interaction plus forte que dans le cas du chlorhydrate de l'[hydroxy-1-(*R*,*S*) isopropylamino-2 ethyl]-6 dihydro-2,3 benzoxazole-1,3 one-2 (Mairesse, Boivin, Thomas, Bonte, Lesieur & Lespagnol, 1984) où les distances Cl^-–N valent respectivement 3,166 (4) et 3,193 (4) Å.

Aucune autre interaction, mises à part les interactions de type van der Waals, ne contribue à la stabilité de l'arrangement cristallin. Nous avons rassemblé, dans le Tableau 2, quelques distances et angles caractéristiques entre sites pharmacologiques actifs. Ce composé présente une structure originale vis à vis d'autres produits présentant le même type d'activité, il n'est donc pas possible de comparer la géométrie des sites actifs.

La distance O(8)···H(12) égale à 2,985 Å exclut l'existence d'une liaison hydrogène intramoléculaire par conséquent il n'y a pas formation d'un pseudocycle.

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Structural Studies of Mitomycins. V. Structure of Mitomycin H

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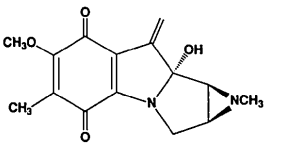
Abstract. [1a*S*-(1aα,8aα,8bα)]-1,1a,2,8,8a,8b-hexahydro-8a-hydroxy-6-methoxy-1,5-dimethyl-8-methyleneazirino[2′,3′:3,4]pyrrolo[1,2-*a*]indole-4,7-dione, $C_{15}H_{16}N_2O_4$, $M_r = 288{\cdot}31$, orthorhombic, $P2_12_12_1$, $a = 10{\cdot}929\ (3)$ $b = 13{\cdot}446\ (1)$, $c = 9{\cdot}686\ (1)$ Å, $V = 1423{\cdot}4\ (6)$ Å^3, $Z = 4$, $D_x = 1{\cdot}35$ g cm^{-3}, Cu $K\alpha$, $\lambda = 1{\cdot}5405$ Å, $\mu = 7{\cdot}8$ cm^{-1}, $F(000) = 304$, $T = 293$ K, $wR = 0{\cdot}061$ for 1590 observed reflections with $I > 3\sigma(I)$. In the title compound, one of the minor constituents from the fermentation broth of mitomycin C, the carbamate group which is one of the characteristic functional groups of the mitomycin family is replaced by an exocyclic C=C bond. Although the overall conformation of the molecule, except this moiety, is similar to that of mitomycin A, significant influences on the geometry due to the double bond are spread over the molecule.

Introduction. Mitomycins are potent antitumor antibiotics and mitomycin C which is a member of the family has been clinically applied to various tumors successfully. Although mitomycin C is a prominent antitumor drug, we have been screening the minor constituents from the fermentation broth of mitomycins since 1977 to discover more effective and less toxic ones. Mitomycin H was discovered as a minor constituent from the fermentation broth of mitomycin C by *Streptomyces caespitosus* and has been proved to have a unique skeleton by chemical and spectroscopic methods (Shirahata, Morimoto, Ashizawa, Mineura, Kono, Saito & Kasai, 1981). The carbamate group at the C(9) position which is one of the structural characteristics of mitomycins is replaced by a C=C bond. To understand the influence of this replacement on the structure of the molecule we have undertaken the X-ray analysis of the present compound.



Experimental. Crystal dimensions $0{\cdot}40 \times 0{\cdot}30 \times 0{\cdot}10$ mm. Enraf–Nonius CAD-4 diffractometer, graphite-monochromated Cu $K\alpha$ radiation. Cell dimensions from setting angles of 25 independent reflections with $20 \le \theta \le 29°$. 1771 reflections surveyed in the range $1 \le 2\theta \le 150°$; $0 \le h \le 13$, $0 \le k \le 16$, $0 \le l \le 12$; 1677 reflections were unique ($R_{int} = 0{\cdot}025$), 1590 observed with $I > 3\sigma(I)$. Three reference reflections monitored periodically showed no significant variation in intensity. Absorption correction was not applied. Secondary-extinction correction (Zachariasen, 1963) was made (final refined extinction coefficient of $1{\cdot}43 \times 10^{-5}$). Structure solved using *MULTAN*11/82 (Main, Fiske, Hull, Lessinger,

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Germain, Declercq & Woolfson, 1982) and Fourier-map recycling. Refinement using *SDP* package (Frenz, 1985), full-matrix least-squares refinement on F, with non-H atoms having anisotropic temperature factors. Most of the H atoms were located from difference Fourier syntheses but not refined. $w = 4F_o^2/[\sigma(I_o)^2 + (0{\cdot}04I_o)^2]^{1/2}/\mathrm{Lp}$, final $R = 0{\cdot}039$, $wR = 0{\cdot}061$, $S = 2{\cdot}35$, maximum shift/e.s.d. in the final least-squares cycle 0·05, maximum peak in the final difference map 0·22 (4) e Å^{-3}. Scattering factors from *International Tables for X-ray Crystallography* (1974, Vol. IV). Final fractional coordinates and equivalent B values are listed in Table 1.*

Discussion. Bond lengths and angles are shown in Table 2. An *ORTEP*II (Johnson, 1976) drawing of the molecule with the atomic numbering is shown in Fig. 1.

C(8*a*)—C(9), C(9)—C(9*a*) and O(5)—C(5) bonds are significantly shorter and C(8)—C(8*a*), N(4)—C(9*a*) and N(4)—C(4*a*) are significantly longer than the corresponding ones in mitomycin A (Hirayama & Shirahata, 1989). It is noteworthy that the exocyclic C=C bond appears to shorten the distant O(5)—C(5) bond and lengthen the second-neighbor bond C(8)—C(8*a*). Although the differences are not so remarkable, C(7)—C(8) and C(6)—C(7) bonds are shorter and the C(4*a*)—C(5) bond is longer than the corresponding bonds in mitomycin A. It is also notable that the sum of bond angles around the N(4) atom of 342·5° is significantly smaller than the corresponding value in mitomycin A.

* Lists of structure factors, anisotropic thermal parameters and H-atom parameters have been deposited with the British Library Document Supply Centre as Supplementary Publication No. SUP 53321 (12 pp.). Copies may be obtained through The Technical Editor, International Union of Crystallography, 5 Abbey Square, Chester CH1 2HU, England.

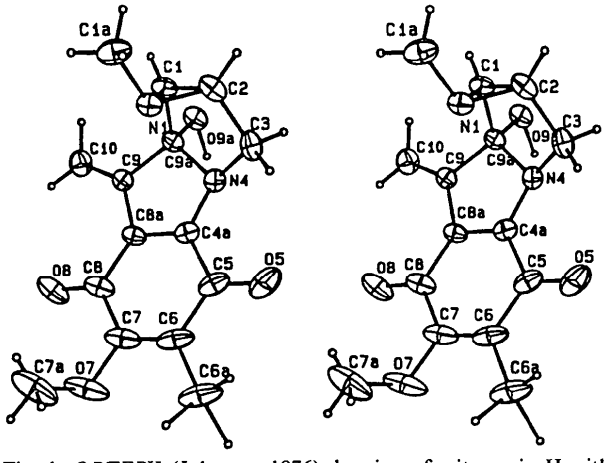

Fig. 1. *ORTEP*II (Johnson, 1976) drawing of mitomycin H with thermal ellipsoids at 30% probability.

Table 1. *Positional parameters and equivalent isotropic thermal parameters* (Å^2) *with their e.s.d.'s*

$B_{eq} = (4/3)\sum_i\sum_j \beta_{ij}\mathbf{a}_i.\mathbf{a}_j$.

	x	y	z	B_{eq}
O(5)	0·6099 (2)	0·51120 (9)	0·5290 (2)	6·90 (4)
O(7)	0·5358 (2)	0·3795 (2)	0·9716 (2)	7·97 (4)
O(8)	0·6763 (2)	0·2225 (1)	0·8999 (1)	5·84 (3)
O(9*a*)	0·9212 (1)	0·22936 (9)	0·4170 (1)	3·68 (2)
N(1)	0·5912 (1)	0·19274 (9)	0·3619 (1)	3·31 (2)
N(4)	0·7461 (1)	0·33549 (9)	0·4546 (1)	3·13 (2)
C(1)	0·7251 (2)	0·1795 (1)	0·3498 (2)	3·35 (3)
C(1*a*)	0·5203 (2)	0·1118 (2)	0·2975 (2)	4·89 (4)
C(2)	0·6612 (2)	0·2542 (2)	0·2635 (2)	3·93 (3)
C(3)	0·6897 (2)	0·3559 (2)	0·3188 (2)	4·23 (3)
C(4*a*)	0·6903 (1)	0·3526 (1)	0·5783 (2)	3.22 (3)
C(5)	0·6205 (2)	0·4450 (1)	0·6115 (2)	4·50 (4)
C(6)	0·5649 (2)	0·4493 (2)	0·7524 (2)	5·16 (4)
C(6*a*)	0·4852 (2)	0·5381 (2)	0·7822 (3)	7·36 (6)
C(7)	0·5842 (2)	0·3763 (2)	0·8411 (2)	5·11 (4)
C(7*a*)	0·4354 (2)	0·3179 (3)	0·9918 (3)	9·11 (9)
C(8)	0·6599 (2)	0·2865 (2)	0·8115 (2)	4·20 (4)
C(8*a*)	0·7081 (1)	0·2795 (1)	0·6728 (2)	3·08 (3)
C(9)	0·7774 (1)	0·2001 (1)	0·6074 (2)	2·89 (2)
C(9*a*)	0·7977 (1)	0·2327 (1)	0·4592 (2)	2·86 (3)
C(10)	0·8211 (2)	0·1149 (1)	0·6568 (2)	4·19 (3)

Table 2. *Bond lengths* (Å) *and angles* (°)

O(5)	C(5)	1·201 (3)		C(1)	C(9*a*)	1·505 (2)	
O(7)	C(7)	1·372 (2)		C(2)	C(3)	1·501 (3)	
O(7)	C(7*a*)	1·389 (4)		C(4*a*)	C(5)	1·493 (2)	
O(8)	C(8)	1·227 (2)		C(4*a*)	C(8*a*)	1·358 (2)	
O(9*a*)	C(9*a*)	1·411 (2)		C(5)	C(6)	1·495 (4)	
N(1)	C(1)	1·479 (3)		C(6)	C(6*a*)	1·505 (3)	
N(1)	C(1*a*)	1·474 (2)		C(6)	C(7)	1·321 (3)	
N(1)	C(2)	1·475 (2)		C(7)	C(8)	1·493 (3)	
N(4)	C(3)	1·477 (2)		C(8)	C(8*a*)	1·446 (2)	
N(4)	C(4*a*)	1·364 (2)		C(8*a*)	C(9)	1·455 (2)	
N(4)	C(9*a*)	1·494 (2)		C(9)	C(9*a*)	1·517 (3)	
C(1)	C(2)	1·482 (3)		C(9)	C(10)	1·330 (2)	

C(7)	O(7)	C(7*a*)	114·6 (2)	C(5)	C(6)	C(7)	120·0 (2)
C(1)	N(1)	C(1*a*)	113·5 (1)	C(6*a*)	C(6)	C(7)	123·8 (3)
C(1)	N(1)	C(2)	60·2 (2)	O(7)	C(7)	C(6)	121·0 (2)
C(1*a*)	N(1)	C(2)	114·4 (1)	O(7)	C(7)	C(8)	114·7 (2)
C(3)	N(4)	C(4*a*)	124·4 (1)	C(6)	C(7)	C(8)	124·5 (2)
C(3)	N(4)	C(9*a*)	110·8 (1)	O(8)	C(8)	C(7)	121·1 (2)
C(4*a*)	N(4)	C(9*a*)	107·3 (1)	O(8)	C(8)	C(8*a*)	123·3 (2)
N(1)	C(1)	C(2)	59·8 (2)	C(7)	C(8)	C(8*a*)	115·7 (2)
N(1)	C(1)	C(9*a*)	114·1 (1)	C(4*a*)	C(8*a*)	C(8)	121·8 (2)
C(2)	C(1)	C(9*a*)	108·9 (1)	C(4*a*)	C(8*a*)	C(9)	108·2 (1)
N(1)	C(2)	C(1)	60·0 (2)	C(8)	C(8*a*)	C(9)	130·0 (2)
N(1)	C(2)	C(3)	112·8 (1)	C(8*a*)	C(9)	C(9*a*)	106·0 (1)
C(1)	C(2)	C(3)	108·6 (1)	C(8*a*)	C(9)	C(10)	131·5 (2)
N(4)	C(3)	C(2)	103·6 (1)	C(9*a*)	C(9)	C(10)	122·5 (1)
N(4)	C(4*a*)	C(5)	123·9 (2)	O(9*a*)	C(9*a*)	N(4)	112·4 (1)
N(4)	C(4*a*)	C(8*a*)	114·0 (1)	O(9*a*)	C(9*a*)	C(1)	106·6 (1)
C(5)	C(4*a*)	C(8*a*)	122·0 (2)	O(9*a*)	C(9*a*)	C(9)	113·9 (1)
O(5)	C(5)	C(5*a*)	121·5 (2)	N(4)	C(9a)	C(1)	102·7 (1)
O(5)	C(5)	C(6)	122·6 (2)	N(4)	C(9*a*)	C(9)	103·9 (1)
C(4*a*)	C(5)	C(6)	115·9 (2)	C(1)	C(9*a*)	C(9)	116·9 (1)
C(5)	C(6)	C(6*a*)	116·2 (2)				

The nonplanarity of the benzoquinone ring which was observed in the crystal structures of mitomycin C (Arora, 1979) and mitomycin A (Hirayama & Shirahata, 1989) is also found in mitomycin H. The deviations of O(5) and O(8) atoms from the least-squares plane defined by C(4*a*), C(5), C(6), C(7), C(8) and C(8*a*) are 0·084 (2) and 0·054 (2) Å, respectively. As in mitomycin C these atoms are on the

same side of the plane. In mitomycin A these atoms are located on the opposite sides. The magnitude of the deviations in the present compound, however, is significantly smaller than those in the two crystallographically independent molecules of mitomycin A and this is possible due to the exocyclic double bond.

The present analysis has revealed that the influence of the exocyclic double bond at C(9) is spread over the molecule. Since the extent is unexpectedly wide the mode of the biological activities of the title compound is possibly quite different from other members of mitomycin family with a carbamate group at C(9).

There is one intermolecular hydrogen bond between the N atom (x, y, z) in the aziridine ring and the hydroxyl group ($-\frac{1}{2}+x, \frac{1}{2}-y, 1-z$). The hydrogen-bond geometries are as follows. N(1)···O(9a) = 3·023 (2), N(1)···H[O(9a)] = 1·96 (3) Å and ∠N(1)···H-O(9a) = 154 (2)°. Other intermolecular interactions are within van der Waals contacts.

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X-ray Structure of the Pyrethroid Insecticide {1*R*-[1α(*S**),2α]}-2-(2,2-Dichlorovinyl)-3,3-dimethylcyclopropanecarboxylic Acid Cyano(3-phenoxyphenyl)methyl Ester (RU 24501)

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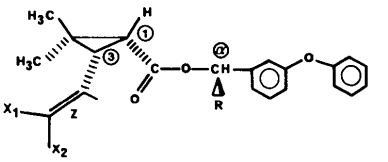
Abstract. α-Cyano-3-phenoxybenzyl {1*R*-[1α(*S**),2α]}-2-(2,2-dichlorovinyl)-3,3-dimethylcyclopropanecarboxylate. The crystal structure of one pyrethroid insecticide patented by Roussel UCLAF has been determined at 293 K by X-ray diffraction. The crystal is orthorhombic, $P2_12_12_1$, $C_{22}H_{19}Cl_2NO_3$ (RU 24501), $M_r = 416{\cdot}30$, $a = 9{\cdot}296$ (3), $b = 35{\cdot}853$ (9), $c = 6{\cdot}212$ (3) Å, $Z = 4$, $V = 2070{\cdot}4$ Å^3, $D_x = 1{\cdot}34$ Mg m^{-3}, Mo $K\alpha$, $\lambda = 0{\cdot}7107$ Å, $\mu = 0{\cdot}288$ mm^{-1}, $F(000) = 864$. The structure was refined from 1526 reflections with $I > 3\sigma(I)$ to $R = 0{\cdot}059$. All H atoms were found on a difference map. The conformation of the compound is compared with those of other known pyrethroid structures in the crystalline state.

Introduction. Considerable progress has been made in relating the structure of pyrethroids with their biological activity but improvement of such concepts needs reliable information on molecular shape (configuration, bond lengths and angles and conformation). As part of this work the results of the structural determination of {1*R*-[1α(*S**),2α]}-cyano-3-phenoxybenzyl 2-(2,2-dichlorovinyl)-3,3-dimethylcyclopropanecarboxylate, (RU 24501), will be compared to those of the isomorphous dibromo derivative (III) (Owen, 1975) and to two pyrethroid insecticides *cis*-3-phenoxybenzyl 2-(2,2-dibromovinyl)-3,3-dimethylcyclopropane carboxylate (I) and the 2-(2,2-dichlorovinyl) (II) analogue (Owen, 1976). The general formula of these compounds is depicted below.



(I) $X_1 = X_2$ = Br, R = H; (II) $X_1 = X_2$ = Cl, R = H; (III) $X_1 = X_2$ = Br, R = CN; (IV) $X_1 = X_2$ = Cl, R = CN

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