NEW PHENOLIC ETHERS FROM ESSENTIAL OILS OF SOME RUTACEAE

WILLIAM E. CAMPBELL and PETER GEORGE

Department of Organic Chemistry, University of Cape Town, Rondebosch 7700, South Africa

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Key Word Index—Agathosma ciliaris; A. imbricata; A. scaberula; Rutaceae; trans-1, 2-methylenedioxy-4-(3'-methoxy-1'-propenyl)benzene; trans-1, 2-dimethoxy-4-(3'-methoxy-1'-propenyl)benzene.

Abstract—Two phenolic ethers were isolated from the essential oils of some Agathosma species. Structures elucidated by spectral analysis and synthesis were trans-1, 2-methylenedioxy-4-(3'-methoxy-1'-propenyl)benzene and trans-1, 2-dimethoxy-4-(3'-methoxy-1'-propenyl)benzene.

In the course of our studies on the essential oils from *Agathosma* species of the South Western Cape Province, we have isolated and identified two new phenolic ethers from the oils of *Agathosma ciliaris*, *A. imbricata and A. scaberula.* Separated by prep. GC, their structures were established as *trans-1*, 2-methy-lenedioxy-4-(3'-methoxy-1'-propenyl)benzene (1) and 1, 2 - dimethoxy-4-3'(-methoxy-1' - propenyl)benzene (2).

Compound 1 had absorption bands in the IR at 1650 cm^{-1} (C=C, alkene), 1604, 1506 cm^{-1} (C=C, arene) and 863, 820, 795 cm⁻¹ (aromatic 1, 2, 4-trisubstitution). The ¹H NMR spectrum clearly showed the presence of the *trans*-3-methoxy-1-propenyl side chain with a 3 proton-singlet at δ 3.36 (OMe), a 2 proton-doublet (J = 5 Hz) at 4.03 (-CH₂), a 1 protonmultiplet at 6.09 (=CH) and a 1 proton-doublet (J = 16 Hz) at 6.52 (=CH). The multiplet at 6.82 and the singlet at 5.92 were assigned to the aromatic protons and to the CH₂ of the methylenedioxy group, respectively. The electron impact mass spectrum gave a M⁺ at m/z 192.0784 (calc. for C₁₁H₁₂O₃ 192.0786).

The IR spectrum of compound 2 also indicated a 1, 2, 4-trisubstituted aromatic compound with absorption at 1644 cm⁻¹ (C=C, alkene), 1597, 1581, 1510 cm⁻¹ (C=C, arene) and 855, 795, 765 cm⁻¹ (1, 2, 4-trisubstitution). The ¹H NMR spectrum gave, in addition to the *trans*-3-methoxy-1-propenyl group and the 3 aromatic protons, a 6 proton-singlet at δ 3.90 which was due to two OMe groups. The electron impact mass spectrum showed a M⁺ at m/z 208.1144 (calc. for C₁₂H₁₆O₃ 208.1144).

In order to confirm the 1, 2, 4-trisubstitution pattern compounds 1 and 2 were synthesized from *trans-3*, 4-methylenedioxycinnamic acid and *trans-3*,4dimethoxycinnamic acid, respectively. Treatment of



the acids with CH_2N_2 converted them to the corresponding methyl esters which were in turn reduced to the alcohols using LiAlH₄. Methylation of the alcohols was achieved with DMSO⁻/MeI. The synthetic ethers were identical in all respects (IR, ¹H NMR and MS) with the natural compounds.

EXPERIMENTAL

A. ciliaris Druce and A. imbricata Willd were collected in the Cape Point Nature Reserve and A. scaberula Dümmer in the Potberg coastal plain (representative voucher specimens Bean 240, 354, 204 in the Bolus Herbarium, University of Cape Town, Rondebosch, Cape).

IR were recorded as liquid films. ¹H NMR in CDCl₃ were determined at 100 MHz using TMS as int. standard. Prep. GLC: 15% FFAP on Chromosorb W, $4 \text{ mm} \times 4 \text{ m}$ glass column, temp. 200°, N₂ at 30 ml/min EI-MS were recorded at 70 eV.

Isolation of essential oils. Fresh stems, twigs and leaves were stream-distilled for 4 hr and the aq. distillates extracted twice with CHCl₃. The CHCl₃ solns, dried (Na_2SO_4) were evapd in vacuo to give the oils.

Trans - 1, 2 - methylenedioxy - 4 - (3' - methoxy - 1' propenyl)benzene (1). Ten 25 μ l injections of the oil yielded 20 mg 1. IR ν_{max} cm⁻¹: 3080 (=C-H), 2930, 2900, 2830 (-C-H), 1650 (C=C, alkene), 1604, 1506 (C=C, arene), 1255 (C-O), 863, 820, 795 (1, 2, 4-trisubstitution); ¹H NMR δ 3.36 (3H, s, 3'-OMe), 4.03 (2H, d, J = 5 Hz, H-3'), 5.92 (2H, s, 1, 2-O-CH₂-O-), 6.09 (1H, m, H-2'), 6.52 (1H, d, J = 16 Hz, H-1'), 6.82 (3H, m, H-3, H-5 and H-6); EI-MS (probe), m/z (rel. int.): 192.0784 [M]⁺ (100) (C₁₁H₁₂O₃), 161 [M-OMe]⁺ (74), 147 [M-OMe-CH₂]⁺ (50), 131 [M-OMe - CH₂O]⁺ (97) 119 (50), 103 (96), 91 [PhCH₂]⁺ (51), 77 [Ph]⁺ (57), 65 [C₅H₅]⁺ (28), 63 (69), 51 [C₄H₃]⁺ (33).

Trans-1, 2-dimethoxy-4-(3'-methoxy-1'-propenyl)benzene (2). Ten 25 μ l injections of the oil yielded 25 mg of 2. IR ν_{max} cm⁻¹: 3010 (=C-H), 2940, 2840 (-C-H), 1644 (C=C, alkene), 1597, 1581, 1510 (C=C, arene), 1265 (C-O), 855, 795, 765 (1, 2, 4-trisubstitution); ¹H NMR δ 3.40 (3H, s, 3'-OMe), 3.90 (6H, s, 1, 2 OMe), 4.08 (2H, d, J = 5 Hz, H-3'), 6.15 (1H, m, H-2'), 6.57 (1H, d, J = 16 Hz, H-1'), 6.92 (3H, m, H-3, H-5 and H-6); EI-MS (probe), m/z (rel. int.): 208.1144 [M]⁺ (100) (C₁₂H₁₆O₃), 177 [M-OMe]⁺ (98), 163 [M-OMe-CH₂]⁺ (30); 146 (69), 131 (47), 119 (30), 103 (37), 91 $[PhCH_2]^+$ (44), 77 $[Ph]^+$ (40), 69 (45).

Synthesis of 1. Trans-3, 4-methylenedioxycinnamic acid (2.5 g) was treated with CH_2N_2 to give trans-3, 4-methylenedioxymethyl cinnamate (2 g) as qhite crystals from MeOH, mp 132-133° (lit.[1], mp 133-134°). The Me ester (2 g) on refluxing with LiAlH₄-Et₂O afforded trans-3, 4methylenedioxycinnamyl alcohol (1.5 g) as white needles from petrol, mp 120-121° (lit.[2], mp 123°). The alcohol (100 mg) dissolved in 2 ml DMSO was stirred for 15 min under N₂ with a soln of 0.3 ml DMSO⁻ (prepared from DMSO and NaH). An excess of MeI (0.3 ml) was then added and the soln stirred for a further 30 min. The mixture was added to H₂O and the soln extracted twice with CH_2Cl_2 . The CH_2Cl_2 soln, dried (MgSO₄) was evapd in vacuo to give 1, an oil (50 mg), bp 247-249°. IR, 'H NMR and MS were identical to those of the natural product.

Synthesis of 2. The same steps were used. Trans-3, 4dimethoxy cinnamic acid (2.5 g) treated with CH₂N₂ gave trans-3, 4-dimethoxy methyl cinnamate (2.2 g) as colourless crystals from MeOH, mp 61–62° (lit.[3], mp 63–64°). LiAlH₄ reduction of the ester in turn afforded trans-3,4-dimethoxycinnamyl alcohol (1.6 g) as colourless needles from aq. MeOH, mp 76-77° (lit.[4], mp 78°). Methylation of the alcohol (100 mg) was achieved with DMSO⁻-MeI as described above, to give 2 as an oil (55 mg), bp 253-255°. The IR, ¹H NMR and MS were identical to those of the natural material.

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A COMPOUND WITH ANTIMICROBIAL ACTIVITY ISOLATED FROM THE RED SEAWEED LAURENCIA CHILENSIS

HUGO VALDEBENITO, MAGALIS BITTNER, PETER G. SAMMES,* MARIO SILVA[†] and WILLIAM H. WATSON[‡]

Chemistry of Natural Products Laboratory, Department of Botany, Facultad de Ciencias Biológicas y de Recuros Naturales, Universidad de Concepción, Chile; *Department of Organic Chemistry, University of Leeds, Leeds, U.K.; ‡Department of Chemistry, Texas Christian University, Texas, U.S.A.

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Key Word Index—Laurencia chilensis; Rhodomelaceae; Ceramiales; alga; 3-hydroxy-4-methylacetophenone.

Abstract—3-Hydroxy-4-methylacetophenone has been investigated in the red seaweed Laurencia chilensis.

The constituents of *Laurencia chilensis* De Toni, Forti et Howe, have not been previously investigated and a mixed collection of \bigoplus , \eth and \Im stages was collected in February 1980 at Cocholgüe (36°36'S: 72°59'W), Bahía Concepción, Chile.

The fresh ground alga (11.5 g) was extracted with CHCl₃ and after removal of solvent, *in vacuo* at 40°, it gave a non-volatile extract A (29 g). The yellowish CHCl₃ soln was distilled at 30° *in vacuo* to give a volatile extract B (6.5 g).

[†]To whom enquiries should be addressed.

The CHCl₃ extract *B* was chromatographed over Si gel (Merck 0.05–0.2 nm) and elution with CHCl₃ gave a mixture of compounds which was purified by further chromatography over Si gel. Elution with CHCl₃ gave 3-hydroxy-4-methylacetophenone (13 mg), mp 105–107° (CHCl₃). λ_{max}^{MeOH} nm (ϵ): 214 (7500), 222 (8470.5), 260 (5117.6), 310 (1588.2). $\lambda_{max}^{MeOH+NaOH}$ nm: 240, 270, 352. ν_{max}^{Nujol} cm⁻¹: 3400, 1660, 1610, 1580, 1130, 1070, 1020, 980, 900, 890 and 810. ¹H NMR (CDCl₃, 100 MHz) (δ): 7.48 (2H, s, H-5, H-6), 7.38–7.40 (1H, d, H-2, J = 1.82 Hz), 5.68 (1H, s, OH), 2.57 (3H, s, CO-CH₃), 2.31 (3H, s, CH₃). MS *m*/*z* (%) 150 M⁺ (36), 136