ASSIGNMENT OF ^{1}H AND ^{13}C NMR SIGNALS AND THE ALKENE GEOMETRY AT C-7 IN BORRELIDIN

MING-S. KUO, DAVID A. YUREK and DAVID A. KLOOSTERMAN

Research Laboratories, The Upjohn Company, Kalamazoo, Michigan 49001, U.S.A.

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In the course of our screening program for new antibiotics, a streptomycete, UC 8842, was isolated from a soil sample collected in Louisiana, U.S.A. UC 8842 was found to produce an antibiotic (U-78,548) active against Gram-positive microbes. The antibiotic was shown to be spectroscopically identical with borrelidin, an antibiotic discovered much earlier as a metabolite of *Streptomyces rochei*,[1] and *Streptomyces* sp. C2989.[2] Borrelidin was also shown to be identical to treponemycin.[3] Although the structure of borrelidin was reported, the geometry at position 7 was not resolved. We now wish to present data to clarify the geometry at the C-7 position of borrelidin along with the ^{1}H and ^{13}C NMR assignments.

To determine the geometry at C-7, we employed nuclear Overhauser enhancement (NOE) techniques. In order to use this technique, unambiguous assignments of the proton signals of the diene moiety and neighboring protons are required. A 2D ^{1}H-^{1}H correlation spectrum (COSY) of borrelidin identified most of the proton signals. However, there were some unresolved signals in the upfield region in the 500 MHz ^{1}H NMR spectrum. Since the carbon signals are well resolved, 2D C-H COSY was used to resolve the partially resolved proton signals. The assignments of proton and carbon signals of borrelidin utilizing ^{1}H-^{1}H and C-H COSY techniques are summarized in Table 1.

It is of interest to note that the carbon signals of the cyclopentanoic acid moiety of borrelidin are more broad than the rest of the carbon signals in the 125 MHz NMR spectrum. The line broadening was not observed in the ^{13}C NMR spectrum of the diazomethane derivative borrelidin.

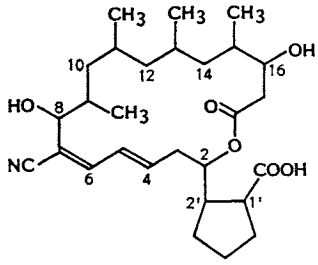
Irradiation of 6-H had a small observable NOE effect (~2%) on 4-H and no significant NOE were observed on other protons. On the other hand, irradiation of 5-H had a large NOE

Table 1. NMR data of borrelidin (free acid).

Atom No.	^{13}C NMR chemical shift (ppm)[a]	^{1}H NMR chemical shift (ppm)[b]	Atom No.	^{13}C NMR chemical shift (ppm)[a]	^{1}H NMR chemical shift (ppm)[b]
2	77.5 (d)	4.95	16	72.9 (d)	3.90
3	36.7 (t)	2.54	17	37.8 (t)	2.24
		2.57			2.44
4	140.2 (d)	6.31	18	173.2 (s)	
5	129.0 (d)	6.59	1′	50.0 (d)	2.40
6	145.5 (d)	6.90	2′	47.5 (d)	2.69
7	119.2 (s)		3′	30.5 (t)	1.99
8	73.1 (d)	4.28			1.40
9	36.0 (d)	1.81	4′	26.2 (t)	1.71
10	39.1 (t)	0.70			1.80
		1.21	5′	32.6 (t)	1.99
11	27.6 (d)	1.63			1.79
12	49.6 (t)	0.97	COOH	180.1 (s)	
		1.09	CN	117.2 (s)	
13	28.5 (d)	1.80	15-CH_3	19.1 (q)	0.86
14	44.6 (t)	0.95	13-CH_3	18.8 (q)	0.85
		1.20	11-CH_3	20.9 (q)	0.84
15	37.1 (d)	1.79	9-CH_3	15.3 (q)	1.02

[a] Relative to MeOH-d_4 (δ 49.0), multiplicities in parenthesis.
[b] Relative to TMS (δ 0).

Fig. 1. Structure of borrelidin.



(~7%) on 8-H. The above results clearly indicate that the lactone ring has a *cis* geometry at the C-6 – C-7 double bond. It was established[4] previously that the lactone ring has a *trans* geometry at the C-4 – C-5 double bond. Thus, the structure of borrelidin is determined as 2-[7-cyano-8,16-dihydroxy-9,11,13,15-tetramethyl-18-oxooxacycloctadeca-4,6(*E*,*Z*)-diene-2-yl]cyclopentacarboxylic acid (Fig. 1).

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