Structural Elucidation of 11-Hydroxy-12,13-epoxyoctadeca-(9Z,15Z)-dienoic Acids from Rice Plants suffering from Rice Blast Disease

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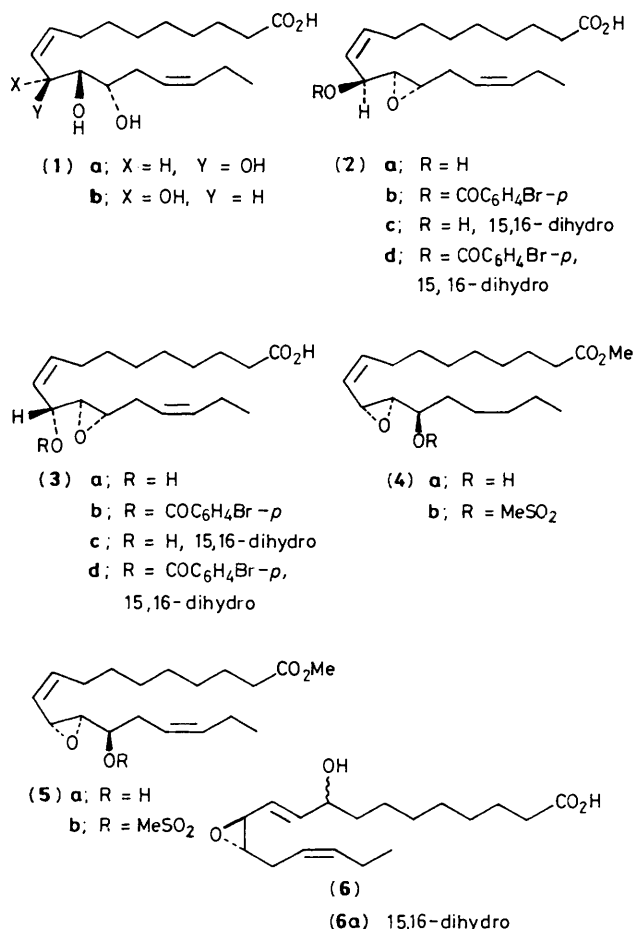[c] Faculty of Pharmaceutical Science, Tokushima Bunri University, Yamashiro cho, Tokushima 770, Japan

The structures and absolute configurations of the 11-hydroxy-12,13-epoxyoctadecadienoic acids isolated from rice plants suffering from rice blast disease have been determined.

Previously[1] we have reported the isolation of the oxygenated fatty acids (1a,b) from rice plants suffering from rice blast disease (*Pyricularia oryzae*). This communication deals with the structure determination of the remaining epoxy alcohols, (2a) and (3a), isolated from the same source.†

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† 5 and 13 mg of (2) and (3) respectively were obtained from fresh Fukunishiki (14 kg). In general, the amounts of the oxygenated fatty acids vary depending on the kind of rice plant examined.

Methyl esters of (2a) and (3a) showed the same fragmentation patterns in the chemical ionisation (C.I.) (isobutane) mass spectra, in which a peak due to $(M + 1 - H_2O)$ was detected at m/z 307 in addition to the $M + 1$ peak at 325 $[C_{17}H_{29}O_2CO_2Me(M^+)+H]$, suggesting that (2) and (3) are stereoisomers. Each ester appeared to be contaminated with small amounts of the dihydro derivative since an $M + 3$ ion was also observed. However h.p.l.c. analysis showed only a single peak for each ester. Sequential spin decoupling experiments in the 400 MHz ^1H n.m.r. spectrum permitted

(1) a; X = H, Y = OH
    b; X = OH, Y = H

(2) a; R = H
    b; R = COC$_6$H$_4$Br-p
    c; R = H, 15,16-dihydro
    d; R = COC$_6$H$_4$Br-p,
       15,16-dihydro

(3) a; R = H
    b; R = COC$_6$H$_4$Br-p
    c; R = H, 15,16-dihydro
    d; R = COC$_6$H$_4$Br-p,
       15,16-dihydro

(4) a; R = H
    b; R = MeSO$_2$

(5) a; R = H
    b; R = MeSO$_2$

(6)
(6a) 15,16-dihydro

formulation of the major component as the methyl ester of 11-hydroxy-12,13-epoxyoctadeca-(9Z,15Z)-dienoic acids, (2a) and (3a).‡ The relatively small coupling constant of 2.2 Hz between 12-H and 13-H indicates the *trans* geometry of the epoxide ring in each ester. The gross structure was supported by electron impact (E.I.) mass spectra, in which a base peak was observed at m/z 213 due to bond fission between C-11 and C-12. Since no ion corresponding to the base peak of the dihydro derivative was observed at m/z 215, the minor components are most likely the 15,16-dihydro derivatives (2c) and (3c), respectively.

In order to determine the stereochemistry of the three asymmetric carbons in each ester, the following experiment was carried out using *erythro* epoxy alcohols (4a) and (5a).[1] *dl*-Epoxy alcohol (4a) was converted into the methanesulpho-nate (4b) quantitatively with MeSO$_2$Cl in Et$_3$N at −10 °C. Compound (4b) was treated with AcOH at room temperature for 1.5 h, causing ring opening of the epoxide. The resultant crude hydroxy acetate was, without purification, hydrolysed by the action of LiOH in MeOH at room temperature for 30 min, furnishing (3c) (20%), trace amounts of (2c), and a 1:1 mixture of rearranged epoxy alcohols (6a) (50%) after separation by SiO$_2$ column chromatography.§ Oxidation of alcohol (3c) with MnO$_2$ gave the corresponding enone in 90% yield. Reduction of the enone with Zn(BH$_4$)$_2$ under Oishi's conditions[2] afforded a mixture of epoxy alcohols (2c) and (3c) in a ratio of 95:5. Since Zn(BH$_4$)$_2$ reduction is known to give the *erythro* epoxy alcohol predominantly, (2c) should have the *erythro* configuration. We have as yet no firm mechanistic evidence as to why AcOH treatment gives *syn*-diols predominantly.

The chemical shifts and coupling constants in the ^{1}H n.m.r. spectra of the synthetic compounds (2c) and (3c) were almost identical with those of the natural alcohols, except for 15,16-H. *dl-erythro* Epoxy alcohol (5a) was similarly trans-formed into the mixture of isomeric alcohols, (3a) (19%) and the rearranged alcohol (6) (34%) by sequential treatments with (i) MeSO$_2$Cl-Et$_3$N at −10 °C, 15 min; (ii) AcOH, room temp., 2.5 h; and (iii) LiOH-MeOH, room temp., 30 min, and finally purification by SiO$_2$ column chromatography. Oxida-tion of (3a) with MnO$_2$ followed by reduction with Zn(BH$_4$)$_2$ afforded the *erythro* epoxy alcohol (2a) in 60% yield. ^{1}H and ^{13}C n.m.r. spectra of (2a) and (3a), thus synthesized were identical with those of the natural compounds. The natural epoxy alcohols were converted into the corresponding p-bro-mobenzoates, h.p.l.c. of which demonstrated clearly that each of the benzoates were contaminated with the dihydro deriva-tives (2d) and (3d).¶

C.d. spectra of the benzoates (2b) and (3b) showed negative and positive Cotton effects, revealing that (2a) and (3a) are (9Z,15Z)-(11S,12S,13S)-11-hydroxy-12,13-epoxyoctadeca-9,15-dienoic acid and its 11-epimer, respectively.[3]

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References

1 T. Kato, Y. Yamaguchi, S. Ohnuma, T. Uyehara, T. Namai, M. Kodama, and Y. Shiobara, *Chemistry Lett.*, 1986, in the press.
2 T. Nakata, T. Tanaka, and T. Oishi, *Tetrahedron Lett.*, 1981, **22**, 4723.
3 N. C. Gonnella, K. Nakanishi, V. S. Martin, and K. B. Sharpless, *J. Am. Chem. Soc.*, 1982, **104**, 3775.