Two New Coumarins from *Murraya* Plants

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Two new coumarins, peroxymurraol (1) and paniculonol isovalerate (2), were isolated from leaves of *Murraya exotica* and *Murraya paniculata*, respectively, and their structures were elucidated.

Keywords *Murraya exotica*; *Murraya paniculata*; Rutaceae; coumarin; hydroperoxide; murraol; osthol; peroxyauraptenol; peroxymurraol; paniculonol

In our phytochemical studies of *Murraya* plants (Rutaceae),[1,2] several coumarins have already been isolated. Further investigation of the leaves of *M. exotica* L. and *M. paniculata* (L.) JACK afforded two new coumarins, named peroxymurraol (**1**) and paniculonol isovalerate (**2**), respectively.

Structure of Peroxymurraol (1) Peroxymurraol (**1**) was obtained as a colorless oil. The molecular formula $C_{15}H_{16}O_5$ was presumed on the basis of the chemical ionization mass (CI-MS) and proton nuclear magnetic resonance (^{1}H-NMR) spectra. The presence of a 7-methoxy-8-substituted coumarin nucleus[3] in this molecule was suggested by the appearance in the ^{1}H-NMR spectrum of two pairs of AB-type doublets [δ 7.34 and 6.88 (each 1H, d, J=8.7 Hz) and δ 7.64 and 6.28 (each 1H, d, J=9.4 Hz)] and a 3H singlet at δ 3.96 assignable to a methoxy group, together with ultraviolet (UV) and infrared (IR) absorption bands (see Experimental). Further, the ^{1}H-NMR spectrum showed a 2H singlet[4] at δ 6.91 and a 6H singlet at δ 1.50 assignable to two methyls attached to a carbon atom bearing an oxygen function. The appearance of a signal at δ 8.03 in the ^{1}H-NMR spectrum, coupled with the occurrence of fragments at m/z 260 corresponding to $[M^+ - \cdot O]$ in the electron impact mass spectrum (EI-MS) and an IR band at ν_{max} 3400 cm^{-1} indicated the presence of a hydroperoxy moiety in this coumarin. These spectral data coupled with the observation of a significant mass fragment peak at m/z 175 ascribed to an ion [a], showed the structure [–CH=CH–C(CH$_3$)$_2$(OOH)] for the side chain at C_8. Treatment of this coumarin with triphenylphosphine in methanol at room temperature gave a colorless oil, which was found to be identical with murraol (**3**) previously isolated from the same plant.[1] On the other hand, a hematoporphyrin-sensitized photooxygenation[5] of osthol (**4**),[6] one of the constituents of this plant,[1] produced two hydroperoxides, one of which was found to be identical with natural peroxymurraol (**1**) and the other with peroxyauraptenol (**5**)[1] by ^{1}H-NMR and IR comparisons, and co-thin layer chromatography (TLC). These results comfirmed the structure of peroxymurraol to be **1**. This is the third example of isolation of a hydroperoxygenated coumarin from a natural source.[1,7]

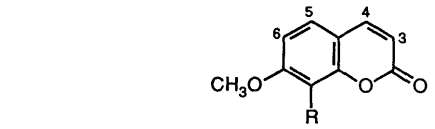
Structure of Paniculonol Isovalerate (2) Paniculonol isovalerate (**2**) was obtained from leaves of *M. paniculata* as a colorless oil, with the molecular formula $C_{20}H_{24}O_6$ from the high-resolution MS. The UV, IR (see Experimental), and ^{1}H-NMR spectra [δ 3.88 (3H, s, OCH$_3$), 7.61 (1H, d, J=9.7 Hz, H-4), 6.21 (1H, d, J=9.7 Hz, H-3), 7.37 (1H, d, J=8.7 Hz, H-5), and 6.86 (1H, d, J=8.7 Hz, H-6)] indicated the presence of a 7-methoxy-8-substituted coumarin nucleus,[3] as in **1**. In the ^{1}H-NMR spectrum, a 6H singlet at δ 1.67 was due to protons of two methyls attached to a carbon having an oxygen function, and a lower field 2H singlet at δ 4.09 was assignable to protons of an isolated methylene located between the aromatic ring and a carbonyl group. The presence of an *O*-isovaleryl moiety in this molecule was revealed by the signals at δ 2.27 (2H, m), 2.19 (1H, m), and 1.00 (6H, d, J=6.7 Hz) in the ^{1}H-NMR spectrum, and mass fragments at m/z 274 $[M^+ - HCO\text{-}CH_2CH(CH_3)_2]$ and 259 $[M^+ - \cdot OCOCH_2CH(CH_3)_2]$. These results led us to propose the structure **2** for paniculonol isovalerate.

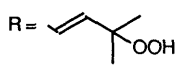
Experimental

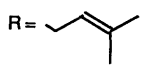
^{1}H-NMR spectra were recorded on a GX-270 (JEOL) spectrometer in $CDCl_3$. Chemical shifts are shown in δ value (ppm) with tetramethylsilane (TMS) as an internal reference. EI-MS were taken with an M-52 (Hitachi) spectrometer having a direct inlet system, and CI-MS and high-resolution MS with an M-80 (Hitachi) spectrometer. UV spectra were determined in methanol and IR spectra were recorded in $CHCl_3$.

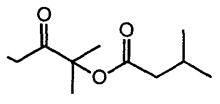
Isolation and Separation of New Coumarins The fresh leaves of *Murraya exotica* L. cultivated at Higashiyama Zoo & Botanical Garden (Nagoya) were extracted with acetone in the same manner as reported previously.[1] Silica gel column chromatography of the acetone extract using benzene as the eluent, followed by repeated preparative thin layer chromatography (P-TLC) (silica gel) afforded peroxymurraol (**1**) in 0.044% yield. In the treatment of the fresh leaves of *M. paniculata* (L.) JACK collected in Iriomote Island (Okinawa) as described in our previous paper,[2] paniculonol isovalerate (**2**) was obtained from benzene fraction of the silica gel chromatography in 0.0022% yield.

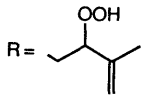
Peroxymurraol (1) Colorless oil. UV λ_{max} nm: 205, 247, 256, 320. IR

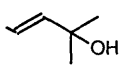


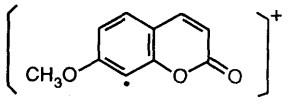
1 : R= 

4 : R= 

2 : R= 

5 : R= 

3 : R= 



a

ν_{max} cm^{-1}: 1600, 1720, 3400 (br). ^{1}H-NMR δ: 8.03 (1H, br s, –OOH), 7.64 (1H, d, J=9.4 Hz), 7.34 (1H, d, J=8.7 Hz), 6.91 (2H, s), 6.88 (1H, d, J=8.7 Hz), 6.28 (1H, d, J=9.4 Hz), 3.96 (3H, s), 1.50 (6H, s). CI-MS m/z: 294 ($M^+ + NH_4$). EI-MS m/z (%): 260 ($M^+ - 16$, 8), 219 (61), 205 (28), 203 (51), 190 (100), 189 (81), 175 (28).

Paniculonol Isovalerate (2) Colorless oil. High-resolution MS: Calcd for $C_{20}H_{24}O_6$: 360.1570. Found: 360.1566. UV λ_{max} nm: 204, 219, 246, 256, 322. IR ν_{max} cm^{-1}: 1610, 1725. ^{1}H-NMR δ: 7.61 (1H, d, J=9.7 Hz), 7.37 (1H, d, J=8.7 Hz), 6.86 (1H, d, J=8.7 Hz), 6.21 (1H, d, J=9.7 Hz), 4.09 (2H, s), 3.88 (3H, s), 2.27 (2H, m), 2.19 (1H, m), 1.67 (6H, s), 1.00 (6H, d, J=6.7 Hz). MS m/z (%): 360 (M^+), 274 (2), 259 (3), 205 (11), 190 (100), 189 (38), 171 (27), 131 (35).

Treatment of Peroxymurraol (1) with Triphenylphosphine Peroxymurraol (**1**) (3 mg) was kept in MeOH (1 ml) with triphenylphosphine (3 mg) at room temperature for 2 h. The mixture was evaporated to dryness *in vacuo*, and the residue was submitted to silica gel P-TLC to afford colorless prisms in quantitative yield; this product was found to be identical with murraol (**3**)[1] isolated from the natural source by IR and ^{1}H-NMR comparisons, and co-TLC. mp 130—132 °C. IR ν_{max} cm^{-1}: 1600, 1720, 3450. ^{1}H-NMR δ: 7.63 (1H, d, J=9.4 Hz), 7.31 (1H, d, J=8.7 Hz), 7.02 (1H, d, J=16.4 Hz), 6.93 (1H, d, J=16.4 Hz), 6.87 (1H, d, J=8.7 Hz), 6.26 (1H, d, J=9.4 Hz), 3.95 (3H, s), 1.47 (6H, s).

Photooxygenation[5] of Osthol (4)[6] Oxygen gas was bubbled through a solution of osthol (**4**) (30 mg) in pyridine (5 ml) containing hematoporphyrin (5 mg), and the solution was irradiated with a high-pressure Hg lamp using a Pyrex glass filter for 1 h. Then, the mixture was evaporated to dryness. The residue was subjected to silica gel P-TLC to afford **1** (7.2 mg) and **5** (11 mg). **1**: Colorless oil. IR ν_{max} cm^{-1}: 1600, 1720, 3400 (br). ^{1}H-NMR δ: 8.10 (1H, br s), 7.63 (1H, d, J=9.4 Hz), 7.33 (1H, d, J=8.7 Hz), 6.91 (2H, s), 6.87 (1H, d, J=8.7 Hz), 6.27 (1H, d, J=9.4 Hz), 3.96 (3H, s), 1.50 (6H, s). This product was found to be identical with natural peroxymurraol (**1**) by IR and ^{1}H-NMR comparisons, and co-TLC. **5**: Amorphous powder from ether. IR ν_{max} cm^{-1}: 1610, 1725, 3400 (br). ^{1}H-NMR δ: 8.52 (1H, br s), 7.63 (1H, d, J=9.4 Hz), 7.35 (1H, d, J=8.7 Hz), 6.87 (1H, d, J=8.7 Hz), 6.25 (1H, d, J=9.4 Hz), 4.94 (1H, s), 4.87 (1H, s), 4.60 (1H, dd, J=5.4, 7.7 Hz), 3.95 (3H, s), 3.26 (1H, dd, J=7.7, 13.8 Hz), 3.15 (1H, dd, J=5.4, 13.8 Hz), 1.90 (3H, s). This product was found to be identical with authentic peroxyauraptenol (**5**)[1] by IR and ^{1}H-NMR comparisons, and co-TLC.

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References and Notes

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