 25 °C. After 2 weeks of the cultivation, the blackish culture solution was extracted with chloroform and its extract was showed seven yellow bands on silicagel plate (Merck Art 7747) using C_6H_6-CH_3OH (9:1) as the solvent [R_f values: 0.75, 0.68(WA), 0.53, 0.34, 0.19, 0.15, 0.10(WE)]. In this paper, the other pale yellow band [R_f 0.75; wasabienone B_0 (WB_0)] was collected and extracted with ether to give an oily substance. WB_0 was further purified by the use of C_6H_6-CH_3OH (97:3), yield 11.7 mg per 6 dm^3 of culture solution.[3] WB_0 showed $[\alpha]_D$ -297.8° (c 0.09, $CHCl_3$), a molecular formula $C_{15}H_{22}O_5$ [Found: m/z 282.1477 (Calcd: 282.1468) and Anal. C, H], UV $\lambda_{max}^{95\%EtOH}$ nm(log ε): 266(3.70), and IR ν(CCl_4): 1715, 1700, 1630, 1340 cm^{-1}. From the ^1H(270 MHz)- and ^{13}C(67.8 MHz)-NMR spectral data of WB_0, the existence of 2-methylbutanoyl group [δ_H ($CDCl_3$): 0.95(3H, t, J=7.3 Hz), 1.05(3H, d, J=6.9 Hz), 1.25-1.45, 1.60-1.85, 2.50-2.57(each 1H, m); δ_C: 11.4, 13.8(each q), 25.6(t), 48.2(d), 195.5(s)] was the same as that of WB_1 (R_f 0.53, **1**) and WB_2(R_f 0.34, **2**), respectively.[4] Further structural characteristics of WB_0 deduced from the NMR spectra were the presence of one olefinic- and one acetyl-methyl group, two methoxyl groups, and one methine proton [δ_H: 1.76(3H, d, J=1.5 Hz), 2.41, 3.32, 3.96(each 3H, s), 4.75(1H, q, J=1.5 Hz); δ_C: 6.9, 25.9, 55.3, 58.2(each q), 55.6(d)]. The former methyl group showed a long-range coupling (J=1.5 Hz) with the methine proton. Moreover, we found one quaternary carbon, two tetrasubstituted double bond carbons, and two carbonyl carbons [δ_C: 91.9, 116.3, 182.8, 205.2, 208.6(each s)]. Considering the

connections of partial groups mentioned above and the number of unsaturation (five units) from the molecular formula, WB_0 must be a monocyclic ketone derivative. Treatment of WB_1 (**1**) in benzene under reflux for 20 h afforded WB_0 in 33% yield.[3] Also, WB_0 gave a monohydrazone [**3**, mp 165-167°C(benzene-hexane), $C_{21}H_{26}N_4O_8$] with 2,4-dinitorophenylhydrazine. In order to clarify the whole structure of WB_0, an X-ray crystallographic analysis was carried out using a single crystal of **3**. It belonged to the orthorhombic $P2_12_12_1$, Z=4, a=23.217(7), b=10.687(3), c=9.348(2) Å, V=2319(1) Å^3, D_m=1.316(7), and D_x=1.321 Mg m^{-3}. Intensity data of independent 2160 reflections were collected on Rigaku AFC-5 diffractometer with Cu-Kα X-ray tube, using ω-2θ scanning technique. The structure was solved by MULTAN78[5] and refined by block diagonal least-squares method to an R value of 0.067 (wR=0.088) by 1598 reflections [$F_o > 3\sigma(F_o)$].[6] 17 out of 26 hydrogen atoms were found in the difference Fourier map, and they were included in the least-squares refinement with isotropic temperature factors. Both two nitro groups and N_2 are nearly in a plane of benzene ring. The cyclopentene ring atoms are also nearly planar with maximum deviation of 0.06 Å. The ORTEP[7] view of **3** is shown in Fig. 1. Based on the stereochemistry of the 2-methylbutanoyl group of WA[1], the structure of WB_0 has been determined to be (5S*)-5-acetyl-3,5-dimethoxy-2-methyl-(4R*)-4-[(2R*)-2-methylbutanoyl]-2-cyclopenten-1-one (**4**). Biological activity of this metabolite is now under investigation.



1 R = OMe

2 R = NH_2



3 X = $N_2HC_6H_3(NO_2)_2$

4 X = O

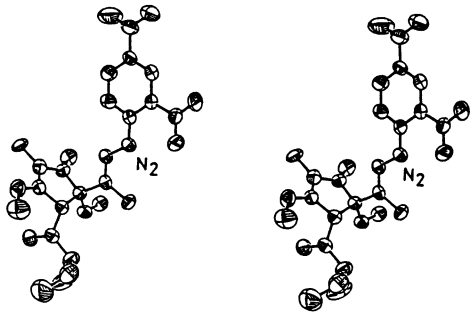


Fig. 1.

This work was supported in part by a Grant-in-Aid for Scientific Research to O.S. and M.N. (No 62540414) from the Ministry of Education, Science and Culture.

References

1) O. Soga, H. Iwamoto, S. Date, T. Watanabe, K. Tanaka, K. Hata, A. Takuwa, and M. Nakayama, Chem. Lett., 1984, 339; O. Soga, H. Iwamoto, A. Takuwa, H. Nozaki, J. Kuramoto, and M. Nakayama, Agric. Biol. Chem., 51, 283 (1987).
2) O. Soga, H. Iwamoto, Y. Ota, M. Odoi, K. Saito, A. Takuwa, and M. Nakayama, Chem. Lett., 1987, 815.
3) WB_0 was always isolated from the culture solution by treatment with attention.
4) O. Soga, H. Iwamoto, Y. Ota, Y. Oiie, A. Takuwa, H. Nozaki, J. Kuramoto, and M. Nakayama, 27th Symposium on the Chem. of Natural Products, Hiroshima, 1985, October, p. 687.
5) P. Main, S. E. Hull, L. Lessinger, G. Germain, J. P. Declercq, and M. M. Woolfson, "MULTAN78: A System of Computer Programs for the Atomic Solution of Crystal Structures from X-Ray Diffraction Data," Univ. of York, England (1978).
6) Atomic coordinates, temperature factors will be deposited with the Cambridge Crystallographic Centre.
7) C. K. Johnson, "ORTEP-II: FORTRAN Thermal Ellipsoid Plot Program for Crystal Structure Illustrations," Oak Ridge National Laboratory, Oak Ridge, Tennessee (1976).

(Received June 20, 1988)