The partial reduction of annulated heterocycles as a general route to medium rings containing oxygen and nitrogen

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General Procedures and Supplementary Material

Synthesis of furan ester 9

Compound **5 (**2.13 g, 12.37 mmol) was dissolved in diethyl ether (100 ml) and methyl chloroacetate (2.15 g, 19.79 mmol) was added with stirring. The reaction mixture was cooled to -5 ^{0}C before the portionwise addition of sodium methoxide (95% powder, 1.05 g, 18.55 mmol) over a period of 10 mins. The resultant deep red supension was allowed to stir and warm to room temperature overnight. The reaction mixture was cooled to 0 ^{0}C before the addition of acetic acid (8 drops) in water (10 ml). The two layers were allowed to separate over a period of 30 mins before diluting further with diethyl ether (100 ml) and extracting from the aqueous. The aqueous layer was further extracted with diethyl ether (2 x 250 ml). The organic layers were combined and washed with saturated sodium chloride solution (100 ml) containing saturated sodium bicarbonate solution (50 ml). The organic layers were dried over anhydrous sodium sulfate and concentrated with azeotropic removal of acetic acid with toluene (100 ml) to afford a crude mixture of the intermediate epoxide **7** (2.42 g, 80%) as a deep red oil.

Compound **7** (2.42 g, 9.9 mmol) was dissolved in toluene (30 ml) followed by the addition of D(+)-10-camphor-sulfonic acid (2.3 g, 9.9 mmol). The reaction mixture was allowed to heat to reflux for 8 hours before allowing to cool to room temperature and concentrating with silica, under reduced pressure and purifying by chromatography (silica, petrol- diethyl ether, 9:1 v/v) to afford compound **9** (1.05g, 59%) as a pale yellow oil.

Spectroscopic data:

Compound 9

^{1}H NMR (300 MHz, $CDCl_3$)	δ_H1.48-1.78 (4H, m, CH_2*CH_2*$CH_2$$CH_2$), 2.46 (2H, t, *J* 5.4 *CH_2*$CH_2CH_2CH_2$), 2.75 (2H, t, *J* 5.8 $CH_2CH_2CH_2$*CH_2*), 3.80 (3H, s, Me) and 7.19 (1H, s, Ar*H* of furan).
^{13}C NMR (75 MHz, $CDCl_3$)	δ_C 19.8 (2), 22.0, 22.4, 22.5, 51.3, 124.0, 132.5, 140.8 and 159.8.
MS (EI, *m/z*)	181 (M^++ 1, 100 %) and 180 (M^+, 85 %).
HRMS (EI, *m/z*)	Found: M^+, 180.0790. $C_{10}H_{12}O_3$ requires *M*, 180.0786.
ν_{max} / cm^{-1}	2939, 2858, 1728, 1709, 1612, 1537, 1442, 1307 and 1164.

Transesterification of methyl ester 9 to isopropyl ester 11

Compound **9** (876 mg, 4.86 mmol) was dissolved in propan-2-ol (25 ml) and titanium tetraethoxide (1.3 ml, 4.86 mmol) was added and the reaction mixture was heated under reflux for 6.5 hours. The mixture was allowed to cool to room temperature, treated with water (10 ml) and the resultant white suspension was concentrated with silica under reduced pressure and purified by chromatography (silica, petrol- diethyl ether, 9:1 v/v) to afford compound **11** (1.0 g, 99%) as a pale yellow oil. Note; the same procedure was applied to the synthesis of compound **10** (isolated as pale yellow oil in 94% yield).

Spectroscopic data:

Compound 10

^{1}H NMR (300 MHz, $CDCl_3$)	δ_H 1.38 (6H, d, *J* 6.3 2 x Me), 2.42 (2H, qt, *J* 7.1 $CH_2CH_2CH_2$), 2.68 (2H, t, *J* 7.3 $CH_2CH_2CH_2$), 2.86 (2H, t, *J* 7.3 $CH_2CH_2CH_2$), 5.24 (1H, sept, *J* 6.3 $CH(CH_3)_2$) and 7.19 (1H, s, Ar*H* of furan).
^{13}C NMR (75 MHz, $CDCl_3$)	δ_C 21.9 (2), 23.4, 25.1, 31.6, 67.9, 134.8, 135.5, 136.3,142.9 and 158.7.
MS (EI, *m/z*)	209 (M^++ 1, 85 %) and 208 (M^+, 25 %).
HRMS (EI, *m/z*)	Found: M^+, 194.0939. $C_{11}H_{14}O_3$ requires *M*,194.0943.
ν_{max} / cm^{-1}	2978, 2940, 1724, 1704, 1632, 1553, and 1109.

Compound 11

^{1}H NMR (300 MHz, $CDCl_3$)	δ_H 1.38 (6H, d, *J* 6.3 2 x Me), 1.70- 1.80 (4H, m, $CH_2CH_2CH_2CH_2$), 2.56 (2H, t, *J* 5.5 $CH_2CH_2CH_2CH_2$), 2.85 (2H, t, *J* 6.0 $CH_2CH_2CH_2CH_2$), 5.26 (1H, sept, *J* 6.3 $CH(CH_3)_2$) and 7.30 (1H, s, Ar*H* of furan).
^{13}C NMR (75 MHz, $CDCl_3$)	δ_C 19.9 (2), 22.0, 22.2, 22.5(2), 67.7, 123.9, 132.0, 138.9, 140.5 and 159.0.
MS (EI, *m/z*)	209 (M^++ 1, 85 %) and 208 (M^+, 25 %).
HRMS (CI, *m/z*)	Found: M^++ H, 209.1177. $C_{12}H_{16}O_3$ requires *M* + *H*, 209.1178.
ν_{max} / cm^{-1}	2979, 2937, 2859, 1720, 1702, 1612, 1536, and 1105.

General procedure for the alkaline hydrolysis of methyl ester 9

Compound **9** (100 mg, 0.55 mmol), was dissolved in methanol/ water mixture (9ml: 1m respectively) followed by the addition of KOH(s) (137mg, 2.44 mmol). The reaction mixture was allowed to heat to reflux for 1 hour before allowing to cool to room temperature and concentrated to dryness. The residue was dissolved in water (10 ml) and

extracted with ether (10 ml). The aqueous layer was acidified with concentrated hydrochloric acid (2ml) and extracted with Et_2O (3x10 ml). Combined organics were dried over anhydrous magnesium sulfate and cocentrated under reduced pressure to afford the desired acid as a white solid (90 mg, 98%) which was then coupled to (*R,R*)-(+)-2,5-Bis(methoxymethyl)-pyrrolidine to afford amide **21** as a colourless oil (144 mg, 87%).

Compound 21

	Spectroscopic data:
^{1}H NMR (300 MHz, $CDCl_3$)	δ_H 1.59- 1.82 (4H, m, $CH_2CH_2CH_2CH_2$), 1.86- 2.26 (4H, m, $CH_2CH_2CH_2CH_2$), 2.42- 2.63 (2H, m, NC(H)CH_2CH_2), 2.73- 3.02 (2H, m, NC(H)CH_2CH_2), 3.04- 3.22 (2H, m, NC(H)CH_2OCH_3), 3.26 (3H, s, -OCH_3), 3.23-3.42(4H, m, NC(H)*CH* and –OCH_3), 3.59 (1H, dd, *J* 9.2 and 3.0, NC(H)*CH*), 4.40- 4.57 (1H, m, *NCH*) 4.79- 4.90 (1H, m, *NCH*) and 7.16 (1H, s, Ar*H* of furan).
^{13}C NMR (75 MHz, $CDCl_3$)	δ_C 20.4, 23.1.(2), 23.2, 24.3, 27.7, 57.3, 57.9, 59.3, 59.4, 72.3, 74.3, 124.3, 131.6, 138.1, 141.8 and 159.9.
MS (EI, *m/z*)	307 (M^+, 100 %).
HRMS (CI, *m/z*)	Found: M^++ H, 308.1866. $C_{17}H_{25}NO_4$ requires *M + H*, 308.1862.
ν_{max} / cm^{-1}	2976, 2932, 2891, 2858, 1615, 1535, 1445, 1372, and 1115.

General procedure for the Birch reduction

Birch reductive alkylation of compound 11

Lithium (27 mg, 3.84 mmol) was added to freshly distilled ammonia (50 ml) and allowed to stir at –78 ^{0} C under an atmosphere of nitrogen for 2 hours before the addition of bis-(2-methoxyethyl)-amine (5 ml, 32 mmol). Compound **11** (200 mg , 0.96 mmol) was dissolved in THF (25 ml) and added to the reaction mixture after 5 minutes. The resultant solution was allowed to stir at –78 ^{0} C for 2.5 hours before the addition of isoprene (50 µl), immediately followed by methyl iodide (2 ml, 32 mmol). After an additional 1 hour, the resultant bright yellow solution was treated with saturated ammonium chloride solution (5 ml) before being allowed to warm to room temperature over 16 hours. The reaction mixture was extracted into diethyl ether (3 x 50 ml), dried over anhydrous sodium sulfate and concentrated under reduced pressure to afford a yellow oil. Purification by chromatography (silica, petrol- diethyl ether, 9:1 v/v) afforded compound **17** (140 mg , 65%) as a colourless oil.

Spectroscopic data:

Compound 12

^{1}H NMR (300 MHz, $CDCl_3$)	δ_H 1.27 (6H, d, *J* 6.3 2 x Me), 1.50 (3H, s, Me), 2.29- 2.45 (6H, m, $CH_2CH_2CH_2$), 4.55 (2H, ABq, *J* 12 -OCH_2) and 5.03 (1H, sept, *J* 6.2 C*H*$(CH_3)_2$).
^{13}C NMR (75 MHz, $CDCl_3$)	δ_C 21.7, 21.8, 22.8, 26.5, 27.4, 28.9, 68.2, 71.4, 86.0, 145.0, 145.7 and 172.3.
MS (CI, *m/z*)	211 (M^++ 1, 40 %) and 228 (M^++ 18, 55 %).
HRMS (CI, *m/z*)	Found: $M^+ + NH_4$, 228.1601. $C_{12}H_{18}O_3$ *requires M +* NH_4, 228.1600.
ν_{max} / cm^{-1}	2981, 2937, 2859, 1728, 1376, and 1270.

Compound 13

^{1}H NMR (300 MHz, $CDCl_3$)	δ_H 0.91 (6H, dd, *J* 7.7 and 6.5 2 x Me of ^{i}Bu group), 1.25 (6H, d, *J* 6.3 2 x Me of ^{i}Pr group), 1.62 (1H, dd, *J* 13.5 and 5.7 C(*H*)CH$(CH_3)_2$), 1.68- 1.84 (1H, m, CH_2C*H*$(CH_3)_2$) 1.89 (1H, dd, *J* 13.5 and 6.3 C(*H*)CH$(CH_3)_2$), 2.25- 2.43 (6H, m, $CH_2CH_2CH_2$), 4.54 (2H, ABq, *J* 12.3 -OCH_2) and 5.03 (1H, sept, *J* 6.2 C*H*$(CH_3)_2$).
^{13}C NMR (75 MHz, $CDCl_3$)	δ_C 22.2, 22.3, 24.0, 24.3, 24.9, 27.4, 27.8, 29.3, 44.6, 68.6, 71.9, 89.6, 145.6, 145.8 and 172.7.
MS (CI, *m/z*)	253 (M^++ 1, 100 %) and 270 (M^++ 18, 90 %).
HRMS (CI, *m/z*)	Found: M^+ + H, 253.1805. $C_{15}H_{24}O_3$ requires *M + H*, 253.1803.
ν_{max} / cm^{-1}	2978, 2954, 2910, 2856, 1747, 1722, 1374, 1235 and 1108.

Compound 17

^{1}H NMR (300 MHz, $CDCl_3$)	δ_H 1.18 (6H, d, *J* 6.2 2 x Me), 1.40 (3H, s, Me), 1.48- 1.68 (4H, m, $CH_2CH_2CH_2CH_2$), 1.82- 2.02 (4H, m, $CH_2CH_2CH_2CH_2$), 4.51 (2H, ABq, *J* 11.8 -OCH_2) and 4.94 (1H, sept, *J* 6.2 C*H*$(CH_3)_2$).
^{13}C NMR (75 MHz, $CDCl_3$)	δ_C 21.2 (2), 21.6, 21.7, 21.8, 22.0, 22.2, 22.4, 68.0, 90.6, 133.2, 133.6 and 172.7.
MS (CI, *m/z*)	137 (M^+- 87, 100 %), 225 (M^++ 1, 55 %) and 242 (M^++ 18, 60 %).
HRMS (CI, *m/z*)	Found: M^+ + H, 225.1486. $C_{13}H_{20}O_3$ requires *M + H*, 225.1490.
ν_{max} / cm^{-1}	2979, 2933, 2843, 1742, 1724, and 1262.

Compound 18

^{1}H NMR (300 MHz, $CDCl_3$)	δ_H 0.91 (6H, dd, *J* 9.0 and 6.6 2 x Me of ^{i}Bu group), 1.24 (6H, d, *J* 6.3 2 x Me of ^{i}Pr group), 1.56- 2.05 (11H, m, 8H of cyclohexyl group and 3H of $CH_2CH(CH_3)_2$), 4.61 (2H, ABq, *J* 12.3 -OCH_2) and 5.00 (1H, sept, *J* 6.2 C$H(CH_3)_2$).
^{13}C NMR (75 MHz, $CDCl_3$)	δ_C 22.1 (2), 22.2, 22.3, 22.5, 22.9, 23.9, 24.5, 24.7, 43.9, 68.5, 77.8, 94.1, 133.2, 134.4 and 173.2.
MS (CI, *m/z*)	267 (M^++ 1, 95 %) and 179 (M^+- 87, 100%).
HRMS (CI, *m/z*)	Found: M^+ + H, 267.1965. $C_{16}H_{26}O_3$ requires *M* + *H*, 267.1960.
ν_{max} / cm^{-1}	2978, 2954, 2910, 2856, 1747, 1722, 1374, 1235 and 1108.

Compound 22

^{1}H NMR (300 MHz, $CDCl_3$)	δ_H 1.42 (3H, s, Me), 1.56- 1.63 (4H, m, NC(H)CH_2CH_2), 1.80-2.07 (8H, m, $CH_2CH_2CH_2CH_2$), 2.95 (1H, t, *J* 9.3 NC(H)CH(H)OCH_3), 3.04- 3.16 (2H, m, NC(H)CH_2OCH_3), 3.21 (3H, s, -OCH_3) 3.27 (3H, s, -OCH_3) 3.46 (1H, m, NC(H)CH(H)OCH_3), 4.17-4.26 (1H, m, *NCH*), 4.40-4.54 (2H, m, -OCH_2) and 4.61- 4.72 (1H, m, *NCH*).
^{13}C NMR (75 MHz, $CDCl_3$)	δ_C 21.9, 22.1, 22.5, 23.3, 23.5, 26.0, 27.2, 57.5, 57.8, 58.8, 58.9, 71.4, 74.2, 75.7, 93.7, 131.1, 135.7 and 172.6.
MS (CI, *m/z*)	324 (M^+ + H, 100 %).
HRMS (EI, *m/z*)	Found: M^+, 323.2099. $C_{18}H_{29}NO_4$ requires *M*, 323.2096.
ν_{max} / cm^{-1}	2927, 2855, 1621, 1449, 1395, 1376, and 1115.

Compound 26 (R = Me)

^{1}H NMR (300 MHz, $CDCl_3$)	δ_H 1.27 (3H, t, *J* 7.0 -OCH_2CH_3), 1.48 (9H, *J* 9.3 C$(CH_3)_3$), 1.59- 1.75 (8H, m, $CH_2CH_2CH_2CH$ and CH_3), 1.90- 2.10 (3H, m, $CH_2CH_2CH_2CH$), 3.95-4.32 (4H, m, -NCH_2 and -OCH_2CH_3).
^{13}C NMR (75 MHz, $CDCl_3$)	δ_C 14.1, 20.0, 20.6, 20.8, 20.9, 21.7, 21.8(2), 22.0(2), 22.1, 22.9, 28.1, 28.2, 28.3, 55.8, 56.0, 60.7, 60.8, 73.1, 73.4, 79.2, 79.8, 131.6(2), 133.6,

133.8, 153.4, 172.2 and 172.3. Note: multiplicity of some signals due to Boc rotomers.

MS (CI, *m/z*) 310 (M^++ 1, 100 %).

HRMS (CI, *m/z*) Found: M^+ + H, 310.2021. $C_{17}H_{27}NO_4$ requires *M* + *H*, 310.2018.

ν_{max} / cm^{-1} 2977, 2936, 2857, 1738, 1701, 1687, 1456, 1366, 1259 and 1177.

Compound 26 (R = H)

^{1}H NMR (300 MHz, $CDCl_3$) δ_H 1.29 (3H, t, *J* 7.1 –OCH_2CH_3), 1.46 (9H, *J* 13.2 $C(CH_3)_3$), 1.58- 1.74 (4H, m, $CH_2CH_2CH_2CH_2$), 1.90- 2.14 (4H, m, $CH_2CH_2CH_2CH_2$), 3.95- 4.22 (4H, m, -NCH_2 and -OCH_2CH_3) and 4.70- 4.82 (1H, m, NC(*H*)CO_2Et).

^{13}C NMR (75 MHz, $CDCl_3$) δ_C 14.2, 14.3, 21.9, 22.1 (2), 22.3 (2), 23.1, 28.2, 28.3, 55.2, 55.6, 60.7, 40.8, 68.5, 68.8, 79.6, 79.7, 128.6, 128.7, 133.8, 153.3, 153.7, 170.6 and 170.8. Note: multiplicity of some signals due to Boc rotomers.

MS (CI, *m/z*) 296 (M^++ 1, 55 %).

HRMS (CI, *m/z*) Found: M^+, 295.1792. $C_{16}H_{25}NO_4$ requires *M*, 295.1784.

ν_{max} / cm^{-1} 2976, 2933, 2858, 1752, 1710, 1685, 1399, 1366, 1183 and 1111.

General procedure for ozonolysis

Ozonolysis of compound 17

Compound **17** (50 mg , 0.22 mmol) was dissolved in dichloromethane (15 ml) and cooled to –78 ^{0} C under an atmosphere of O_2. Ozone was generated and bubbled through the reaction mixture for 1.5 hours. The resultant blue solution was saturated with O_2 for 10 minutes before the addition of dimethyl sulfide (0.16 ml , 2.2 mmol). The reaction mixture was allowed to warm to room temperature over 16 hours. The resultant solution was extracted with brine (2 x 5 ml), dried over anhydrous sodium sulfate and concentrated under reduced pressure to afford compound **19** (59 mg , 100%) as a pale yellow oil.

Spectroscopic data:

Compound 14

^{1}H NMR (300 MHz, $CDCl_3$) δ_H 1.33 (6H, dd, *J* 16.4 and 6.2 2 x Me), 1.43 (3H, s, Me), 1.52- 1.81 (3H, m, C(OH)CH_2CH_2CH), 2.01 (1H, dd, *J* 14.4 and 4.9 C(OH)*CH*), 2.12 (1H, dd, *J* 14.4 and 4.9 C(OH)*CH*), 2.20- 2.44 (1H, m,

	C(OH)*CH*) 2.98 (1H, s, OH), 3.5 (1H, dd, *J* 11.7 and 2.6 –O*CH*C(OH)), 3.84 (1H, d, *J* 11.7, -O*CH*C(OH)), 5.22 (1H, sept, *J* 6.3, *CH*(CH_3)$_2$) and 6.74 (1H, s, OH).
^{13}C NMR (75 MHz, $CDCl_3$)	δ_C 19.1, 21.5, 21.8, 22.1, 30.8, 35.0, 70.5, 70.8, 78.6, 96.4, 99.8 and 175.4.
MS (CI, *m/z*)	260 (M^+, 80 %).
HRMS (CI, *m/z*)	Found: M^+, 260.1260. $C_{12}H_{20}O_6$ requires *M*, 260.1260.
ν_{max} / cm^{-1}	3387, 2977, 2936, 1702, 1281 and 956.

Compound 19

^{1}H NMR (300 MHz, $CDCl_3$)	δ_H 1.27 (6H, d, *J* 6.3 2 x Me), 1.56 (3H, s, Me), 1.59- 1.67 (1H, m, $CH_2C(H)HCH_2CH_2$), 1.81- 1.90 (3H, m, $CH_2CH_2CH(H)CH_2$), 2.36- 2.55 (2H, m, $CH_2CH_2CH_2CH_2$), 2.75- 2.90 (1H, m, C(H)*H*$CH_2CH_2CH_2$), 2.93- 3.02 (1H, m, C(H)*H*$CH_2CH_2CH_2$), 4.07 (2H, ABq, *J* 16.5 -*OCH*$_2$) and 5.15 (1H, sept, *J* 6.2 C*H*(CH_3)$_2$).
^{13}C NMR (75 MHz, $CDCl_3$)	δ_C 18.2, 21.9, 22.0, 23.4, 23.6, 35.0, 36.1, 70.4, 70.6, 86.6, 169.5, 206.5 and 211.8.
MS (EI, *m/z*)	257 (M^++ 1, 100 %) and 274 (.M^++ 18, 55 %).
HRMS (CI, *m/z*)	Found: $M^+ + NH_4$, 274.1659. $C_{13}H_{20}O_5$ requires *M* + *NH*$_4$, 274.1654.
ν_{max} / cm^{-1}	2982, 2940, 1738, 1721, 1145 and 1103.

Compound 20

^{1}H NMR (300 MHz, $CDCl_3$)	δ_H 0.95 (6H, 2 x d, *J* 6.6 2 x Me of ^{i}Bu group), 1.25 (6H, d, *J* 6.3 2 x Me of ^{i}Pr group), 1.60- 1.95 (7H, m, $CH_2CH_2CH_2CH_2$ and *CH*$_2$*CH*(CH_3)$_2$), 2.28- 2.52 (2H, m, $CH_2CH_2CH_2CH_2$), 2.70- 2.81 (1H, m, C(H)*H*$CH_2CH_2CH_2$),2.96- 3.10 (1H, m, C(H)*H*$CH_2CH_2CH_2$), 3.93 (2H, ABq, *J* 16.8 -OCH_2) and 5.15 (1H, sept, *J* 6.3 C*H*(CH_3)$_2$ of ^{i}Pr group).
^{13}C NMR (75 MHz, $CDCl_3$)	δ_C 21.9, 22.0, 23.1, 23.5, 23.9, 24.0, 24.4, 34.7, 35.2, 38.9, 70.2, 70.5, 89.4, 169.0, 205.7 and 212.0.
MS (EI, *m/z*)	298 (M^+, 10 %) and 299 (M^++ 1, 100 %).
HRMS (EI, *m/z*)	Found: M^+, 298.1776. $C_{16}H_{26}O_5$ requires *M*, 298.1780.
ν_{max} / cm^{-1}	2957, 2874, 1754, 1737, 1720, 1147 and 1104.

Compound 27

^{1}H NMR (300 MHz, $CDCl_3$)	δ_H 1.30 (3H, t, *J* 7-OCH_2CH_3), 1.41- 1.62 (10H, m, $C(CH_3)_3$ and $C(O)CH_2CH$),1.67- 1.92 (3H, m, $C(O)CH_2C(H)HCH_2$), 2.16- 2.35 (2H, m, $C(O)CH_2CH_2CH_2CH_2$) 2.64- 2.88 (2H, m, $C(O)CH_2$), 4.00 (2H, ABq, *J* 17.5 NCH_2) 4.21- 4.32 (2H, m, -OCH_2CH_3) and 12.18 (1H, d, *J* 13.1 OH).
^{13}C NMR (75 MHz, $CDCl_3$)	δ_C 14.1, 14.2, 19.9, 20.7, 24.8, 25.0, 27.7, 27.8, 28.1, 28.2, 35.6, 36.0, 58.6, 59.3, 61.0, 80.9, 81.6, 108.3, 108.5, 154.6, 155.7, 169.9, 170.0, 176.8, 177.3, 211.1 and 211.3. Note: multiplicity of some signals due to Boc rotomers.
MS (EI, *m/z*)	327 (M^+, 5 %) and 227 (M^+- 100, 100 %).
HRMS (CI, *m/z*)	Found: $M^+ + H$, 328.1751. $C_{16}H_{25}NO_6$ requires *M* + *H*, 328.1760.
ν_{max} / cm^{-1}	3407, 2978, 2936, 1713, 1657, 1621, 1458, 1409, 1369, 1234 and 1161.
Compound 15	
^{1}H NMR (300 MHz, $CDCl_3$)	δ_H 1.20 (6H, dd, *J* 6.3 and 1.9 2 x Me), 1.50 (3H, s, Me), 1.79- 1.91 (1H, m, $CH_2C(H)HCH_2$), 1.97- 2.18 (1H, m, $CH_2CH(H)CH_2$), 2.31- 2.47 (2H, m, $CH_2CH_2CH_2$), 2.65- 2.79 (1H, m, $C(H)HCH_2CH_2$), 2.87- 3.00 (1H, m, $C(H)HCH_2CH_2$), 4.05 (2H, ABq, *J* 17.6 -OCH_2) and 5.10 (1H, sept, *J* 6.3 $CH(CH_3)_2$).
^{13}C NMR (75 MHz, $CDCl_3$)	δ_C 21.3, 21.4, 25.2, 29.6, 39.0, 40.3, 70.0, 71.0, 85.2, 168.7, 205.0 and 212.0.
MS (CI, *m/z*)	243 (M^++ 1, 8 %) and 260 (M^++ 18, 100 %).
HRMS (CI, *m/z*)	Found: $M^+ + NH_4$, 260.1498. $C_{12}H_{18}O_5$ requires *M* + NH_4, 260.1498.
ν_{max} / cm^{-1}	2981, 2937, 1721, 1449, 1375, 1278, 1146 and 1102.
Compound 16	
^{1}H NMR (300 MHz, $CDCl_3$)	δ_H 0.98 (6H, 2 x d, *J* 6.6 2 x Me of ^{i}Bu group), 1.25 (6H, d, *J* 6.3 2 x Me of ^{i}Pr group), 1.58- 2.20 (5H, m, $CH_2CH_2CH_2$ and $CH_2CH(CH_3)_2$), 2.33- 2.52 (2H, m, $CH_2CH_2CH_2$), 2.65- 2.81 (1H, m, $C(O)C(H)HCH_2CH_2$) 2.92- 3.08 (1H, m, $C(O)C(H)HCH_2CH_2$), 4.02 (2H, ABq, *J* 18.0

	-OCH_2) and 5.17 (1H, sept, *J* 6.2 C*H*$(CH_3)_2$ of ^{i}Pr group).
^{13}C NMR (75 MHz, $CDCl_3$)	δ_C 21.9, 22.0, 23.8, 23.9, 24.2, 25.5, 39.4, 41.0, 43.9, 70.3, 71.1, 88.5, 168.8, 204.8 and 212.6.
MS (CI, *m/z*)	284 (M^+, 10 %) 285 (M^++ 1, 30 %) and 302 (M^++ 18, 100 %).
HRMS (CI, *m/z*)	Found: M^+ + H, 285.1708. $C_{15}H_{24}O_5$ requires *M* + *H*, 285.1702.
ν_{max} / cm^{-1}	2956, 2874, 1720, 1713, and 1102.

Compound 23

^{1}H NMR (300 MHz, $CDCl_3$)	δ_H 1.52 (3H, s, Me), 1.60- 1.83 (4H, m, CH_2*CH_2*$CH_2$$CH_2$), 1.95- 2.15 (4H, m, *CH_2*$CH_2$$CH_2$*$CH_2$*) and 4.63 (2H, ABq, *J* 11.7 - *OCH_2*).
^{13}C NMR (75 MHz, $CDCl_3$)	δ_C 21.4, 22.1, 22.2, 22.6, 22.8, 77.8, 91.7, 133.1, 133.3, and 174.8.
MS (CI, *m/z*)	183 (M^++ 1, 5 %) and 200 (M^++ 18, 100 %).
HRMS (CI, *m/z*)	Found: M^+ + NH_4, 200.1286. $C_{10}H_{14}O_3$ requires *M* + *NH_4*, 200.1287.
ν_{max} / cm^{-1}	3176, 2932, 2857, 1736, 1720, 1446, 1332 and 1137.
Specific rotation	$[\alpha]_D^{24}$ +108 (*c* =1, CH_2Cl_2).

X-ray data for compound **14**
CCDC depostion number is 156092

Molecular Structure Corporation. (1995). teXsan. Single Crystal Structure Analysis Software. Version 1.7. MSC, 3200 Research Forest Drive, The Woodlands, TX 77381, USA.

North, A.C.T., Phillips, D. C. & Mathews, F. S. (1968). Acta Cryst. A24, 351-359.

Sheldrick, G.M. (1985). In: "Crystallographic Computing 3" (Eds G.M. Sheldrick, C. Kruger and R. Goddard) Oxford University Press, pp. 175-189.

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_computing_cell_refinement 'MSC/AFC Diffractometer Control'

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83.56(3)
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\y scans (North,Phillips & Matthews,
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The scan width was (0.84+0.30tan\q)\%
with an \w
scan speed of 32\% per minute
(up to 4 scans to achieve I/\s(I) > 10).
Stationary background counts were
recorded at each end of the
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;
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    0   -1   -2
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O(4) 0.2590 0.5143 -0.2807 0.057 1.000 . Uani c ?
O(5) 0.2930 0.9466 -0.1416 0.076 1.000 . Uani c ?
H(5) 0.2747 0.8862 -0.2545 0.085 1.000 . Uiso c ?
O(6) -0.0691 0.8014 0.0412 0.068 1.000 . Uani c ?
H(6) -0.1014 0.8857 0.0742 0.136 1.000 . Uiso c ?
C(1) 0.3380 0.7254 -0.0441 0.048 1.000 . Uani c ?
C(2) 0.2757 0.8777 -0.0080 0.053 1.000 . Uani c ?
C(3) 0.3402 0.9702 0.1957 0.061 1.000 . Uani c ?
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H(3B) 0.3075 1.0654 0.1967 -1.200 1.000 . Uiso c ?
C(4) 0.2990 0.9317 0.3583 0.058 1.000 . Uani c ?
H(4A) 0.3249 1.0053 0.4773 -1.200 1.000 . Uiso c ?
H(4B) 0.3531 0.8477 0.3827 -1.200 1.000 . Uiso c ?
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C(6) 0.0833 0.8131 0.0986 0.051 1.000 . Uani c ?
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H(7B) 0.0961 0.6097 -0.0512 -1.200 1.000 . Uiso c ?
C(8) 0.2772 0.6467 -0.2592 0.052 1.000 . Uani c ?
C(9) 0.2044 0.4269 -0.4808 0.055 1.000 . Uani c ?
H(9) 0.1277 0.4788 -0.5566 -1.200 1.000 . Uiso c ?
C(10) 0.3265 0.3868 -0.5774 0.085 1.000 . Uani c ?
H(10A) 0.3600 0.4680 -0.5946 -1.500 1.000 . Uiso c ?
H(10B) 0.2920 0.3229 -0.7024 -1.500 1.000 . Uiso c ?
H(10C) 0.4058 0.3436 -0.4971 -1.500 1.000 . Uiso c ?
C(11) 0.1385 0.3053 -0.4570 0.074 1.000 . Uani c ?
H(11A) 0.2147 0.2497 -0.3925 -1.500 1.000 . Uiso c ?
H(11B) 0.0890 0.2502 -0.5831 -1.500 1.000 . Uiso c ?
H(11C) 0.0698 0.3383 -0.3800 -1.500 1.000 . Uiso c ?
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H(12B) 0.5360 0.7681 -0.0711 -1.500 1.000 . Uiso c ?
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O(3) 0.1072 0.0579 0.0448 -0.0162 0.0134 0.0106
O(4) 0.0721 0.0420 0.0526 -0.0066 0.0129 0.0046
O(5) 0.1113 0.0490 0.0524 -0.0221 0.0130 0.0161
O(6) 0.0570 0.0789 0.0662 0.0023 0.0084 0.0055
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0.0068   0.0004   0.0027
 C(5)  0.0737   0.0559   0.0442
0.0037   0.0112   0.0076
 C(6)  0.0550   0.0526   0.0459   -
0.0021   0.0066   0.0091
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0.0069   0.0144   0.0083
 C(9)  0.0584   0.0518   0.0549   -
0.0077   0.0096   -0.0015
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0.0184   0.0405   -0.0192
 C(11)  0.0719   0.0549   0.0913   -
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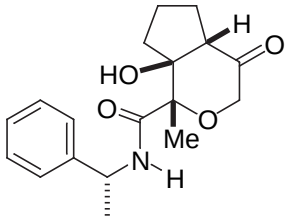
X-ray data for crystalline derivative of 23: made with (*S*,*S*) auxiliary and coupled to *R*-methyl benzylamine**.**

CCDC depostion number is 156091



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The data were collected using the RAXIS in 45 x 2.7 degree phi oscillations, of 20 minutes per exposure. The structure was solved by direct methods and non-H atoms were refined anisotropically whilst H atoms were included in calculated positions. The absolute configuration was input.

Hydrogen bonds with H..A < r(A) + 2.000 Angstroms and <DHA > 110 deg.

D-H	d(D-H)	d(H..A)	<DHA	d(D..A)	A
O2-H2	0.820	2.145	131.12	2.754	O4
N1-H1	0.860	2.383	150.64	3.161	O2 [x-1/2, -y+1/2, -z+2]

Molecular Structure Corporation. (1995). teXsan.
Single Crystal Structure Analysis Software. Version 1.7.
MSC, 3200 Research Forest Drive, The Woodlands, TX 77381, USA.

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'International Tables Vol C Tables 4.2.6.8 and 6.1.1.4'
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'O' 'O' 0.0106 0.0060
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x 2.7 degree phi scans'

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 Refinement of F^2^ against ALL
reflections.  The weighted R-factor wR
and
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conventional R-factors R are based
 on F, with F set to zero for negative
F^2^. The threshold expression of
 F^2^ > 2sigma(F^2^) is used only for
calculating R-factors(gt) etc. and is
 not relevant to the choice of reflections
for refinement.  R-factors based
 on F^2^ are statistically about twice as
large as those based on F, and R-
 factors based on ALL data will be even
larger.
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3P] where P=(Fo^2^+2Fc^2^)/3'
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SHELXL
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O2 O 0.43614(10) 0.27291(7)
1.13627(18) 0.0594(4) Uani 1 d . . .
H2 H 0.4447 0.2264 1.1118 0.089 Uiso
1 calc R . .
O3 O 0.18048(15) 0.48875(8) 1.1469(2)
0.0804(5) Uani 1 d . . .
O4 O 0.37111(11) 0.15766(7)
0.92206(19) 0.0659(4) Uani 1 d . . .
N1 N 0.19277(11) 0.16979(7) 0.8191(2)
0.0524(4) Uani 1 d . . .
H1 H 0.1336 0.2000 0.8111 0.063 Uiso
1 calc R . .
C1 C 0.28564(14) 0.28514(9) 0.9358(2)
0.0460(4) Uani 1 d . . .
C2 C 0.31916(14) 0.29499(9) 1.1125(2)
0.0467(4) Uani 1 d . . .
C3 C 0.24104(19) 0.25056(10)
1.2283(3) 0.0600(5) Uani 1 d . . .
H3A H 0.1610 0.2563 1.1979 0.072
Uiso 1 calc R . .
H3B H 0.2603 0.1949 1.2309 0.072 Uiso
1 calc R . .
C4 C 0.2638(3) 0.28896(12) 1.3898(3)
0.0823(7) Uani 1 d . . .
H4A H 0.1964 0.2854 1.4577 0.099
Uiso 1 calc R . .
H4B H 0.3276 0.2633 1.4435 0.099 Uiso
1 calc R . .
C5 C 0.29241(19) 0.37462(12)
1.3538(3) 0.0678(5) Uani 1 d . . .
H5A H 0.3622 0.3901 1.4090 0.081
Uiso 1 calc R . .
H5B H 0.2304 0.4088 1.3886 0.081 Uiso
1 calc R . .
C6 C 0.30871(15) 0.38069(9) 1.1721(2)
0.0510(4) Uani 1 d . . .
H6 H 0.3813 0.4081 1.1506 0.061 Uiso
1 calc R . .
C7 C 0.21232(16) 0.42596(9) 1.0939(3)
0.0546(5) Uani 1 d . . .
C8 C 0.15649(18) 0.39582(9) 0.9454(3)
0.0681(6) Uani 1 d . . .
H8A H 0.0749 0.4073 0.9511 0.082
Uiso 1 calc R . .
H8B H 0.1874 0.4246 0.8546 0.082 Uiso
1 calc R . .
C9 C 0.3684(2) 0.32607(11) 0.8207(3)
0.0688(6) Uani 1 d . . .
H9A H 0.3759 0.3806 0.8502 0.103
Uiso 1 calc R . .
H9B H 0.3391 0.3224 0.7135 0.103 Uiso
1 calc R . .
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H9C H 0.4423 0.3010 0.8262 0.103 Uiso 1 calc R . .
C10 C 0.28536(14) 0.19752(9) 0.8925(2) 0.0474(4) Uani 1 d . . .
C11 C 0.18620(15) 0.09024(10) 0.7508(3) 0.0552(5) Uani 1 d . . .
H11 H 0.2654 0.0715 0.7381 0.066 Uiso 1 calc R . .
C12 C 0.1352(2) 0.09551(13) 0.5860(3) 0.0827(7) Uani 1 d . . .
H12A H 0.1825 0.1287 0.5202 0.124 Uiso 1 calc R . .
H12B H 0.0593 0.1174 0.5927 0.124 Uiso 1 calc R . .
H12C H 0.1313 0.0437 0.5397 0.124 Uiso 1 calc R . .
C13 C 0.12570(14) 0.03235(9) 0.8606(2) 0.0482(4) Uani 1 d . . .
C14 C 0.09904(18) -0.04255(10) 0.8037(3) 0.0651(6) Uani 1 d . . .
H14 H 0.1157 -0.0558 0.6982 0.078 Uiso 1 calc R . .
C15 C 0.0480(2) -0.09718(11) 0.9031(4) 0.0779(7) Uani 1 d . . .
H15 H 0.0311 -0.1473 0.8640 0.093 Uiso 1 calc R . .
C16 C 0.02183(18) -0.07894(12) 1.0579(3) 0.0713(6) Uani 1 d . . .
H16 H -0.0133 -0.1162 1.1235 0.086 Uiso 1 calc R . .
C17 C 0.04753(17) -0.00542(11) 1.1163(3) 0.0645(5) Uani 1 d . . .
H17 H 0.0303 0.0075 1.2219 0.077 Uiso 1 calc R . .
C18 C 0.09929(16) 0.04945(10) 1.0173(3) 0.0567(5) Uani 1 d . . .
H18 H 0.1167 0.0992 1.0576 0.068 Uiso 1 calc R . .

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C6 0.0502(9) 0.0437(8) 0.0592(12) -0.0097(7) 0.0024(8) -0.0051(6)
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C8 0.0729(13) 0.0416(9) 0.0896(17) -0.0024(9) -0.0182(11) 0.0073(8)
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C10 0.0471(9) 0.0479(8) 0.0473(11) -0.0065(7) 0.0010(7) -0.0019(7)
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C16 0.0610(12) 0.0613(11) 0.0917(19) 0.0112(12) -0.0038(12) -0.0014(9)
C17 0.0583(11) 0.0716(12) 0.0636(14) 0.0008(10) 0.0020(10) 0.0089(8)
C18 0.0518(10) 0.0530(10) 0.0654(14) -0.0133(9) 0.0016(9) 0.0028(7)

_geom_special_details
;
 All esds (except the esd in the dihedral angle between two l.s. planes)

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 are estimated using the full covariance
matrix.  The cell esds are taken
 into account individually in the
estimation of esds in distances, angles
 and torsion angles; correlations between
esds in cell parameters are only
 used when they are defined by crystal
symmetry.  An approximate (isotropic)
 treatment of cell esds is used for
estimating esds involving l.s. planes.
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O4 C10 1.230(2) . ?
N1 C10 1.325(2) . ?
N1 C11 1.465(2) . ?
N1 H1 0.8600 . ?
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C1 C2 1.535(3) . ?
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C2 C6 1.540(2) . ?
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C3 H3A 0.9700 . ?
C3 H3B 0.9700 . ?
C4 C5 1.519(3) . ?
C4 H4A 0.9700 . ?
C4 H4B 0.9700 . ?
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C5 H5A 0.9700 . ?
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O1 C1 C10 107.05(12) . . ?
C9 C1 C10 107.08(15) . . ?
O1 C1 C2 108.08(14) . . ?
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