Supplementary Material (ESI) for Chemical Communications

Supporting Information

Solid Phase Synthesis of a Spiro[5.5]ketal Library

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General:

^{1}H NMR and ^{13}C spectra were recorded on a Varian Mercury 600 or a Bruker DRX 500 spectrometer. NMR spectra were calibrated to the solvent signal of $CDCl_3$ (7.26 ppm and 77.16 ppm). The following abbreviations were used to explain multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, quint = quintet, sext = sextet, sept = septet, m = multiplet, br = broad.

GC-MS(EI) were measured on a Hewlett-Packard 6890 Series gas chromatograph connected to a Hewlett-Packard 5973 series mass spectrometer; column: H&W 19091σ-102 HP-5MS capillary: 25.0 m × 201 μm × 0.33 μm nominal. The temperature program used was: 1 min 50°C followed by heating to 300°C during 6.25 min, then the temperature was kept at 300°C for further 5 minutes.

LC-MS was performed on a 1100 series Hewlett-Packard machine connected to a Finnigan LCQ ESI-Spectrometer; column: VP 50 / 10 Nucleosil C18PPN-column (Macherey-Nagel); gradient: 90 / 10 (v / v) H_2O / acetonitrile (0.1% formic acid) to 10 / 90 (v / v) in 30 min, flow 1.00 ml / min.

Preparative HPLC was conducted by using a Agilent 1100 Series; column: VP 125 / 21 NUCLEODUR C18 Gravity, 5 μ (Macherey-Nagel); gradient: 60 / 40 (v / v) H_2O / acetonitrile (no acid!) to 100% acetonitrile in 29 min, flow 10 ml / min.

High resolution mass spectra (HR-MS) were measured on a finnigan MAT 8200 spectrometer.

Chiral GC was measured on a Agilent Technologies 6890N; column: Lipodex-E (25 m, 0.025 mm); 85 °C isotherm.

Wang resin activation as trichloroacetimidate and loading of the alcohols was carried out following the procedure given by Hanessian and co-workers.[1]

General procedure for the synthesis of Wang resin loaded with *β*-hydroxyaldehydes 5 starting from resin loaded with homoallylic alcohol 11:[2]

A suspension of 0.8 g of resin **9** loaded with homoallylic alcohol (0.8 mmol) in 15 ml dichloromethane in a three-necked flask was cooled to -78 °C. After 5 min stirring ozone was passed through the suspension. After 1-3 min the color changed to greenish blue indicating saturation. In general, ozonolysis was stopped after 7-8 min. Ozone was removed by flushing with argon until decolorization (~1 min). At -78 °C 1.05 g of triphenylphosphine (4 mmol, 5 eq) was added and the suspension was shaken for 16 h at room temperature. The resin was filtered and washed successfully with 8 ml of CH_2Cl_2 (3×), 8 ml of THF (3×), 8 ml of CH_2Cl_2 (3×) and 8 ml of methanol (3×). The yellow resin was dried with air for 1 h followed by thorough drying *in vacuo* over 2 days. The *β*-hydroxyaldehyde linked to resin **5** showed no IR absorption at $\tilde{\nu}$ = 3300-3500 cm^{-1} (O-H) whereas a strong band at $\tilde{\nu}$ = 1721 cm^{-1} (C=O) was observed. The loading was determined by means of the DNP method[3, 4] (0.65-0.75 mmol/g, 72-83%).

General procedure for the synthesis of Wang resin loaded with *β*-hydroxyaldehyde 5 starting from resin loaded with *β*-hydroxyester 10:

Resin **10** loaded with *β*-hydroxyester (0.8 g, 0.8 mmol) was washed twice with 8 ml of dry THF. To the swollen resin 4 ml of a 1 M solution of DIBAH in toluene (0.4 mmol, 5 eq) was added slowly at room temperature. After 5 h shaking at room temperature the bright, colorless resin was filtered and washed successively with 8 ml of dry THF (2x), 8 ml of THF:methanol:AcOH = 47:47:6 (3×), 8 ml of THF (3×), 8 ml of CH_2Cl_2 (3×) and 8 ml of methanol (3×). It was dried with air for 1 h followed by drying *in vacuo* over night. The IR absorption of the ester had disappeared while a broad band at $\tilde{\nu}$ = 3433 cm^{-1} was recorded. The loading was determined via Fmoc derivatisation, cleavage of the fluorenylmethyl group under basic condition and quantification by UV absorption (0.9 mmol/g, 90%).

A solution of 1.01 g of IBX (3.6 mmol, 5 eq)[5] in a mixture of 8 ml of dry DMSO:dry THF = 1:1 was added to 0.8 g resin loaded with diol (0.72 mmol). After 16 h shaking at room temperature the yellow resin was filtered and washed successively with 8 ml of DMSO (3×), 8 ml of THF (3×), 8 ml of CH_2Cl_2 (3×) and 8 ml of methanol (3×). It was dried with air for 1 h followed by thorough drying *in vacuo* over 2 days. The *β*-hydroxyaldehyde linked to resin **5** showed no IR absorption at $\tilde{\nu}$ = 3300-3500 cm^{-1} (O-H) whereas a strong band at $\tilde{\nu}$ = 1721 cm^{-1} (C=O) was observed. The loading was determined by the DNP method which is based on formation of the corresponding dinitrophenylhydrazone (0.75 mmol/g, 83%).[3]

General procedure for the synthesis of Wang resin loaded with alkynone starting from resin loaded with *β*-hydroxyaldehyde 5:

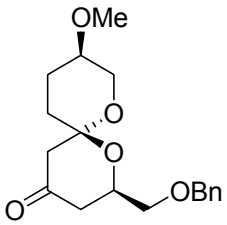
A solution of 3.92 mmol of protected alkyne (7 eq) in 4 ml dry THF was treated at 0 °C with 3.9 ml of a 1 M solution of ethylmagnesium bromide in THF (0.99 eq). After 2 h stirring at room temperature the solution was transferred under inert conditions to 0.8 g resin loaded with *β*-hydroxyaldehyde **7** that had been washed twice with dry THF and suspended in 4 ml dry THF. The reaction mixture was shaken for 16 h at room temperature, filtered and washed successively with 8 ml of dry THF (1x), 8 ml of THF:methanol:AcOH = 47:47:6 (3×), 8 ml of THF (3×), 8 ml of CH_2Cl_2 (3×) and 8 ml of methanol (3×). The yellow resin was dried with air for 1 h followed by thorough drying *in vacuo* over night. After completion of the reaction no IR absorption at $\tilde{\nu}$ = 1721 cm^{-1} (C=O) could be observed anymore and a weak band at $\tilde{\nu}$ = 2230 cm^{-1} (C≡C) and a broad band at $\tilde{\nu}$ = 3432 cm^{-1} (O-H) could be observed.

A solution of 1.01 g of IBX (3.6 mmol, 5 eq)[5] in a mixture of dry DMSO:dry THF = 1:1 was added to 0.8 g resin loaded with propargylic alcohol. After 16 h shaking at room temperature the yellow resin was filtered and washed successively with 8 ml of DMSO (3×), 8 ml of THF (3×), 8 ml of CH_2Cl_2 (3×) and 8 ml of methanol (3×). It was dried with air for 1 h followed by thorough drying *in vacuo* over night. The alkynone linked to the resin showed an IR absorption at $\tilde{\nu}$ = 2209 cm^{-1} (O-H) whereas no absorption between $\tilde{\nu}$ = 3300-3500 cm^{-1} could be observed.

General procedure for cleavage from the solid support and spiroketalization of the alkynones:

Resin loaded with alkynone (0.8 g) was treated at room temperature with 8 ml of a solution of 2% methanesulfonic acid in dichloromethane. After shaking for 30 min the resin was filtered and washed twice with 8 ml of dichloromethane and twice with 8 ml of methanol. At 40 °C and under reduced pressure dichloromethane was evaporated and the resulting solution was shaken for further 30 min at room temperature. Toluene (20 ml) and 3 drops of water were added and methanol was removed under reduced pressure. The toluene solution was shaken for 2 h and 0.3 ml of triethylamine was added. The solution was immediately filtered through a plug of silica. Evaporation of the eluent gave a reddish brown oil that was purified by column chromatography (a gradient of cyclohexane/EtOAc = 8/1 to 6/1 was used) to yield the desired spiroketals as colorless or slightly yellow oils in overall yields ranging from 5 to 45% and 90 to ≥ 98% purity.

(2*R*,6*R*,9*R*)-2-((Benzyloxy)methyl)-9-methoxy-1,7-dioxaspiro[5.5]undecan-4-one (25)



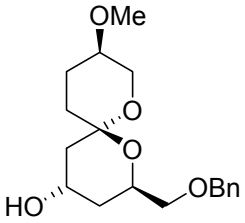
Yield = 82.2 mg (0.257 mmol, 29%); R_f = 0.36 (cyclohexane/EtOAc = 2/1); purity = 98%; $[\alpha]_D^{20}$ = -38.2 ° (c = 2.85, $CHCl_3$); ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ (ppm) = 7.23-7.34 (m, 5H, 5 × $C_{ar}H$), 4.61 (d, ^2J = 12.3 Hz, 1H, PhCH_2), 4.56 (d, ^2J = 12.3 Hz, 1H, PhCH_2), 4.01-4.08 (m, 1H), 3.65-3.71 (m, 1H), 3.61 (dd, ^3J = 10.5 Hz, ^3J = 3.8 Hz, 1H), 3.54 (dd, ^3J = 10.5 Hz, ^3J = 4.8 Hz, 1H), 3.33 (s, 3H, OCH_3), 3.24-3.33 (m, 2H), 2.46 (dd, ^3J = 14.3 Hz, ^3J = 11.5 Hz, 1H), 2.29-2.44 (m, 2H), 1.60-2.02 (m, 4H), 1.56 (ddd, ^3J = 13.6 Hz,

^3J = 13.6 Hz, ^3J = 4.5 Hz, 1H); ^{13}C-NMR (125.8 MHz, $CDCl_3$): δ(ppm) = 205.5 (s), 138.1 (s), 127.8 (d), 127.7 (d), 127.7 (d), 98.6 (s), 73.8 (d), 73.6 (t), 71.9 (t), 68.8 (d), 62.9 (t), 56.5 (q), 50.8 (t), 43.1 (t), 33.9 (t), 25.1 (t); GC-MS(EI): t_R = 7.63 min; m/z (rel. Int. [%]): 320 (4) [M^+], 199 (27), 169 (4), 129 (20), 111 (13), 91 (100) [Bn^+], 71 (17), 58 (11); HR-MS(EI): calcd. for $C_{18}H_{24}O_5$ 320.1624, found 320.1619 $[M]^+$.

Representative procedure for the reduction of spiroketals with support-bound hydride in solution-phase:

A solution of (2*R*,6*R*,9*R*)-2-((Benzyloxy)methyl)-9-methoxy-1,7-dioxaspiro[5.5]undecan-4-one (**25**) (41.1 mg, 0.128 mmol, 1 eq) in 0.5 ml of dry methanol was treated three times with 51 mg of polymer-supported borohydride **26** (~0.38 mmol, borohydride on Amberlite IRA 400, ~2.5 mmol/g; Aldrich Cat. No. 32,864-2) in 1.5 h intervals.[6] After 4.5 h completion of the reaction was controlled by TLC (cyclohexane/EtOAc = 1/1), the suspension was filtered and the eluent was evaporated to dryness. Purification and separation of the two epimers **27** and **28** was achieved by HPLC (VP 125 / 21 NUCLEODUR C18 Gravity, 5 µ (Macherey-Nagel); 40% to 100% CH_3CN (no TFA!); 10.0 ml / min).

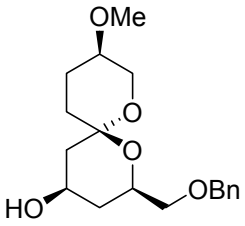
(2*R*,4*S*,6*R*,9*R*)-2-((Benzyloxy)methyl)-9-methoxy-1,7-dioxaspiro[5.5]undecan-4-ol (27):



yield = 20.4 mg (0.063 mmol, 49%); R_f = 0.44 (cyclohexane/EtOAc = 1/1); purity = 94%; $[\alpha]_D^{20}$ = -22.8 ° (c = 1.73, $CHCl_3$); ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ(ppm) = 7.22-7.35 (m, 5H, 5 × $C_{ar}H$), 4.58 (s, 2H, CH_2Ph), 4.05-4.13 (m, 2H), 3.75 (ddd, ^3J = 10.2 Hz, ^3J = 4.8 Hz, ^3J = 2.2 Hz, 1H),

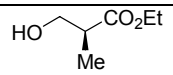
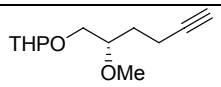
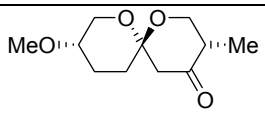
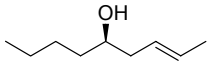
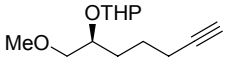
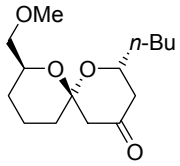
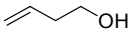
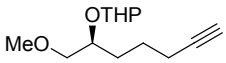
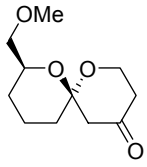
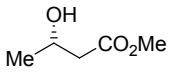
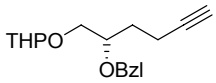
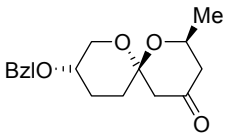
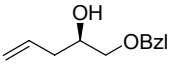
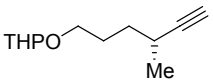
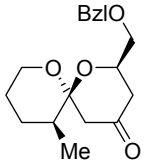
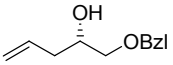
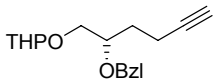
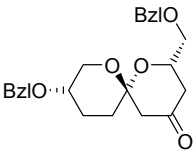
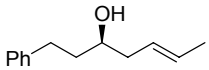
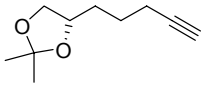
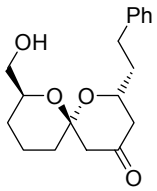
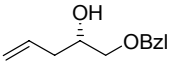
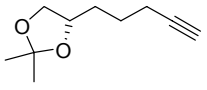
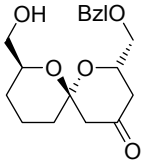
3.53 (d, ^3J = 1.8 Hz, 1H), 3.52 (d, ^3J = 2.8 Hz, 1H), 3.35 (s, 3H, OCH_3), 3.23-3.33 (m, 1H), 1.86-1.94 (m, 1H), 1.71-1.83 (m, 4H), 1.67 (d, ^3J = 3.5 Hz, 1H), 1.62 (dd, ^3J = 10.7 Hz, ^3J = 3.1 Hz, 1H), 1.50-1.59 (m, 2H); GC-MS(EI): t_R = 7.52 min; m/z (rel. Int. [%]): 322 (1) [M^+], 304 (2) [M^+-H_2O], 216 (10), 201 (15), 183 (24), 157 (27), 129 (24), 107 (26), 91 (100) [Bn^+]; HR-MS(FAB: 3-NBA): calcd. for $C_{18}H_{26}O_5$ 322.1780, found 323.1875 $[M+H]^+$.

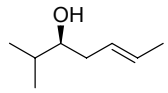
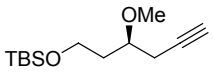
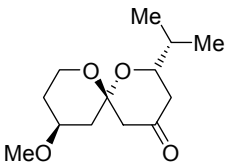
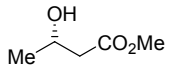
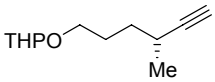
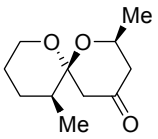
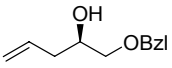
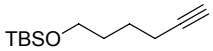
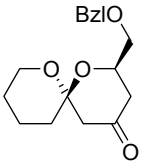
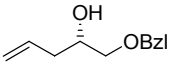
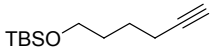
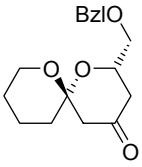
(2*R*,4*R*,6*R*,9*R*)-2-((Benzyloxy)methyl)-9-methoxy-1,7-dioxaspiro[5.5]undecan-4-ol (28):



yield = 15.1 mg (0.047 mmol, 37%); R_f = 0.53 (cyclohexane/EtOAc = 1/1); purity = 98%; ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ(ppm) = 7.23-7.36 (m, 5H, 5 × $C_{ar}H$), 4.57 (s, 2H, CH_2Ph), 4.08 (sept, ^3J = 5.4 Hz, 1H), 3.74-3.82 (m, 1H), 3.63-3.69 (m, 1H), 3.53 (dd, ^3J = 10.3 Hz, ^3J = 5.3 Hz, 1H), 3.49 (dd, ^3J = 10.3 Hz, ^3J = 4.8 Hz, 1H), 3.22-3.37 (m, 2H), 3.34 (s, 3H, CH_3), 1.87-2.01 (m, 3H), 1.69-1.86 (m, 2H), 1.53-1.60 (m, 2H), 1.28 (quint, ^3J = 12.0 Hz, 2H); GC-MS(EI): t_R = 7.61 min; m/z (rel. Int. [%]):322 (1) [M^+], 304 (2) [M^+-H_2O], 216 (41), 201 (19), 183 (61), 157 (50), 129 (34), 107 (30), 91 (100) [Bn^+]; HR-MS(FAB: 3-NBA): calcd. for $C_{18}H_{26}O_5$ 322.1780, found 323.1885 $[M+H]^+$.

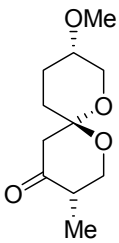
Table 1: Examples for spiroacetal ketone library members.

building block 1	**building block 2**	**product**	**overall yield[a] [%]**	**diaste-reomer ratio[b]**
			45	80:20
			12	100:0[c]
			24	100:0[c]
			31	90:10
			35	80:20
			38	100:0[c]
			5	100:0[c]
			19	100:0[c]

			12	100:0[c]
			25	73:27
			27	100:0[c]
			25	100:0[c]

[a] Overall yields over 7 steps on the solid phase. [b] Determined via GC-MS and NMR. [c] Only one diastereomer detected.

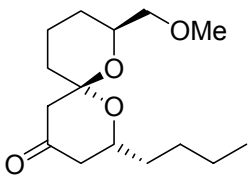
(3*S*,6*S*,9*S*)-9-Methoxy-3-methyl-1,7-dioxaspiro[5.5]undecan-4-one



Yield = 85.3 mg (0.398 mmol, 45%); R_f = 0.41 (cyclohexane / EtOAc = 2 / 1); purity = 91%; d. r. = 80 / 20; ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ (ppm) = 3.87 (dd, ^3J = 10.8 Hz, ^3J = 7.3 Hz, 1H), 3.39-3.70 (m, 3H), 3.29 (s, 3H, OCH_3), 3.15-3.25 (m, 2H), 2.30-2.60 (m, 3H), 1.46-1.96 (m, 5H), 0.90 (d, ^3J = 6.8 Hz, 3H, $CHCH_3$); ^{13}C-NMR (125.8 MHz, $CDCl_3$): δ (ppm) = 206.7 (s), 99.8 (s), 73.8 (d), 65.6 (t), 62.6 (t), 56.4 (q), 51.1 (t), 44.3 (d), 33.9 (t), 24.9 (t), 9.0 (q); GC-MS(EI): t_R = 5.47 min; m / z (rel. Int. [%]): 214 (27) [M^+], 184 (29), 156 (5), 139 (16), 126

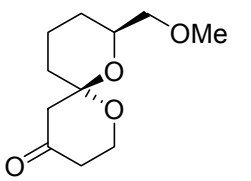
(100), 96 (16), 84 (25), 69 (17), 58 (26); HR-MS(EI): calcd. for $C_{11}H_{18}O_4$ 214.1205, found 214.1197 $[M]^+$.

(2*R*,6*R*,8*S*)-2-Butyl-8-((methoxy)methyl)-1,7-dioxaspiro[5.5]undecan-4-one



Yield = 29.6 mg (0.109 mmol, 12%); R_f = 0.43 (cyclohexane / EtOAc = 2 / 1); purity = 98%; $[\alpha]_D^{20}$ = -44.8 ° (c = 2.55, $CHCl_3$); ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ(ppm) = 3.85-3.92 (m, 1H), 3.66-3.73 (m, 1H), 3.32 (s, 3H, OCH_3), 3.27-3.36 (m, 2H), 2.32-2.45 (m, 3H), 2.17 (dd, ^3J = 14.6 Hz, ^3J = 11.3 Hz, 1H), 1.92 (ddt, ^2J = 26.8 Hz, ^3J = 13.3 Hz, ^3J = 4.0 Hz, 1H), 1.78-1.83 (m, 1H), 1.22-1.69 (m, 11H), 0.91 (t, ^3J = 7.1 Hz, 3H, CH_2CH_3); ^{13}C-NMR (125.8 MHz, $CDCl_3$): δ(ppm) = 206.0 (s), 141.7 (s), 128.5 (t), 128.4 (d), 126.1 (d), 99.4 (q), 75.9 (t), 70.0 (t), 68.3 (t), 59.6 (t), 51.9 (t), 47.1 (t), 37.9 (t), 34.7 (t), 32.0 (t), 26.7 (t), 18.8 (q); ^{13}C-NMR (125.8 MHz, $CDCl_3$): δ(ppm) = 206.4 (s), 99.3 (s), 76.0 (t), 69.9 (d), 68.8 (d), 59.6 (q), 51.9 (t), 47.2 (t), 34.8 (t), 27.9 (t), 26.8 (t), 22.8 (t), 18.8 (t), 14.1 (q); GC-MS(EI): t_R = 6.10 min; m / z (rel. Int. [%]): 270 (1) $[M^+]$, 238 (2), 225 (100), 213 (9), 111 (18), 99 (35), 84 (40), 71 (43), 55 (24); HR-MS(FAB: 3-NBA): calcd. for $C_{15}H_{26}O_4$ 270.1831, found 271.1927 $[M+H]^+$.

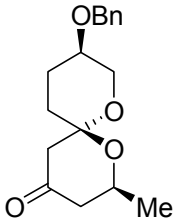
(6*R*,8*S*)-8-((Methoxy)methyl)-1,7-dioxaspiro[5.5]undecan-4-one



Yield = 46.0 mg (0.215 mmol, 24%); R_f = 0.39 (cyclohexane / EtOAc = 2 / 1); purity = 98%;

$[\alpha]_D^{20}$ = -60.0 ° (c = 2.85, $CHCl_3$); ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ (ppm) = 3.89-4.00 (m, 2H), 3.70-3.76 (m, 1H), 3.31 (s, 3H, OCH_3), 3.27-3.38 (m, 2H), 2.52 (ddd, ^3J = 14.5 Hz, ^3J = 11.9 Hz, ^3J = 8.3 Hz, 1H), 2.44 (d, ^3J = 14.5 Hz, 1H), 2.39 (d, ^3J = 14.5 Hz, 1H), 2.27-2.33 (m, 1H), 1.87 (ddt, ^2J = 26.5 Hz, ^3J = 13.3 Hz, ^3J = 4.1 Hz, 1H), 1.77-1.83 (m, 1H), 1.61-1.68 (m, 1H), 1.53-1.59 (m, 1H), 1.43 (td, ^3J = 13.4 Hz, ^3J = 4.7 Hz, 1H), 1.25 (ddd, ^2J = 25.3 Hz, ^3J = 12.7 Hz, ^3J = 3.7 Hz, 1H); ^{13}C-NMR (125.8 MHz, $CDCl_3$): δ (ppm) = 205.7 (s), 99.9 (s), 75.9 (t), 69.9 (d), 59.6 (d), 58.9 (q), 52.4 (t), 41.1 (t), 34.5 (t), 26.6 (t), 18.6 (t); GC-MS(EI): t_R = 5.33 min; m / z (rel. Int. [%]): 214 (1) [M^+], 183 (1) [M^+-OMe], 169 (100), 125 (54), 112 (18), 97 (17), 84 (28), 71 (34), 55 (22).

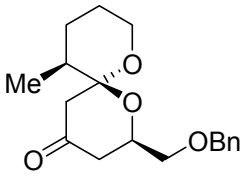
(2*S*,6*R*,9*R*)-9-(Benzyloxy)-2-methyl-1,7-dioxaspiro[5.5]undecan-4-one



Yield = 79.9 mg (0.275 mmol, 31%); R_f = 0.35 (cyclohexane / EtOAc = 2 / 1); purity = 97%; $[\alpha]_D^{20}$ = -53.4 ° (c = 2.91, $CHCl_3$); d. r. = 90 / 10; ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ (ppm) = 7.23-7.39 (m, 5H, 5 × C_{ar}H), 4.57 (d, ^2J = 12.0 Hz, 1H, PhCH_2), 4.50 (d, ^2J = 12.0 Hz, 1H, PhCH_2), 4.00 (dtd, ^2J = 17.5 Hz, ^3J = 6.2 Hz, ^3J = 2.8 Hz, 1H), 3.67 (ddd, ^3J = 10.2 Hz, ^3J = 4.8 Hz, ^3J = 2.1 Hz, 1H), 3.42-3.51 (m, 1H), 3.33 (t, ^3J = 10.3 Hz, 1H), 2.28-2.40 (m, 3H), 2.17 (dd, ^3J = 14.2 Hz, ^3J = 11.2 Hz, 1H), 1.82-2.01 (m, 3H), 1.50-1.60 (m, 1H), 1.30 (d, ^3J = 6.3 Hz, 3H); ^{13}C-NMR (125.8 MHz, $CDCl_3$): δ (ppm) = 205.7 (s), 138.4 (s), 128.6 (d), 127.9 (d), 127.8 (d), 98.4 (s), 72.1 (d), 70.9 (t), 65.5 (d), 63.1 (t), 50.6 (t), 48.4 (t),

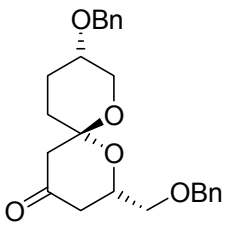
34.2 (t), 25.5 (t), 21.7 (q); GC-MS(EI): t_R = 7.21 min; m / z (rel. Int. [%]): 290 (3) [M^+], 260 (6), 229 (5), 203 (20), 169 (10), 139 (6), 126 (49), 105 (10), 91 (100) [Bn^+]; HR-MS(FAB: 3-NBA): calcd. for $C_{17}H_{22}O_4$ 290.1518, found 291.1568 $[M+H]^+$.

(2*R*,6*S*,11*S*)-2-((Benzyloxy)methyl)-11-Methyl-1,7-dioxaspiro[5.5]undecan-4-one



Yield = 92.5 mg (0.304 mmol, 35%); R_f = 0.50 (cyclohexane / EtOAc = 2 / 1); purity = 92%; d. r. = 75 / 25; ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ (ppm) = 7.23-7.38 (m, 5H, 5 × $C_{ar}H$), 4.67 (d, ^2J = 12.5 Hz, 1H, PhCH_2), 4.64 (d, ^2J = 12.2 Hz, 1H, PhCH_2), 4.09-4.17 (m, 1H), 3.55-3.67 (m, 4H), 2.67 (d, ^3J = 14.2 Hz, 1H), 2.32-2.39 (m, 2H), 2.26 (d, ^3J = 14.5 Hz, 1H), 1.52-1.70 (m, 3H), 1.01 (d, ^3J = 6.2 Hz, 3H, CH_3); ^{13}C-NMR (125.8 MHz, $CDCl_3$): δ (ppm) = 206.4 (s), 138.4 (s), 128.5 (d), 127.7 (d), 127.5 (d), 101.7 (s), 73.5 (t), 72.4 (t), 68.7 (d), 60.8 (t), 49.0 (t), 43.2 (t), 38.4 (d), 27.7 (t), 25.7 (t), 16.9 (q); GC-MS(EI): t_R = 7.32 min; m / z (rel. Int. [%]): 304 (20) [M^+], 286 (1), 198 (8), 183 (29), 157 (18), 139 (35), 128 (9), 107 (21), 91 (100) [Bn^+].

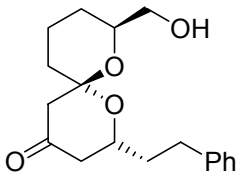
(2*S*,6*S*,9*S*)-9-Benzyloxy-2-((benzyloxy)methyl)-1,7-dioxaspiro[5.5]undecan-4-one



Yield = 99.4 mg (0.335 mmol, 38%); R_f = 0.30 (cyclohexane / EtOAc = 2 / 1); purity = 91%; $[\alpha]_D^{20}$ = 38.8 ° (c = 3.65, $CHCl_3$); ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ (ppm) = 7.25-7.36 (m, 10H, 10 × $C_{ar}H$),

4.64 (d, ^2J = 12.1 Hz, 1H, PhCH_2), 4.60 (d, ^2J = 12.3 Hz, 1H, PhCH_2), 4.58 (d, ^2J = 12.1 Hz, 1H, PhCH_2), 4.51 (d, ^2J = 11.8 Hz, 1H, PhCH_2), 4.04-4.12 (m, 1H), 3.70 (ddd, ^3J = 10.2 Hz, ^3J = 4.4 Hz, ^3J = 1.8 Hz, 1H), 3.64 (dd, ^3J = 10.5 Hz, ^3J = 3.8 Hz, 1H), 3.57 (dd, ^3J = 10.5 Hz, ^3J = 4.8 Hz, 1H), 3.50 (tt, ^3J = 10.5 Hz, ^3J = 4.5 Hz, 1H), 3.40 (t, ^3J = 10.2 Hz, 1H), 2.32-2.52 (m, 4H), 1.87-2.05 (m, 3H), 1.57 (td, ^3J = 13.1 Hz, ^3J = 4.5 Hz, 1H); ^{13}C-NMR (125.8 MHz, $CDCl_3$): δ(ppm) = 205.3 (s), 138.4 (s), 138.1 (s), 128.6 (t), 128.5 (t), 128.5 (t), 127.6 (t), 127.6 (t), 127.5 (t), 98.6 (s), 72.0 (t), 71.9 (d), 70.8 (t), 68.7 (t), 63.1 (d), 50.7 (t), 43.1 (t), 37.0 (t), 34.0 (t), 25.5 (t); GC-MS(EI): t_R = 10.71 min; m / z (rel. Int. [%]): 396 (3) [M^+], 305 (1) [M^+-Bn], 275 (7), 231 (7), 203 (5), 111 (5), 91 (100) [Bn^+], 65 (6); LC-MS(ESI): t_R = 10.13 min; m / z: 397.22 $[M+H]^+$.

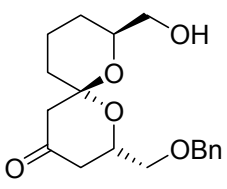
(2*R*,6*R*,8*S*)-8-((Hydroxy)methyl)-2-(2-(phenyl)ethyl)-1,7-dioxaspiro[5.5]undecan-4-one



Yield = 14.1 mg (0.046 mmol, 5%); R_f = 0.32 (cyclohexane / EtOAc = 2 / 1); purity = 94%; $[\alpha]_D^{20}$ = 26.2 ° (c = 0.95, $CHCl_3$); ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ(ppm) = 7.14-7.30 (m, 5H, 5 × $C_{ar}H$), 3.89-3.97 (m, 1H), 3.56 (tt, ^3J = 9.1 Hz, ^3J = 2.9 Hz, 1H), 3.45 (dd, ^3J = 11.5 Hz, ^3J = 3.3 Hz, 1H), 3.39 (dd, ^3J = 11.7 Hz, ^3J = 6.7 Hz, 1H), 2.91 (ddd, ^3J = 13.9 Hz, ^3J = 10.6 Hz, ^3J = 5.3 Hz, 1H, PhCH_2), 2.68 (ddd, ^3J = 13.9 Hz, ^3J = 10.3 Hz, ^3J = 6.2 Hz, 1H, PhCH_2), 2.41 (s, 2H, C(5)H_2), 2.38 (dd, ^3J = 15.2 Hz, ^3J = 2.1 Hz, 1H), 2.23 (dd, ^3J = 14.1 Hz, ^3J = 11.3 Hz, 1H), 1.82-2.22 (m, 4H), 1.63-1.74

(m, 2H), 1.45 (ddd, ^3J = 13.3 Hz, ^3J = 13.3 Hz, ^3J = 4.6 Hz, 2H), 1.28 (dddd, ^3J = 12.9 Hz, ^3J = 12.9 Hz, ^3J = 12.1 Hz, ^3J = 4.1 Hz, 1H); ^{13}C-NMR (125.8 MHz, $CDCl_3$): δ(ppm) = 206.0 (s), 150.2 (s), 128.6 (d), 128.4 (d), 126.1 (d), 99.4 (s), 71.0 (d), 68.5 (d), 65.9 (t), 51.9 (t), 47.1 (t), 37.7 (t), 34.8 (t), 31.9 (t), 25.7 (t), 18.5 (t); GC-MS(EI): t_R = 7.53 min; m / z (rel. Int. [%]): 304 (11) [M^+], 286 (15) [M^+-H_2O], 273 (56), 199 (26), 174 (10), 155 (23), 128 (37), 117 (47), 91 (100) [Bn^+]; LC-MS(ESI): t_R = 8.39 min; m / z: 305.17 $[M+H]^+$; HR-MS(FAB: 3-NBA): calcd. for $C_{18}H_{24}O_4$ 304.1675, found 305.1734 $[M+H]^+$.

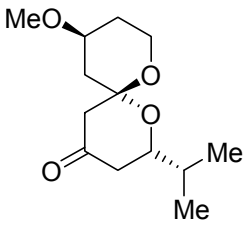
(2*S*,6*S*,8*S*)-2-((Benzyloxy)methyl)-8-((hydroxy)methyl)-1,7-dioxaspiro[5.5]undecan-4-one



Yield = 52.9 mg (0.165 mmol, 19%); R_f = 0.37 (cyclohexane / EtOAc = 2 / 1); purity = 95%; ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ(ppm) = 7.25-7.38 (m, 5H, 5 × $C_{ar}H$), 4.64 (d, ^2J = 12.5 Hz, h, CH_2Ph), 4.60 (d, ^2J = 12.2 Hz, h, CH_2Ph), 4.09-4.15 (m, 1H), 3.67-3.74 (m, 1H), 3.63 (dd, ^3J = 10.7 Hz, ^3J = 3.7 Hz, 1H), 3.57 (dd, ^3J = 10.7 Hz, ^3J = 5.0 Hz, 1H), 3.52 (dd, ^3J = 11.6 Hz, ^3J = 3.1 Hz, 1H), 3.45 (dd, ^3J = 11.7 Hz, ^3J = 6.7 Hz, 1H), 2.48 (dd, ^3J = 14.8 Hz, ^3J = 11.5 Hz, 1H), 2.43 (s, 2H, C(5)H_2), 2.34 (dd, ^3J = 14.6 Hz, ^3J = 2.6 Hz, 1H), 2.15 (br, 1H, OH), 1.97 (ddt, ^2J = 26.6 Hz, ^3J = 13.3 Hz, ^3J = 4.0 Hz, 1H), 1.85-1.92 (m, 1H), 1.64-1.72 (m, 1H), 1.42-1.53 (m, 2H), 1.30 (ddd, ^2J = 24.9 Hz, ^3J = 13.2 Hz, ^3J = 4.0 Hz, 1H); ^{13}C-NMR (125.8 MHz, $CDCl_3$): δ(ppm) = 206.0 (s), 138.2 (s), 128.5 (d), 127.8 (d), 127.6 (d), 99.6 (s), 73.5 (t), 72.1 (t), 71.2 (d), 68.5 (d), 65.8 (t), 51.8 (t), 43.2 (t), 34.5 (t), 25.7 (t), 18.4 (t); GC-MS(EI): t_R = 7.74 min; m / z (rel. Int. [%]): 320

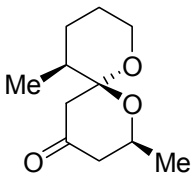
(2) [M^+], 302 (1) [M^+-H_2O], 289 (7), 229 (1), 199 (43), 155 (18), 128 (7), 113 (18), 91 (100) [Bn^+].

(2*R*,6*S*,10*S*)-10-Methoxy-2-(1-(methyl)ethyl)-1,7-dioxaspiro[5.5]undecan-4-one



Yield = 25.3 mg (0.104 mmol, 12%); R_f = 0.40 (cyclohexane / EtOAc = 2 / 1); purity = 98%; $[\alpha]_D^{20}$ = 80.1 ° (c = 2.17, $CHCl_3$); ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ (ppm) = 3.63 (m, 2H), 3.50-3.57 (m, 2H), 3.36 (s, 3H, OCH_3), 2.37-2.48 (m, 3H), 2.27 (ddd, ^3J = 12.7 Hz, ^3J = 4.5 Hz, ^3J = 1.8 Hz, 1H), 2.19 (dd, ^3J = 13.8 Hz, ^3J = 11.6 Hz, 1H), 1.97 (ddd, ^3J = 12.3 Hz, ^3J = 3.9 Hz, ^3J = 1.8 Hz, 1H), 1.77 (sext, ^3J = 6.7 Hz, 1H), 1.43 (ddd, ^2J = 24.1 Hz, ^3J = 12.5 Hz, ^3J = 5.1 Hz, 1H), 1.33 (dd, ^3J = 11.9 Hz, ^3J = 11.5 Hz, 1H), 1.02 (d, ^3J = 6.7 Hz, 3H, $CHCH_3$), 0.93 (d, ^3J = 7.0 Hz, 3H, $CHCH_3$); ^{13}C-NMR (125.8 MHz, $CDCl_3$): δ (ppm) = 207.2 (s), 101.9 (s), 75.2 (d), 74.2 (d), 60.8 (t), 56.9 (d), 53.1 (t), 45.9 (t), 42.7 (t), 34.6 (d), 32.4 (t), 19.8 (q), 19.8 (q); GC-MS(EI): t_R = 5.76 min; m / z (rel. Int. [%]): 242 (4) [M^+], 199 (24) [M^+-*i*-Pr], 167 (51), 155 (25), 131 (30), 123 (100), 112 (66), 97 (50), 71 (31); HR-MS(FAB: 3-NBA): calcd. for $C_{13}H_{22}O_4$ 242.1518, found 243.1623 [M+H]$^+$.

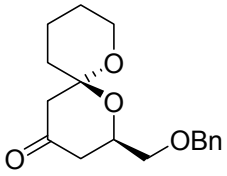
(2*S*,6*S*,11*S*)-2,11-Dimethyl-1,7-dioxaspiro[5.5]undecan-4-one



Yield = 43.0 mg (0.217 mmol, 25%); R_f = 0.43 (cyclohexane / EtOAc = 2 / 1); purity = 95%; d. r. = 73 / 27; ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ (ppm) = 3.98-4.08 (m, 1H), 3.45-3.58 (m,

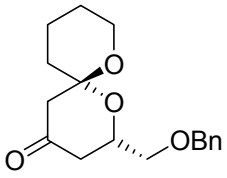
2H), 2.61 (d, ^3J = 14.2 Hz, 1H), 2.32-2.38 (m, 1H), 2.10-2.25 (m, 2H), 1.47-1.70 (m, 5H), 1.30 (d, ^3J = 6.2 Hz, 3H), 0.97 (d, ^3J = 6.2 Hz, 3H); ^{13}C-NMR (125.8 MHz, $CDCl_3$): δ(ppm) = 207.0 (s), 101.5 (s), 65.2 (d), 60.7 (t), 48.8 (t), 48.5 (t), 38.5 (d), 27.4 (t), 25.9 (t), 21.7 (q), 16.9 (q); GC-MS(EI): t_R = 4.87 min; m / z (rel. Int. [%]): 198 (2) [M^+], 154 (5), 140 (10), 129 (100), 111 (48), 97 (20), 87 (47), 69 (41), 55 (28).

(2*R*,6*R*)-2-((Benzyloxy)methyl)-1,7-dioxaspiro[5.5]undecan-4-one



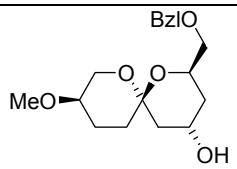
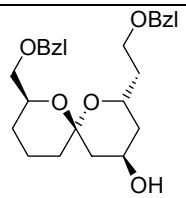
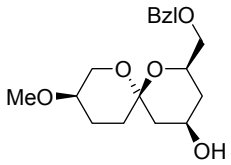
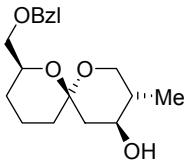
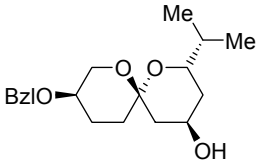
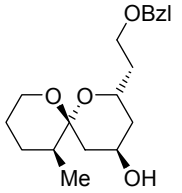
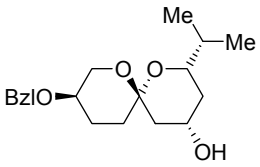
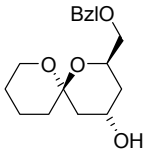
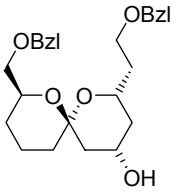
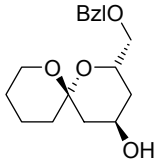
Yield = 70.0 mg (0.241 mmol, 27%); R_f = 0.37 (cyclohexane / EtOAc = 2 / 1); purity = 97%; $[\alpha]_D^{20}$ = -55.7 ° (c = 2.74, $CHCl_3$); ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ(ppm) = 7.24-7.36 (m, 5H, 5 × C_{ar}H), 4.64 (d, ^2J = 12.3 Hz, 1H, PhCH_2), 4.60 (d, ^2J = 12.3 Hz, 1H, PhCH_2), 4.09 (ddt, ^3J = 11.4 Hz, ^3J = 4.9 Hz, ^3J = 3.4 Hz, 1H), 3.55-3.64 (m, 4H), 2.29-2.46 (m, 4H), 1.91 (ddt, ^2J = 26.1 Hz, ^3J = 13.2 Hz, ^3J = 4.3 Hz, 1H), 1.82-1.87 (m, 1H), 1.45-1.66 (m, 4H); ^{13}C-NMR (125.8 MHz, $CDCl_3$): δ(ppm) = 206.0 (s), 138.2 (s), 128.5 (d), 127.8 (d), 127.6 (d), 99.2 (s), 73.5 (t), 72.2 (t), 68.6 (d), 61.2 (t), 52.0 (t), 43.2 (t), 34.8 (t), 24.5 (t), 18.8 (t); GC-MS(EI): t_R = 7.26 min; m / z (rel. Int. [%]): 290 (11) [M^+], 192 (16), 169 (56), 151 (3), 140 (7), 125 (100), 107 (8), 91 (99) [Bn^+], 65 (14); HR-MS(EI): calcd. for $C_{17}H_{22}O_4$ 290.1518, found 290.1533 [$M]^+$.

(2*S*,6*S*,9*S*)-2-((Benzyloxy)methyl)-1,7-dioxaspiro[5.5]undecan-4-one



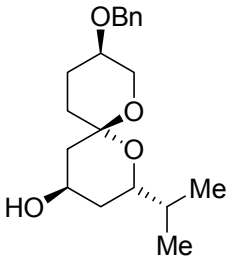
Yield = 64.5 mg (0.222 mmol, 25%); R_f = 0.47 (cyclohexane / EtOAc = 2 / 1); purity = 96%; $[\alpha]_D^{20}$ = 54.1 ° (c = 2.94, $CHCl_3$); ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ(ppm) = 7.23-7.36 (m, 5H, 5 × $C_{ar}H$), 4.64 (d, ^2J = 12.3 Hz, 1H, PhCH_2), 4.60 (d, ^2J = 12.3 Hz, 1H, PhCH_2), 4.06-4.13 (m, 1H), 3.54-3.64 (m, 4H), 2.28-2.46 (m, 4H), 1.81-1.98 (m, 2H), 1.44-1.65 (m, 4H); ^{13}C-NMR (125.8 MHz, $CDCl_3$): δ(ppm) = 205.9 (s), 138.2 (s), 128.5 (d), 127.8 (d), 127.6 (d), 99.2 (s), 73.5 (t), 72.3 (t), 68.6 (d), 61.2 (t), 52.0 (t), 43.3 (t), 34.8 (t), 24.5 (t), 18.8 (t); GC-MS(EI): t_R = 7.21 min; m / z (rel. Int. [%]): 290 (4) [M^+], 272 (1), 192 (8), 140 (5), 125 (85), 107 (6), 91 (100) [Bn^+], 65 (14); HR-MS(FAB: 3-NBA): calcd. for $C_{17}H_{22}O_4$ 290.1518, found 291.1588 $[M+H]^+$.

Table 2: Examples for library members obtained after reduction of the keto groups.

product	**overall yield[a] [%]**	**product**	**overall yield[a] [%]**
	39		48
	37		49
	46		39
	40		45
	39		55

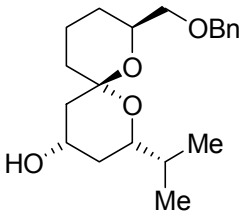
[a] For one step starting from corresponding ketone.

(2*R*,4*R*,6*S*,9*R*)-9-Benzyloxy-2-(1-(methyl)ethyl)-1,7-dioxaspiro[5.5]undecan-4-ol



Yield = 7.9 mg (0.025 mmol, 46%); R_f = 0.39 (cyclohexane / EtOAc = 1 / 1); purity = 97%; ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ(ppm) = 7.24-7.36 (m, 5H, 5 × $C_{ar}H$), 4.58 (d, ^2J = 12.3 Hz, 1H, CH_2Ph), 4.53 (d, ^2J = 12.3 Hz, 1H, CH_2Ph), 4.06 (quint, ^3J = 4.0 Hz, 1H), 3.74 (dt, ^3J = 12.1 Hz, ^3J = 1.9 Hz, 1H), 3.68 (dd, ^3J = 12.1 Hz, ^3J = 1.8 Hz, 1H), 3.52 (ddd, ^3J = 11.9 Hz, ^3J = 7.2 Hz, ^3J = 2.1 Hz, 1H), 3.39-3.43 (m, 1H), 1.93-1.99 (m, 3H), 1.78-1.85 (m, 2H), 1.64 (dd, ^3J = 13.7 Hz, ^3J = 6.9 Hz, 1H), 1.53 (dd, ^3J = 14.3 Hz, ^3J = 3.5 Hz, 1H), 1.32-1.44 (m, 2H), 0.97 (d, ^3J = 6.8 Hz, 3H, CH_3), 0.89 (d, ^3J = 6.8 Hz, 3H, CH_3); GC-MS(EI): t_R = 7.44 min; m / z (rel. Int. [%]): 320 (1) [M^+], 302 (1) [M^+-H_2O], 290 (8), 259 (5), 207 (8), 169 (6), 156 (59), 141 (13), 91 (100) [Bn^+].

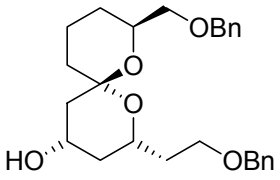
(2*R*,4*S*,6*R*,8*S*)-8-((Benzyloxy)methyl)-2-(1-(methyl)ethyl)-1,7-dioxaspiro[5.5]undecan-4-ol



Yield = 6.9 mg (0.021 mmol, 40%); R_f = 0.43 (cyclohexane / EtOAc = 1 / 1); purity = 95%; ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ(ppm) = 7.26-7.36 (m, 5H, 5 × $C_{ar}H$), 4.59 (d, ^2J = 12.5 Hz, 1H, PhCH_2), 4.56 (d, ^2J = 12.2 Hz, 1H, PhCH_2), 4.14 (sept, ^3J = 5.4 Hz, 1H), 3.75-3.82 (m, 1H), 3.46 (dd, ^3J = 10.2 Hz, ^3J = 6.0 Hz, 1H), 3.41 (dd, ^3J = 10.5 Hz, ^3J = 4.5 Hz, 1H), 3.30 (ddd, ^3J = 11.4 Hz, ^3J = 7.2 Hz, ^3J = 1.8 Hz, 1H), 1.97-2.06 (m, 2H), 1.91 (ddt, ^2J = 26.9 Hz, ^3J = 13.4 Hz, ^3J = 4.0 Hz, 1H), 1.55-1.72 (m, 5H), 1.46 (ddd, ^3J = 13.2 Hz, ^3J = 13.3 Hz, ^3J = 4.5 Hz, 1H), 1.22-1.32 (m, 2H), 1.11 (dd, ^2J = 23.2 Hz, ^3J = 11.5 Hz, 1H), 0.99 (t, ^3J = 6.7 Hz, 3H, CH_3), 0.92 (t,

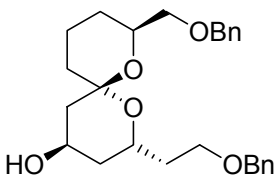
^3J = 6.7 Hz, 3H, CH_3); GC-MS(EI): t_R = 7.40 min; m / z (rel. Int. [%]): 334 (1) [M^+], 316 (1) [M^+-H_2O], 243 (1) [M^+-Bn], 225 (7), 213 (29), 195 (7), 160 (11), 112 (8), 91 (100) [Bn^+].

(2*R*,4*S*,6*R*,8*S*)-2-(2-(Benzyloxy)ethyl)-8-((benzyloxy)methyl)-1,7-dioxaspiro[5.5]undecan-4-ol



Yield = 20.2 mg (0.047 mmol, 39%); R_f = 0.49 (cyclohexane / EtOAc = 1 / 1); purity = 95%; ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ (ppm) = 7.23-7.35 (m, 10H, 10 × $C_{ar}H$), 4.54 (d, ^2J = 12.2 Hz, 1H, PhCH_2), 4.50 (d, ^2J = 12.5 Hz, 1H, PhCH_2), 4.48 (s, 2H, PhCH_2), 4.16 (tt, ^3J = 10.9 Hz, ^3J = 5.0 Hz, 1H), 3.80-3.87 (m, 1H), 3.71-3.77 (m, 1H), 3.68 (ddd, ^3J = 8.5 Hz, ^3J = 8.5 Hz, ^3J = 6.3 Hz, 1H), 3.32-3.41 (m, 2H), 2.04 (ddd, ^3J = 12.3 Hz, ^3J = 5.0 Hz, ^3J = 1.6 Hz, 1H), 1.91-1.97 (m, 1H), 1.76-1.89 (m, 3H), 1.55-1.67 (m, 4H), 1.46 (ddd, ^3J = 13.2 Hz, ^3J = 13.2 Hz, ^3J = 4.3 Hz, 1H), 1.26-1.36 (m, 1H), 1.26 (dd, ^3J = 11.8 Hz, ^3J = 11.8 Hz, 1H), 1.17 (dd, ^2J = 23.2 Hz, ^3J = 11.5 Hz, 1H); GC-MS(EI): t_R = 10.70 min; m / z (rel. Int. [%]): 426 (1) [M^+], 408 (1) [M^+-H_2O], 335 (1), 317 (5), 287 (10), 181 (6), 160 (8), 107 (5), 91 (100) [Bn^+].

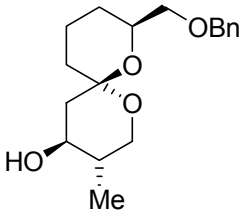
(2*R*,4*R*,6*R*,8*S*)-2-(2-(Benzyloxy)ethyl)-8-((benzyloxy)methyl)-1,7-dioxaspiro[5.5]undecan-4-ol



Yield = 25.2 mg (0.059 mmol, 48%); R_f = 0.41 (cyclohexane / EtOAc = 1 / 1); purity = 98%; ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ (ppm) = 7.23-7.38 (m, 10H, 10 × $C_{ar}H$), 4.52 (d, ^2J = 12.5 Hz, 1H, PhCH_2), 4.51 (d, ^2J = 12.0 Hz, 1H, PhCH_2), 4.48 (d, ^2J = 11.5 Hz, 1H, PhCH_2), 4.47 (d, ^2J = 12.2 Hz, 1H, PhCH_2),

4.17-4.23 (m, 1H), 4.06 (t, ^3J = 2.9 Hz, 1H), 3.85-3.92 (m, 1H), 3.72 (td, ^3J = 8.7 Hz, ^3J = 6.0 Hz, 1H), 3.62 (ddd, ^3J = 9.2 Hz, ^3J = 6.5 Hz, ^3J = 4.9 Hz, 1H), 3.35 (dd, ^3J = 10.0 Hz, ^3J = 7.0 Hz, 1H), 3.31 (dd, ^3J = 10.0 Hz, ^3J = 3.7 Hz, 1H), 1.75-1.92 (m, 5H), 1.53-1.63 (m, 3H), 1.41-1.53 (m, 3H), 1.25 (ddd, ^2J = 25.3 Hz, ^3J = 12.8 Hz, ^3J = 3.7 Hz, 1H); ^{13}C-NMR (125.8 MHz, $CDCl_3$): δ (ppm) = 138.6 (s), 138.5 (s), 128.5 (d), 128.4 (d), 127.8 (d), 127.6 (d), 127.6 (d), 98.3 (s), 73.3 (t), 73.2 (t), 69.0 (d), 66.9 (t), 65.3 (d), 61.0 (d), 40.2 (t), 38.6 (t), 36.1 (t), 34.9 (t), 26.8 (t), 18.1 (t); GC-MS(EI): t_R = 10.60 min; m / z (rel. Int. [%]): 426 (2) [M^+], 408 (1) [M^+-H_2O], 335 (1), 317 (11), 181 (11), 160 (13), 146 (8), 113 (9), 91 (100) [Bn^+].

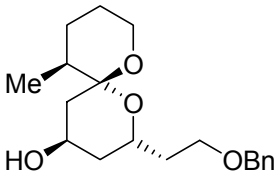
(3*S*,4*S*,6*R*,8*S*)-8-((Benzyloxy)methyl)-3-methyl-1,7-dioxaspiro[5.5]undecan-4-ol



Yield = 11.2 mg (0.037 mmol, 49%); R_f = 0.38 (cyclohexane / EtOAc = 1 / 1); purity = 98%; $[\alpha]_D^{20}$ = 36.9 ° (c = 1.93, $CHCl_3$); ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ (ppm) = 7.26-7.37 (m, 5H, 5 × $C_{ar}H$), 4.56 (d, ^2J = 12.0 Hz, 1H, PhCH_2), 4.53 (d, ^2J = 12.0 Hz, 1H, PhCH_2), 3.94 (tdd, ^3J = 9.4 Hz, ^3J = 4.2 Hz, ^3J = 2.3 Hz, 1H), 3.76-3.79 (m, 1H), 3.63 (t, ^3J = 11.7 Hz, 1H), 3.40-3.48 (m, 3H), 1.98 (dd, ^3J = 14.0 Hz, ^3J = 2.7 Hz, 1H), 1.87 (ddt, ^2J = 26.7 Hz, ^3J = 12.8 Hz, ^3J = 3.9 Hz, 1H), 1.76-1.85 (m, 1H), 1.51-1.63 (m, 3H), 1.48 (ddd, ^3J = 13.3 Hz, ^3J = 13.3, ^3J = 4.5 Hz, 1H), 1.24 (ddd, ^2J = 25.2 Hz, ^3J = 13.0 Hz, ^3J = 3.9 Hz, 1H), 0.91 (d, ^3J = 6.7 Hz, 3H, CH_3); ^{13}C-NMR (125.8 MHz, $CDCl_3$): δ (ppm) = 138.5 (s), 128.5 (d), 127.7 (d), 127.6 (d), 99.4 (s), 73.5 (t), 69.2 (d), 68.7 (d), 61.3

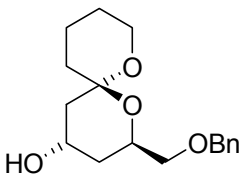
(t), 41.3 (t), 26.7 (t), 18.2 (t), 13.2 (q); GC-MS(EI): t_R = 7.20 min; m / z (rel. Int. [%]): 306 (2) [M^+], 288 (3) [M^+-H_2O], 197 (16), 185 (21), 167 (37), 141 (10), 123 (22), 113 (10), 91 (100) [Bn^+]; HR-MS(FAB: 3-NBA): calcd. for $C_{18}H_{26}O_4$ 306.3966, found 307.1937 [M+H]$^+$.

(2*R*,4*R*,6*R*,11*S*)-2-(2-(Benzyloxy)ethyl)-11-methyl-1,7-dioxaspiro[5.5]undecan-4-ol



Yield = 10.1 mg (0.032 mmol, 39%); R_f = 0.36 (cyclohexane / EtOAc = 1 / 1); purity = 96%; $[\alpha]_D^{20}$ = 76.0 ° (c = 0.82, $CHCl_3$); ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ (ppm) = 7.25-7.37 (m, 5H, 5 × C_{ar}H), 4.53 (d, ^2J = 12.0 Hz, 1H, PhCH_2), 4.49 (d, ^2J = 12.0 Hz, 1H, PhCH_2), 4.04-4.14 (m, 2H), 3.71 (td, ^3J = 8.7 Hz, ^3J = 6.0 Hz, 1H), 3.51-3.65 (m, 3H), 1.72-1.88 (m, 4H, 2 × CH_2), 1.59-1.67 (m, 2H), 1.36-1.70 (m, 8H, 3 × CH_2, 1 × C*H*CH_3 OH), 0.86 (d, ^3J = 6.2 Hz, 3H, CH_3); ^{13}C-NMR (125.8 MHz, $CDCl_3$): δ (ppm) = 138.6 (s), 128.5 (d), 127.9 (d), 127.7 (d), 100.4 (s), 73.2 (t), 66.8 (t), 65.3 (d), 60.6 (d), 60.4 (t), 38.8 (d), 38.4 (t), 36.5 (t), 36.1 (t), 26.9 (t), 26.0 (t), 16.9 (q); GC-MS(EI): t_R = 7.45 min; m / z (rel. Int. [%]): 320 (3) [M^+], 302 (4) [M^+-H_2O], 251 (7), 212 (25), 146 (77), 124 (24), 91 (100) [Bn^+]; HR-MS(FAB: 3-NBA): calcd. for $C_{19}H_{28}O_4$ 320.1988, found 321.2070 [M+H]$^+$.

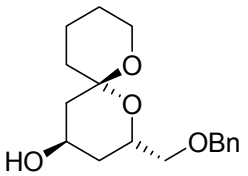
(2*R*,4*S*,6*R*)-2-((Benzyloxy)methyl)-1,7-dioxaspiro[5.5]undecan-4-ol



Yield = 15.9 mg (0.054 mmol, 45%); R_f = 0.40 (cyclohexane / EtOAc = 1 / 1); purity = 95%;

$[\alpha]_D^{20}$ = -30.8 ° (c = 1.51, $CHCl_3$); ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ (ppm) = 7.23-7.36 (m, 5H, 5 × $C_{ar}H$), 4.63 (d, ^2J = 12.3 Hz, h, CH_2Ph), 4.59 (d, ^3J = 12.6 Hz, h, CH_2Ph), 4.14 (dddd, ^2J = 12.1 Hz, ^3J = 4.9 Hz, ^3J = 4.9 Hz, ^3J = 2.3 Hz, 1H), 4.06 (quint, ^3J = 3.0 Hz, 1H), 3.73 (ddd, ^3J = 11.4 Hz, ^3J = 11.4 Hz, ^3J = 3.0 Hz, 1H), 3.57-3.63 (m, 1H), 3.54 (d, ^3J = 4.8 Hz, 2H, CH_2OBn), 1.81-1.95 (m, 2H), 1.73 (ddd, ^3J = 13.6 Hz, ^3J = 5.1 Hz, ^3J = 2.1 Hz, 1H), 1.44-1.66 (m, 8H); ^{13}C-NMR (125.8 MHz, $CDCl_3$): δ (ppm) = 138.8 (s), 128.5 (d), 127.6 (d), 127.6 (d), 98.0 (s), 73.5 (t), 67.5 (t), 65.0 (d), 64.2 (d), 61.0 (t), 40.4 (t), 35.3 (t), 34.5 (t), 25.0 (t), 18.6 (t); GC-MS(EI): t_R = 7.13 min; m / z (rel. Int. [%]): 292 (1) [M^+], 274 (9) [M^+-H_2O], 201 (12) [M^+-Bn], 183 (7), 171 (42), 153 (78), 127 (53), 107 (28), 91 (100) [Bn^+]; HR-MS(FAB: 3-NBA): calcd. for $C_{17}H_{24}O_4$ 292.1675, found 293.1727 [M+H]$^+$.

(2*S*,4*R*,6*S*)-2-((Benzyloxy)methyl)-1,7-dioxaspiro[5.5]undecan-4-ol



Yield = 17.8 mg (0.061 mmol, 55%); R_f = 0.42 (cyclohexane / EtOAc = 1 / 1); purity = 97%; $[\alpha]_D^{20}$ = 31.0 ° (c = 1.29, $CHCl_3$); ^{1}H-NMR (500.1 MHz, $CDCl_3$): δ (ppm) = 7.25-7.38 (m, 5H, 5 × $C_{ar}H$), 4.65 (d, ^2J = 12.5 Hz, 1H, PhCH_2), 4.62 (d, ^2J = 12.2 Hz, 1H, PhCH_2), 4.16 (dddd, ^2J = 12.1 Hz, ^3J = 4.8 Hz, ^3J = 4.8 Hz, ^3J = 2.3 Hz, 1H), 4.06-4.11 (m, 1H), 3.76 (ddd, ^3J = 12.0 Hz, ^3J = 11.2 Hz, ^3J = 2.3 Hz, 1H), 3.61-3.66 (m, 1H), 3.56 (d, ^3J = 5.0 Hz, 2H, CH_2OBn), 1.86-1.97 (m, 1H), 1.87 (d, ^3J = 14.5 Hz, 1H), 1.76 (d, ^3J = 13.5 Hz, 1H), 1.47-1.68 (m, 8H); GC-MS(EI): t_R = 7.13 min; m / z (rel. Int. [%]): 292 (1) [M^+], 274 (7) [M^+-H_2O], 201 (10), 171 (38), 153 (73), 127

(48), 107 (25), 91 (100) [Bn^+], 55 (15); HR-MS(FAB: 3-NBA): calcd. for $C_{17}H_{24}O_4$ 292.4675, found 293.1737 $[M+H]^+$.

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