NEW CLERODANE DITERPENOIDS FROM TEUCRIUM SPINOSUM L.

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Abstract - Two new diterpenoids, isolated from Teucrium spinosum (Labiatae) have been shown to possess the clerodane structures [I] and [II] respectively.

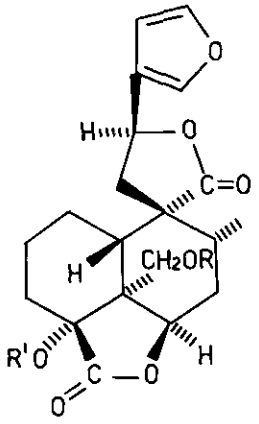
In continuing our studies[1-6] on the diterpenoids of Teucrium species (family Labiatae), we now report the isolation and structure determination of two new compounds from T.spinosum L.

The *minor product*, teuspinin [I], $C_{20}H_{24}O_7$, has m.p. 221°-225° (from acetone-hexane), $[\alpha]_D^{21°}$ +62.7° (acetone; c, 0.126). It was accompanied by major amounts of 19-acetyl-teuspinin [II], $C_{22}H_{26}O_8$, m.p. 178°-179° (from hexane-AcOEt), $[\alpha]_D^{21°}$ +65.1° ($CHCl_3$; c, 0.36)(Found: C, 62.79; H, 6.39. $C_{22}H_{26}O_8$ requires C, 63.15; H, 6.26%); CD $\Delta\varepsilon_{222}$ -1.60 (EtOH; c, 0.199).

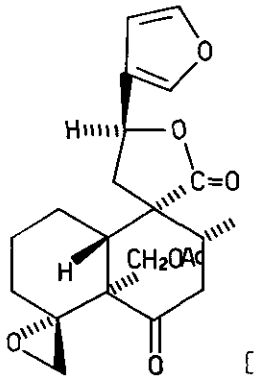
Treatment of teuspinin [I] with Ac_2O-pyridine at room temp. for 24 hr. gave 19-acetyl-teuspinin [II], identical with the natural product. Both [I] and [II] yielded a diacetyl derivative, $C_{24}H_{28}O_9$ [III] when left for a week at room temp. with Ac_2O-pyridine, thus suggesting the presence of a hindered, possibly tertiary, hydroxyl group.

The IR spectrum of teuspinin [I] showed absorption at 3500 and 3200 cm^{-1} (OH), 1780 and 1755 (γ-lactones), and 880 (furan ring). In the mass spectrum, peaks occurred at m/e 376 (M^+), 358, 264, 95, 94. The ^{1}H-NMR spectrum (acetone-d_6, 100 MHz) contained signals at δ 1.06 (3H, d, J 6.5 Hz, CH_3), 4.06 and 4.32 (2H, q_{AB}, J 13 Hz, C-$\underline{CH_2}$OH), 4.98 (1H, t, J 3 Hz, H-6), 5.49 (1H, t, J 8 Hz, H-12), 6.48 (1H, m, β-furan proton), 7.54 and 7.64 (2H, m, α-furan protons).

The IR spectrum of [II] had absorption at 3450 cm^{-1} (broad, OH), 1710-1760 (broad, acetate and γ-lactones), 1240 (acetate), and 880 (furan ring). Peaks occurred in the mass spectrum at m/e 418 (M^+), 400, 358, 264, 95, 94. The ^{1}H-NMR spectrum ($CDCl_3$, 100 MHz) gave signals at δ 1.06 (3H, d, J 6.5 Hz, CH_3), 2.08 (3H, s, CH_3COO), 4.58 and 4.76 (2H, q_{AB}, J 13 Hz, C-CH_2OAc), 4.79 (1H, t, J 3 Hz, H-6), 5.34 (1H, t, J 8 Hz, H-12), 6.34 (1H, m, β-furan proton), 7.42 (2H, m, α--furan protons). Allowing for the difference of the solvent, the NMR spectra of



[I] R=H R'=H
[II] R=Ac R'=H
[III] R=Ac R'=Ac



[IV]

[I] and [II] are similar except that the AB quartet of the C-$\underline{CH_2}$OAc is shifted downfield in [II] and a three-proton singlet appears at δ 2.08. ^{1}H-NMR spin decoupling studies, based on the signals at δ 4.79 and 1.06, confirmed the presence of the -CH(OCO-)-CH_2-CH-CH_3 fragment.

The diacetyl derivative [III], MS m/e 460 (M^+), m.p. 160°-162° (from hexane--AcOEt), $[\alpha]_D^{19°}$ +96.3° ($CHCl_3$; c, 0.055), had two three-proton singlets at δ 2.04 and 2.07 while the other signals in its ^{1}H-NMR spectrum ($CDCl_3$, 100 MHz) were identical with those of [II]. The IR spectrum showed no hydroxyl absorption. Since there were no other C$\underline{H}$OR resonances in [I], [II] or [III], the hydroxyl remaining in [II] and acetylated in [III] must be tertiary.

These data are in accord with the structures [I], [II] and [III] for teuspinin, 19-acetyl-teuspinin and the diacetyl derivative. The small coupling constant for H-6 indicated that this proton is equatorial whilst the rather easy acetylation (for a tertiary hydroxyl group) indicated that this group is also equatorial; hence the lactone bridge has to be diaxial. Even under drastic conditions, no dehydration of [II] was observed, thus confirming that the tertiary hydroxyl group is equatorial.

A similar structure, with the C-18/C-6 lactone bridge and a 5-CH_2OH group, has been reported recently[7] for plaunol-B.

The ^{13}C-NMR spectrum of [II] ($CDCl_3$, 25 MHz) is consistent with the proposed structure: C-1 21.3 t; C-2 24.1 t; C-3 29.6 t; C-4 79.4 s; C-5 47.9 s; C-6 76.9 d; C-7 29.4 t; C-8 34.0 d; C-9 49.9 s; C-10 47.2 d; C-11 41.8 t; C-12 71.8 d; C-13 124.6 s; C-14 107.8 d; C-15 144.1 d; C-16 139.6 d; C-17 16.2 q; C-18 175.6 s; C-19 59.9 t; C-20 176.2 s.

The relative stereochemistry at C-8, C-9 and C-12 is consistent with spectral data reported for similar diterpenoids[1-7]; the absolute configuration is likely to belong to the neo-clerodane skeleton[8,9]. This view is supported by the occur-

rence in T.spinosum of a third diterpenoid, the known 19-acetyl-gnaphalin [IV] which was recently extracted from T.gnaphalodes[4], and whose stereochemistry was proved by correlation with teucvin.

Experimental.

Air-dried leaves of T.spinosum L. (300 g) were powdered and extracted as described for other Teucrium species[1]. Treatment of the extract and column chromatography[1], eluent light petroleum - ethyl acetate (1:1), yielded in the order 19-acetyl--teuspinin (200 mg), teuspinin (20 mg) and 19-acetyl-gnaphalin (70 mg).

19-Acetyl-gnaphalin [IV] was identified by conventional methods and comparison with a sure specimen.

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