First synthesis of an optically active derivative of 3-selenabicyclo[3.3.1]nonane

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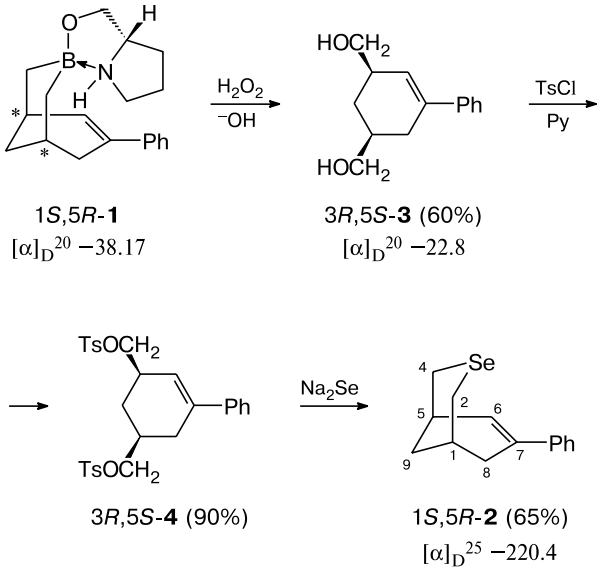
The 3-heterobicyclo[3.3.1]nonane fragment with O, S, or N atoms is found in some naturally occurring compounds.[1—4] For analogous selenium derivatives, only two representatives have been reported to exhibit antiarrhythmia activity.[5]

Earlier,[6,7] starting from 3-borabicyclo[3.3.1]non-6-ene derivatives, we obtained 3-thia- and 3-azabicyclo[3.3.1]non-6-enes (including optically active forms). Proceeding further along this line, we used optically active compound **1** as the starting material for the synthesis of (1*S*,5*R*)-7-phenyl-3-selenabicyclo[3.3.1]non-6-ene (**2**) (Scheme 1).

Scheme 1



Chiral borane **1** (97% *de*) was converted into bistosylate **4**.[6] Heating of the latter with Na_2Se in boiling EtOH gave the target (1*S*,5*R*)-7-phenyl-3-selenabicyclo[3.3.1]non-6-ene (**2**) as pale yellow needles. Its structure was confirmed by elemental analysis and physicochemical methods.

All manipulations with heteroatomic compounds were carried out in an atmosphere of dry argon. ^{1}H, ^{13}C, and ^{77}Se NMR spectra were recorded on a Bruker DRX-500 instrument (500.13 (^{1}H), 125.75 (^{13}C), and 95.39 MHz (^{77}Se)) in $CDCl_3$; ^{77}Se chemical shifts are referenced to Ph_2Se_2. The mass spectrum was recorded on an MS Kratos instrument (200 eV).

(1*S*,5*R*)-7-Phenyl-3-selenabicyclo[3.3.1]non-6-ene (2). An aqueous solution of Na_2Se (0.5 g, 4 mmol) and ditosylate **4** (0.63 g, 12 mmol) were added simultaneously from two funnels in an atmosphere of dry argon to boiling EtOH (10 mL). The reaction mixture was refluxed for 1.5 h. The solvent was removed *in vacuo* and the residue was diluted with a mixture of hexane and THF. The solution was filtered, a greater part of the solvent was removed, and the residue was kept at ~4 °C for 12 h. The crystals that formed were separated. The yield of compound **2** was 0.19 g (63%), m.p. 152 °C, $[\alpha]_D^{25}$ −220.4 (c = 0.5, MeOH). Found (%): C, 63.80; H, 6.17; Se, 30.93. $C_{14}H_{16}Se$. Calculated (%): C, 63.88; H, 6.13; Se, 30.00. ^{77}Se NMR, δ: 17.09. ^{1}H NMR, δ: 1.60 (d, 1 H, $H(9)_{syn}$, $^2J_{H(9)_{syn},H(9)_{anti}}$ = 13.0 Hz); 1.73 (br.d, 1 H, $H(9)_{anti}$, $^2J_{H(9)_{syn},H(9)_{anti}}$ = 13.0 Hz); 2.34—2.39 (m, 3 H, H(1), $H(2)_\beta$, $H(4)_\beta$); 2.61 (m, 1 H, H(5)); 2.68 (dd, 2 H, $H(8)_\alpha$, $H(8)_\beta$, $^2J_{H(8)_\alpha,H(8)_\beta}$ = 18.5 Hz, $^3J_{H(8)_\alpha,H(1)}$ = 7.0 Hz); 3.15 (dd, 1 H, $H(2)_\alpha$, $^2J_{H(2)_\beta,H(2)_\alpha}$ = 13.5 Hz, $^4J_{H(2)_\alpha,H(9)_{anti}}$ = 3.0 Hz); 3.18 (dd, 1 H, $H(4)_\alpha$, $^2J_{H(4)_\beta,H(4)_\alpha}$ = 13.5 Hz, $^4J_{H(4)_\alpha,H(9)_{anti}}$ = 3.0 Hz); 6.05 (t, 1 H, H(6), ^3J = 6.0 Hz); 7.18 (t, 1 H, Ph_p, ^2J = 7.3 Hz); 7.27 (t, 1 H, Ph_m, ^2J = 7.3 Hz); 7.41 (d, 1 H, Ph_o, ^2J = 7.3 Hz). ^{13}C NMR, δ: 26.04 (C(1), C(4)); 27.44 (C(2)); 28.85 (C(5)); 30.68 (C(9)); 33.57 (C(8)); 125.34 (Ph_o); 126.40 (C(6)); 126.92 (Ph_p); 128.22 (Ph_m); 140.70 (C(7)); 141.84 (Ph_{ipso}). MS (EI, 200 eV), m/z (I_{rel} (%)): 264 $[M]^+$ (22).

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