

CARBON-13 NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY OF C/D-CIS POLYOXYPREGNANES. II

Takashi Yamagishi, Koji Hayashi and Hiroshi Mitsuhashi
(Faculty of Pharmaceutical Sciences, Hokkaido University, Sapporo, Hokkaido 060, Japan)
and
Mamoru Imanari and Kazuhito Matsushita
(JEOL AID Division Application Laboratory, Nakagami 1418, Akishima, Tokyo 196, Japan)

(Received in Japan 6 June 1973; received in UK for publication 27 July 1973)

A number of C/D-cis polyoxypregnane derivatives possessing an oxo or a carbinol group at C-20 have been isolated from the plants of family Asclepiadaceae,¹ Ranunculaceae,² and Scrophulariaceae.¹ The configuration of the side chain at C-17 in these compounds has been determined by ORD measurements of C-20 oxo derivatives³ and further by chemical correlation. However, it is not applicable to the compounds having a strong chromophore absorbing at around 300 nm.

Carbon-13 NMR has proved to be a useful tool for the investigation of stereochemistry of santonin derivatives,⁴ norbornanes,⁵ methylcyclohexane,⁶ and pimaradienes.⁷ All these results indicate the following facts: when the two carbon atoms with 1-4 relation are in a gauche and an anti orientation to each other, the chemical shifts of both carbons are higher in the former case than the latter case. In other words, when the dihedral angle between the two carbon atoms by Newman's projection becomes small, the chemical shift of each carbon is considerably shifted to an upper field. On the basis of these facts, the C-12 signals of the C-17 α -isomers in which dihedral angles between C-12 and C-20 are about 30° should be expected to appear at a higher field than those of β -isomers in which the dihedral angles are about 150° (see Fig. 1a). On the other hand, in the C-17 β isomers, the chemical shifts of C-18, whose dihedral angle to C-20 is about 30°, are higher than those of the α -isomers (see Fig. 1b).

We have measured the C-13 NMR spectra of thirteen C/D-cis polyoxypregnane derivatives and been able to make satisfactory assignments of almost all of the resonances.⁸ The Table lists the chemical shifts of C-12, C-18, and C-20 obtained in several solvents. The signals of C-18

in 1a, 1b, and 2c appeared at lower fields by 2.92, 3.08, and 3.46 ppm than those in 1f, 1h,⁹ and 2e, while those of C-12 were shifted upfields by 5.33, 2.68, and 6.06 ppm, respectively as illustrated in Fig. 2. Although the solvents used and acylation of the C-12 hydroxyl group influence the chemical shifts, the rule mentioned above is applicable to the determination of the configuration at the C-17 position among the epimeric pairs of C/D-cis polyoxypregnane derivatives.

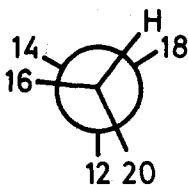


Fig. 1a

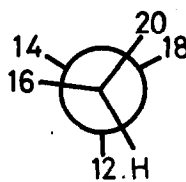


Fig. 1b

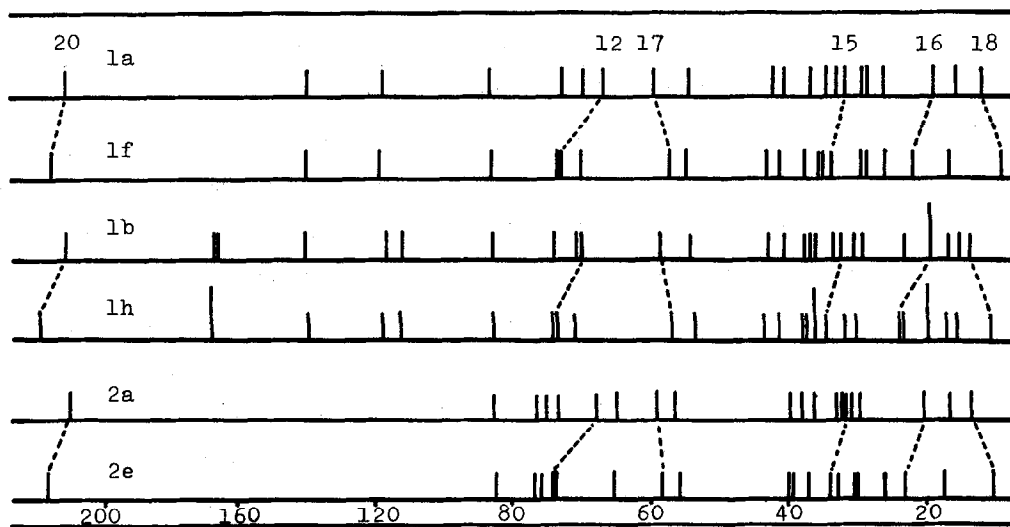


Fig. 2 Chemical shift correlations for changes in C-17 configuration for lineolon (1a), cynanchogenin (1b), and glycolineolon (2a).

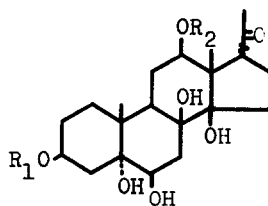
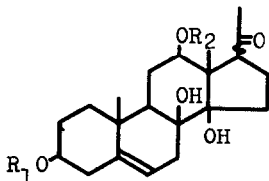
TABLE

Carbon-13 Chemical Shifts of C-12, C-18, and C-20

	C-20	C-18	C-12
17a- COCH ₃	210.47(P) 208.95(P) 209.32(C) 209.32(C) 209.98(C) 210.65(P) 210.53(P)	209.32(Di) 208.45(Di) 14.99(C) 14.99(C) 15.11(C) 14.99(P) 209.77(Di)	13.83(Di) 15.04(Di) 70.99(C) 70.99(C) 72.62(C) 69.59(P) 69.29(P)
17b- COCH ₃	210.47(P) 210.53(P)	14.80(P) 15.53(C)	68.98(P) 71.96(C)
17c- COCH ₃	216.72(P) 217.14(C) 217.51(C)	214.89(Di) 11.53(P) 11.83(C) 12.02(C)	73.84(P) 73.78(C) 73.90(C)
17d- COCH ₃	213.14(Di)	213.14(Di)	10.92(Di)
17e- COCH ₃			74.50(Di)

(C) In CDCl₃ solution(P) In pyridine-d₅(Di) In Me₂SO-d₆

All of the ¹³C FT-NMR spectra were obtained at 25.1 MHz using a JEOL PS-100/PFT-100 spectrometer system, and facilitated by the complete proton noise decoupling technique. The measurement conditions are as follows: rf pulse width, 10μsec (π/4 pulse); data points, time domain 8192 points; frequency domain, 4096 points. The data recorded are in ppm downfield from the carbon resonance of internal tetramethylsilane and thought to be accurate to ±0.05 ppm.



1a: $R_1=R_2=H$, 17 β -H

1b: $R_1=H$, $R_2=ikemaoyl$, 17 β -H

1c: $R_1=Ac$, $R_2=ikemaoyl$, 17 β -H

1d: $R_1=Bz$, $R_2=ikemaoyl$, 17 β -H

1e: $R_1=R_2=Bz$, 17 β -H

1f: $R_1=R_2=H$, 17 α -H

1g: $R_1=R_2=Ac$, 17 α -H

1h: $R_1=H$, $R_2=ikemaoyl$, 17 α -H

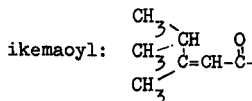
2a: $R_1=R_2=H$, 17 β -H

2b: $R_1=CHO$, $R_2=H$, 17 β -H

2c: $R_1=H$, $R_2=ikemaoyl$, 17 β -H

2d: $R_1=Me$, $R_2=H$, 17 β -H

2e: $R_1=R_2=H$, 17 α -H



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