HETEROCYCLES, Vol. 26, No. 7, 1987

THREE NEW COUMARINS FROM MURRAYA EXOTICA

Chihiro Ito and Hiroshi Furukawa*
Faculty of Pharmacy, Meijo University, Tempaku, Nagoya 468,
Japan

Abstract — Three new coumarins named peroxyauraptenol (1) having hydroperoxy group, *cis*-dehydroosthol (3), and murraol (5) were isolated from leaves of *Murraya exotica* (Rutaceae), and the structures were assigned by chemical and/or spectrometric studies.

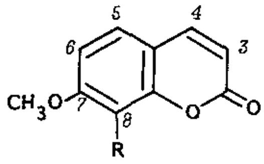
During our investigation on the constituents of the plants of genus *Murraya*,[1] many kind of monomeric and dimeric carbazoles and coumarins have been isolated and determined the structures. This paper describes the isolation of three new coumarins, peroxyauraptenol, *cis*-dehydroosthol, and murraol from leaves of *Murraya exotica* L.,[2] and structure elucidation.

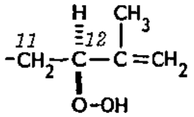
Peroxyauraptenol (1) was obtained (0.002% yield from fresh leaves) as colorless prisms, mp 114-116°C, $[\alpha]_D$ +3.53° ($CHCl_3$). The molecular formula $C_{15}H_{16}O_5$ was suggested by analyses of chemical ionisation (CI) ms (NH_3 and iso-C_4H_{10}), ^1H-nmr, and ^{13}C-nmr[3] spectra. The presence of 7-methoxy-8-substituted coumarin nucleus in this molecule was indicated by the uv (MeOH) [λ_{max} 248, 257, and 322 nm], ir ($CHCl_3$) [ν_{max} 1730 cm^{-1}], and ^1H-nmr ($CDCl_3$) spectra [δ 3.95 (3H, s, OCH_3), 7.64 (1H, d, J = 9.4 Hz), 6.26 (1H, d, J = 9.4 Hz), 7.36 (1H, d, J = 8.7 Hz), and 6.87 (1H, d, J = 8.7 Hz)].[4] Further, the ^1H-nmr spectrum showed ABC-type signals at δ 3.16 (1H, dd, J = 5.4 & 13.8 Hz), 3.27 (1H, dd, J = 7.7 & 13.8 Hz), and 4.60 (1H, dd, J = 5.4 & 7.7 Hz), two 1H-singlets at δ 4.88 and 4.94 assignable to exomethylene protons, and a 3H-singlet at δ 1.91 due to an allyl methyl group. The appearance of the signals at δ_H 4.60 (1H, dd, J = 5.4 & 7.7 Hz), one of the ABC-type protons, and δ_C 87.3 (d) together with the occurrence of fragments corresponding to $[M^+-\cdot OH]$ and $[M^+-\cdot OOH]$ in the EI-ms spectrum, and ir band at 3520 cm^{-1} showed the presence of hydroperoxy moiety in this coumarin. These data coupled with the observation of a significant mass fragment peak at m/z 189 (100

%) ascribed to an ion [a], showed the structure [$-CH_2-CH(OOH)-C(CH_3)=CH_2$] for the side chain. Treatment of this coumarin with triphenyl phosphine in methanol at room temperature gave 2: $[\alpha]_D$ -4.6° ($CHCl_3$);[5] ^{1}H-nmr ($CDCl_3$) δ: 7.62 (1H, d, J = 9.8 Hz), 7.43 (1H, d, J = 8.7 Hz), 6.86 (1H, d, J = 8.7 Hz), 6.24 (1H, d, J = 9.8 Hz), 4.90 (1H, br s), 4.80 (1H, br s), 4.35 (1H, m), 3.93 (3H, s), 3.20 (dd, J = 5.1 & 13.8 Hz), 3.09 (1H, dd, J = 13.8 & 8.4 Hz), and 1.90 (3H, s); EI-ms m/z: 243 (M^+-17), 190 (100 %), 189, 175, 161, and 131; ir ν_{max} ($CHCl_3$) cm^{-1}: 1720 and 1610; uv λ_{max} (MeOH) nm: 248, 257, and 322. All the above data were in agreement with those listed in the literature[6,7] for auraptenol (2) which was first isolated from *Citrus aurantium*,[6] and then, also from *M. exotica*[7] collected in India. Negative $[\alpha]_D$ value in chloroform of 2 derived from peroxyauraptenol suggested S-configuration for the asymmetric center according to the proposition by Schoolery.[7] These results led us to propose the structure 1 to peroxyauraptenol.

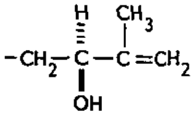
Since the first isolation of a coumarin hydroperxide from the plants of genus *Mammea* by Crombie *et al.*,[8] this is the second example of an isolation of hydroperoxygenated coumarin from natural sources.

cis-Dehydroosthol (3), $C_{15}H_{14}O_3$ [m/z 242.0919 (M^+, found); 242.0941, calcd.] was obtained (0.024% yield) as a colorless oil [ir ν_{max} ($CHCl_3$) cm^{-1}: 1725 and 1600] and gave uv spectral data typical of 7-oxygenated coumarin nucleus [uv λ_{max} (MeOH) nm :220, 277, and 322].[4] The ^{1}H-nmr ($CDCl_3$) spectrum contained signals assignable to a methoxy [δ 3.91 (3H, s)], an allyl methyl [δ 1.60 (3H, s)] and an exo-methylene group [δ 4.84 (2H, s)] as well as three pair of doublets [δ 7.62 (1H, d, J = 9.4 Hz), 7.36 (1H, d, J = 8.7 Hz), 6.84 (1H, d, J = 8.7 Hz), 6.45 (1H, d, J = 12 Hz), 6.24 (1H, d, J = 9.4 Hz), 6.20 (1H, d, J = 12 Hz)]. Among these three pair of doublets, two of them at δ 7.62 and 6.24, and δ 7.36 and 6.84 were easily assignable to H-4 and -3, and H-5 and -6, respectively, in coumarin nucleus.[4] The observation of another pair of doublets having large coupling constant (J = 12 Hz) at δ 6.45 and 6.20 revealed the presence of (Z)-disubstituted double bond in the molecule. On the results of these spectral data coupled with a similar mass fragment pattern [m/z 242 (M^+, 100%), 227, 211, 189, 183, 155, 131, 128, and 115] with that of *trans*-dehydroosthol (4)[9] which was also isolated from the same plant source and characterized,[10] the structure of *cis*-dehydroosthol was proposed to formula 3.

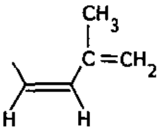


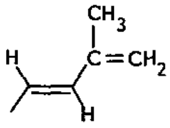
(1) R =


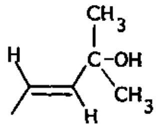
$$\mathrm{-\overset{11}{CH_2}-\overset{H}{\underset{O-OH}{\overset{12}{C}}}-\overset{CH_3}{C}=CH_2}$$

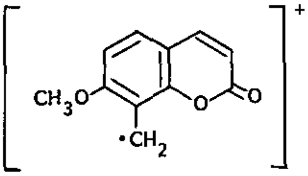
(2) R =


$$\mathrm{-CH_2-\overset{H}{\underset{OH}{C}}-\overset{CH_3}{C}=CH_2}$$

(3) R =


(4) R =


(5) R =




(a)

Murraol (5), colorless prisms (0.013% yield), mp 105-107°C; $C_{15}H_{16}O_4$ [m/z 260.1029, found; 260.1047, calcd.]; uv λ_{max} (MeOH) nm: 244, 254, 274(sh.), 282, and 318; ir ν_{max} ($CHCl_3$) cm^{-1}: 1600, 1720, and 3450. The ^1H-nmr ($CDCl_3$) spectrum indicated the presence of a methoxy group [δ 3.95 (3H, s)] and two methyls [δ 1.47 (6H, s)] attached to a carbon atom bearing a hydroxy group [δ 1.82 (1H, broad s, exchangeable with D_2O)]. Observation of characteristic two pair of doublets [δ 7.62 and 6.26 (each 1H, d, J = 9.4 Hz), and δ 7.30 and 6.86 (each 1H, d, J = 8.7 Hz)][4] suggested that murraol possessed the same 7-methoxy-8-substituted coumarin nucleus as 1 and 3 described above. Remaining AB-type signals at δ 7.02 and 6.93 (each 1H, d) having a large coupling constant (J = 16.4 Hz) were attributable to (E)-disubstituted double bond same as that of trans-dehydroosthol (4). In the mass spectrum, murraol furnished ions at m/z 242 (M^+-H_2O, 100%), 227, 211, 183, 155, 131, 128, and 115 corresponding to the behavior of 4, in addition to fragments at m/z 260 (M^+), 245, 218, 217, 203, and 189. Based on these results, we assigned structure 5 to murraol.

ACKNOWLEDGEMENT

We thank Mr. K. Masuda of Meijo University for measurements of high resolution and CI mass spectra. And we are grateful to Mr. H. Sano of Higashiyama Zoo & Botanical Garden in Nagoya for supplying the plant material (*Murraya exotica*).

REFERENCES AND NOTES

1) H. Furukawa, T.-S. Wu, T. Ohta, and C.-S. Kuoh, *Chem. Pharm. Bull.*, **33**, 4132 (1985); A. T. McPhail, T.-S. Wu, T. Ohta, and H. Furukawa, *Tetrahedron Letts.*, **24**, 5377 (1983); H. Furukawa, T.-S. Wu, and T. Ohta, *Chem. Pharm. Bull.*, **31**, 4202 (1983); H. Furukawa, M. Yogo, C. Ito, T.-S. Wu, and C.-S. Kuoh, *Chem. Pharm. Bull.*, **33**, 320 (1985); H. Furukawa, T.-S. Wu, and C.-S. Kuoh, *Chem. Pharm. Bull.*, **33**, 2611 (1985).

2) Cultivated in Higashiyama Zoo & Botanical Garden, Nagoya.

3) **1**: ^{13}C-nmr ($CDCl_3$) δ: 160.9 (s), 160.7 (s, C-2), 153.6 (s), 143.8 (d, C-4), 127.2 (d, C-5), 114.3 (s, C-8), 113.4 (t, C-14), 113.2 (d, C-3), 113.0 (s, C-9), 107.4 (d, C-6), 87.3 (d, C-12), 56.3 (q, OCH_3), 24.3 (t, C-11), and 18.6 (q, C-15); ms (EI) m/z 259, 190, 189, 175, 159, 146, 131, 118, and 103.

4) R. D. H. Murray, J. Mendez, and S. A. Brown, "*The Natural Coumarins*" p 27, John Wiley & Sons Ltd., New York, 1982.

5) Unfortunately, the yield of peroxyauraptenol (**1**) from the plant was so scarce that we could not obtain **2** enough to get the satisfactory $[\alpha]_D$ value [lit.[7] $[\alpha]_D$ -11.83° ($CHCl_3$)].

6) W. L. Stanley, A. C. Waiss, Jr., R. E. Lundin, and S. H. Vannier, *Tetrahedron*, **21**, 89 (1965).

7) B. R. Barik, A. K. Dey. P. C. Das, A. Chatterjee, and J. N. Shoolery, *Phytochemistry*, **22**, 792 (1983).

8) L. Crombie, D. E. Games, N. J. Haskins, G. F. Reed, R. A. Finnegan, and K. E. Merkel, *Tetrahedron Lett.*, 3975 (1970); L. Crombie, D. E. Games, N. J. Haskins, and G. F. Reed, *J. Chem. Soc., Perkin Trans. I*, 2241 (1972).

9) F. Bohlmann, H. Franke, and C. Zdero, *An. Quim.*, **68**, 765 (1972).

10) **4**: (0.004% yield) colorless oil; $C_{15}H_{14}O_3$ [m/z 242.0919 (M^+, found); 242.0941, calcd.]; uv λ_{max} (MeOH) nm: 218, 262, 275, 290 (sh.), 300, 316, and 340 (sh.); ^{1}H-nmr δ ($CDCl_3$): 7.63 (1H, d, J = 9.4 Hz, H-4), 7.49 (1H, d, J = 16.8 Hz), 7.30 (1H, d, J = 8.7 Hz, H-5), 6.90 (1H, d, J = 16.8 Hz), 6.87 (1H, d, J = 8.7 Hz, H-6), 6.27 (1H, d, J = 9.4 Hz, H-3), 5.19 (1H, s, $=CH_2$), 5.14 (1H, s, $=CH_2$), 3.97 (3H, s, OCH_3), and 2.03 (3H, s, allyl-CH_3); ms m/z: 242 (M^+, 100%), 227, 211, 183, 155, 131, 128, and 115.

Received, 2nd March, 1987