NOTES

THE CARBON-13 NMR SPECTRUM OF GOUGEROTIN

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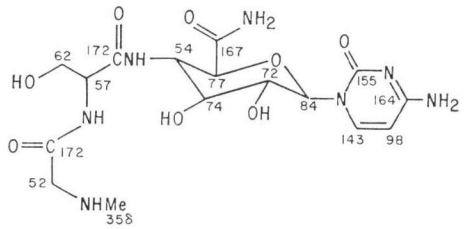
Gougerotin was isolated from *Streptomyces gougerotii* in 1962[1], its structure was established in 1969[2] and total syntheses were announced in 1972[3] and in 1975[4].

In the course of a soil screen we isolated gougerotin from an organism identified as *Streptomyces puniceus* subsp. *doliceus* subsp. nov. (NRRL 11160). It was co-produced with the clazamycins[5,6]. The ultraviolet[3] and proton magnetic resonance[7] spectra of our sample were in good agreement with those published for gougerotin. Identification was completed when we interpreted the C-13 NMR spectrum. Since the assigned spectrum can facilitate early identification of this antibiotic and its analogs[8] and be useful in biosynthetic studies[9], we present it here.

The CMR spectrum of gougerotin in D_2O consists of 15 lines. The chemical shifts and assignments of these are shown in Fig. 1.

The cytosine assignments[10] were the simplest to make in view of the certainty of the presence of a cytosine residue (the UV and PMR spectra). The remainder of the spectrum can easily be misinterpreted to be that of a furanoside ring to which was attached a carbon bridge as in the ezomycins. However, comparison with the published spectra of hikizimycin[11] (for corrected structure see references 12 and 13), showed that a 4-amino-4-deoxypyranose ring was present. The remainder of the spectrum was assignable on the basis of chemical shifts once it was accepted that a uronamide was present and that the δ 62 triplet was assignable to a serine moiety. The remainder of the spectrum was assigned from chemical shift tables.

Fig. 1.



* The numbers refer to the shift in ppm from external TMS. The spectrum was run on a varian CFT-20 using 100 mg gougerotin in 1.0 ml D_2O adjusted to pH 2 with 6 N HCl.

Table 1. The CMR spectrum of gougerotin.

Shift (ppm)	Multiplicity	Assignment
35.3	q	N-methyl
52.8	t	alpha to N
54.6	d	alpha to N
57.0	d	alpha to N
62.7	t	
72.6	d	
74.6	d	alpha to O
77.1	d	
84.6	d	
98.5	d	cytosine, C-5
143.1	d	cytosine, C-6
155	s	cytosine, C-2
164	s	cytosine, C-4
167	s	carbonyls
172 (2 peaks)	s	carbonyls

(q=quartet, t=triplet, d=doublet, s=singlet)

References

1) KANZAKI, T.; E. HIGASHIDE, H. YAMAMOTO, M. SHIBATA, K. NAKAZAWA, H. IWASAKI, T. TAKEWAKA & A. MIYAKE: Gougerotin, a new antibacterial antibiotic. J. Antibiotics, Ser. A 15: 93~97, 1962
2) FOX, J. J.; Y. KUWADA & K. A. WATANABE: Nucleoside. LVI. On the structure of the nucleoside antibiotic, gougerotin. Tetrahedron Lett. 1968: 6029~6032, 1968
3) WATANABE, K.; E. A. FALCO & J. J. FOX: Total synthesis of gougerotin. J. Am. Chem. Soc. 94: 3272~3274, 1972
4) LICHTENTHALER, F. W.; T. MORINO, W. WINTERFELDT & Y. SANEMITSU: Nucleosides. XXVI. An alternate synthetic approach to gougerotin. Tetrahedron Lett. 1975: 3527~3530, 1975
5) DEBOER, C.; L. A. DOLAK & D. H. PETERSON:

Composition of matter and process. U.S. Patent 4,113,855, Sept. 12, 1978

6) HORIUCHI, Y.; S. KONDO, T. IKEDA, D. IKEDA, K. MIURA, M. HAMADA, T. TAKEUCHI & H. UMEZAWA: New antibiotics, clazamycins A and B. J. Antibiotics 32: 762~764, 1979
7) LICHTENTHALER, F. W.; T. MORINO & H. M. MENZEL: Nucleosides. XXV. On the structure of aspiculamycin: its identity with the nucleoside antibiotic gougerotin. Tetrahedron Lett. 1975: 665~668, 1975
8) LICHTENTHALER, F. W.; G. TRUMMLITZ, G. BAMBACH & I. RYCHLIK: Syntheses eines biologisch aktiven Gougerotin-analogens. Angew. Chem. 83: 331~332, 1971
9) STOTHERS, J. B.: "Carbon-13 NMR Spectroscopy." Vol. 24 of "Organic Chemistry." Academic Press, New York, 1972
10) JONES, A. J.; D. M. GRANT, M. W. WINKLEY & R. K. ROBINS: Carbon-13 magnetic resonance. XVII. Pyrimidine and purine nucleosides. J. Am. Chem. Soc. 92: 4079~4087, 1970
11) UCHIDA, K.; E. BREITMAIER & W. A. KOENIG: ^{13}C NMR investigations of the nucleoside antibiotic hikizimycin and its constituents. Tetrahedron 31: 2315~2317, 1975
12) ENNIFAR, S. & B. C. DAS: Structural identity of anthelmycin with hikizimycin. J. Chem. Soc., Chem. Comm., 1977: 41~42, 1977
13) VUILHORGNE, M.; S. ENNIFAR, B. C. DAS, J. W. PASCHAL, R. NAGARAJAN, E. W. HAGAMAN & E. WENKERT: Structure analysis of the nucleoside disaccharide antibiotic anthelmycin by carbon-13 nuclear magnetic resonance spectroscopy. A structural revision of hikizimycin and its identity with anthelmycin. J. Org. Chem. 42: 3289~3291, 1977