refine structure: *TEXSAN LS*. Software used to prepare material for publication: *TEXSAN FINISH*. Literature survey: *CSSR* (1984).

Lists of structure factors, anisotropic displacement parameters, H-atom coordinates and complete geometry, including bond distances and angles involving H atoms, have been deposited with the IUCr (Reference: LI1121). Copies may be obtained through The Managing Editor, International Union of Crystallography, 5 Abbey Square, Chester CH1 2HU, England.

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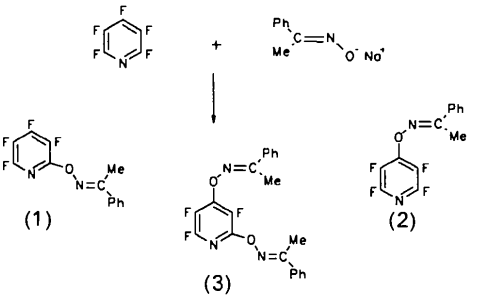
Comment

The structure determination reported herein is part of an investigation into the substitution reactions of hydroxylamine, oxime and hydrozone salts with pentafluoropyridine and related compounds, in which novel 2-substitution was observed to compete with the expected 4-substitution (Banks, Jondi & Tipping, 1989; Jondi, 1989). The structural information was required to confirm that the title compound was a 2-substituted tetrafluoropyridine and that the substituent was the —O—N=C(Me)Ph group having the same configuration, *i.e.* (*E*), as the oximate reactant. Confirmation that the compound was the 2-substituted oxime (1) enabled the other products of the reaction, compounds (2) and (3), to be positively identified.



Acta Cryst. (1995). C51, 293–295

(*E*)-Acetophenone *O*-(3,4,5,6-Tetrafluoro-2-pyridyl)oxime, Formed by 2-Substitution of Pentafluoropyridine by (*E*)-Acetophenone Oximate

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Abstract

Despite the oxyimino chain being unconjugated [N—O 1.434 (2) and C—N 1.278 (2) Å] in the title compound, $C_{13}H_8F_4N_2O$, the planar α-phenylethylimino and tetrafluoro-2-oxopyridine moieties are only slightly twisted relative to each other [C—O—N—C 167.6 (2)°]. This facilitates stacking along the *ac* diagonal so that fluorinated pyridine substituents alternate with non-fluorinated phenyl rings.

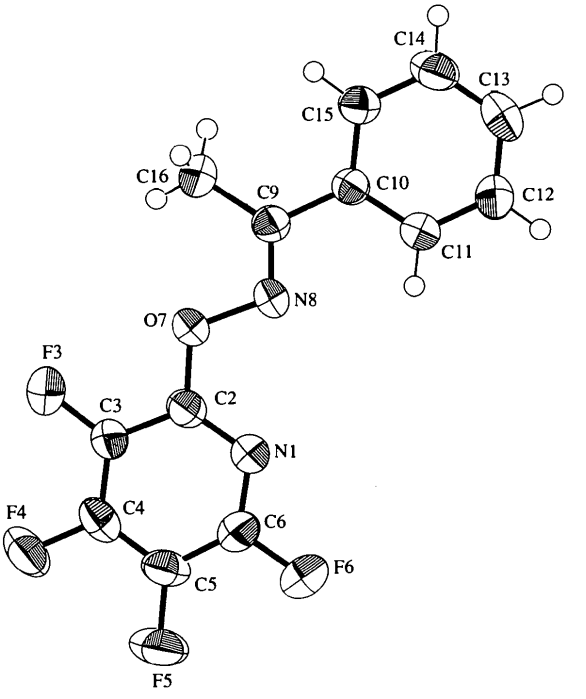

Fig. 1. *ORTEP*II (Johnson, 1976) view of the title molecule showing the atom-numbering scheme and ellipsoids set at the 50% probability level.

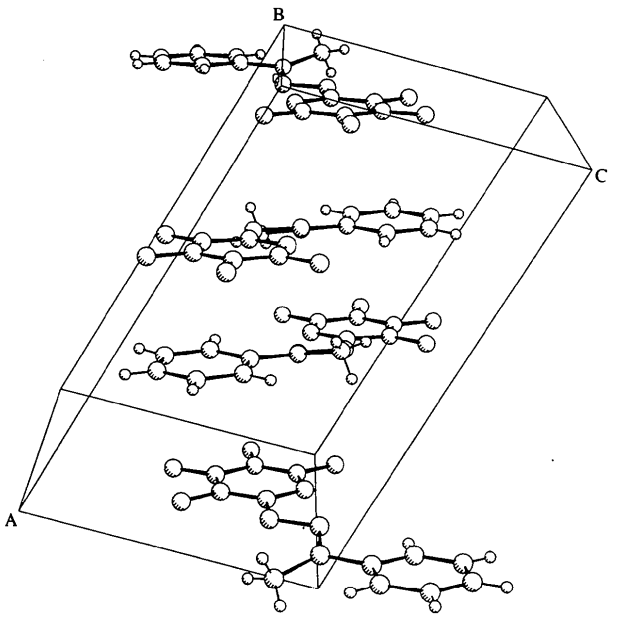

Fig. 2. Stacking along the *ac* diagonal, drawn using *PLUTO* (Motherwell & Clegg, 1978), with closest approaches between adjacent non-bonded ring atoms in the stack of C2···C10^{i} 3.425 (3) Å and C3···C15^{ii} 3.490 (3) Å [symmetry codes: (i) $1-x, 1-y, 1-z$; (ii) $\frac{1}{2}-x, y-\frac{1}{2}, \frac{1}{2}-z$].

Experimental

Pentafluoropyridine (8.10 g, 47.9 mmol) was added slowly to a cooled (273 K) stirred slurry of (*E*)-sodium acetophenone oximate [prepared *in situ* from sodium hydride (1.15 g, 47.9 mmol) and (*E*)-acetophenone oxime (6.30 g, 46.7 mmol) in diethyl ether (*ca* 100 ml)] and the mixture was stirred at 273 K for 2 h. The resulting mixture was filtered and the solvent removed from the filtrate *in vacuo* to give a solid residue (12.50 g) which was shown by TLC (eluant 1:3 *v/v* $CHCl_3$:*n*-C_6H_{14}) to contain three components (R_F = 0.60, 0.50 and 0.15). Separation by dry-column flash chromatography (Merck Kieselgel 60 GF_{254}; *n*-C_6H_{14}) afforded (*a*) 4-[(*E*)-α-phenylethyliminooxy]tetrafluoropyridine (2) (6.10 g, 21.5 mmol, 45%; analysis found C 54.8, H 3.0, F 26.3, N 9.6%, M^+ = 284; $C_{13}H_8F_4N_2O$ requires C 54.9, H 2.8, F 26.8, N 9.9%, M = 284), m.p. 331–333 K (eluant 1:3 *v/v* $CHCl_3$:*n*-C_6H_{14}); (*b*) the title compound (1) (4.90 g, 17.3 mmol, 36%; analysis found C 54.9, H 2.7, F 27.0, N 9.7%, M^+ = 284; $C_{13}H_8F_4N_2O$ requires C 54.9, H 2.8, F 26.8, N 9.9%, M = 284), m.p. 389–391 K (eluant 1:2 *v/v* $CHCl_3$:*n*-C_6H_{14}); and (*c*) 2,4-bis[(*E*)-α-phenylethyliminooxy]trifluoropyridine (3) (0.80 g, 2.0 mmol, 4%; analysis found C 63.4, H 4.2, F 14.1, N 10.4%, M^+ = 399; $C_{21}H_{16}F_3N_3O_2$ requires C 63.2, H 4.0, F 14.3, N 10.5%, M = 399), m.p. 373–375 K (eluant $CHCl_3$). The crystals of compound (1), obtained by slow evaporation of the eluant, were suitable for the structure determination.

Crystal data

$C_{13}H_8F_4N_2O$
M_r = 284.21
Monoclinic
$P2_1/n$
a = 13.579 (3) Å
b = 11.107 (2) Å
c = 8.299 (1) Å
β = 105.90 (1)°
V = 1203.8 (8) Å^3
Z = 4
D_x = 1.568 Mg m^{-3}
Mo $K\alpha$ radiation
λ = 0.71069 Å
Cell parameters from 25 reflections
θ = 16.2–24.5°
μ = 0.1365 mm^{-1}
T = 296 K
Plate
0.40 × 0.30 × 0.10 mm
Colourless

Data collection

Enraf–Nonius CAD-4 diffractometer
$\omega/2\theta$ scans
Absorption correction: none
2039 measured reflections
1937 independent reflections
1365 observed reflections [$I > 2\sigma(I)$]
R_{int} = 0.024
θ_{max} = 24.0°
$h = 0 \rightarrow 13$
$k = -12 \rightarrow 0$
$l = -9 \rightarrow 8$
3 standard reflections monitored every 200 reflections
intensity decay: not significant

Refinement

Refinement on F
R = 0.034
wR = 0.029
S = 2.065
1365 reflections
214 parameters
All H-atom parameters refined
$w = 1/[\sigma^2(F) + 0.00023F^2]$
$(\Delta/\sigma)_{max}$ = 0.0403
$\Delta\rho_{max}$ = 0.16 e Å^{-3}
$\Delta\rho_{min}$ = −0.17 e Å^{-3}
Extinction correction: Zachariasen (1967) type 2, Gaussian isotropic
Extinction coefficient: 14.75 × 10^{-7}
Atomic scattering factors from *International Tables for X-ray Crystallography* (1974, Vol. IV)

Table 1. *Fractional atomic coordinates and equivalent isotropic displacement parameters* (Å^2)

$U_{eq} = (1/3)\Sigma_i\Sigma_j U_{ij} a_i^* a_j^* \mathbf{a}_i.\mathbf{a}_j$.

	x	y	z	U_{eq}
F3	0.42929 (10)	0.3795 (1)	−0.0290 (1)	0.0699 (7)
F4	0.43380 (10)	0.1371 (1)	−0.0695 (2)	0.0806 (7)
F5	0.3912 (1)	−0.0104 (1)	0.1653 (2)	0.0918 (8)
F6	0.3447 (1)	0.0939 (1)	0.4300 (2)	0.0897 (8)
O7	0.3891 (1)	0.4714 (1)	0.2387 (2)	0.0587 (7)
N1	0.3633 (1)	0.2798 (2)	0.3369 (2)	0.0513 (9)
N8	0.3636 (1)	0.5144 (2)	0.3851 (2)	0.0527 (9)
C2	0.3854 (2)	0.3498 (2)	0.2242 (3)	0.046 (1)
C3	0.4082 (2)	0.3051 (2)	0.0837 (3)	0.047 (1)
C4	0.4102 (2)	0.1838 (2)	0.0629 (3)	0.054 (1)
C5	0.3888 (2)	0.1097 (2)	0.1801 (3)	0.058 (1)
C6	0.3659 (2)	0.1636 (2)	0.3123 (3)	0.057 (1)
C9	0.3877 (2)	0.6256 (2)	0.4070 (2)	0.044 (1)
C10	0.3632 (2)	0.6812 (2)	0.5532 (2)	0.042 (1)
C11	0.3428 (2)	0.6106 (2)	0.6786 (3)	0.052 (1)
C12	0.3172 (2)	0.6620 (2)	0.8118 (3)	0.061 (1)
C13	0.3114 (2)	0.7852 (2)	0.8237 (3)	0.064 (1)
C14	0.3322 (2)	0.8563 (2)	0.7027 (3)	0.063 (1)
C15	0.3582 (2)	0.8052 (2)	0.5682 (3)	0.052 (1)
C16	0.4367 (3)	0.6974 (3)	0.2990 (4)	0.078 (1)

Table 2. *Selected geometric parameters* (Å, °)

O7—N8	1.434 (2)	C3—C4	1.360 (3)
O7—C2	1.357 (2)	C4—C5	1.364 (3)
N1—C2	1.312 (2)	C5—C6	1.359 (3)
N1—C6	1.309 (3)	C9—C10	1.478 (3)
N8—C9	1.278 (2)	C9—C16	1.486 (3)
C2—C3	1.378 (3)		

N8—O7—C2	113.3 (1)	N8—C9—C10	114.5 (2)
O7—N8—C9	109.3 (2)	N8—C9—C16	124.9 (2)
O7—C2—N1	122.5 (2)	C9—C10—C11	120.9 (2)

Data collection: CAD-4 diffractometer control software (Enraf–Nonius, 1989). Cell refinement: CAD-4 diffractometer control software. Data reduction: *TEXSAN PROCESS* (Molecular Structure Corporation, 1985). Program(s) used to solve structure: *SHELXS86* (Sheldrick, 1985). Program(s) used to refine structure: *TEXSAN LS*. Software used to prepare material for publication: *TEXSAN FINISH*. Literature survey: *CSSR* (1984).

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Acta Cryst. (1995). C**51**, 295–298

2′-Carbamate Taxol

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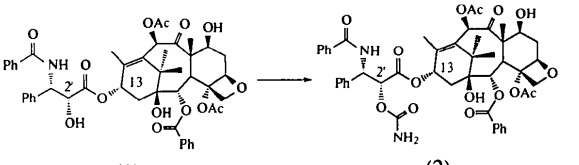
Abstract

Comparison of the conformation of 2′-carbamate taxol, {2a*R*-[2aα,4β,4aβ,6β,9α,(αR^*,βS^*),11α,-12α,12aα,12bα]}-6,12b-bis(acetyloxy)-12-(benzoyloxy)-2a,3,4,4a,5,6,9,10,11,12,12a,12b-dodecahydro-4,11-dihydroxy-4a,8,13,13-tetramethyl-5-oxo-7,11-methano-1*H*-cyclodeca[3,4]benzo[1,2-*b*]oxet-9-yl β-(benzoylamino)-α-(carbamoyloxy)benzenepropanoate, $C_{48}H_{52}N_2O_{15}$, with the known X-ray structures of taxotere and methyl (2*R*,3*S*)-*N*-benzoyl-3-phenylisoserinate reveals that the most pronounced differences are in the conformation of the C13 side-chain fragment. The carbamate N atom forms two intermolecular hydrogen bonds with the taxol core and stabilizes the crystal.

Comment

Taxol, (1), a naturally occurring diterpene isolated from the bark of *Taxus brevifolia* (Wani, Taylor, Wall, Coggon & McPhail, 1971), is considered the most exciting lead in the chemotherapy of several malignant solid tumors (Rowinsky & Donehower, 1991). For more than 20 years, attempts to determine the crystal structure for the whole molecule have not been successful due to difficulties in obtaining crystals suitable for X-ray diffraction experiments. To date, detailed structural information on taxol has been restricted to a crystallographic study of taxotere, a semi-synthetic taxol analog with a modified side chain at the 13*R* position (Gueritte-Voegelein, Guénard, Mangatal, Potier, Guilhem, Cesario & Pascard, 1990).

In the course of our SAR program on taxol analogs, we synthesized 2′-carbamate taxol (2) which is, to our knowledge, the simplest crystalline taxol derivative containing both the oxetane ring and the complete taxol-type side chain, and investigated its structure by single-crystal analysis. It was synthesized in two steps, acylation of taxol at the 2′ position with chloromethyl chloroformate, followed by treatment of the 2′-chloromethyl carbonate intermediate with ammonia in acetone at room temperature.



(1) (2)

The conformation of the tetracyclic ring system in 2′-carbamate taxol is essentially indentical to that of taxotere. The slight differences in the conformations of the benzoyl group at C2 and the acetyl group at C4 were also observed in the crystal structures of other taxanes (Appendino *et al.*, 1992; Gunawardana *et al.*, 1992). However, the side chain at C13 possesses a different conformation from that of taxotere. The *N*-benzoyl group at the 3′ position is rotated approximately 90° away from the corresponding position of the *tert*-butyl group of taxotere. The