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# (3*R*,5*S*,6*R*,8*S*,9*S*)-1-Azonia-9-ethyl-3-hydroxy-5-(6-methoxyquinolin-4-yl)-3-methyl-4-oxa-tricyclo[6.2.2.0]dodecane trifluoromethanesulfonate: insight into the sterochemistry of the cyclization mechanism

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**Key indicators**

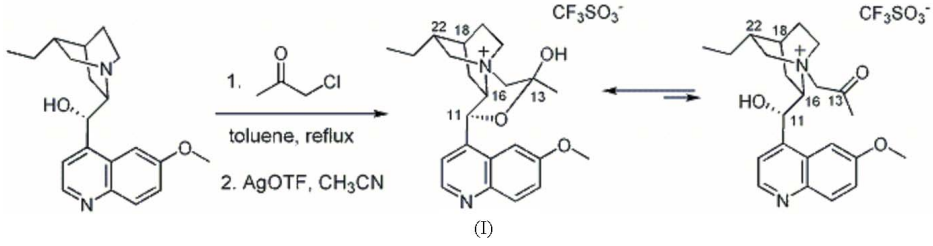
Single-crystal X-ray study
*T* = 293 K
Mean σ(C–C) = 0.005 Å
*R* factor = 0.043
*wR* factor = 0.124
Data-to-parameter ratio = 8.4

For details of how these key indicators were automatically derived from the article, see http://journals.iucr.org/e.

The analysis of the crystal structure of the title compound, $C_{23}H_{31}N_2O_3^+\cdot CF_3SO_3^-$, allowed the determination of the relative configuration at the five stereogenic centres.

## Comment

In the context of our research on the asymmetric epoxidation of alkenes, we carried out some syntheses of new catalysts derived from the Cinchona alkaloids. The alkylation of dihydroquinidine with chloroacetone in toluene gave a quaternary ammonium salt that cyclized to form a tricyclic hemiacetal, (I), as shown in the scheme below.




(I)

The absolute configuration of the precursor (dihydroquinidine) was known (Dijkstra *et al.*, 1989; Suszko-Purzycka *et al.*, 1991) and is fixed at three chiral centres (16*R*, 18*S*, 22*S*). From the present crystallographic analysis, the relative configurations of the two remaining asymmetric centres of the title compound (C11 and C13) are established: the resulting configurations at the five stereogenic centres are 11*S*, 13*R*, 16*R*, 18*S*, 22*S* (Fig. 1).

The ring containing the O atom of the hemiacetal (C11, O12, C13, C14, N15, C16) adopts a twist-boat conformation with puckering parameters $\theta$ = 87.9 (2)° and $\varphi$ = 21.0 (2)°, close to 90° and 30° respectively (Cremer & Pople, 1975).

The trifluoromethanesulfonate counter-ion is involved in the stability of the packing and participates in a strong hydrogen bond with the OH hydroxyl group on atom C13 [O26—H···O33$^{i}$: $D$···$A$ = 2.808 (4) Å; $D$—H···$A$ = 163 (6)°; symmetry code: (i) = $x$, $-1+y$, $1+z$) (Fig. 2)].

## Experimental

The precursor in the synthesis, dihydroquinidine, was commercially available in an optically pure form [> 96.0%, Aldrich], with known configurations at the three chiral centres of 16*R*, 18*S*, and 22*S*. To a solution of dihydroquinidine (100 mg, 0.3 mmol) in toluene (3 ml) was added dropwise a solution of chloroacetone (28.63 mg, 0.31 mmol) in toluene (2 ml). As the reaction mixture was stirred under reflux overnight, its colour changed to pink. The solvent was

evaporated under vacuum. This product in acetonitrile (10 ml) was placed in a round-bottomed flask wrapped in aluminium foil. Silver trifluoromethanesulfonate (72.9 mg, 0.3 mmol) was added and the reaction was stirred at room temperature for 4 h. The reaction mixture was filtered (×3) over fluorisil and concentrated under vacuum. The crude material was purified by recrystallization ($CHCl_3$/$Et_2O$), affording 132 mg (83% yield) of the title compound as pink crystals. Crystals suitable for X-ray diffraction analysis were also grown from a mixed ($CHCl_3$/$Et_2O$, 1:1) solvent.

### *Crystal data*

$C_{23}H_{31}N_2O_3^+\cdot CF_3O_3S^-$
$M_r$ = 532.57
Monoclinic, $P2_1$
$a$ = 11.312 (1) Å
$b$ = 8.059 (1) Å
$c$ = 14.074 (1) Å
$\beta$ = 101.49 (1)°
$V$ = 1257.3 (2) Å$^3$
$Z$ = 2
$D_x$ = 1.407 Mg m$^{-3}$
Cu $K\alpha$ radiation
$\mu$ = 1.72 mm$^{-1}$
$T$ = 293 (2) K
Prism, pale pink
0.50 × 0.35 × 0.20 mm

### *Data collection*

Enraf–Nonius CAD-4 diffractometer
$\omega/2\theta$ scans
Absorption correction: analytical (de Meulenaer & Tompa 1965)
$T_{min}$ = 0.480, $T_{max}$ = 0.725
2906 measured reflections
2794 independent reflections
2634 reflections with $I > 2\sigma(I)$
$R_{int}$ = 0.024
$\theta_{max}$ = 75.0°
3 standard reflections
every 60 reflections
intensity decay: 1.5%

### *Refinement*

Refinement on $F^2$
$R[F^2 > 2\sigma(F^2)]$ = 0.043
$wR(F^2)$ = 0.124
$S$ = 0.99
2794 reflections
333 parameters
H atoms treated by a mixture of independent and constrained refinement
$w = 1/[\sigma^2(F_o^2) + (0.082P)^2 + 0.328P]$ where $P = (F_o^2 + 2F_c^2)/3$
$(\Delta/\sigma)_{max}$ = 0.002
$\Delta\rho_{max}$ = 0.33 e Å$^{-3}$
$\Delta\rho_{min}$ = −0.34 e Å$^{-3}$
Extinction correction: *SHELXL97*
Extinction coefficient: 0.0263 (16)

All non-H atoms were refined anisotropically. H atoms were placed in idealized positions and allowed to ride on their parent atoms, with C—H = 0.97 Å and $U_{iso}$(H) = 1.2$U_{eq}$(C) for methylene groups, C—H = 0.93 Å and $U_{iso}$(H) = 1.2$U_{eq}$(C) for aromatic C atoms, and C—H = 0.96 Å and $U_{iso}$(H) = 1.5$U_{eq}$(C) for the methyl group. The H atom of the OH group (O26) was located in a difference Fourier map and refined freely.

No Friedel-related reflections were measured in the present data collection. The absolute configuration was assigned on the basis of the known configuration of the C16, C18 and C22 atoms of the precursor in the synthesis, dihydroquinidine (see scheme). The relative configurations of the other two asymmetric centres (C11 and C13) were deduced from this analysis.

Data collection: *CAD-4-MACH3* (Enraf–Nonius, 2000); cell refinement: *CAD-4-MACH3*; data reduction: *HELENA* (Spek, 1997); program(s) used to solve structure: *SHELXS97* (Sheldrick, 1997); program(s) used to refine structure: *SHELXL97* (Sheldrick, 1997); molecular graphics: *PLATON* (Spek, 2003); software used to prepare material for publication: *PLATON*.

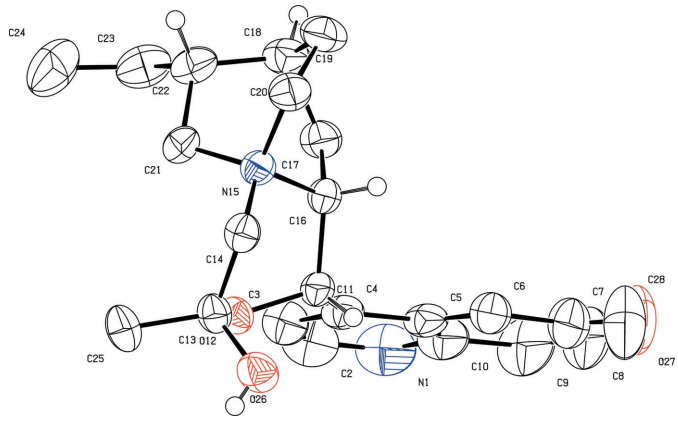



**Figure 1**
A view of the molecular structure of the title compound, with the atom-numbering scheme. Displacement ellipsoids are drawn at the 50% probability level.

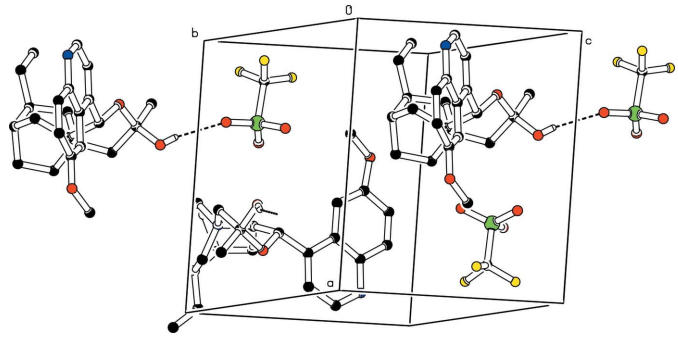



**Figure 2**
View of the crystal packing, showing two instances of the intermolecular hydrogen bond involving the trifluoromethanesulfonate counter-ion as dashed lines. H atoms not involved in hydrogen bonding have been omitted.

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