Methylation of randianin. A solution of randianin (**1**, 20 mg) in MeOH was treated with CH_2N_2 at room temp. The product was isolated and was purified by prep TLC [silica gel, MeOH–$CHCl_3$ (v/v 17:100)] to give pure methyl ester of randianin **2**, mp 200–202°. ^{1}H NMR (pyridine-d_5) δ4.89 (2H, *d*, C-1′ and C-1″), 4.5 (2H, *m*, C-6′), 3.8–4.3 (8H, *m*, sugar protons), 3.69 (3H, *s*, $-CO_2Me$), 3.35 (1H, *m*), 3.05 (1H, *m*), 1.2–2.2 (CH_2 envelope), 1.30 (3H, *s*, Me), 1.23 (3H, *s*, Me), 0.99 (3H, *s*, Me), 0.92 (3H, *s*, Me), 0.91 (3H, *s*, Me), 0.82 (3H, *s*, Me), 0.80 (3H, *s*, Me); ^{13}C NMR data see Fig. 1; EIMS *m/z* M^+ was not recorded, 325 (0.01%), 262 (53), 203 (100), 163 (8).

Acetylation of compound 2. **2** (20 mg) was dissolved in pyridine (1 ml) and acetic anhydride (1 ml). The mixture was heated in an oil bath at 70° for 6 hr. The product was worked-up in the usual manner and was purified by prep TLC (silica gel, $CHCl_3$) to yield 20 mg of pure acetate **3**, mp 145. ^{1}H NMR ($CDCl_3$) δ5.28 (1H, *t*, $J = 6.6$ and 7.3 Hz, C-12), sugar protons and coupling constants (See Table 1), 3.62 (3H, *s*, Me), 3.03 (1H, *m*, C-3), 2.13 (3H, *s*, –OAc), 2.08 (3H, *s*, OAc), 2.06 (3H, *s*, OAc), 2.02 (3H, *s*, OAc), 2.01 (6H, *s*, 2 × –OAc), 1.90 (3H, *s*, OAc), 1.11 (3H, *s*, Me), 0.92 (3H, *s*, Me), 0.89 (9H, *s*, 3 × Me), 0.72 (3H, *s*, Me), 0.71 (3H, *s*, Me).

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A CHROMANE DERIVATIVE RELATED TO STELLATIN, AND AN α-PYRONE DERIVATIVE FROM *EMERICELLA HETEROTHALLICA**

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Key Word Index—*Emericella heterothallica*; Eurotiaceae; chromane; emehetin; α-pyrone; stellatin; 6-ethyl-4-hydroxy-3,5-dimethyl-2-pyrone.

Abstract—Emehetin, a novel chromane derivative related to stellatin, and 6-ethyl-4-hydroxy-3,5-dimethyl-2-pyrone isolated along with emeheterone and stellatin from the culture filtrate of the fungus *Emericella heterothallica*. Their molecular structures were investigated by spectroscopic means and chemical correlations.

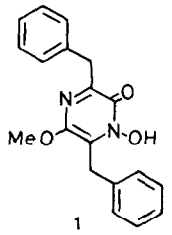
INTRODUCTION

In the previous paper [2], we reported the isolation of a new pyrazinone derivative designated emeheterone (**1**) and a dihydroisocoumarin, stellatin (**2**), from the dichloromethane extract of the culture filtrate of *Emericella heterothallica* (Kwon, Fennell & Raper) Malloch and Cain (mating type a), strain ATCC 16824. Further investigation of this extract led us to isolate a novel chromane derivative, emehetin (**3**), and a new α-pyrone derivative (**4**).

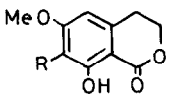
* Part 27 in the series 'Studies on Fungal Products'. For Part 26 see ref. [1].

RESULTS AND DISCUSSION

Emehetin (**3**), mp 109–110°, gave a molecular ion at *m/z* 252 in EIMS, and its elemental analysis confirmed the molecular formula $C_{13}H_{16}O_5$. The ^{1}H NMR signals at δ3.86 (3H), 6.12 (1H), 10.24 (1H), and 12.39 (1H) were assigned to a methoxy group, an aromatic proton, an aldehyde, and a hydroxy group, respectively, in the benzene ring. The partial structure CH_2CH_2O in **3** was confirmed from the decoupling experiments for the four protons at δ2.56, 2.99, 3.83, and 4.23. Emehetin (**3**) was easily oxidized with manganese dioxide to give compound **5**, which was identified with the compound derived from stellatin (**2**) by oxidation with manganese dioxide. The structure of **5** was determined by its ^{1}H NMR

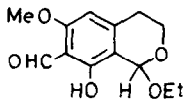


1



2 R = CH_2OH

5 R = CHO



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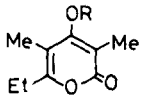

4 R = H

6 R = Ac

spectrum in comparison with those of **2** and **3**. It was thus confirmed that emehetin had the structure shown as **3**, except the substituents at C-1. From the decoupling experiments, the ^{1}H NMR signals at δ1.30 (3H), 3.76 (1H), and 3.91 (1H) were assigned to the protons of an ethoxy group. The ^{1}H NMR signal at δ5.66 (1H), which was coupled with the ^{13}C NMR signal at δ100.72, was assignable to the acetal proton. From the above results, the structure of emehetin was determined as **3**. The ^{13}C NMR signals were also explainable with this structure (**3**). Emehetin (**3**) is optically active, but the absolute configuration has not yet been determined.

Compound **4**, mp 152–154°, $C_9H_{12}O_3$, would be a 4-hydroxy-2-pyrone derivative, judged from the UV spectrum [3]. The ^{1}H NMR signals at δ1.98 (3H, *s*), 2.00 (3H, *s*), and 1.19 (3H, *t*) and 2.54 (2H, *q*) suggested the presence of two methyl groups and one ethyl group. The spectral data of **4** were comparable with those of the compound which was synthesized chemically by the condensation of three molecules of propionyl chloride [4], in all respects. On acetylation, **4** gave a monoacetate (**6**), $C_{11}H_{14}O_4$. The ^{13}C NMR signals at δ159.46 (*m*), 164.65 (*q*), and 112.85 (*q*) in **6** were observed to be changed into quartet, singlet, and singlet, respectively, by selective irradiation of one of the methyl protons (δ1.90). Furthermore, the carbon signals at δ159.46, 160.31 (*m*), and 107.41 (*m*) were changed to quartet, triplet, and broad singlet, respectively, on selective irradiation of the other methyl protons appeared at δ1.84. From these results, the structure of compound **4** was confirmed as 6-ethyl-4-hydroxy-3,5-dimethyl-2-pyrone. This is 'so called' tripropionic lactone, which might be biogenetically derived from three molecules of propionic acid.

EXPERIMENTAL

General. Mps: uncorr. Low pressure LC (LPLC) was performed on a Chemco Low-Prep 81-M-2 in a glass column (200 × 10 mm) packed with silica gel CQ-3 (30–50 μm; Wako).

Isolation of the metabolites (**3**, **4**). *Emericella heterothallica*, strain ATCC 16824 (mating type a), was cultivated at 27° for 21 days in Czapek–Dox medium containing 0.1% yeast extract. The culture filtrate (30 l) was extracted with CH_2Cl_2 at pH 2, and the organic layer dried (Na_2SO_4) and evapd. The residue (9.1 g) was chromatographed on silica gel with $CHCl_3$ followed by LPLC using cyclohexane–AcOEt (5:1) to give emehetin (**3**) (80 mg), and with $CHCl_3$–MeOH (30:1) followed by LPLC using C_6H_6–Me_2CO (10:1) to obtain 6-ethyl-4-hydroxy-3,5-dimethyl-2-pyrone (**4**) (60 mg).

Emehetin (**3**). Pale yellow prisms (cyclohexane); mp 109–110°; $[\alpha]_{365}^{25}$ −33.5° ($CHCl_3$; *c* 1.18); IR ν_{max}^{KBr} cm^{-1}: 3400–2700 (OH), 1630 (chelated CO); UV λ_{max}^{MeOH} (log ε): 283 (4.27), 340 (3.68); EIMS (probe) 70 eV, *m/z* (rel. int.): 252 [M]$^+$ (9), 207 [M − OEt]$^+$ (100); (Found: C, 62.1; H, 6.5. Calc. for $C_{13}H_{16}O_5$: C, 61.9; H, 6.4%); ^{1}H NMR (270.17 MHz, $CDCl_3$, TMS as int. std.) δ: 1.30 (3H, *dd*, *J* = 7.3, 6.7 Hz, $CH_2\underline{Me}$), 2.56 (1H, *ddd*, *J* = 17.7, 3.7, 1.2 Hz), 2.99 (1H, *ddd*, *J* = 17.7, 11.6, 6.1 Hz), 3.76 (1H, *dq*, *J* = 9.7, 6.7 Hz, $\underline{CH_2}Me$), 3.83 (1H, *ddd*, *J* = 12.2, 6.1, 1.2 Hz), 3.86 (3H, *s*, OMe), 3.91 (1H, *dq*, *J* = 9.7, 7.3 Hz, $\underline{CH_2}Me$), 4.23 (1H, *ddd*, *J* = 12.2, 11.6, 3.7 Hz), 5.66 (1H, *s*, −OCHO−), 6.12 (1H, *s*, ArH), 10.24 (1H, *s*, CHO), 12.39 (1H, *br s*, ArOH); ^{13}C NMR (100.40 MHz, $CDCl_3$, TMS) δ: 15.38 (*qt*), 29.21 (*t*m), 55.83 (*q*), 56.37 (*tqd*), 63.76 (*tt*), 92.58 (*dm*), 100.72 (*dt*), 109.39 (*dd*), 116.02 (*m*), 146.18 (*m*), 161.57 (*d*), 161.77 (*m*), 193.77 (*d*).

6-Ethyl-4-hydroxy-3,5-dimethyl-2-pyrone (**4**). Colourless prisms (C_6H_6); mp 152–154°; IR ν_{max}^{KBr} cm^{-1}: 3400–2600 (OH), 1680, 1660 (CO); UV λ_{max}^{MeOH} nm (log ε): 289 (4.11); EIMS (probe) 70 eV, *m/z* (rel. int.): 168 [M]$^+$ (72), 140 [M − CO]$^+$ (42), 125 [M − CO − Me]$^+$ (100), 113 (47), 87 (67); (Found: C, 64.4; H, 7.3. Calc. for $C_9H_{12}O_3$: C, 64.3; H, 7.2%); ^{1}H NMR (99.60 MHz, $CDCl_3$, TMS) δ: 1.19 (3H, *t*, *J* = 7.4 Hz, $CH_2\underline{Me}$), 1.98 (3H, *s*, Me), 2.00 (3H, *s*, Me), 2.54 (2H, *br q*, *J* = 7.4 Hz, $\underline{CH_2}Me$), 7.65 (1H, *br*, OH); ^{13}C NMR (100.40 MHz, $CDCl_3$, TMS) δ: 8.64 (*q*), 9.64 (*q*), 11.64 (*qt*), 24.32 (tq), 98.45 (*q*), 106.80 (*m*), 160.06 (*m*), 165.78 (*br q*), 166.89 (q).

Oxidation of emehetin (**3**) *with manganese dioxide.* MnO_2 (200 mg, activated with HNO_3) was added to the stirred soln of emehetin (**3**) (25 mg) in $CHCl_3$ (2 ml). After 10 min, excess MnO_2 was filtered off and the solution evapd. The residue was recrystallized from MeOH to give a dihydroisocoumarin aldehyde (**5**) (18 mg), colourless prisms; mp 171–173°; IR ν_{max}^{KBr} cm^{-1}: 3400–2600 (OH), 1730, 1690 (CO); UV λ_{max}^{MeOH} nm (log ε): 244 (4.40), 273 *sh* (4.06), 325 (3.73); EIMS (probe) 70 eV, *m/z* (rel. int.): 222 [M]$^+$ (76), 194 (82), 193 (100); (Found: C, 59.7; H, 4.6. Calc. for $C_{11}H_{10}O_5$: C, 59.5; H, 4.5%); ^{1}H NMR (270.17 MHz, $CDCl_3$, TMS) δ: 3.05 (2H, *t*, *J* = 5.8 Hz), 3.99 (3H, *s*, OMe), 4.52 (2H, *t*, *J* = 5.8 Hz), 6.32 (1H, *s*, ArH), 10.41 (1H, *s*, CHO), 12.61 (1H, *br s*, ArOH).

Oxidation of stellatin (**2**) *with manganese dioxide.* MnO_2 (500 mg) was added to the stirred soln of stellatin (**2**) (65 mg) in $CHCl_3$ (3 ml). After 10 min, the same procedure, as described above, gave an aldehyde (**5**) (55 mg). This compound (**5**) was identified with the compound derived from **3**, by comparison of the IR and ^{1}H NMR spectra and the TLC behaviour, and the mmp.

Acetylation of 6-ethyl-4-hydroxy-3,5-dimethyl-2-pyrone (**4**). Compound **4** (30 mg) was dissolved in the mixture of pyridine (1 ml) and Ac_2O (1 ml), and the soln was kept overnight at room temp. The mixture was poured into ice-H_2O and extracted with EtOAc. The evapd extract was purified by LPLC using C_6H_6 to obtain a monoacetate (**6**), amorphous solid; IR ν_{max}^{KBr} cm^{-1}: 1780, 1720 (CO); UV λ_{max}^{MeOH} nm (log ε): 222*sh* (3.57), 298 (4.03); EIMS (probe) 70 eV, *m/z* (rel. int.): 210.0894 [M]$^+$ (210.0893 for $C_{11}H_{14}O_4$, 30), 168 [M − CH_2CO]$^+$ (100), 140 (81), 125 (78); ^{1}H NMR (99.60 MHz, $CDCl_3$, TMS) δ: 1.22 (3H, *t*, *J* = 7.6 Hz, $CH_2\underline{Me}$), 1.84 (3H, *s*, Me), 1.90 (3H, *s*, Me), 2.34 (3H, *s*, OAc), 2.55 (2H, *q*, *J* = 7.6 Hz, $\underline{CH_2}Me$); ^{13}C NMR (100.40 MHz, $CDCl_3$, TMS) δ: 10.07 (*q*, Me), 10.13 (*q*, Me), 11.68 (*qt*, $CH_2\underline{Me}$), 20.35 (*Q*, $CO\underline{Me}$), 24.49 (*tq*, $\underline{CH_2}Me$), 107.41 (*m*, C-5), 112.85 (*q*, C-3), 159.46 (*m*, C-4), 160.31 (*m*, C-6), 164.65 (*q*, C-2), 166.79 (*q*, $\underline{C}OMe$).

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3-(4-HYDROXY-3,5-DIMETHOXYPHENYL)-PROPANAL FROM *SORBUS AUCUPARIA* SAPWOOD

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Key Word Index—*Sorbus aucuparia*; Rosaceae; mountain ash; phenols; 3-(4-hydroxy3,5-dimethoxyphenyl)-propanal.

Abstract—3-(4-hydroxy-3,5-dimethoxyphenyl)-Propanal (dihydrosinapic aldehyde) has been isolated from the sapwood of *Sorbus aucuparia* in a yield of 2×10^{-4}%. Its structure has been elucidated spectroscopically.

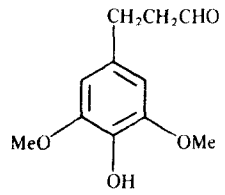
INTRODUCTION

Sorbus aucuparia L., mountain ash (Rosaceae), is a common tree in Northern Europe. From the heartwood of *S. aucuparia*, Erdtman *et al.* have isolated the biphenyls aucuparin and dimethoxyaucuparin [1, 2]. The same group isolated a lignan xyloside, lyoniside, from the sapwood [3]. In connection with our studies on the aucuparins [4, 5], we have studied the wood constituents of *S. aucuparia*. In this communication, we report the isolation and structure elucidation of a novel dihydrocinnamic aldehyde from *S. aucuparia* sapwood.

RESULTS AND DISCUSSION

The title compound **1** was isolated in 2×10^{-4}% yield from the sapwood (see Experimental). Its UV spectrum ($\lambda_{max} = 280$ nm) is typical for substituted aromatic compounds. The IR spectrum shows absorption at 1732 cm^{-1}, indicating a non-conjugated carbonyl function. In the NMR spectrum of the substance, two identical aromatic methoxyl groups give rise to a six-proton singlet at δ3.90 ppm. A broad singlet (1H) at δ5.4 is probably due to a hydroxyl proton, and a two-proton singlet at 7.20 ppm indicates two identical aromatic protons. These observations are in good accordance with NMR spectra of other syringyl (4-hydroxy-3,5-dimethoxyphenyl) systems [2, 5]. A multiplet at δ2.8 (4H) and a narrow one at δ9.75 (1H) would seem to indicate an oxygenated three-carbon side chain, either with a carboxylic acid or an aldehyde function as end group. The IR spectrum is, however, different from the one reported for 3-(4-hydroxy-3,5-dimethoxyphenyl)-propanoic acid [6], indicating an aldehyde structure.

This is substantiated by the mass spectrum, with a molecular ion at *m/z* 210 (0.6% intensity), which corresponds to a formula of $C_{11}H_{14}O_4$. Other important ions are found at *m/z* 182 and 181 [M − CO and M − CHO], and at *m/z* 167 (base peak; M − CH_2CHO, stabilized by rearrangement to a tropylium ion). Loss of the whole side chain is less favoured, as demonstrated by an intensity of



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