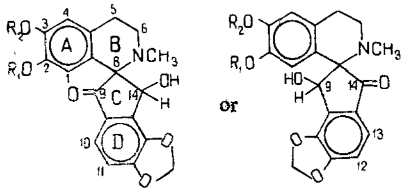
A STUDY OF THE STRUCTURE AND STEREOCHEMISTRY OF CORYDAINE AND CORPAINE BY MEANS OF THE INTRAMOLECULAR NUCLEAR OVERHAUSER EFFECT

D. A. Fesenko and M. E. Perel'son

UDC 547.92

We have previously [1, 2] reported the isolation from Corydalis paczoskii of two new spirobenzylisoquinoline alkaloids – corydaine (I) and corpaine (II) – and we have also established their structure by spectral methods and shown the cis arrangement of the hydroxy group in ring C with respect to the unshared pair of the nitrogen atom (from the IR and NMR spectra). In the present paper we give additional information, obtained by the use of the intramolecular nuclear Overhauser effect (NOE), in favor of the structures proposed previously for (I) and (II), we make a choice between the two variants of the structure (I) and (II), and we establish the relative configurations of (I) and (II). The possibility of the successful application of the NOE to the study of the structure and stereochemistry of the spirobenzylisoquinoline alkaloids has been shown by Bell and Saunders and their colleagues [3-7]. The NOE figures for (I) and (II) are given in Table 1.



I $R_1 + R_2 = CH_2$
II $R_1 = H$, $R_2 = CH_3$

An increase in the integral intensity of the signal from the C_4-H by 21% when the signal of the protons of the methoxy group is saturated and the absence of an increase in the intensity of the C_1-H signal confirms the conclusion that the methoxyl is located at C_3 [2]. A NOE is observed between the protons at C_5 and C_4-H, which shows the correctness of the assignment of the signals with $\delta = 6.50$ ppm in (I) and $\delta = 6.53$ ppm in (II) to C_4-H. The absence of a NOE between the methine proton of ring C and C_{10}-H in (I) (or C_{13}-H in (II)) is in harmony with the location of the methylenedioxy group in ring D proposed previously. The values of the long-range spin-spin coupling constants between C_{14}-H (or C_9-H) and C_{10}-H, C_{11}-H (or C_{12}-H, C_{13}-H) also confirm the position of the methylenedioxy group in ring D ($J_{H_{14}H_{10}} = 0.4$ Hz, $J_{H_{14}H_{11}} = 0{,}6$ Hz) [8].

All-Union Scientific-Research Institute for Medicinal Plants. Translated from Khimiya Prirodynkh Soedinenii, No. 2 pp. 166-168, March, 1971. Original article submitted January 5, 1971.

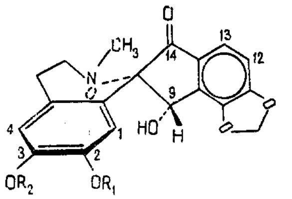
TABLE 1. Intramolecular Nuclear Overhauser Effect in Corydaine and Corpaine

Substance	Proton observed	σ, ppm	Proton ir-radiated	σ, ppm	Increase in integral intensity, %
I	C_1-H	6,01	C_9-H	4,97	26
	C_4-H	6,50	C_5-H	2,93	24
	C_9-H	4,97	C_1-H	6,01	15
	C_9-H	4,97	$N-CH_3$	2,23	—
	$C_{13}-H$	7,40	C_9-H	4,97	—
II	C_1-H	6,14	C_9-H	5,04	24
	C_1-H	6,14	C_3-OCH_3	3,82	—
	C_4-H	6,53	C_3-OCH_3	3,83	21
	C_4-H	6,53	C_5-H	2,98	25
	C_9-H	5,04	C_1-H	6,14	15
	C_9-H	5,04	$N-CH_3$	2,30	—
	$C_{13}-H$	7,40	C_9-H	5,04	—

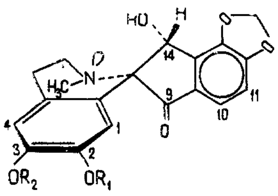
---

*Spectra taken in $CDCl_3$ (internal standard HMDS) on a NA-100D spectrometer.

Assuming the cis arrangement of the hydroxyl and the unshared pair of the nitrogen atom, the spatial structures of (I) and (II) can be represented by formulas (III) and (IV). In structure (IV), the N-methyl group is in the axial position, since the structure with the equatorial configuration must be excluded from consideration because of the impossibility of the formation of a hydrogen bond of the OH ··· N type. In strucutre (III), the proton at C_9 is 1.85 Å from the proton at C_1, and in (IV) the distance between the C_{14}-H and the C_1-H is approximately 3.5 Å (distances measured on a model of the Dreiding type). For structure (III)



III



IV

the existence of a NOE between C_1-H and C_9-H may be expected, while for (IV) it should be absent [3, 7]. On saturating the signal from C_9-H, an increase in the integral intensity of the C_1-H signal by 26% in (I) and by 24% in (II) was observed, which permits a conclusion in favor of structure (III). The N-methyl group in (III) is equatorial, since its axial arrangement is sterically hindered because of interference on the part of the hydroxy and Ar-CH_2 groups, as follows from a consideration of Stuart models. The absence of a NOE between C_9-H and N-CH_3 confirms their trans arrangement and, consequently, the cis arrangement of the unshared pair of the nitrogen atom at the OH group.

The results obtained correspond to the published results of the study of the NOE in the spirobenzylisoquinoline alkaloids [3-7].

Thus, the structure and relative configurations of (I) and (II) can be expressed by formula (III).

SUMMARY

The structure and relative configuration of corydaine and corpaine, spirobenzylisoquinoline alkaloids isolated previously from *Corydailis paczoskii* have been established.

LITERATURE CITED

1. Kh. Sh. Baisheva, D. A. Fesenko, B. K. Rostotskii, and M. E. Perel'son, Khim. Prirodn. Soedin., 6, 456 (1970).

2. Kh. Sh. Baisheva, D. A. Fesenko, M. E. Perel'son, and B. K. Rostotskii, Khim. Prirodn. Soedin., 6, 574 (1970).
3. J. K. Saunders, R. A. Bell, C.-Y. Chen, D. B. MacLean, and R. H. F. Manske, Can. J. Chem., 46, No. 17, 2876 (1968).
4. R. H. F. Manske, R. Rodrigo, D. B. MacLean, D. E. F. Gracey, and J. K. Saunders, Can. J. Chem., 47, No. 19 3585 (1969).
5. R. H. F. Manske, R. G. A. Rodrigo, D. B. MacLean, D. E. F. Gracey, and J. K. Saunders, Can. J. Chem., 47, No. 19 3589 (1969).
6. D. B. MacLean, R. A. Bell, J. K. Saunders, C.-Y. Chen, and R. H. F. Manske, Can. J. Chem., 47, No. 19, 3593 (1969).
7. R. A. Bell and J. K. Saunders, Can. J. Chem., 48, No. 7, 1114 (1970).
8. J. K. Saunders, R. A. Bell, C-Y. Chen, D. B. MacLean, and R. H. F. Manske, Can. J. Chem., 46, No. 17, 2873 (1968).