

SESQUITERPENE-COUMARIN ETHERS OF *FERULA TINGITANA*

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*Ferula tingitana* L. (Umbelliferae) is a robust perennial herb native to the Mediterranean coastal region. According to Dioscorides (1), a gum-resin from this plant is called "silphion" and has been used for treatment of several diseases; this plant has also been suggested to be one of the sources of the important medicinal gum-resin "ammoniacum." The roots were shown by tlc to contain the same major compounds as the gum resin, and because roots are more accessible, they were extracted. We previously described a new daucane ester from the petroleum ether extract of the roots (2), and here we report three known sesquiterpene-coumarin ethers, namely colladonin (3,4), isosamarandin angelate (1) (5), and feselol (2) (6), as well as the known aromatic ketone, latifolon (7); all were obtained from the  $C_6H_6$  extract of the roots.

The identities of the compounds were established by comparing their spectral data ( $^1H$  nmr, ms, ir, and uv) as well as mp and optical rotations, to those values reported in the literature, and in the case of colladonin, comparison with an authentic sample. Because little mass

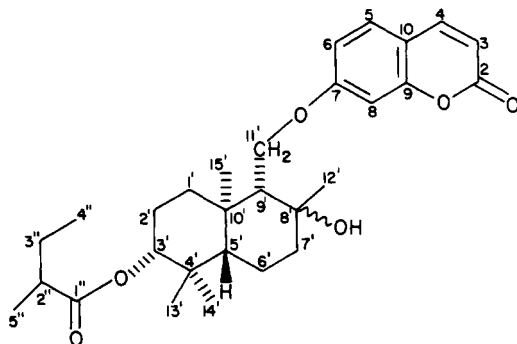
spectral data were presented previously, we discuss here the ms and provide  $^{13}C$ -nmr data for isosamarandin angelate (1) and feselol (2) (see Experimental section).

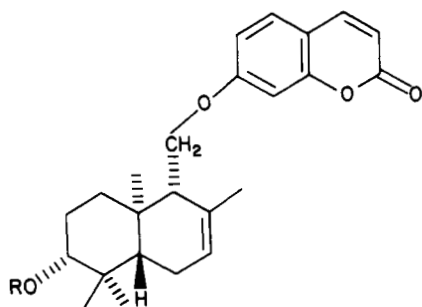
In our work, three populations were found to exhibit the same type of umbelliferone 7-O-terpene ethers, compounds which are typical for the genus *Ferula* (8). Earlier reports that the roots of *F. tingitana* contain linear-furanocoumarins (9), compounds which are only rarely found in *Ferula* species, suggest that the plant material in this earlier study may have been misidentified.

## EXPERIMENTAL

PLANT MATERIAL.—*F. tingitana* was collected from the Aegean Coast of Turkey (Kusadasi) in June 1982. A voucher specimen, identified by Dr. E. Tuzlaci (Istanbul), is deposited in the Herbarium of the Faculty of Pharmacy, University of Istanbul (ISTE 48938). Small samples of two other populations, from Side (Antalya) and Sütcüler (Isparta), were also analyzed; each of these populations was separated from the site of the bulk collection by over 400 km.

INSTRUMENTS.—Spectra were recorded on the following instruments: uv, Varian Techtron 635; ir, Perkin-Elmer 577;  $^1H$  nmr, NT-200





**2** R=H  
**2a** R=Ac

MHz;  $^{13}\text{C}$  nmr, Bruker WH-90; ms, DuPont 21-490.

**ISOLATION AND IDENTIFICATION OF THE COMPOUNDS.**—Dried and coarsely powdered roots of *F. tingitana* (2.5 kg) were extracted in a Soxhlet apparatus with petroleum ether (2) and then  $\text{C}_6\text{H}_6$ . The  $\text{C}_6\text{H}_6$  extract was concentrated in vacuo and chromatographed on a Sephadex LH-20 column ( $3 \times 50$  cm), eluted with EtOH. The compounds were obtained in the following order: feselol (150 mg), colladonin (30 mg), isosamarandin angelate (62 mg), and latifolon (44 mg).

**ISOSAMARCANDIN ANGELATE (1).**— $^{13}\text{C}$  nmr ( $\text{CDCl}_3$ ) 161.3 (s, C-2), 113.3 (d, C-3), 143.5 (d, C-4), 128.8 (d, C-5), 113.4 (d, C-6), 161.8 (s, C-7), 101.6 (d, C-8), 156.0 (s, C-9), 112.8 (s, C-10), 37.9 (t, C-1'), 23.6 (t, C-2'), 80.2 (d, C-3'), 37.9 (s, C-4'), 55.1 (d, C-5'), 20.0 (t, C-6'), 44.1 (t, C-7'), 72.5 (s, C-8'), 59.4 (d, C-9'), 37.9 (s, C-10'), 66.5 (t, C-11'), 28.4 (q, C-12'), 24.7 (q, C-13'), 17.0 (q, C-14'), 15.8 (q, C-15'), 167.9 (s, C-1''), 128.5 (s, C-2''), 137.6 (d, C-3''), 16.2 (q, C-4''), 20.7 (q, C-5''); ms (probe) 70 eV  $m/z$  (rel. int.) 482  $[\text{M}]^+$  (9.9), 464  $[\text{M}-\text{H}_2\text{O}]^+$  (37.7), 364  $[\text{M}-\text{C}_5\text{H}_8\text{O}_2-\text{H}_2\text{O}]^+$  (40.3), 349  $[\text{M}-\text{C}_5\text{H}_8\text{O}_2-\text{H}_2\text{O}-\text{Me}]^+$  (19.9), 321  $[\text{M}-\text{C}_9\text{H}_5\text{O}_3]^+$  (8.8), 302  $[\text{M}-\text{C}_9\text{H}_6\text{O}_3-\text{H}_2\text{O}]^+$  (75.9), 219  $[\text{M}-\text{C}_9\text{H}_6\text{O}_3-\text{C}_5\text{H}_8\text{O}_2-\text{H}_2\text{O}]^+$  (88.3), 162  $[\text{C}_9\text{H}_6\text{O}_3]^+$  (90), 83  $[\text{C}_5\text{H}_7\text{O}]^+$  (86.3). (Found: C, 72.21; H, 7.91.  $\text{C}_{29}\text{H}_{38}\text{O}_6$  requires: C, 72.19; H, 7.88).

**FESELOL (2).**— $^{13}\text{C}$  nmr ( $\text{CDCl}_3$ ) 161.3 (s, C-2), 113.1 (d, C-3), 143.5 (d, C-4), 128.8 (d, C-5), 113.1 (d, C-6), 162.2 (s, C-7), 101.5 (d, C-8), 156.0 (s, C-9), 112.6 (s, C-10), 37.9 (t, C-1'), 27.4 (t, C-2'), 78.9 (d, C-3'), 38.8 (s, C-4'), 49.5 (d, C-5'), 23.4 (t, C-6'), 123.9 (d, C-7'), 132.4 (s, C-8'), 53.9 (d, C-9'), 35.9 (s, C-10'), 67.1 (t, C-11'), 28.1 (q, C-12'), 21.6 (q, C-13'), 15.3 (q, C-14'), 14.2 (q, C-15'); ms (probe) 70 eV  $m/z$  (rel. int.) 382  $[\text{M}]^+$  (50), 220  $[\text{M}-\text{C}_9\text{H}_5\text{O}_3]^+$  (65), 203  $[\text{C}_{15}\text{H}_{23}]^+$  (100), 162  $[\text{C}_9\text{H}_6\text{O}_3]^+$  (85), 133  $[\text{C}_9\text{H}_6\text{O}_3-\text{COH}]^+$  (70).

(Found: C, 75.36; H, 7.88.  $\text{C}_{24}\text{H}_{30}\text{O}_4$  requires: C, 75.39; H, 7.85%).

**ACETYL FESELOL (2a).**—Acetylation was carried out in the usual manner with  $\text{Ac}_2\text{O}$  in pyridine using 20 mg of **2**. The uv was similar to that of **2**, while the ir showed the hydroxyl band at 3450 of **2** had disappeared and the acetyl peak was observed at  $1725\text{ cm}^{-1}$ .  $^1\text{H}$  nmr ( $\text{CDCl}_3$ ) 0.9 (3H, s, H-13'), 0.95 (3H, s, H-14'), 0.98 (3H, s, H-15'), 1.7 (3H, br s, H-12'), 2.07 (3H, s, OCOMe), 4.02 (1H, dd,  $J=10$  and 6 Hz, H-11a'), 4.15 (1H, dd,  $J=7.5$  Hz and 4 Hz, H-11b'), 4.55 (1H, br t,  $J=10$  Hz and 5 Hz, H-3'), 5.55 (1H, br s, H-7'), 6.25 (1H, d,  $J=9$  Hz, H-3), 6.82 (2H, m, H-6 and H-8), 7.36 (1H, d,  $J=9$  Hz, H-5), 7.64 (1H, d,  $J=9$  Hz, H-4); ms (probe)  $m/z$  (rel. int.) 424  $[\text{M}]^+$  (25), 364  $[\text{M}-\text{AcOH}]^+$  (28), 349  $[\text{M}-\text{AcOH}-\text{Me}]^+$  (12), 203  $[\text{C}_{15}\text{H}_{23}]^+$  (100), 162  $[\text{C}_9\text{H}_6\text{O}_3]^+$  (85), 133  $[\text{C}_9\text{H}_6\text{O}_3-\text{COH}]^+$  (95).

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