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Supporting Information

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Enantioselective Synthesis of Tertiary Alcohols *via* Desymmetric Benzoylation of 2-Substituted Glycerols

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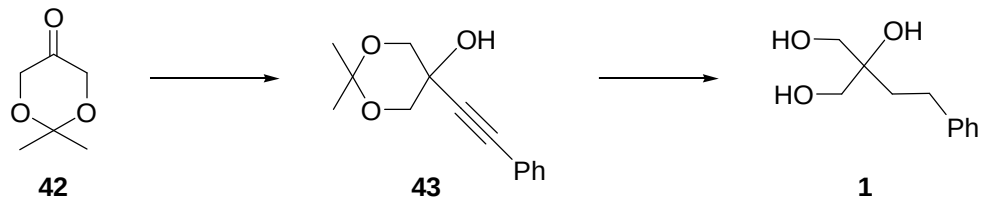
General. NMR spectra were obtained on Bruker AVANCE 300 spectrometer (300 MHz for ^{1}H NMR, 75 MHz for ^{13}C NMR) and measured in $CDCl_3$ or CD_3OD. Chemical shifts were recorded in ppm relative to internal standard $CDCl_3$ or CD_3OD, and coupling constants were reported in Hz. The high resolution mass spectra were recorded on VG Autospec Ultima spectrometer. The enantioselectivities were determined by HPLC. HPLC measurements were done on a DIONEX model equipped with P580G pump, UV 525 detector (Linear Instruments) measured at 254 nm, and chiral column DAICEL AD-H. Eluting solvent was a mixture of 2-propanol and hexane. Optical rotations were measured on a polarimeter (JASCO) in a 10-cm cell. All reactions were carried out in oven-dried glassware under a N_2 atmosphere. All solvents were distilled from the indicated drying reagents right before use: Et_2O and THF (Na, benzophenone), and CH_2Cl_2 (P_2O_5). The normal work-up included extraction, drying over Na_2SO_4 and evaporation of volatile materials in vacuo. Purification by column chromatography were performed using Merck silica gel 60 (230~400 mesh).

?. Preparation of the Triol 1

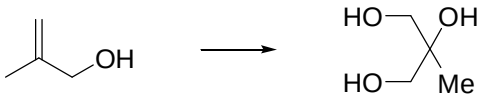


42 **43** **1**

n-BuLi (2.5 M in hexane, 3.0 mL, 7.5 mmol) was added to phenylacetylene (0.84 mL, 7.69 mmol) dissolved in THF (5 mL) at -78? dropwise. After stirring the resulting solution at -78? for 20 minutes, the ketone **42** (500 mg, 3.84 mmol, ref : D. C. Forbes, D. G. Ene, M. P. Doyle, *Synthesis*, **1998**, *6*, 879) in THF (5 mL) was injected and the mixture was stirred at -78? for 2 hours. The reaction mixture was quenched with saturated aqueous NH_4Cl (7 mL), worked up with Et_2O (5 mL × 3) and purified by column chromatography (Et_2O/hexane = 1/5) to afford the alcohol **43** (786 mg, 88% yield). 10% Pd/C (78 mg) was added to **43** (786 mg, 3.38 mmol) dissolved in acetic acid (5 mL) and a hydrogen balloon (an atmospheric pressure) was installed using a three-way stopcock. After replacing the air in the flask by hydrogen gas three times, the mixture was stirred at room temperature for 6 hours, and then filtered through celite (500 mg) with MeOH (10 mL). Evaporation of the volatile materials *in vacuo* followed by chromatographic purification (MeOH/CH_2Cl_2 = 1/20) furnished the triol **1** (637 mg, 96% yield).

For **1** : ^{1}H NMR (300 MHz, CD_3OD) d 7.21 (4H, m), 7.10 (1H, m), 3.51 (4H, s), 2.67 (2H, m), 1.74 (2H, m); ^{13}C NMR (75 MHz, CD_3OD) d 141.9, 128.4, 128.2, 125.9, 73.9, 66.9, 36.3, 29.2. HRMS (EI) calcd for $C_{11}H_{16}O_3$: 196.1099, found : 196.1067.

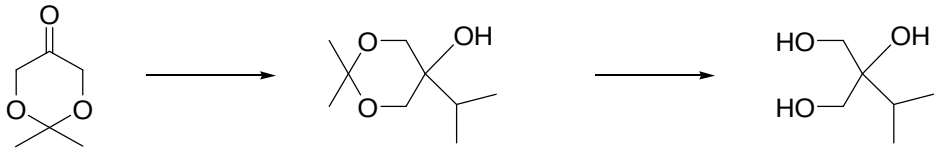
? . Preparation of the Triol 14



44 **14**

Metallyl alcohol **44** (500 mg, 6.9 mmol) dissolved in a 4:1 mixture of acetone and water (15 mL) was reacted with OsO_4 (2 mg) in the presence of 4-methylmorpholine N-oxide (1.6 g, 13.8 mmol) at room temperature for 1 day. The reaction mixture was quenched with saturated aqueous Na_2SO_3 (1 mL) at room temperature for 30 minutes and then filtered through celite (2 g) with EtOAc. After evaporation of the volatile materials *in vacuo*, the residue was purified by column chromatography ($MeOH/CH_2Cl_2$ = 1/10) to afford **14** (603 mg, 82% yield, ref: A. Bongini, G. Cardillo, M. Orena, G. Porzi, & S. Sandri, *J. Org. Chem.* **1982**, *47*, 4626).

? . Preparation of the Triol 16

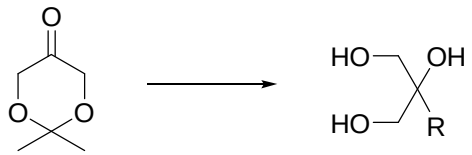


42 **45** **16**

To isoprpylmagnesium chloride (2.0 M in Et_2O, 3.4 mL, 6.8 mmol) in THF (10 mL) was added the ketone **42** (300 mg, 2.31 mmol) in THF (5 mL) through a cannula at 0? . The reaction proceeded at 0? for 1 hour, and then quenched with saturated aqueous NH_4Cl (10 mL). Work-up with Et_2O (5 mL × 3) and chromatographic separation (EtOAc/hexane = 1/5) yielded the isopropyl adduct (269 mg, 67% yield). To the acetonide **45** (269 mg, 1.54 mmol) dissolved in a 2:1 mixture of MeOH and H_2O (9 mL) was added 2 drops of conc. HCl at room temperature and the mixture was stirred at room temperature for 6 hours. Evaporation of the volatile materials *in vacuo* followed by chromatographic purification of the residue (MeOH/CH_2Cl_2 = 1/20) gave rise to the triol **16** (200 mg, 97% yield).

For **16** : ^{1}H NMR (300 MHz, CD_3OD) d 3.51 (4H, s), 1.92 – 1.83 (1H, m), 0.93 (6H, d, *J* = 7.0 Hz); ^{13}C NMR (75 MHz, CD_3OD) d 75.2, 63.3, 30.5, 15.9, 15.7. HRMS (EI) calcd for $C_6H_{14}O_3$: 134.0943, found: 134.0947.

? . Preparation of the Triols 17-21



42

17 : R = $(CH_2)_2CHMe_2$ **20** : R = Ph
18 : R = $CH_2CH{=}CH_2$ **21** : R = CH_2Ph
19 : R = $CH{=}CH_2$

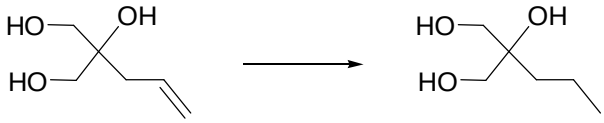
Compound **17**-**21** were obtained according to the procedure described in the preparation of the triol **16** except the reaction temperature of -30? for **19**. The Grignard reagents added to **42** and the overall yields from **42** in the preparation of the triols are as follows: **17** (1.0 M $Me_2CHCH_2CH_2MgBr$ in THF, 56%), **18** (1.0 M $CH_2{=}CHCH_2MgBr$ in Et_2O, 73%, ref: J. Lee, J.-H. Kang, S.-Y. Lee, K.-C. Han, C. M. Torres, D. K. Bhattacharyya, P. M. Blumberg & V. E. Marquez *J. Med. Chem.* **1999**, *42*, 4129), **19** (1.0 M $CH_2{=}CHMgBr$ in THF, 62%), **20** (1.0 M PhMgBr in THF, 70%, ref: M. Goodall, P. M. Kelly, D. Parker, K. Gloe & H. Stephan *J. Chem. Soc. Perkin Trans. 2*, **1997**, 59) and **21** (1.0 M $PhCH_2MgCl$ in Et_2O, 67%).

For **17** : ^{1}H NMR (300 MHz, CD_3OD) d 3.43 (4H, s), 1.48 (3H, m), 1.25 (2H, m), 0.88 (6H, d, *J* = 6.6 Hz); ^{13}C NMR (75 MHz, CD_3OD) d 74.4, 66.2, 32.3, 31.7, 28.5, 22.5. HRMS (EI) calcd $C_8H_{18}O_3$: 162.1256, found: 162.1282.

For **19** : ^{1}H NMR (300 MHz, CD_3OD) d 5.95 (1H, m), 5.38 (1H, d, *J* = 17.4 Hz), 5.19 (1H, d, *J* = 10.9 Hz), 3.43 (4H, s); ^{13}C NMR (75 MHz, CD_3OD) d 139.1, 114.2, 75.4, 65.2. HRMS (EI) calcd for $C_5H_{10}O_3$: 118.0630, found: 118.0641.

For **21** : ^{1}H NMR (300 MHz, CD_3OD) d 7.28-7.14 (5H, m), 3.40 (4H, s), 2.79 (2H, s); ^{13}C NMR (75 MHz, CD_3OD) d 137.0, 130.3, 127.4, 125.8, 74.4, 64.2, 39.4. HRMS (EI) calcd for $C_{10}H_{14}O_3$: 182.0943, found: 182.0957.

? . Preparation of the Triol 15

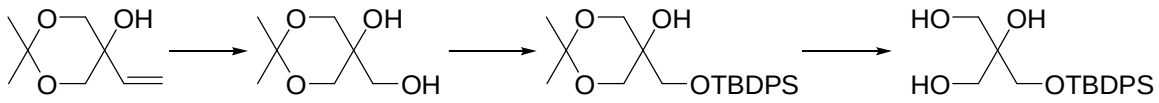


18 **15**

To **18** (300 mg, 2.27 mmol) dissolved in MeOH (5 mL) was added 10% Pd/C (30 mg) and a hydrogen balloon (an atmospheric pressure) was installed using a three-way stopcock. After replacing the air in the flask by hydrogen gas three times, the mixture was stirred at room temperature for 6 hours, and then filtered through celite (500 mg) with MeOH (10 mL). Evaporation of the volatile materials *in vacuo* followed by chromatographic separation (MeOH/CH_2Cl_2 = 1/20) gave the triol **15** (291 mg, 95% yield).

For **15** : ^{1}H NMR (300 MHz, CD_3OD) d 3.50 (4H, s), 1.55 (2H, m), 1.43 (2H, m), 0.92 (3H, t, *J* = 6.9 Hz); ^{13}C NMR (75 MHz, CD_3OD) d 73.8, 66.6, 36.8, 14.6, 13.4. HRMS (EI) calcd for $C_6H_{14}O_3$: 134.0943, found: 134.0962.

?. Preparation of the Triol 22



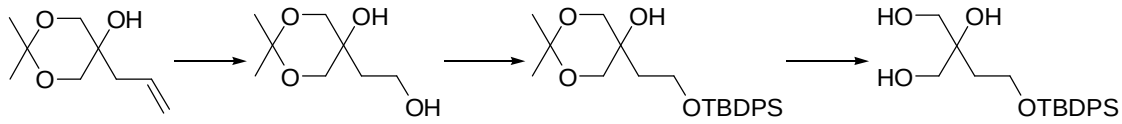
46 **47** **48** **22**

Ozone was bubbled into the alcohol **46** (529 mg, 3.34 mmol) in MeOH (7 mL) at -78?, which was obtained during the preparation of the triol **19**. After **46** was consumed completely, $NaBH_4$ (151 mg, 4.0 mmol) was added to the solution and it was stirred at 0? for 30 minutes. The resulting mixture was quenched with saturated aqueous NH_4Cl (5 mL), worked up with EtOAc (5 mL × 3) and chromatographically purified (EtOAc/hexane = 5/1) to produce the diol **47** (433 mg, 80% yield). To **47** (433 mg, 2.67 mmol) were added DMF (5 mL), imidazole (218 mg, 3.2 mmol) and TBDPSCl (0.75 mL, 2.9 mmol) in sequence, and the solution was stirred at room temperature for 10 hours. The mixture was diluted with Et_2O (15 mL), quenched with saturated aqueous NH_4Cl (10 mL), worked up with Et_2O (5 mL × 3) and separated by column chromatography (EtOAc/hexane = 1/4) to render the silyl ether **48** (802 mg, 75% yield). To **48** (802 mg, 2.0 mmol) dissolved in a 2:1 mixture of MeOH and H_2O (6 mL) was added a drop of 1 M HCl. After stirring the mixture at room temperature for 10 hours, it was quenched with 2 drops of 1 M NaOH, evaporated *in vacuo* and purified

chromatographically (MeOH/CH_2Cl_2 = 1/20) to provide the triol **22** (439 mg, 61% yield).

For **22** : ^{1}H NMR (300 MHz, $CDCl_3$) d 7.65-7.64 (4H, m), 7.42-7.35 (6H, m), 3.62 (6H, s), 3.24 (1H, br), 2.75 (1H, br), 1.06 (9H, s); ^{13}C NMR (75 MHz, $CDCl_3$) d 135.5, 132.6, 130.0, 127.8, 74.3, 65.7, 64.5, 26.8, 19.2. HRMS (EI) calcd for $C_{20}H_{28}O_4Si$: 360.1757, found: 360.1776.

? . Preparation of the Triol 23

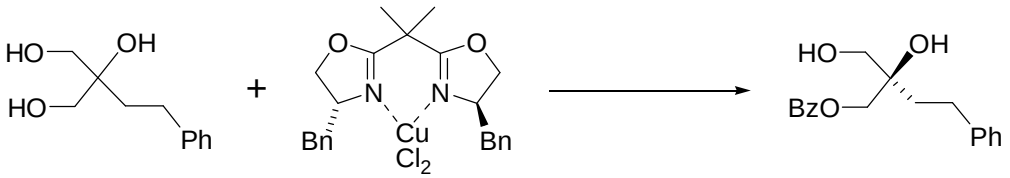


49 **50** **51** **23**

The triol **23** was obtained according to the procedure described in the preparation of the triol **22**. The chemical yield of each step is as follows. **49** to **50** : 84%, **50** to **51** : 82%, **51** to **23** : 55%.

For **23** : ^{1}H NMR (300 MHz, $CDCl_3$) d 7.67-7.65 (4H, m), 7.44-7.36 (6H, m), 3.86 (2H, *t*, *J* = 5.2 Hz), 3.64-3.61 (6H, m), 1.74 (2H, t, *J* = 5.2 Hz), 1.05 (9H, s); ^{13}C NMR (75 MHz, $CDCl_3$) d 135.4, 132.5, 130.0, 127.8, 74.4, 66.2, 60.5, 36.0, 26.7, 18.9. HRMS (EI) calcd for $C_{21}H_{30}O_4Si$: 374.1913, found: 374.1932.

? . General Procedure for the Enantioselective Desymmetrization

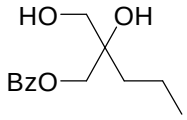


2 **10**−$CuCl_2$ **13**

To **10–**$CuCl_2$ (124 mg, 0.25 mmol) in THF (36 mL) were added Et_3N (0.76 mL, 6 mmol) in THF (24 mL), and a mixture of **2** (981 mg, 5 mmol) and BzCl (0.69 mL, 5.5 mmol) in THF (24 mL) dropwise at room temperature, respectively, through two separate cannulas. Their addition rates were 15 drops/minute. After the resulting mixture was stirred at room temperature for 1 hour, it was quenched with saturated aqueous NH_4Cl (20 mL), worked up with EtOAc (15 mL × 3) and purified by column chromatography (EtOAc/hexane = 1/2) to supply the monobenzoate **13** (1.45 g, 97% yield).

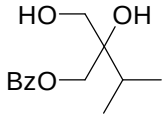
For **13** : ^{1}H NMR (300 MHz, $CDCl_3$) d 7.99 (2H, d, *J* = 7.4 Hz), 7.56 (1H, t, *J* = 7.4 Hz), 7.42 (1H, t, *J* = 7.8 Hz), 7.34-7.19 (5H, m), 4.45 (1H, d, *J* = 11.4 Hz), 4.26 (1H, d, *J* = 11.5 Hz), 3.59 (2H, q, *J* = 11.6 Hz), 2.77 (2H, m), 2.65 (2H, br), 1.87 (2H, m); ^{13}C NMR (75 MHz, $CDCl_3$) d 167.0, 141.8, 133.4, 129.7, 129.4, 128.5, 128.4, 128.2, 126.0, 73.6, 66.4, 65.4, 36.3, 29.1. HRMS (EI) calcd for $C_{18}H_{20}O_4$: 300.1362, found: 300.1375.

For **49**: (ref) P. Wipf & W. Xu *J. Org. Chem.* **1993**, *58*, 5880.



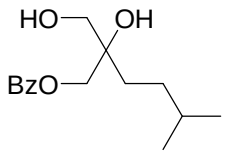
25

^{1}H NMR (300 MHz, $CDCl_3$) d 8.01 (2H, d, *J* = 7.4 Hz), 7.56 (1H, m), 7.42 (2H, t, *J* = 7.8 Hz), 4.40 (1H, d, *J* = 8.0 Hz), 4.12 (1H, d, *J* = 8.1 Hz), 3.58 (2H, q, *J* = 11.5 Hz), 2.83 (2H, br), 1.56 (2H, m), 1.43 (2H, m), 0.92 (3H, t, *J* = 7.1 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) d 167.1, 133.4, 129.6, 129.4, 128.5, 73.8, 66.7, 65.5, 36.8, 16.1, 14.7. HRMS (EI) calcd for $C_{13}H_{18}O_4$: 238.1205, found: 238.1237.



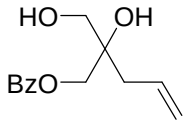
26

^{1}H NMR (300 MHz, $CDCl_3$) d 8.01 (2H, d, *J* = 7.7 Hz), 7.57 - 7.52 (1H, m), 7.48 - 7.42 (2H, m), 4.45 (1H, d, *J* = 11.6 Hz), 4.31 (1H, d, *J* = 11.6 Hz), 3.44 (2H, s), 2.80 (2H, br), 2.01 – 1.91 (1H, m), 1.01 (6H, d, *J* = 7.0 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) d 167.2, 133.4, 129.7, 129.6, 128.5, 75.2, 65.6, 64.0, 32.0, 16.9, 16.7. HRMS (EI) calcd for $C_{13}H_{18}O_4$: 238.1205, found: 238.1214.



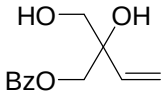
27

^{1}H NMR (300 MHz, $CDCl_3$) d 7.98 (2H, d, *J* = 7.3 Hz), 7.55 (1H, m), 7.45 (2H, m), 4.41 (2H, d, *J* = 11.3 Hz), 4.23 (2H, d, *J* = 11.3 Hz), 3.42 (2H, q, *J* = 11.6 Hz), 2.7 (2H, br), 1.91 (1H, m), 1.51 (2H, m), 1.42 (2H, m), 0.98 (6H, d, *J* = 6.6 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) d 167.3, 133.6, 129.8, 129.7, 128.7, 74.4, 66.8, 65.7, 42.9, 34.3, 24.9, 23.4. HRMS (EI) calcd for $C_{15}H_{22}O_4$: 266.1518, found: 266.1502.



28

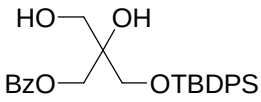
^{1}H NMR (300 MHz, $CDCl_3$) d 8.00 (2H, d, *J* = 7.3 Hz), 7.53 (1H, t, *J* = 7.4 Hz), 7.37 (2H, t, *J* = 7.4 Hz), 5.94-5.84 (1H, m), 5.15 (1H, s), 5.11 (1H, d, *J* = 4.0 Hz), 4.34 (1H, d, *J* = 11.4 Hz), 4.27 (1H, d, *J* = 11.4 Hz), 3.57 (1H, d, *J* = 11.6Hz), 3.50 (1H, d, *J* = 11.6 Hz), 3.13 (2H, br), 2.36 (2H, d, *J* = 7.5 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) d 166.9, 133.3, 132.1, 129.7, 129.5, 128.4, 119.4, 73.4, 66.5, 65.4, 39.0. HRMS (EI) calcd for $C_{13}H_{16}O_4$: 236.1049, found: 236.1052.



29

^{1}H NMR (300 MHz, $CDCl_3$) d 7.99 (2H, d, *J* = 7.1 Hz), 7.56 – 7.51 (1H, m), 7.40 (2H, t, *J* = 7.8 Hz), 5.96-5.87 (1H, m), 5.51 (1H, d, *J* = 10.9 Hz), 5.27 (1H, d, *J* = 6.0 Hz), 4.44 (1H, d, *J* = 11.4 Hz), 4.31 (1H, d, *J* = 11.4 Hz), 3.61 (1H, d, *J* = 11.6 Hz), 3.55 (1H, d, *J* = 11.6 Hz), 2.79 (2H, br); ^{13}C NMR (75 MHz, $CDCl_3$) d 166.9, 137.2, 133.3, 129.6, 129.5, 128.4, 116.8, 75.0, 67.3, 65.9. HRMS (EI) calcd for $C_{12}H_{14}O_4$: 222.0892, found: 222.0901.

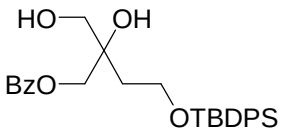
For **30**: (ref) Z. M. Wang & K. B. Sharpless *Synlett*, **1993**, *8*, 603.



32

^{1}H NMR (300 MHz, $CDCl_3$) d 7.94 (2H, d, *J* = 7.1 Hz), 7.62 (4H, m), 7.52 (1H, m), 7.37 (8H, m), 4.43 (2H, s), 3.70 (2H, d, *J* = 8.3 Hz), 3.67 (2H, s), 2.90 (2H, br), 1.06 (9H, s); ^{13}C NMR (75 MHz, $CDCl_3$) d 166.6, 135.5, 133.2, 132.5, 129.9, 129.7, 128.4,

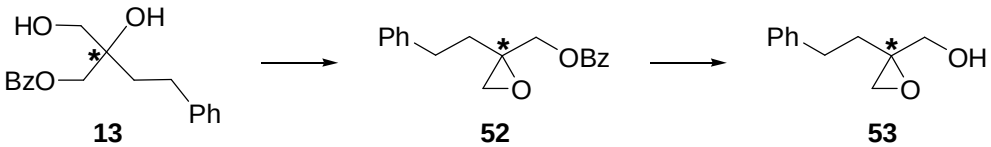
127.8, 113.8, 74.2, 65.0, 64.5, 63.9, 26.8, 19.2. HRMS (EI) calcd for $C_{27}H_{32}O_5Si$: 464.2019, found: 464.2035.



33

^{1}H NMR (300 MHz, $CDCl_3$) d 8.01 (2H, d, *J* = 7.3 Hz), 7.69-7.66 (4H, m), 7.55 (1H, t, *J* = 7.5 Hz), 7.44-7.37 (8H, m), 4.41 (2H, s), 4.00-3.92 (2H, m), 3.66 (2H, s), 1.86-1.85 (1H, m), 1.84-1.82 (1H, m), 1.07 (9H, s); ^{13}C NMR (75 MHz, $CDCl_3$) d 166.6, 135.5, 133.2, 132.4, 130.0, 129.6, 128.4, 127.9, 73.9, 66.9, 66.0, 60.7, 35.2, 26.7, 18.9. HRMS (EI) calcd for $C_{28}H_{34}O_5Si$: 478.2176, found: 478.2152.

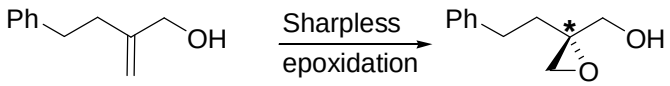
? . The Absolute Configuration of 13



13 **52** **53**

The benzoate **13** (38 mg, 0.12 mmol) in CH_2Cl_2 (2 mL) was reacted with *p*-toluenesulfonyl chloride (27 mg, 0.13 mmol) and Et_3N (21 μL, 0.15 mmol) at room temperature for 6 hours. DBU (38 μL, 0.24 mmol) was added to the reaction mixture

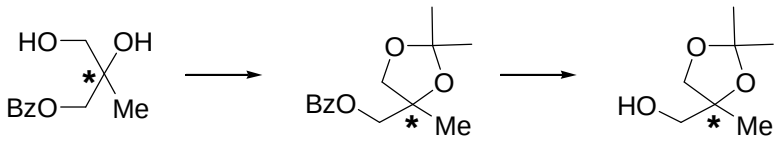
and the mixture was stirred at room temperature for 5 hours. After quenching the reaction with saturated aqueous NH_4Cl (2 mL), work-up with Et_2O (3 mL × 3) and chromatographic separation (EtOAc/hexane = 1/10) gave the epoxide **52** (32 mg, 89% yield). **52** (32 mg, 0.11 mmol) in MeOH (2 mL) was hydrolyzed with K_2CO_3 (2 mg, 0.01 mmol) at room temperature for 5 hours. The reaction was quenched with saturated aqueous NH_4Cl (2 mL) and worked up with EtOAc (2 mL × 3). The crude product was purified by column chromatography (EtOAc/hexane = 1/3) to afford the epoxy alcohol **53** (18 mg, 89% yield).



54 (*R*) − **53**

The authentic epoxy alcohol (*R*)-**53** was prepared by the reported Sharpless epoxidation using diethyl L-tartrate (ref: B. H. Lipshutz, S. Sharma, S. H. Dimock, J. R. Behling, *Synthesis* **1992**, 191). **53** and (*R*)-**53** were analyzed by HPLC using chiral column DAICEL AS-H and 3% isopropanol in hexane as eluting solvent. Comparison of their chromatograms shows that **53** has *S* configuration and therefore **13** has *R* configuration.

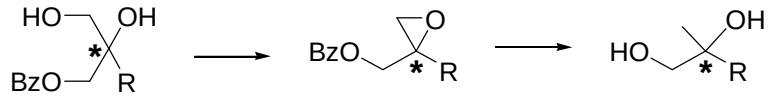
?. The Absolute Configuration of 24



24 **55** **56**

The benzoate **24** (55 mg, 0.26 mmol) was reacted with 2,2-dimethoxypropane (64 μL, 0.52 mmol) in the presence of *p*-toluenesulfonic acid monohydrate (2 mg) in CH_2Cl_2 (2 mL) at room temperature for 2 hours. After quenching the mixture with K_2CO_3 (5 mg) at room temperature for 10 minutes, it was filtered through celite (500 mg) with Et_2O (5 mL) and the filtrate was evaporated *in vacuo*. The crude **55** was hydrolyzed with K_2CO_3 (4 mg, 0.029 mmol) in MeOH (2 mL) at room temperature for 5 hours. Work-up with EtOAc (2 mL × 3) and the subsequent chromatographic separation (EtOAc/hexane = 1/2) afforded the alcohol **56** (26 mg, 68% yield), the high volatility of which seemed to cause the lower chemical yield. While the $[a]^{23}_{,D}$ value of our synthetic **56** is –5.11° (*c* 1.0, CH_2Cl_2), the reported $[a]^{23}_{,D}$ value of (*S*)-**56** is –5.33° (*c* 0.3, CH_2Cl_2, ref: J. S. Dung, R. W. Armstrong, O. P. Anderson, R. M. Williams, *J. Org. Chem.* **1983**, *48*, 3592). It is concluded that the absolute configuration of the major stereoisomer in **24** is *R*.

¥¥°. The Absolute Configuration of 26, 29-31 and 33



26, 29–**31, 33** **57**–**61** **62**–**66**

26, 57, 62 : R = $CHMe_2$
29, 58, 63 : R = $CH{=}CH_2$
30, 59, 64 : R = Ph
31, 60, 65 : R = CH_2Ph
33, 61, 66 : R = $(CH_2)_2OTBDPS$

The benzoate (**26**, **29**–**31** and **33**, 0.2 mmol) dissolved in CH_2Cl_2 (2 mL) was reacted with *p*-toluenesulfonyl chloride (48 mg, 0.25 mmol) and Et_3N (60 μL, 0.43 mmol) in the presence of 4-dimethylaminopyridine (3 mg, 0.025 mmol) at room temperature for 3 hours. To the reaction mixture was added DBU (83 μL, 0.55 mmol) at room temperature. After 4 hours at room temperature, quenching with saturated aqueous NH_4Cl (5 mL), work-up with Et_2O (3 mL × 3) and chromatographic purification yielded the epoxide (**57**–**61)**. The epoxide (**57**–**61**, 0.18 mmol) was reduced with $LiAlH_4$ (95%, 35 mg, 0.88 mmol) in THF (2 mL) at room temperature for 1 hour. The reaction was quenched with H_2O (35 μL), 15% aqueous NaOH (35 μL) and H_2O (105 μL) in sequence at 0? , and then EtOAc (3 mL) and celite (50 mg) were added. The resulting mixture was stirred at room temperature for 1 hour, filtered through celite (500 mg) and $MgSO_4$ (200 mg) with EtOAc (10 mL), evaporated *in vacuo*, and the residue was purified by column chromatography (EtOAc/hexane = 2/1) to give the diol (**62**–**66**). Chemical yields in each step are as follows: **57** (92% from **26**), **58** (92% from **29**), **59**

(93% from **30**), **60** (91% from **31**), **61** (92% from **33**), **62** (84% from **57)**, **63** (79% from **58**), **64** (86% from **59**), **65** (83% from **60**) and **66** (44% from **61**).

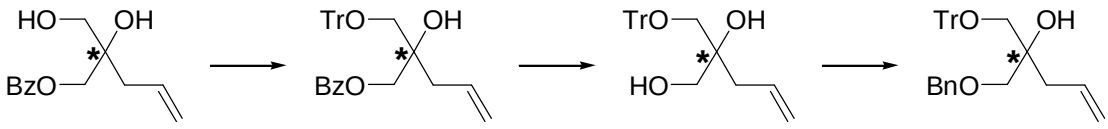
The absolute configuration of **26**, **29**–**31** and **33** are explained in Table 4 by comparison of the measured optical rotation of **62**–**66** with the known.

Table 4. The $[a]_D$ values of **62-66** and the absolute configurations of **26, 29-31** and **33**

entry	measured value	known value	absolute configuration
1	**62** : $[a]_D^{24}$? 11.5° (*c* 0.93, $CHCl_3$)	(*S*)-**62** : $[a]_D^{22}$? 12.1° [a] (*c* 1.01, $CHCl_3$)	(*R*)-**26**
2	**63** : $[a]_D^{24}$? 4.29° (*c* 1.0, $CHCl_3$)	(*S*)-**63** : $[a]_D^{22}$? 4.83° [b] (*c* 1.37, $CHCl_3$)	(*R*)-**29**
3	**64** : $[a]_D^{24}$ +10.1° (*c* 1.37, $CHCl_3$)	(*R*)-**64** : $[a]_D^{20}$? 10.6° [c] (*c* 1.76, $CHCl_3$)	(*R*)-**30**
4	**65** : $[a]_D^{24}$? 16.4° (*c* 1.13, EtOH)	(*R*)-**65** : $[a]_D^{20}$ +17.3° [d] (*c* 1.2, EtOH)	(*R*)-**31**
5	**66** : $[a]_D^{24}$ +6.1° (*c* 1.45, $CHCl_3$)	(*S*)-**66** : $[a]_D^{20}$ +6.8° [e] (*c* 1.76, $CHCl_3$)	(*R*)-**33**

[a] K. Mori, M. Sakakibara, K. Okada, *Tetrahedron* **1984**, *40*, 1761. [b] O. Masaki, K. Tetsuo, L. E. Ernest, *J. Org. Chem.* **1986**, *51*, 2599. [c] A. Archelas, R. Furstoss, *J. Org. Chem.* **1999**, *64*, 6112. [d] V. F. Stephen, L. E. Ernest, *J. Org. Chem*. **1985**, *50*, 3402. [e] J. Scherkenbeck, M. Barith, U. Thiel, K. -H. Metten, F. Heinemann, P. Welzel, *Tetrahedron* **1988**, *44*, 6325.

¥¥±. The Absolute Configuration of 28



28 **67** **68** **69**

The benzoate **28** (40 mg, 0.17 mmol) in CH_2Cl_2 (2 mL) was reacted with trityl chloride (56 mg, 0.29 mmol) and Et_3N (35 µL, 0.25 mmol) in the presence of 4-dimethylamino-

pyridine (2 mg, 0.017mmol) at room temperature for a day. After quenching with saturated aqueous NH_4Cl (5 mL), work-up with Et_2O (3 mL × 3) and chromatographic separation (EtOAc/hexane = 1/50) gave rise to the trityl ether **67** (34 mg, 41% yield) along with the starting diol **28** (20 mg, 50%). **67** (34 mg, 0.07 mmol) was hydrolyzed with K_2CO_3 (2 mg, 0.014 mmol) in MeOH (1 mL) at room temperature for 5 hours. Quenching with saturated aqueous NH_4Cl (3 mL), work-up with EtOAc (3 mL × 3) and column chromatography (EtOAc/hexane = 1/3) yielded the diol **68** (22 mg, 85% yield). **68** (22 mg, 0.06 mmol) in a 4:1 mixture of THF and DMF (1 mL) was treated with NaH (60% dispersion in mineral oil, 4 mg, 0.1 mmol) at 0? for 10 minutes and then benzyl bromide (9 μL, 0.074 mmol) in the presence of $(n\text{-Bu})_4NI$ (2 mg) at room temperature for 12 hours. The reaction mixture was quenched with saturated aqueous NH_4Cl (3 mL), worked up with Et_2O (3 mL × 3) and the residue was purified chromatographically (EtOAc/hexane = 1/60) to render the alcohol **69** (16 mg, 81% yield). Comparison of the observed $[a]^{23}_{,D}$ value of **69** (+2.61°, *c* 1.35, $CHCl_3$) with the known $[a]^{23}_{,D}$ value (–2.86°, *c* 1.55, $CHCl_3$, ref: J. -H. Kang, M. A. Siddiqui, D. M. Sigano, K. Krajewski, N. E. Lewin, Y. Pu, P. M. Blumberg, J. Lee, V. E. Marquez, *Org. Lett.* **2004**, *6*, 2413) indicates that the absolute configuration of the major enantiomer in **28** is *R*.