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Berberis ALKALOIDS

XXXI. THE STRUCTURE OF TURCONIDINE

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From young shoots of Berberis turcomanica *Kar. we have isolated the new bistetrahydroisoquinoline base turconidine. Its structure has been established by the results of UV, mass, and PMR spectroscopies and also from measurements of intramolecular NOEs.*

Continuing investigations of alkaloids from young shoots of *Berberis turcomanica* Kar. [1], from the nonphenenolic fraction of the total ether-extracted alkaloids we have isolated a new base with the composition $C_{23}H_{30}O_4N_2$, which has been called turconidine (I). In the IR spectrumn of (I) there is an absorption maximum at 286 nm, which is characteristic for tetrahydroisoquinolines [2]. According to the nature of its mass fragmentation, turconidine belongs to the bistetrahydroisoquinolines of the type of turcberine, which we had isolated previously from the same plant [1]. The intensities of the peaks of ions with m/z 398, 397, 357, and 198^{++} in turconidine differed substantially from those of the corresponding ions from turcberine, which was apparently connected with the distribution of the substituents and of the diphenyl ether bond.

The PMR spectrum of turconidine showed the following signals: three one-proton singlets from aromatic protons, five three-proton singlets of methyl groups (3 OCH_3 and 2 $N-CH_3$) two two-proton singlets from isolated methylene groups, and four two-proton triplets with the SSCCs J = 5.9 Hz from two pairs of neighboring methylenes. The measurement of intramolecular nuclear Overhauser effects (NOE) enabled the substitution of the isoquinoline nuclei and the linkage of the two parts of the dimer to be established unequivocally. The appearance of only singlet signals of aromatic protons showed the presence of only one proton in one of the aromatic rings and of two *para*-located protons in the other. A characteristic feature of the PMR spectrum of turconidine was the presence of two singlet signals of methylene groups at 3.36 and 3.27 ppm. Only methylene groups at C-1 and C-1′ could give such signals. Irradiation of the signal at 3.27 ppm exhibited a NOE of 14% on the aromatic proton resonating at 6.12 ppm. No NOE was observed on the irradiation of the methylene protons at 3.36 ppm. The NOE results for turconidine are given below:

Signals irradiated, ppm	Signals observed, ppm				
	6.12	6.50	6.63	2.31	2.32
3.86 (3H, s, OCH_3)	—	—	18%	—	—
3.79 (3H, s, OCH_3)	—	16%	—	—	—
3.36 (2H, s, CH_2)	—	—	—	—	1—2%
3.27 (2H, s, CH_2)	14%	—	—	1—2%	—
2.79 (2H, t, CH_2)	—	—	10%	—	—
2.83 (2H, t, CH_2)	—	16%	—	—	—

Consequently, in one of the isoquinoline fragments position 8 was occupied by a proton and in the other by an oxygen substituent. The two-proton singlet at 3.36 ppm and the one-proton singlet at 6.12 ppm did not respond by an NOE of appreciable magnitude (2-3%) on irradiation of any of the methoxy signals. It followed from this that positions 8 and 7′ were substituted by the diphenyl ether bridge. Consequently, the signals at 3.27, 3.36, and 6.12 ppm related to the protons at H_2-1′, H_2-1, and H-8′, respectively. From this, it also followed that only one isolated proton could be located in ring *B*, and the remaining, third, aromatic proton could occupy only position 5′. These aromatic protons, appearing in the form of one-proton singlets at 6.63 and 6.50 ppm, responded with NOEs of 16-18% to irradiation of the methoxyl signals at 3.86 and 3.79 ppm, respectively, and with NOEs of 10-16% to irradiation of the methylene protons observed in the region of 2.8 ppm. Thus, it

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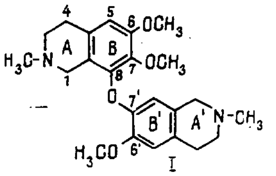
was possible to conclude that positions 5′ and 5 were occupied by protons, and 6 and 6′ by methoxy groups with chemical shifts of 3.86 and 3.78 ppm. In this case, position 7 was necessarily substituted by a methoxy group exhibiting no appreciable NOEs (2-3%) on any of the groups of signals in the spectra and appearing at 3.62 ppm.

The two triplet groups of signals of methylene protons at 2.83 and 2.79 ppm exhibiting NOEs on the aromatic protons H-5 and H-5′ belonged to methylenes in positions 4 and 4′. The other two triplets, at 2.57 and 2.56 ppm, cold be assigned to methylenes in positions 3 and 3′. From the quantitative scheme of interaction through space on the basis of an analysis of the two-dimensional NOE graph it was possible to assign the signals of the four methylenes and two $N-CH_3$ groups. The methylenes showed the following signals: H-3 at 2.57 pm, H_2-3′ at 2.56 ppm, H-4 at 2.83 ppm, and H-4′ at 2.79 ppm. The N-methyls formed the signals: 2-$N-CH_3$ at 2.32 ppm and 2′-$N-CH_3$ at 2.31 ppm. In accordance with the NOE values, the signals at 3.86 and 3.79 ppm were assigned to the methoxyls at C-6′ and C-6, respectively.

On the basis of the facts given, it was possible to make a definitive assignment of the signals in the PMR spectrum of turconidine (I). The assignment of the signals of (I) is given below:

Position of the proton in the molecule	Chemical shift, ppm	Position of the proton in the molecule	Chemical shift, ppm
H_2-1	3.36 (2H, s)	H_2-1′	3.27 (2H, s)
2-$N-CH_3$	2.32 (3H, s)	2′-$N-CH_3$	2.31 (3H, s)
H_2-3	2.57 (2H, t)	H_2-3′	2.56 (2H, t)
H_2-4	2.83 (2H, t)		
H-5	6.50 (1H, s)	H_2-4′	2.79 (2H, t)
6-OCH_3	3.79 (3H, s)	H-5′	6.63 (1H, s)
7-OCH_3	3.62 (3H, s)	6′-OCH_3	3.86 (3H, s)
		H-8′	6.12 (1H, s)

On the basis of the results presnted, structure (I) is proposed for turconidine.



I

EXPERIMENTAL

For general observations, see [1].

NMR spectra were taken on WM-500 (Bruker) and BS 567 A/100 MHz (Tesla) instruments. HMDS was used as an internal standard, and deuterochloroform as solvent. The purity of the alkaloid was checked with the aid of TLC on plates coated with alumina (Brockmann activity grade II). The revealing agents were the Dragendorff reagent and iodine vapor. Solvent systems: benzene–ethanol (9:1) and (4:1). Column chromatography was conducted on alumina with a particle size of 125-160 μm.

Isolation of Turconidine. The mother liquor from turcberine (0.3 g) obtained in the separation of he nonphenolic fraction of the total ether-extracted material [1] from young shoots of *B. turcomanica* was chromatographed on a column of alumina (12 g). The alkaloids were eluted with benzene–methanol mixtures in various ratios. Elution with benzene–methanol (95:5) led to the isolation of 0.04 g of turconidine (I) in amorphous form.

IR: ν_{max}^{KBr} 2940, 2840, 2780, 1610, 1580, 1520, 1450, 1380, 1320, 1260, 1130, 870, 760 cm^{-1}.

UV: $\lambda_{max}^{C_2H_5OH}$ 225 (sh), 284 nm (log ε 3.87; 3.44).

^{13}C NMR ($CDCl_3$, δ, ppm): 28.64(t); 29.06(t); 45.74(q); 45.75(q); 52.22(t); 52.33(t); 52.65(t); 55.82(q); 56.13(q); 57.10(t); 60.67(q); 108(d); 111.83(d); 112.31(d); 121.48(s); 126.67(s); 126.87(s); 129.50(s); 139.69(s); 144.74(s); 145.54(s); 147.03(s); 151.68(s).

Mass spectrum m/z (I, %): 398(M^{+}, 68), 397(62), 367(42), 221(70), 220(31), 206(100), 198.5^{++}(9), 192(14), 190(25), 175(35).

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