

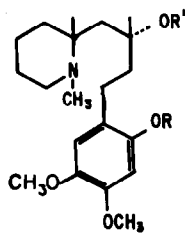
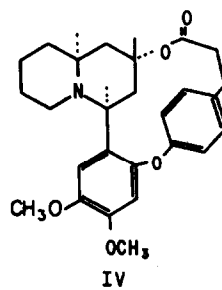
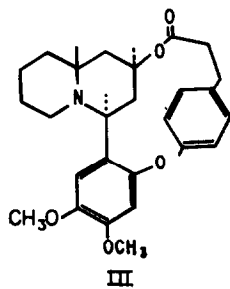
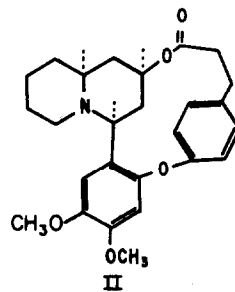
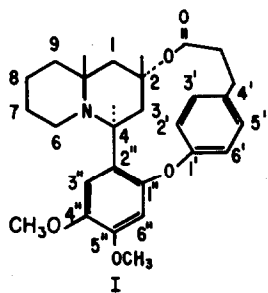
LYTHRACEAE ALKALOIDS.
STRUCTURE AND STEREOCHEMISTRY
OF THE BIPHENYL ETHER ALKALOIDS
OF DECODON VERTICILLATUS (1)

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(Received 17 July 1966; in revised form 15 August 1966)

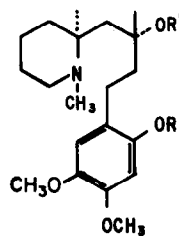
In our previous paper we reported the structures of the major alkaloids that have been isolated from the Lythraceae plant family. (2) We then turned our attention to two minor alkaloids from Decodon verticillatus, decaline and vertaline. (3) These alkaloids were of interest because further investigation of the basic extracts of Decodon revealed the presence of appreciable amounts of two new alkaloids, desmethyldecaline and desmethylvertaline, which on methylation were converted to decaline and vertaline. Structurally decaline and vertaline were of interest because each contained a chemically inert oxygen link that was assumed to be an ether, as no direct evidence for its presence could be detected in the infrared or n. m. r. spectra. The presence of two methoxyl groups and the observation of six aromatic protons in the n. m. r. spectra of these bases was compatible with a biphenyl ether function.

At this point an x-ray analysis of the structure of the hydrobromide of vertaline was undertaken and this resulted in structure I (private communication by Dr. J. Hamilton and Dr. L. Steinrauf) for vertaline. (4)

We were then able to assign structure IV to decaline with the aid of the vertaline structure. The i. r., n. m. r. optical rotatory dispersion and mass spectra of decaline and vertaline are virtually identical and the u. v. spectra are identical. This establishes that the methoxylation pattern of the biphenyl ether is the same in each and the bases differ only in the stereochemistry at the quinolizidine ring.



- V a. $R = H, R' = H$
 b. $R = CH_3, R' = H$
 c. $R = R' = CH_3CO$



- VI a. $R = H, R' = H$
 b. $R = CH_3, R' = H$
 c. $R = R' = CH_3CO$

When decaline and vertaline are converted to N-oxides the n. m. r. resonance of H-3'' shifts from 2.8 τ to 2.1 τ . A similar shift was observed previously with the biphenyl alkaloids (2) and is due to the N-oxide oxygen coming in close proximity to the phenyl ring at H-3''. This peak is a singlet in decaline and vertaline, as predicted by the methoxylation pattern in I.

The deshielding of H-3'' in the N-oxides requires that the oxygen of the N-oxide group be next to H-3''. Stereochemical analysis with the aid of Dreiding Models reveals that only structures II-IV fulfill this requirement. It was possible to eliminate structure III as a possibility on the basis of the cis or trans nature of the quinolizidine ring juncture. Vertaline and desmethylvertaline do not exhibit "Bohlmann bands" in the infrared consistent with the cis ring fusion. However, "Bohlmann bands" are clearly observable in the infrared spectra of decaline and desmethyldecaline consistent with a trans-quinolizidine ring fusion. (5) Furthermore, the chemical shift of H-4 (6.68 τ in the vertaline series and 7.05 τ in the decaline series) is consistent with a cis-fusion in the former and a trans-fusion in the latter. (6) Finally the N-methyl resonance of the methiodide of decaline (6.79 τ) is at higher field than that of vertaline (6.41 τ) consistent with a trans-fusion in decaline. (7) Therefore, decaline is either II or IV.

It was possible to uniquely assign the structure IV to decaline on the basis of the Emde degradation of the methiodides of decaline and vertaline. Emde reduction with sodium in liquid ammonia results not only in cleavage of the quarternary amine (2) but also in cleavage of the biphenyl ether (8) and lactone to yield 3-phenylpropanol and Va in the decaline series and VIa in the vertaline series. Compounds Va and VIa were methylated to yield Vb and VIb and acetylated to yield Vc and VIc.

It was not possible to obtain the derivatives of V and VI in crystalline form although in some instances satisfactory analytical data were obtained on the amorphous preparations. The spectral data in Table I confirm the assigned structures. The u. v. spectra (e. g. VIa, λ_{\max} 285 m μ ϵ 5890) and mass spectra (e. g. VIc, M^+ 407, N-methylpiperi-

deine ion 98) provides further support for these structures.

TABLE I

	<u>N-CH₃^a</u>	<u>OCH₃^a</u>	<u>CH₃CO^a</u>	<u>CH₃CO^b</u>
Va	7.70	6.21 (6 protons)		
Vb	7.68	6.25, 6.20, 6.16		
Vc	7.80	6.20, 6.15	7.62, 8.00	1770, 1740
VIa	7.60	6.20 (6 protons)		
VIb	7.60	6.21, 6.19, 6.14		
VIc	7.75	6.23, 6.18	7.70, 8.00	1770, 1740

a. n. m. r. (τ) b. i. r. (cm^{-1})

The optical rotation of Vb is $+60^\circ$ and that of VIb is -35° which establishes that Vb and VIb are diastereomers. Therefore IV is the structure of decaline. (9)

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- (1) Address correspondence to J. P. F. at The Salk Institute.
 - (2) J. P. Ferris, C. B. Boyce, R. C. Briner, B. Douglas, J. L. Kirkpatrick, J. A. Weisbach, Tetrahedron Letters, in press (1966)
 - (3) J. P. Ferris, J. Org. Chem. 27, 2985 (1962)
 - (4) See accompanying communication.
 - (5) F. Bohlmann, Chem. Ber. 91, 2157 (1958)
 - (6) F. Bohlmann, D. Schumann and C. Arndt, Tetrahedron Letters, 2705 (1965)
 - (7) T. M. Moynehan, K. Schofield, R. A. Y. Jones and A. R. Katritzky, J. Chem. Soc. 2637 (1962)
 - (8) P. A. Sartoretto and F. J. Sowa, J. Am. Chem. Soc. 59, 503 (1937) and R. H. F. Manske, ibid. 72, 55 (1950)
 - (9) Another biphenyl ether alkaloid, lagerine, oxygenated at the 5'' and 6' positions and with the lactone side chain at the 3' position has been isolated from Lagerstroemia indica.