NMR Spectroscopic Studies on Peptide Alkaloids $^1$H and $^{13}$C Spectra of Zizyphin A and Frangulanin

Ernst Haslinger* and Wolfgang Robien

Institut für Organische Chemie, Universität Wien, A-1090 Wien, Österreich

(Received 25 May 1981. Accepted 9 June 1981)

$^1$H and $^{13}$C studies of the styrylamine moiety in the 13-membered cyclopeptide alkaloid zizyphin A and the 14-membered cyclopeptide alkaloid frangulanin are reported.

(Keywords: Cyclopeptide alkaloids, partially relaxed $^1$H-NMR spectra; $^1$$^1$$^3$J$^{1H,13C}$-Coupling constants)

NMR-Spektroskopische Untersuchungen an Peptid-Alkaloiden. $^1$H- und $^{13}$C-Spektren von Zizyphin A und Frangulanin

Es werden $^1$H- und $^{13}$C-spektroskopische Untersuchungen des 13-gliedrigen Cyclopeptidalalkaloids Zizyphin A und des 14-gliedrigen Cyclopeptidalalkaloids Frangulanin beschrieben.

Introduction

Cyclopeptide alkaloids are particularly common in plants of the Rhamnaceae family, but they have also been found in Sterculiaceae, Rubiaceae, Urticeae, Hymenocardiaeeae and Celastraceae$^{1,2}$. They have an alkoxystyrylamin group as common structural unit in a 13-, 14- or 15-membered heterocyclic ring system. Recently growing interest in the conformation of cyclic peptides has also induced NMR-investigations of these compounds. Up to now only a few $^{13}$C-NMR-studies of cyclopeptide alkaloids have been reported in the literature$^{3-6}$.

UV spectra of these alkaloids show a different behaviour, dependent on the ring size, indicating substantial conjugation of the enamine residue with the aromatic ring in the 13- and 14-membered molecules$^4$.

As our first assignment$^3$ of the carbon resonances of the styrylamin
unit in frangulanin$^{12}$ (2) was based on solvent induced shifts and tentatively concerning the carbons in the double bond$^5$ we have reinvestigated the styrylamin resonances of 2 and zizyphin A (1)$^{7-9}$. No exhaustive $^1$H-NMR study on 1 has been reported so far; we therefore studied the $^1$H-NMR-Spectrum of this compound in order to gain information from $^1$H-$^1$H double resonance experiments.

\begin{figure}[h]
\centering
\includegraphics[width=0.8\textwidth]{structures.png}
\caption{
Structures of frangulanin (2) and zizyphin A (1).
}
\end{figure}

**Results and Discussion**

$^1$H-NMR Studies on Zizyphin A (1)

The $^1$H-NMR-spectrum of 1 is shown in Fig. 1, the assignment of the $^1$H-resonances is given in Table 1. The resonances of the styrylamino group are remarkable different from the corresponding resonances of 2 (Tab. 2). The vinylic protons have a larger vicinal coupling constant in 1 indicating a less strained structure, what is supported by the larger coupling of the NH proton to the vinylic hydrogen.

In the region from 5.22 to 4.00 ppm the resonances of six protons appear. These can be assigned to the hydrogens in positions 2, 3, 6, 35, 18 and 21. As several lines in this region are overlapping, we used partially relaxed spectra to make the splitting pattern of single protons visible. This technique has been used earlier with frangulanin (2)$^{10,11,13}$ and is based on the fact, that the protons in position 3 and 6 have longer relaxation times, than the other three (Fig. 2). The protons in positions 18 and 35 have in turn been assigned by $^1$H-$^1$C double resonance experiments. The assignment of the methylresonances has also been made by means of partially relaxed spectra.

The absorption of the N(CH$_3$)$_2$-group at ambient temperature is very broad, showing restricted motion of the side chain. A similar