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TWO NEW C-METHYLATED FLAVONOIDS FROM *MYRICA GALE**

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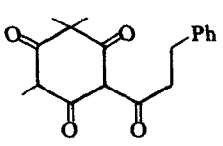
Key Word Index—*Myrica gale*; Myricaceae; flavonoids; 2',4'-dihydroxy-6'-methoxy-3',5'-dimethylchalcone; 2'-hydroxy-4',6'-dimethoxy-3'-methyldihydrochalcone.

Abstract—From the leaves of *Myrica gale* 2',4'-dihydroxy-6'-methoxy-3',5'-dimethylchalcone has been isolated. The fruits yielded 2'-hydroxy-4',6'-dimethoxy-3'-methyldihydrochalcone. The constitutions were deduced from spectroscopic data and confirmed by synthesis.

INTRODUCTION

Myrica gale (bog myrtle, Norwegian pors) is a small bush very common on moist ground and peat land in northern Europe. It has been used in folk medicine, as a substituent for hop in the brewing of beer and as a moth repellant. Today it still has commercial value as a flavour in liquor and as a perfume. There have been several investigations on the volatile components of *M. gale*. The leaf-extract is reported to contain about 130 components [4]. Among these there are a number of mono- and sesquiterpenoids which give the plant its characteristic pleasant scent.

During earlier investigations of this plant we have found several new compounds such as the flavonoids **1**–**3** [1] and the cyclophanes porson [2], galeon and hydroxygaleon [3]. We now report the occurrence of two new C-methylated flavonoids, both of which are biogenetically related to **1**, **2** and **3**. One of the new flavonoids is a chalcone and the other a dihydrochalcone.



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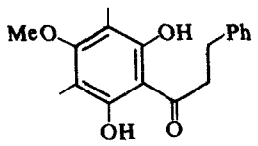

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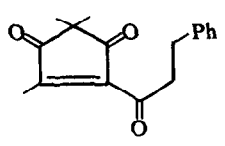

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RESULTS AND DISCUSSION

2',4'-Dihydroxy-6'-methoxy-3',5'-dimethylchalcone (**4**)

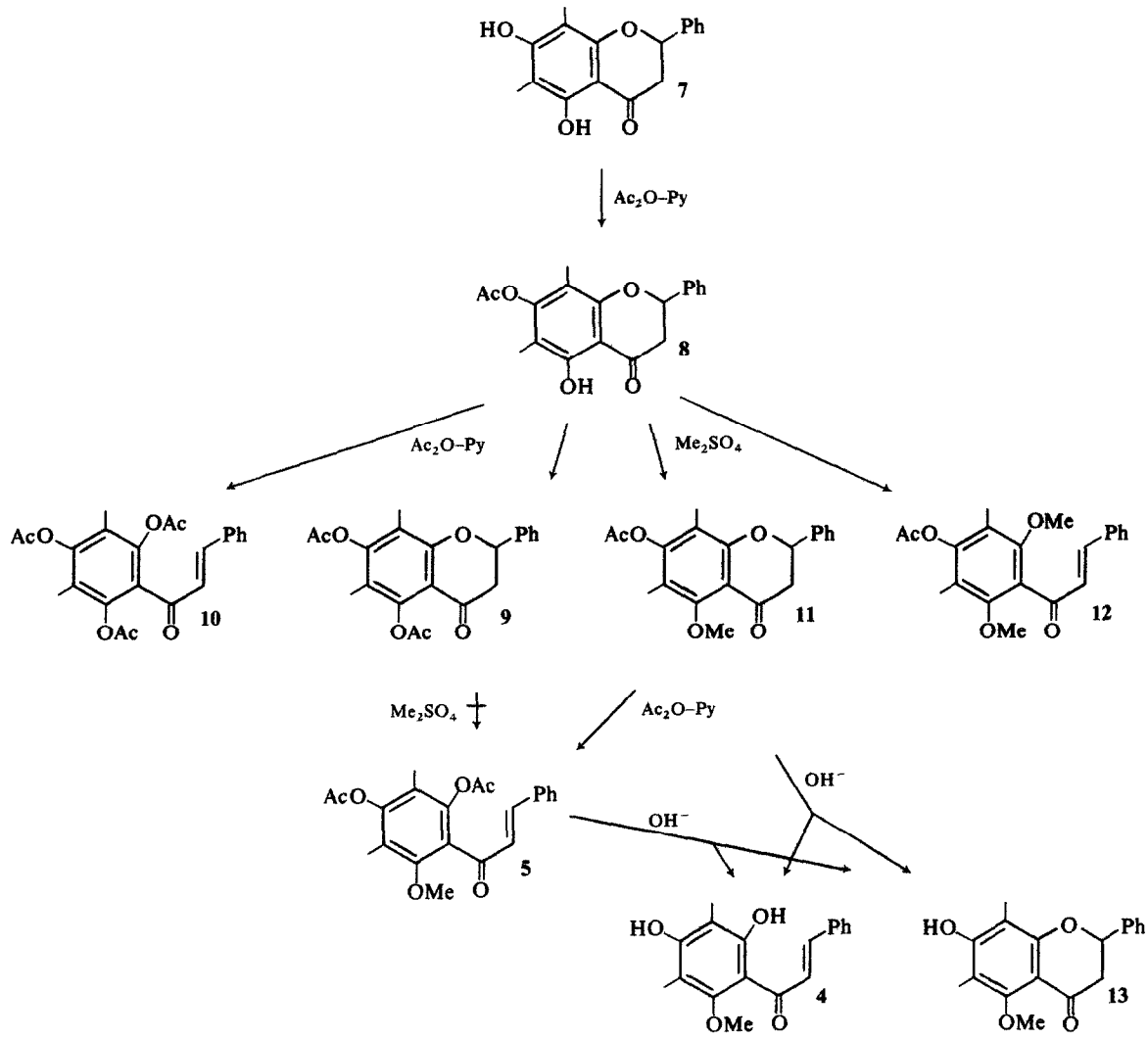
The chalcone **4** was isolated from an acetone extract of air-dried leaves. After evaporation in vacuum the extract was chromatographed on a silica gel column. Repeated column chromatography yielded crude **4** which was purified by preparative-TLC. The main impurities seemed to be steroids and triterpenoids. Crystallization from methanol gave yellow needles, mp 125–126°, $C_{18}H_{18}O_4$.

The PMR spectrum of **4** reveals the presence of a phenyl group (5H, *m*), a *trans* disubstituted double bond (AB-system, J_{AB} = 16 Hz), two non-identical aromatic Me groups (δ 2.11 and 2.14, both 3H and *s*) and one aromatic OMe group (δ 3.65, 3H *s*). Furthermore, two signals which disappear on shaking with D_2O were ascribed to two OH groups one of which was strongly hydrogen bonded (δ 13.6, 1H *s*). This suggested that one and only one OH group was located in one of the positions *ortho* to the cinnamoyl group (position 2' or 6'). Now, supposing a 1,3,5-trioxygenation pattern the constitution of **4** could only be 2',4'-dihydroxy-6'-methoxy-3',5'-dimethylchalcone. Support for this conclusion was found in the other spectra. The MS showed the M^+ peak to be the base peak and cleavages at various positions in the side chain gave peaks of high abundance. The IR spectrum shows a broad band at 1630 cm^{-1} which is characteristic for a conjugated, hydrogen-bonded carbonyl group. In good accordance with the chromophoric system is also the UV spectrum (λ_{max} 339 nm). Acetylation of **4** furnished an oily diacetate (**5**), $C_{22}H_{22}O_6$. In the PMR spectrum of this diacetate the two OH protons have been exchanged with two acetyl-Me groups at δ 1.91 and 2.07. In order to verify the suggested constitution of **4** we have synthesized **4**, its diacetate **5** and the isomeric diacetate **6**.

Synthesis of 4 and its diacetate 5 (Scheme 1)

5,7-Dihydroxy-6,8-dimethylflavanone(**7**)(desmethoxymatteucinol) was synthesized by well known routes [5–7]. Careful acetylation of **7** yielded nearly quantita-

* Part 4 of the series: 'Chemistry of *Myrica gale* L.' For parts 1–3 see references [1–3].



Scheme 1.

tively the mono-acetate 7-acetoxy-5-hydroxy-6,8-dimethylflavanone (**8**) [7]. More vigorous acetylation gave a mixture which by preparative-TLC was separated into the diacetate 5,7-diacetoxy-6,8-dimethylflavanone (**9**) [8] and the triacetate 2′,4′,6′-triacetoxy-3′,5′-dimethylchalcone (**10**). These products correspond to those obtained by acetylation of naringenin [9].

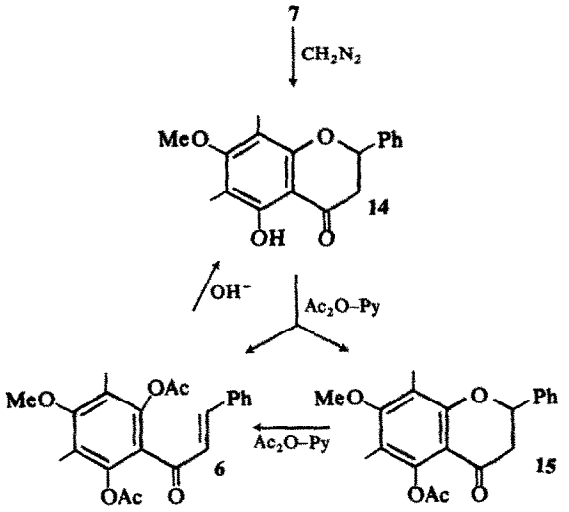
The three flavanones **7**, **8** and **9** all had mps which agreed well with previously reported values. To our knowledge the chalcone **10** has not been previously reported. Its PMR spectrum contained an AB-system diagnostic of a *trans* disubstituted double bond in a chalcone. The PMR spectra of the flavanones **7**, **8** and **9** showed ABX systems characteristic for two H_3 and one H_2. These features are the main differences in the PMR spectra of a chalcone and the corresponding flavanone.

Several attempts were made to synthesize **5** by methylation of **9** with di-Me-sulphate and potassium carbonate in acetone solution, but no reaction took place. However methylation of **8** in the same manner yielded a mixture which by preparative-TLC could be separated into 7-acetoxy-5-methoxy-6,8-dimethylflavanone (**11**) and 4′-acetoxy-2′,6′-dimethoxy-3′,5′-dimethylchalcone (**12**). The flavanone **11** has previously been synthesized from 7-hydroxy-5-methoxy-6,8-dimethylflavanone (5-*O*-methyldesmethoxy-matteucinol) (**13**) which occurs naturally in *Eugenia javanica* Lam. [8]. Both mp and spectra (PMR, IR) of **11** accord well with what has been reported earlier. On the other hand the chalcone **12** is a new compound. Its PMR spectrum clearly showed the presence of two OMe groups (δ 3.71, 6H, *s*) and the characteristic olefinic AB system. Acetylation of **11** gave a diacetate which in all respects is identical with the diacetate **5** from natural **4**.

Hydrolysis of **5** and **11** gave the same mixture which by preparative-TLC was separated into **4** and **13**. Synthetic **4** had identical mp, spectroscopic and chromatographic properties with natural **4**. Both mp and spectra (UV, IR, PMR and MS) of synthetic **13** accord well with what has been reported [8]. This synthesis therefore also is a total synthesis of 5-*O*-methyldesmethoxy-matteucinol.

Synthesis of 6 (Scheme 2)

Methylation of 5,7-dihydroxy-6,8-dimethylflavanone (**7**) with diazomethane gave the mono-Me derivative **14**. This compound which has previously been isolated from *Unona lawii* [10] had identical mp and spectroscopic properties with the natural flavanone. Acetylation of **14** yielded two products, one monoacetate ($C_{20}H_{20}O_5$) and one diacetate ($C_{22}H_{22}O_6$). The diacetate is a chalcone (AB system, δ 6.92 and 7.48) and it is isomeric with the diacetate of the natural compound (**5**). The spectroscopic properties, however, are markedly different and therefore its constitution must be **6**. On hydrolysis the chalcone **6** yielded only the flavanone **14**. No trace of the corresponding chalcone was observed. The mono-acetate was obviously the flavanone **15** (ABX system, δ 2.80, 2.93 and 5.44). This mono-acetate has been prepared earlier [8], but the reported mp (130–132°) was different from ours (114.5–115°). It would appear that the mp of **14** has been mistaken for the mp of **15** by the earlier workers.



Scheme 2.

2′-Hydroxy-4′,6′-dimethoxy-3′-methyldihydrochalcone (**16**)

The dihydrochalcone **16** was isolated from an ether extract of the fruits. Repeated column and TLC and crystallization from methanol gave colourless needles, mp 146–147°, $C_{18}H_{20}O_4$.

The PMR spectrum of **16** showed a phenyl group (5H, *m*), one aromatic Me group (δ 2.01, 3H, *s*), two OMe groups (δ 3.86, 6H, broad *s*), one aromatic hydrogen (δ 5.96, 1H, *s*), one strongly hydrogen bonded OH group (δ 13.91, 1H, *s*) and an AA′BB′ system (δ 3.11 and 3.23, 4H) very similar to the system observed in the PMR spectra of the flavonoids **1**, **2** and **3** previously isolated from this plant [1].

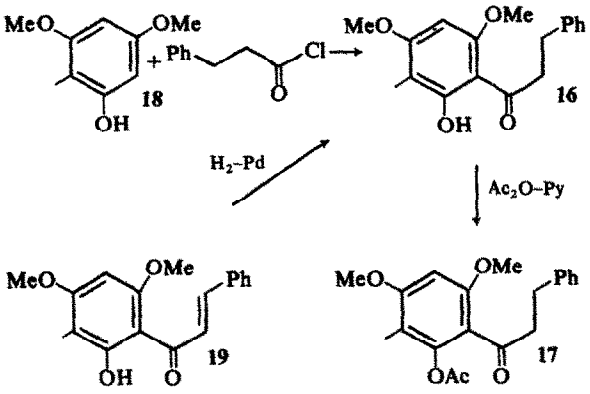
Because of the absence of the olefinic bond the base peak in the MS was no longer the M^+ peak, but the peak derived from α-cleavage at the carbonyl group(*m/e* 195, loss of Ph–CH_2–CH_2·); this also corresponds to earlier observations [1]. In the IR spectrum a conjugated, hydrogen bonded carbonyl group was clearly indicated (ν_{max} 1632 cm^{-1}).

Acetylation of **16** furnished a mono-acetate (mp 90–91° (**17**). In the PMR spectrum of this acetate the resonance of the OH proton had been replaced by an acetyl Me group (δ 1.93, 3H, *s*). The IR spectrum showed that the carbonyl group was still conjugated, but no longer hydrogen bonded (ν_{max} 1678 cm^{-1}).

Again supposing a 1,3,5-trioxygenated aromatic nucleus there were two possible constitutions for this new natural dihydrochalcone. It could either be as **16** with the Me group in the 3′ position or with the Me group in the 5′ position. Before synthesizing either of the two we did a Gibb's test for an unsubstituted *para* position relative to the OH group [11]. This test clearly indicated that **16** was the constitution of the natural product.

Synthesis of 16 (Scheme 3)

Synthetic **16** was obtained in two ways. Friedel–Crafts condensation of 3,5-dimethoxy-2-methylphenol (**18**) [12, 13] with 3-phenylpropionyl chloride gave the dihydrochalcone **16** which was acetylated to the mono-acetate **17**. Both of the synthetic products had identical physical, chromatographic and spectral properties with natural **16** and the corresponding acetate **17**.



Scheme 3.

The other route was by reduction of aurentiacin (**19**) which had been synthesized earlier [14]. Again all properties of the product were identical with those of the natural dihydrochalcone.

EXPERIMENTAL

All spectra were recorded under the following conditions unless otherwise stated. UV in MeOH soln, IR in KBr disc, PMR at 60 MHz in $CDCl_3$ soln and MS at 70 eV direct inlet. Preparative-TLC was carried out on 'Merck Fertigplatten', 0.25 mm thickness, Si gel GF 254. An Me_2CO–C_6H_6 mixture (1:20) was used as eluent unless otherwise stated.

Plant material. Myrica gale L. was collected in Bymarka, Trondheim during summer and autumn 1973 and identified by Professor N. A. Sørensen, of this University.

Isolation of 2′-4′-dihydroxy-6′-methoxy-3′,5′-dimethylchalcone (**4**). Air-dried leaves (715 g) were extracted at room temp. with 5 l. hexane ×3. The extract was evapd in *vacuo* and the resulting oil (22.2 g) gave after crystallization from MeOH a mixture of *n*-alkanes. Comparison with authentic samples by GLC gave the following % composition of the mixture: C_{25} (1), C_{27} (3), C_{28} (1), C_{29} (87), C_{30} (3), C_{31} (1) and C_{33} (3). The leaves were then extracted at room temp. with 5 l. Me_2CO ×5. The concd extract was chromatographed on a Si gel column with C_6H_6

as eluent and fractions shown to contain **4** (by PMR) were collected and re-chromatographed by preparative-TLC. Crystallization from MeOH gave 102 mg **4** as yellow needles, mp 125–126°. $M^{\cdot+}$ 298.1206 calc. for $C_{18}H_{18}O_4$ 298.1205. λ_{max} nm (log ε). 339 (4.19), 396 *sh* (3.65), with NaOMe. 239 (4.65), 2.80 (4.44), 412 (4.20). ν_{max} cm^{-1}. 3400 (*m*, broad), 2925 (*m*), 1630 (*s*), 1610 (*s*), 1545 (*m*), 1450 (*m*), 1353 (*s*), 1227 (*m*), 1169 (*s*), 1114 (*m*), 990 (*m*), 972 (*m*), 913 (*w*), 791 (*w*), 762 (*m*), 742 (*w*), 691 (*m*). PMR δ ppm: 2.11, 2.14 and 3.65 (all 3H and *s*), 5.6 and 13.6 (both 1H, *br s* and disappearing with D_2O), 7.2–7.9 (5H, *m*), 7.86 and 7.93 (AB-system, J_{AB} = 16 Hz). MS *m/e* (%). 298 (100, $M^{\cdot+}$), 297 (39, M-H; *m**), 221 (74, M-Ph·, *m**), 195 (28, M-PhCH=CH·), 194 (74, M-PhCH=CH_2), 166 (9, *m/e* 194-CO, *m**), 165 (13, *m/e* 194-HCO·), 131 (14, Ph—CH=CH—C≡O +, 298 → 131, *m**), 102 (29, Ph—C≡$CH^{\cdot+}$).

The diacetate **5**. Acetylation of **4** with Ac_2O–Py in the usual manner gave a pale yellow oil which was **5**, $M^{\cdot+}$ 382.1422, calc. for $C_{22}H_{22}O_6$ 382.1416. λ_{max} nm (log ε). 298 (4.25), no change on addition of MeONa. ν_{max} cm^{-1}. 1765 (*s*), 1650 (*m*), 1605 (*s*). PMR δ ppm: 1.91, 2.07, 2.11, 2.31 and 3.66 (all 3H and *s*), 7.01 and 7.47 (AB-system J_{AB} = 16.5 Hz), 7.2–7.7 (5H, *m*). MS *m/e* (%): 382 (55, $M^{\cdot+}$), 340 (100, M–CH_2CO, m*), 339 (24, M-MeCO), 298 (39, *m/e* 340-CH_2CO, m*).

5,7-Dihydroxy-6,8-dimethylflavanone (**7**). 2,4,6-Trihydroxyxylene was obtained from *m*-xylene by trinitration, reduction to the triamine and hydrolysis [6]. To a mixture of cinnamoylchloride (5.2 g) and 2,4,6-trihydroxyxylene (4.5 g) in nitrobenzene (50 ml) was added dropwise under N_2-atmosphere a soln of $AlCl_3$ (13 g) in nitrobenzene (80 ml). After stirring for 72 hr at 20° and 1 hr at 65° the nitrobenzene was removed by steam distillation. The residue was filtered and through the filtrate was led a stream of CO_2 gas. The ppt. was filtered off, extracted with MeOH, chromatographed on a Si gel column and crystallized from MeOH. The yield was 2.8 g (34%), mp 202–203°, lit. [7] 201–202°. $M^{\cdot+}$ 284.1044, calc. for $C_{17}H_{16}O_4$ 284.1049. λ_{max} nm (log ε). 294 (4.24), 344 (3.52), with NaOMe. 338 (4.46). ν_{max} cm^{-1}. 3200 (*s*), 2921 (*m*), 1631 (*s*), 1604 (*s*), 1590 (*s*). PMR (Acetone-d_6) δ ppm. 2.02, 2.04 (both 3H and *s*), 2.81, 3.05, 5.52 (ABX-system, J_{AB} = 17, J_{AX} = 12.5 and J_{BX} = 3 Hz), 7.3–7.7 (5H, *m*), 12.37 (1H, *s*), 4.00 (1H, *br*, *s*). MS *m/e* (%). (100, $M^{\cdot+}$), 283 (25, M-H), 181 (69, M-PhCH=CH·).

7-Acetoxy-5-hydroxy-6,8-dimethylflavanone (**8**). To a soln of **7** (97.4 mg) in Ac_2O (0.5 ml) was added one drop of Py and after 1 hr at 20° the soln was evapd to dryness. Preparative-TLC and crystallization from MeOH gave 98.3 g (88%) of **8** as colourless needles, mp 161.5–162°, lit. [7] 162°. $M^{\cdot+}$ 326.1154 as calc. for $C_{19}H_{18}O_5$. λ_{max} nm (log ε): 277 (4.07), 356 (3.58), with NaOMe: 279 (3.98), 342 (3.75). ν_{max} cm^{-1}. 3420 (*m*), 2930 (*m*), 1752 (*s*), 1641 (*s*), 1626 (*s*), 1604 (*m*). PMR δ ppm. 2, 2, 2.35 (all 3H and *s*), 2.88, 3.03 and 5.41 (ABX-system J_{AB} = 17, J_{AX} = 12.5 and J_{BX} = 3 Hz). 7.4 (5H, *m*), 11.71 (1H, *s*, disapp. with D_2O). MS *m/e* (%). 326 (100, $M^{\cdot+}$), 284 (71, M-CH_2CO, m*), 180 (97, *m/e* 284-PhCH=CH_2, m*), 152 (35, *m/e* 180–CO. m*).

5,7-Diacetoxy-6,8-dimethylflavanone (**9**) *and 2',4',6'-triacetoxy-3',5'-dimethylchalcone* (**10**). A soln of **7** (97 mg) in Ac_2O (2 ml) and Py (1 ml) was refluxed for 2 hr and evapd to dryness. A mixture of **9** and **10** was formed and the two acetates were easily separable by preparative-TLC. The diacetate **9** crystallized as colourless plates from MeOH, mp 177–177.5°, lit. [8] 177–178°, yield 67.2 mg. $M^{\cdot+}$ 368.1261, calc. for $C_{21}H_{20}O_6$ 368.1260. λ_{max} nm (log ε). 261 (3.98), 326 (3.53), with NaOMe. 288 (3.71), 340 sh (3.13). ν_{max} cm^{-1}. 1760 (*s*), 1695 (*m*) 1688 (*m*), 1613 (*m*). PMR δ ppm: 1.96, 2.05, 2.4, 2.45 (all 3H and *s*), 2.83, 2.96, 5.48 (ABX-system, J_{AB} = 17. J_{AX} = 12.5, J_{BX} = 3 Hz), 7.41 (5 H, *s*). MS *m/e* (%). 368 (10, $M^{\cdot+}$), 326 (100, M-CH_2CO, m*), 284 (66, *m/e* 326-CH_2CO, *m**), 207 (13, *m/e* 284-Ph·, m*), 180 (48, *m/e* 284-PhCH=CH_2, m*). The triacetate **10** was crystallized as colourless needles from MeOH, mp 94–95°, yield 57.5 mg $M^{\cdot+}$ 410.1360, calc. for $C_{23}H_{22}O_7$ 410.1366. λ_{max} nm (log ε): 301 (4.19), with NaOMe: 283 (4.49). ν_{max} cm^{-1}: 2930 (*w*), 1766 (*s*), 1650 (*m*), 1603 (*s*). PMR δ ppm. 1.97 2.13 (both 6H and *s*), 2.36 (3H, *s*), 6.93, 7.49 (AB-system, J_{AB} = 16 Hz), 7.2–7.7 (5H, *m*). MS *m/e* (%). 410 (39, $M^{\cdot+}$), 368 (42, M-CH_2CO, *m**), 326 (100, *m/e* 368-CH_2CO, *m**), 284 (85, *m/e* 326-CH_2CO, *m**), 207 (16, *m/e* 284-Ph·, m*), 180 (38, *m/e* 284-PhCH=CH_2, m*).

7-Acetoxy-5-methoxy-6,8-dimethylflavanone (**11**) *and 4'-acetoxy-2',6'-dimethoxy-3',5'-dimethylchalcone* (**12**). *To a soln of* **8** (60.6 mg) in Me_2CO (12 ml) and $diMeSO_4$ (0.5 ml) was added dry K_2CO_3 (1 g). The mixture was refluxed for 7 hr and evapd to dryness. Extraction twice with 10 ml Me_2CO gave a mixture which was separated into the two products by preparative-TLC. The mono-Me-ether **11** was crystallized as colourless needles from MeOH mp 160.5–161°, lit. [8] 156–158°, yield 37.3 mg. $M^{\cdot+}$ 340.1310, calc. for $C_{20}H_{20}O_5$ 340.1311. λ_{max} nm (log ε). 265 (4.00), 330 (3.60), with NaOMe. 264 (4.01), 331 (3.55). ν_{max} cm^{-1}. 1757 (*s*) 1690 (*s*). 1600 (*m*), 1582 (*s*). PMR δ ppm. 2.06 (6H, *s*), 2.37, 3.84 (both 3H and *s*), 2.88, 3, 5.44 (ABX-system, J_{AB} = 17, J_{AX} = 12.5, J_{BX} = 3 Hz), 7.45 (5H, narrow *m*). MS *m/e* (%). 340 (81, $M^{\cdot+}$), 339 (5, M-H·), 298 (10, M-CH_2CO, *m**), 236 (37, M-PhCH=CH_2, *m**), 194 (100, *m/e* 236-CH_2CO, *m**). The di-Me-ether **12** was isolated as a colourless oil, yield 17.6 mg, $M^{\cdot+}$ 354.1474, calc. for $C_{21}H_{22}O_5$ 354.1467. λ_{max} nm (log ε). 294 (4.16), with NaOMe: 291 (4.18). ν_{max} cm^{-1}. 1760 (*s*), 1648 (*s*), 1603 (*s*). PMR δ ppm: 2.08, 3.71 (both 6H and *s*), 2.37 (3H, *s*), 7.04, 7.40 (AB-system J_{AB} = 16 Hz), 7.2–7.7 (5H, *m*). MS *m/e* (%). 354 (100, $M^{\cdot+}$), 312 (20, M-CH_2CO, *m**), 284 (17, *m/e* 312-CO), 221 (23, *m/e* 312-$PhCH_2$·), 209 (24, *m/e* 312-PhCH=CH·).

2',4'-Diacetoxy-6'-methoxy-3',5'-dimethylchalcone (**5**). A soln of **11** (32 mg) and dry NaOAc (84.6 mg) in Ac_2O (2 ml) was refluxed for 10 hr, evapd to dryness and extracted twice with 10 ml Me_2CO. Preparative-TLC gave **5** as a pale yellow oil, yield 29.9 mg. All chromatographic and spectroscopical data were identical with those of the diacetate (**5**) prepared from the natural compound.

2',4'-Dihydroxy-6'-methoxy-3'5'-dimethylchalcone (**4**) and *7-hydroxy-5-methoxy-6,8-dimethylflavanone* (**13**). A soln of **5** (15.5 mg) in 5% KOH in MeOH (5 ml) was left for 4 hr at room temp. After neutralization and evaporation to dryness, the mixture was separated by preparative-TLC. **4** Was isolated as yellow needles from MeOH, yield 5.3 mg. Its physical and spectroscopical data were identical with those of the natural compound. In addition the flavanone **13** was isolated as colourless needles from MeOH, yield 5 mg, mp 207–208°, lit. [8] 207–209°. All spectroscopical data were as given for the natural compound [8]. Hydrolysis of **5** under reflux for 15 min gave a higher yield of the flavanone **13**. A soln of **11** (34.6 mg) in 2% KOH in MeOH (10 ml) was refluxed for 45 min. A work-up procedure as described above gave **4** (4.8 mg) and **13** (19.3 mg).

Attempted methylation of 5,7-diacetoxy-6,8-dimethylflavanone (**9**). A mixture of **9** (55 mg), Me_2SO_4 (0.5 ml) and dry K_2CO_3 (1 g) in Me_2CO (20 ml) was refluxed for 36 hr. After evaporation, extraction with 10 ml Me_2CO ×3 and preparative-TLC only unreacted **9** (51.3 mg) was recovered.

5-Hydroxy-7-methoxy-6,8-dimethylflavanone (**14**). To a soln of **7** (250 mg) in MeOH (50 ml) was added CH_2N_2 (1 g) in Et_2O (30 ml). After 15 hr at room temp. HOAc (2 ml) was added and the soln evapd to dryness. Crystallization from MeOH gave **14** as yellow needles, yield 245.1 mg, mp 129.5–130°, lit. [7, 10] 130°, [8] 130–132°. Spectroscopical data as for natural **14** [10].

5-Acetoxy-7-methoxy-6,8-dimethylflavanone (**15**) *and 2',6'-diacetoxy-4'-methoxy-3',5'-dimethylchalcone* (**6**). Acetylation of **14** (80.1 mg) with Ac_2O–Py by refluxing for 1.5 hr gave a mixture which was separated by preparative-TLC. Crystallization from MeOH gave **15** as colourless needles, yield 78.2 mg. Mp 114.5–115°, lit. [8] 130–132° is not correct and is presumably due to an interchange with the mp of 14. $M^{\cdot+}$ 340.1310 calc. for $C_{20}H_{20}O_5$ 340.1311. λ_{max} nm (log ε) = 326 (3.57), 268 (4.07), 222 (4.34), deteriorates on addition of NaOMe. ν_{max} cm^{-1}. 1757 (*s*), 1682 (*s*), 1605 (*s*), PMR δ ppm 2.07, 2.18, 2.4, 3.76 (all 3H and *s*), 2.8, 2.93, 5.44 (ABX-system J_{AB} = 17, J_{AX} = 12.5, J_{BX} = 3 Hz), 7.43 (5H, narrow *m*). MS *m/e* (%). 340 (11, $M^{\cdot+}$), 298 (100, M-CH_2CO, *m**), 221 (13, *m/e* 298-Ph·, *m**), 194 (39, *m/e* 298-PhCH=CH_2, *m**). In addition **6** was isolated as a yellow oil, yield 13.8 mg, $M^{\cdot+}$ 382.1420 calc. for $C_{22}H_{22}O_6$ 382.1416. λ_{max} nm (log ε): 220 *sh* (4.12), 301 (4.20), with NaOMe.

240 (4.32), 293 (4.27). ν_{max} cm^{-1}. 1766 (*s*), 1647 (*s*), 1604 (*s*). PMR δ ppm: 2.11, 2.14 (both 6H and *s*), 3.79 (3H, *s*), 6.92, 7.48 (AB-system J_{AB} = 16 Hz), 7.2–7.7 (5H, *m*). MS *m/e* (%): 382 (25, $M^{\cdot+}$), 340 (24, M-CH_2CO, m*), 298 (100, *m/e* 340-CH_2CO, *m**), 221 (14, *m/e* 298-Ph·, *m**), 194 (38, *m/e* 298-PhCH=CH_2, *m**). Acetylation of **15** (13 mg) in the same manner as above gave 9 mg of **6**. Hydrolysis of **6** (23.9 mg) by 10 min refluxing in 5% KOH in MeOH (10 ml), gave 16.4 mg of **14**.

Isolation of 2'-hydroxy-4',6'-dimethoxy-3'-methyldihydrochalcone (**16**). Soxhlet extraction of fruits of *M. gale* (680 g) with Et_2O (1 l.) for 4 hr gave a brown oil (38 g) which was shown by TLC to contain considerable amounts of **1** and **2**. Repeated chromatography on Si gel columns with hexane–C_6H_6 as eluent and TLC (hexane–C_6H_6, 1:1), furnished **16** which was crystallized as colourless needles from MeOH, yield 20 mg, mp 146–147°, $M^{\cdot+}$ 300.1357 calc. for $C_{18}H_{20}O_4$ 300.1360. λ_{max} nm (log ε): 335 *sh* (3.46), 290 (4.14), no change with NaOMe. ν_{max} cm^{-1}: 3400 (*w*), 2920 (*w*), 1632 (*s*), 1596 (*s*), 1500 (*m*), 1455 (*m*), 1413 (*s*), 1294 (*s*), 1282 (*s*), 1236 (*s*), 1211 (*s*), 1206 (*s*), 1130 (*s*), 881 (*m*), 792 (*m*), 699 (*m*). PMR δ ppm: 2.01, 3.85, 3.86 (all 3H and *s*), 3.11, 3.23 (AA'BB'-system, 5.96 (1H, *s*), 7.22 (5H, narrow *m*), 13.91 (1H, *s*, disapp. with D_2O). MS *m/e* (%): 300 (41, $M^{\cdot+}$), 283 (3, M-OH·), 269 (3, M-OMe·), 196 (11, M-PhCH=CH_2), 195 (100, M-$PhCH_2$—CH_2·), 168 (27, *m/e* 196-CO), 104 (4, PhCH=$CH_2^{\cdot+}$), 91 (8, $C_7H_7^+$. Treatment of **16** with Gibb's reagent (2,6-dichlorobenzoquinone-4-chloroimide) in Py–borate buffer [10] gave a deep blue–green colour.

2'-Acetoxy-4',6'-dimethoxy-3'-methyldihydrochalcone (**17**). Acetylation of **16** in the usual way with Ac_2O–Py yielded a monoacetate (**17**) which was crystallized as colourless needles from MeOH, mp 90–91°, $M^{\cdot+}$ 342.1471, calc. for $C_{20}H_{22}O_5$ 342.1466. λ_{max} nm (log ε): 295 (3.68), 268 (3.76), no change with NaOMe. ν_{max} cm^{-1}: 1770 (*s*), 1678 (*s*), 1615 (*s*), 1583 (*m*). PMR δ ppm: 1.93, 2.17, 3.77, 3.83 (all 3H and *s*), 3.01, 3.04 (AA'BB'-system), 6.31 (1H, *s*), 7.19 (5H, narrow *m*). MS *m/e* (%): 342 (22, $M^{\cdot+}$), 300 (18, M-CH_2CO, *m**), 237 (10, M-$PhCH_2CH_2$·), 195 (100, *m/e* 300-$PhCH_2CH_2$·, *m**), 168 (27, *m/e* 300-PhCH=CHCHO).

Synthesis of 2'-hydroxy-4',6'-dimethoxy-3'-methyldihydrochalcone (**16**). (A) 3,5-Dimethoxyphenol was obtained by methylation of phloroglucinol [12]. Formylation with $Zn(CN)_2$–HCl and subsequent Clemmensen-reduction [13] furnished 3,5-dimethoxy-2-methylphenol (**18**), mp 67°, lit. [15] 67–68°. A soln of **18** (0.25 g), 3-phenylpropionylchloride (0.3 g) and freshly sublimed $AlCl_3$ (0.3 g) in nitrobenzene (10 ml) was left for 10 days at room temp. under a N_2-atmosphere. 2N HCl (50 ml) was then added and the nitrobenzene removed by steam distillation. Extraction with 25 ml Et_2O ×3, evaporation, preparative-TLC and crystallization from MeOH gave 2'-hydroxy-4',6'-dimethoxy-3'-methyldihydrochalcone (**16**) as colourless needles, yield 0.07 g, mp 145.5–146°, unchanged mmp with natural **16**. Acetylation with Ac_2O–Py gave the monoacetate **17**, mp 91°. Chromatographic and spectroscopical data for the synthetic compounds were as given for the corresponding natural ones. (B) Aurentiacin (**19**) was obtained by an aldol condensation of 2'-hydroxy-4',6'-dimethoxy-3'-methylacetophenone and benzaldehyde. The product crystallized as yellow needles from hexane–C_6H_6, mp 140.5–141°, lit. [13] 140–141°. Hydrogenation of **19** (78 mg) with 10% Pd–C (54.5 mg) for 4 hr gave **16** (75.5 mg), all data identical with natural **16**.

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