

## COUMARINS FROM THE LEAVES OF *PHEBALIUM SQUAMEUM*

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**Abstract**—The leaves of *Phebalium squameum* have yielded two novel coumarins identified, on the basis of spectral data, as (+)-7-(6,7-epoxy-3,7-dimethyl-5-oxooctanoxo)-coumarin and (–)-7-(6,7-dihydroxy-3,7-dimethyl-5-oxooctanoxo)-coumarin

In a recent revision of the genus *Phebalium* Vent. Wilson [1] recognized the existence of 44 species distributed throughout Australia, Tasmania and New Zealand (North Island). Previous phytochemical studies have revealed a number of species to contain coumarins, notably furocoumarins [2], while furoquinoline alkaloids have been reported from *P. nudum* Hook. [3]. The present paper reports the isolation of two novel coumarins from a small sample of the previously unworked species *P. squameum* (Labill.) Engl.

Column chromatography of a petrol (bp 40–60°) extract of the leaves over silica gel followed by centrifugal prep. TLC of fractions from the column yielded two major compounds both of which quenched ( $F_{254}$ ) and fluoresced (blue, 366 nm) in UV light. Despite giving a positive reaction with Dragendorff's reagent MS indicated that neither compound contained nitrogen while both had the spectral characteristics of simple 7-alkoxy coumarins [4].

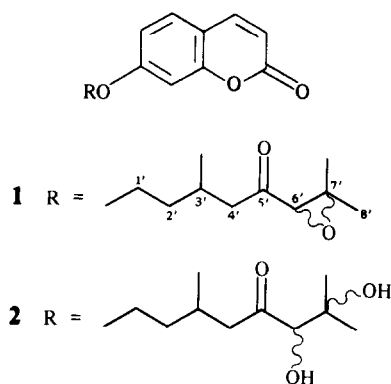
Compound **1** ( $C_{19}H_{22}O_5$ ) showed in the  $^1H$ NMR spectrum signals characteristic of a 7-oxycoumarin (Table 1). This was confirmed by the EIMS which gave a major ion at  $m/z$  162 [ $C_9H_6O_3$ ] $^+$  for the coumarin nucleus together with a base peak  $m/z$  169 [ $C_{10}H_{17}O_2$ ] $^+$  for the C-7 substituent. Analysis of non-coumarin protons in the  $^1H$ NMR spectrum with the aid of decoupling experiments indicated the sequence –O–CH<sub>2</sub>–CH<sub>2</sub>–CH(Me)–CH<sub>2</sub>–CO–. The remaining signals were made up of methyl singlets resonating at  $\delta$  1.25 and 1.41 and a methine singlet at  $\delta$  3.35. These can be assigned to H-6 and the C-7 methyl substituents of a 6,7-epoxygeranyl unit (epoxy  $\nu_{max}$  920  $cm^{-1}$ ) so allowing the formulation of the unusual 5-oxo-6,7-epoxygeranyloxy side chain and structure. The  $^{13}C$  NMR spectrum was in full agreement with this proposal.

Compound **2** ( $C_{19}H_{24}O_6$ ), was more polar than **1** and exhibited an IR band for OH. The  $^1H$ NMR spectrum (Table 1) was comparable to that of **1** in most respects but revealed changed chemical shifts for H-6 ( $\delta$  4.96) and the C-7 methyls and additional broad signals (exchangeable with D<sub>2</sub>O) for two OH protons. These changes are compatible with the assignment of structure **2**.

To our knowledge this is the first report of either **1** or **2**. Related 7-geranyloxy coumarins have been encountered in other rutaceous taxa including *Aegle marmelos* Corr., *Citrus paradisi* Macfad. and *Geyera parviflora* Lindl. [2] but this is the first time they have been encountered in *Phebalium*.

Table 1  $^1H$ NMR assignments for **1** (360 MHz) and **2** (250 MHz) run in CDCl<sub>3</sub>

H	1	2
3	6.21 d (9.5)	6.25 d (9.5)
4	7.61 br d (9.5)	7.64 br d (9.5)
5	7.33 d (8.6)	7.36 d (8.6)
6	6.80 dd (2.3, 8.6)	6.83 dd (2.3, 8.6)
8	6.76 br d (2.3)	6.80 br d (2.3)
1'	4.03 t (6.3)	4.06 t (6.6)
2'	1.70 m	1.72 m
2''	1.83 m	1.87 m
3'	2.33 m	2.38 m
3'-Me	0.99 d (6.6)	1.01 d (6.8)
4'	2.44 dd (7.7, 16.5)	2.60 dd (7.7, 17.4)
4''	2.58 dd (5.6, 16.5)	2.82 dd (5.8, 17.4)
6'	3.35 s	3.96 br s
Me	1.25 s	1.20 s
Me	1.41 s	1.29 s
OH		2.39 br s
OH	--	3.70 br s



## EXPERIMENTAL

**Plant material.** A leaf sample of *P. squameum* was collected from cultivated material at the Australian National Botanic Gardens in September 1985 and a voucher specimen (No 69802) has been deposited in the Herbarium of ANBG.

**Extraction and isolation.** The ground leaves (19 g) were extracted with petrol (bp 40–60°) to exhaustion. The concd extract was subjected to CC over silica gel eluting with petrol (bp 60–80°) and then petrol containing increasing amounts of EtOAc. Fractions were monitored by TLC and those containing comparable mixtures were bulked and purified by centrifugal PTLC (silica gel; solvent, EtOAc–petrol gradients). Two compounds, (visualized in UV light, 366 nm), were isolated as oils; **1** (12 mg,  $R_f$  0.43—solvent EtOAc–petrol, 1:1) and **2** (14 mg,  $R_f$  0.29—solvent as **1**).

**7-(6,7-epoxy-3,7-dimethyl-5-oxooctanoxy)-coumarin (1).**  $[\alpha]_D^{+36}$  (CHCl<sub>3</sub>,  $c$  0.23). Found  $M^+$  330.1465, C<sub>19</sub>H<sub>22</sub>O<sub>5</sub> re-

quires 330.1467. UV  $\lambda_{max}$  (EtOH) nm 238 sh, 250 sh, 300 sh, 324. IR  $\nu_{max}$  (liq. film) cm<sup>-1</sup>: 2960, 2930, 1732, 1715, 1612, 1510, 1400, 1295, 1281, 1232, 1133, 920, 836. <sup>1</sup>H NMR (360 MHz, CDCl<sub>3</sub>) see Table 1. <sup>13</sup>C NMR (90.56 MHz, CDCl<sub>3</sub>) ppm  $q$  at 17.9 (3'-Me), 19.4 (C-7'), 24.2 (C-8');  $t$  at 35.1 (C-2'), 47.4 (C-4'), 66.0 (C-1'),  $d$  at 25.6 (C-3'), 64.9 (C-6'), 100.9 (C-3), 112.3 (C-6, C-8), 128.4 (C-5), 143.1 (C-4),  $s$  at 60.0 (C-7'), 112.0 (C-10), 155.3 (C-9), 160.6 (C-7)\*, 161.6 (C-2)\*, 205.3 (C-5'), \*assignments interchangeable, EIMS  $m/z$  (rel. int.) 330 [ $M$ ]<sup>+</sup> (40), 315 (14), 215 (20), 189 (2), 175 (19), 169 (100), 162 (87), 144 (78), 111 (15), 105 (19), 95 (54), 89 (25), 71 (14).

**7-(6,7-Dihydroxy-3,7-dimethyl-5-oxooctanoxy)-coumarin (2)**  $[\alpha]_D^{+28}$  (CHCl<sub>3</sub>,  $c$  0.21). Found  $M^+$  348.1572, C<sub>19</sub>H<sub>24</sub>O<sub>6</sub> requires 348.1572. UV  $\lambda_{max}$  (EtOH) nm 238 sh, 250 sh, 300 sh, 324. IR  $\nu_{max}$  (liq. film) cm<sup>-1</sup>: 3440, 2960, 2930, 1730, 1708, 1612, 1510, 1352, 1295, 1283, 1232, 1128, 837. <sup>1</sup>H NMR (250 MHz, CDCl<sub>3</sub>) see Table 1. EIMS  $m/z$  (rel. int.): 348 [ $M$ ]<sup>+</sup> (1), 330 (1), 290 (31), 259 (19), 215 (32), 175 (22), 162 (43), 145 (10), 134 (32), 129 (100), 111 (34), 89 (11), 71 (24).

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