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# (−)-2-Methylamino-1-(spiro[cyclopentane-1,1′-inden]-3′-yl)ethanol Hydrobromide

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**Abstract.** $C_{16}H_{22}NO^+.Br^-$, $M_r = 324{\cdot}3$, monoclinic, $P2_1$, $a = 17{\cdot}847\ (8)$, $b = 6{\cdot}559\ (3)$, $c = 6{\cdot}994\ (3)$ Å, $\beta = 97{\cdot}66\ (2)^\circ$, $V = 811{\cdot}40$ Å$^3$, $Z = 2$, $D_m = 1{\cdot}34\ (1)$ (xylene/chloroform), $D_c = 1{\cdot}33$ Mg m$^{-3}$, $\mu$(Mo $K\alpha$) = $2{\cdot}45$ mm$^{-1}$. The final $R = 0{\cdot}058$ for 1041 observed reflexions. The absolute configuration was found to be *R* at the asymmetric carbon atom C(14).

**Introduction.** The title compound, hereinafter referred to as KABI 2023, has been synthesized by the pharmaceutical company Kabi AB (Jönsson, Merenyi & Dahlander, 1978). It has contractile response to the urethra. This effect is mediated by α-adrenergic receptors. The substance has been used to study the heterogenicity of postsynaptic α-adrenergic receptors (Gahlin & Sparf, 1978). The structure of the racemic mixture of this compound as an HCl salt in triclinic crystals has been determined earlier (Hebert, 1978). The crystal structure and the absolute configuration of the biologically active (−) enantiomer are reported here.

Transparent plates of KABI 2023 were obtained from Kabi AB. A crystal 0·05 × 0·2 × 0·4 mm was chosen for intensity measurements on a Pailred diffractometer. Using graphite-monochromatized Mo $K\alpha$ radiation 2055 reflexions within $\sin\theta/\lambda \le 0{\cdot}65$ Å$^{-1}$ were recorded. Standard reflexions measured at regular intervals during the data collection showed no significant change in intensity. After correction for Lorentz and polarization factors 1041 reflexions had $F_o > 5\sigma(F_o)$. These were used in the refinement.

Multisolution tangent refinement located the Br atom and a ten-atom fragment. Subsequent electron density calculations revealed the non-hydrogen atoms of the molecule. Isotropic refinement and appropriate assignment of atom type converged at $R = 0{\cdot}11$. After anisotropic refinement the positions of all H atoms were calculated geometrically, and in the following refinement cycles all H atoms bonded to C were allowed to ride on their corresponding C atoms, except for the methyl group which was refined as a rigid group. The two N—H distances were constrained to 1·01 Å and the O—H to 0·99 Å along the hydrogen bond O—H···Br. The H atoms were given a common temperature factor which refined to a final value $U = 0{\cdot}11$ Å$^2$. The weighting scheme was $0{\cdot}5237/[\sigma^2(F_o) + 0{\cdot}001F_o^2]$. The final $R' = \sum w^{1/2}||F_o| - |F_c||/\sum w^{1/2}|F_o|$ was 0·058 with $R = 0{\cdot}058$. Apart from three peaks close to the Br atom the final difference

Table 1. *Fractional atom coordinates* (×10⁴, *for* H *atoms* ×10³) *and equivalent isotropic temperature factors* (Å² ×10³) *for non-hydrogen atoms*

$U_{eq} = (U_1 U_2 U_3)^{1/3}$ where $U_1$, $U_2$, $U_3$ are the principal radii of the thermal ellipsoids.

| | *x* | *y* | *z* | $U_{eq}$ |
|---|---|---|---|---|
| Br | 1129 (1) | 2500 | 7153 (2) | 62 (1) |
| O | 9051 (5) | 3701 (14) | 6216 (14) | 66 (5) |
| N | 9560 (5) | −279 (15) | 6795 (15) | 47 (5) |
| C(1) | 7037 (6) | 2014 (13) | 6402 (15) | 38 (6) |
| C(2) | 6785 (6) | 578 (17) | 5032 (18) | 50 (6) |
| C(3) | 6018 (7) | 91 (22) | 4814 (20) | 63 (8) |
| C(4) | 5529 (7) | 972 (29) | 5941 (23) | 68 (10) |
| C(5) | 5794 (7) | 2506 (45) | 7333 (17) | 67 (8) |
| C(6) | 6549 (6) | 2924 (18) | 7585 (16) | 44 (7) |
| C(7) | 6988 (8) | 4431 (17) | 8937 (19) | 59 (8) |
| C(8) | 6956 (8) | 3893 (27) | 11120 (20) | 75 (9) |
| C(9) | 6420 (17) | 5334 (37) | 11724 (31) | 158 (21) |
| C(10) | 6252 (17) | 6954 (31) | 10321 (30) | 169 (24) |
| C(11) | 6663 (11) | 6632 (24) | 8720 (27) | 97 (12) |
| C(12) | 7760 (7) | 4227 (21) | 8373 (18) | 59 (8) |
| C(13) | 7807 (6) | 2883 (15) | 7000 (16) | 46 (6) |
| C(14) | 8490 (6) | 2173 (21) | 6177 (18) | 53 (7) |
| C(15) | 8855 (7) | 458 (21) | 7464 (18) | 51 (7) |
| C(16) | 9953 (7) | −1891 (20) | 8127 (21) | 66 (8) |
| H(O) | 900 | 479 | 524 | |
| H(N*A*) | 936 | −76 | 545 | |
| H(N*B*) | 1005 | 53 | 705 | |
| H(2) | 717 | −15 | 417 | |
| H(3) | 580 | −101 | 374 | |
| H(4) | 494 | 51 | 579 | |
| H(5) | 541 | 333 | 814 | |
| H(8*A*) | 751 | 412 | 1194 | |
| H(8*B*) | 678 | 234 | 1128 | |
| H(9*A*) | 665 | 599 | 1309 | |
| H(9*B*) | 591 | 452 | 1189 | |
| H(10*A*) | 565 | 696 | 983 | |
| H(10*B*) | 641 | 840 | 1100 | |
| H(11*A*) | 629 | 679 | 739 | |
| H(11*B*) | 712 | 773 | 875 | |
| H(12) | 820 | 497 | 885 | |
| H(14) | 832 | 167 | 472 | |
| H(15*A*) | 846 | −79 | 744 | |
| H(15*B*) | 898 | 104 | 892 | |
| H(16*A*) | 1043 | −256 | 755 | |
| H(16*B*) | 950 | −298 | 805 | |
| H(16*C*) | 1012 | −147 | 961 | |

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Table 2. *Intramolecular bond distances* (Å) *and angles* (°) *with estimated standard deviations in parentheses*

| | | | |
|---|---|---|---|
| C(1)–C(2) | 1·376 (14) | C(10)–C(11) | 1·434 (21) |
| C(2)–C(3) | 1·394 (15) | C(11)–C(7) | 1·556 (18) |
| C(3)–C(4) | 1·379 (19) | C(7)–C(12) | 1·488 (17) |
| C(4)–C(5) | 1·436 (26) | C(12)–C(13) | 1·314 (15) |
| C(5)–C(6) | 1·363 (15) | C(13)–C(1) | 1·494 (14) |
| C(6)–C(1) | 1·411 (14) | C(13)–C(14) | 1·491 (15) |
| C(6)–C(7) | 1·513 (17) | C(14)–O | 1·414 (14) |
| C(7)–C(8) | 1·576 (18) | C(14)–C(15) | 1·530 (12) |
| C(8)–C(9) | 1·446 (22) | C(15)–N | 1·481 (9) |
| C(9)–C(10) | 1·450 (26) | N–C(16) | 1·518 (15) |

| | | | |
|---|---|---|---|
| C(6)–C(1)–C(2) | 121·8 (9) | C(11)–C(7)–C(12) | 113·8 (12) |
| C(13)–C(1)–C(2) | 131·3 (10) | C(7)–C(8)–C(9) | 104·3 (14) |
| C(6)–C(1)–C(13) | 106·9 (8) | C(8)–C(9)–C(10) | 111·5 (15) |
| C(1)–C(2)–C(3) | 117·3 (11) | C(9)–C(10)–C(11) | 109·8 (16) |
| C(2)–C(3)–C(4) | 121·9 (12) | C(10)–C(11)–C(7) | 106·5 (15) |
| C(3)–C(4)–C(5) | 120·3 (12) | C(7)–C(12)–C(13) | 113·9 (11) |
| C(4)–C(5)–C(6) | 117·3 (15) | C(12)–C(13)–C(14) | 128·8 (11) |
| C(5)–C(6)–C(1) | 121·1 (12) | C(12)–C(13)–C(1) | 108·3 (10) |
| C(5)–C(6)–C(7) | 129·3 (13) | C(1)–C(13)–C(14) | 122·8 (10) |
| C(1)–C(6)–C(7) | 109·5 (9) | C(13)–C(14)–O | 112·6 (11) |
| C(6)–C(7)–C(8) | 112·1 (11) | C(13)–C(14)–C(15) | 107·9 (8) |
| C(6)–C(7)–C(11) | 113·0 (12) | O–C(14)–C(15) | 105·4 (7) |
| C(6)–C(7)–C(12) | 101·3 (10) | C(14)–C(15)–N | 111·5 (6) |
| C(8)–C(7)–C(11) | 103·9 (12) | C(15)–N–C(16) | 112·1 (8) |
| C(8)–C(7)–C(12) | 113·0 (12) | | |

Table 3. *Ratios of calculated and observed structure factors of reflexions showing the accentuated effect of anomalous dispersion*

| $h\ k\ l$ | $\lvert F_c(hkl)\rvert/\lvert F_c(h\bar{k}l)\rvert$ | $\lvert F_o(hkl)\rvert/\lvert F_o(h\bar{k}l)\rvert$ | $h\ k\ l$ | $\lvert F_c(hkl)\rvert/\lvert F_c(h\bar{k}l)\rvert$ | $\lvert F_o(hkl)\rvert/\lvert F_o(h\bar{k}l)\rvert$ |
|---|---|---|---|---|---|
| $\bar{14}$ 1 2 | 1·11 | 1·08 | 8 1 2 | 1·05 | 1·04 |
| $\bar{11}$ 1 2 | 1·07 | 1·14 | 10 1 2 | 0·89 | 0·85 |
| $\bar{10}$ 1 2 | 1·03 | 1·09 | 12 1 2 | 0·95 | 0·94 |
| $\bar{7}$ 1 2 | 1·33 | 1·36 | 3 2 2 | 0·95 | 0·84 |
| $\bar{5}$ 2 2 | 0·96 | 0·89 | 4 2 2 | 1·09 | 1·05 |
| 5 1 2 | 1·10 | 1·04 | 13 2 2 | 1·20 | 1·09 |
| 7 1 2 | 0·98 | 0·95 | | | |

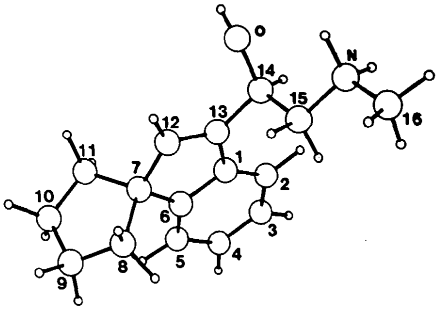

Fig. 1. Drawing of the molecule with the numbering of the atoms.

map showed no peaks >0·32 e Å$^{-3}$. Table 1 gives the final atomic coordinates and equivalent isotropic temperature factors for non-hydrogen atoms. Bond distances and angles are listed in Table 2.* The atomic scattering factors were those of the *SHELX* system. All calculations except for the data reduction were performed with *SHELX* (Sheldrick, 1975). The drawings were produced by *PLUTO* (W. D. S. Motherwell) and *ORTEP* (Johnson, 1965). All computations were made on an Amdahl 470 V/7A computer.

**Discussion.** The KABI 2023 molecule has an asymmetric carbon atom C(14). The absolute configuration was first determined using Hamilton's (1965) statistical test. The $R_G[=(\sum w||F_o| - |F_c||^2/\sum w|F_o|^2)^{1/2}]$ values for the 14(*R*) and 14(*S*) enantiomers were 0·0676 and 0·0710 respectively. Hence, the 14(*R*) configuration is correct at a significance level lower than 0·5%. This result was confirmed by measuring Bijvoet pairs ($hkl$–$h\bar{k}l$) (Bijvoet, Peerdeman & van Bommel, 1951). A comparison of the observed and calculated structure factor ratios (Table 3) shows that the correct 14(*R*) enantiomer was chosen initially. The (–) form of KABI 2023 has a higher biological activity than the (+) form. The corresponding *R* configuration at the *β* carbon atom C(14) is in agreement with earlier results on similar compounds (Giesecke & Hebert, 1979).

The molecule is illustrated in Fig. 1. The overall structure of the title compound shows no significant differences from the hydrochloride salt of the racemic mixture (Hebert, 1978) or from the related substance KABI 1847 (Carlström, 1976). The molecule consists of three approximately planar parts: the indene ring system, the cyclopentane ring and the ethylamine side chain. Pertinent torsion angles are given in Table 4. The cyclopentane ring has an envelope conformation with $C_s$ symmetry. The plane of the ethylamine side chain is approximately perpendicular to the indene ring system. This conformation has been found in many related substances (Giesecke & Hebert, 1979). The bond lengths and angles show no significant deviation from standard values. As in the hydrochloride salt of the racemic mixture, the conformation around the spiro atom C(7) is slightly distorted with the angles C(6)–C(7)–C(12) and C(8)–C(7)–C(11) smaller than the values expected from a perfect tetrahedral arrangement.

Table 4. *Selected torsion angles* (°)

| | |
|---|---|
| C(1)–C(13)–C(14)–C(15) | –91·5 (12) |
| C(14)–C(15)–N–C(16) | 176·5 (10) |
| C(1)–C(6)–C(7)–C(8) | –121·2 (14) |
| C(6)–C(7)–C(8)–C(9) | –103·4 (18) |
| C(13)–C(12)–C(7)–C(11) | –122·3 (16) |
| C(12)–C(7)–C(11)–C(10) | –142·3 (19) |

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* Lists of structure factors and anisotropic thermal parameters have been deposited with the British Library Lending Division as Supplementary Publication No. SUP 35739 (7 pp.). Copies may be obtained through The Executive Secretary, International Union of Crystallography, 5 Abbey Square, Chester CH1 2HU, England.

Table 5. *Hydrogen-bonded interactions*

The columns labelled $x'$, $y'$, $z'$ give the symmetry of the acceptor atom $Y'$. E.s.d.'s for bonds involving H atoms are not given since the H atoms are geometrically constrained.

| $X$ | H | $Y'$ | $x'$ | $y'$ | $z'$ | $X\cdots Y'$ | $H\cdots Y'$ | $X-H\cdots Y'$ |
|---|---|---|---|---|---|---|---|---|
| O | H(O) | Br | $1-x$ | $\frac{1}{2}+y$ | $1-z$ | 3·415 (9) Å | 2·43 Å | 180° |
| N | H(N*A*) | Br | $1-x$ | $-\frac{1}{2}+y$ | $1-z$ | 3·218 (9) | 2·22 | 167 |
| N | N(N*B*) | Br | $1+x$ | $y$ | $z$ | 3·332 (9) | 2·31 | 171 |

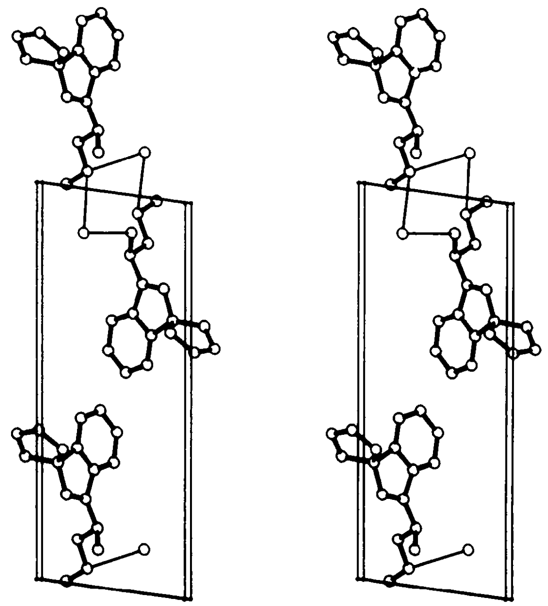

Fig. 2. Stereoscopic drawing of the molecular packing as seen along *b*. Thin lines represent hydrogen bonds.

The molecular packing and hydrogen-bonding system are shown in Fig. 2 and the hydrogen-bonded interactions are listed in Table 5. The crystal packing fully utilizes the hydrogen-bonding potential of the molecule. N—H···Br and O—H···Br bonds hold the structure together in the *b* direction. In the other directions van der Waals contacts are the only intermolecular interactions. No distances violating ordinary packing requirements are found in the structure apart from the hydrogen bonds.

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# 4,4,5,5-Tetramethyl-2-phenyl-1,3-dioxolan-2-ylium Dichloroiodate(I)

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**Abstract.** $C_{13}H_{17}O_2^+.ICl_2^-$, orthorhombic, *Pnma*, $a = 17\cdot51\ (1)$, $b = 10\cdot22\ (1)$, $c = 9\cdot11\ (1)$ Å, $V = 1630$ Å$^3$, $M_r = 403\cdot1$, $Z = 4$, $D_c = 1\cdot642$, $D_m = 1\cdot66$ Mg m$^{-3}$, $\mu$(Mo $K\alpha$) = 2·12 mm$^{-1}$. Final $R = 0\cdot049$ for 756 reflections. The 4,4,5,5-tetramethyl-2-phenyl-1,3-dioxolan-2-ylium cation is bisected by a crystallographic mirror plane which also contains a linear, symmetrical $ICl_2^-$ ion.

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