Supporting Information for the paper "Parallel Kinetic Resolution of Racemic Aldehydes by Use of Asymmetric Horner-Wadsworth-Emmons Reactions"

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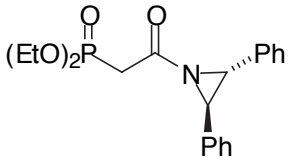
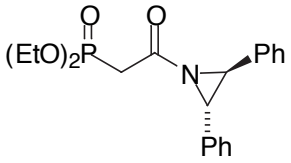
General. All solvents were distilled prior to use. Diethyl ether and tetrahydrofuran were distilled from sodium/benzophenone. Dichloromethane, benzene, toluene and triethylamine were destilled from CaH_2. All reactions were carried out in oven-dried or flame-dried glassware and under argon unless water was used as a reaction medium. Commercially available compounds were used as received unless otherwise indicated. Potassium and sodium hexamethyldisilazide (KHMDS, NaHMDS) were purchased as stock solutions (0.5 M in toluene and 0.6 M in hexane, respectively) and titrated according to the method of Ireland and Meissner.[1] 18-Crown-6 was recrystallized from anhydrous acetonitrile and dried under vacuum. TLC analyses were performed on Merck aluminum-backed F254 silica gel plates, using UV light and a solution of 5% phosphomolybdic acid in ethanol for visualization. Flash chromatography was performed as described by Still and coworkers[2] using Amicon Matrex 60Å silica gel (35-70 μ). Ozonolysis was performed with a Fischer OZ 500 Ozone Generator. Enantiomeric excesses were determined by a Varian 9012 HPLC using a Chiralcel ODH column. NMR spectra were recorded in $CDCl_3$ unless otherwise indicated, using $CHCl_3$ (δ 7.27 ppm) and $CDCl_3$ (δ 77.0 ppm) as internal references for ^1H and ^{13}C, respectively. Optical rotations were determined on a Perkin Elmer 241 Polarimeter. GC/MS was performed on a Hewlett Packard 5890A gas chromatograph coupled to a VG MASSLAB automated mass spectrometer. IR spectra were recorded on neat samples using AgCl plates. Microanalyses were performed by the Microanalysis Laboratory, Institute of Physical Chemistry, University of Vienna, Austria.



3a



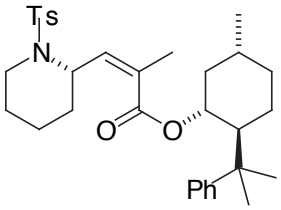
3b

Phosphonate 3b. To a solution of diethylphosphonoacetic acid (156.0 mg, 0.80 mmol) in 15 mL of dry benzene at 0 °C was added oxalylchloride (150 μL, 1.75 mmol). The solution was stirred overnight and slowly allowed to warm up to room temperature. The solution was concentrated and the residue dissolved in 9 mL dry CH_2Cl_2. In a separate flask, (*S*,*S*)-2,3-diphenylaziridine[3] (152.6 mg, 0.78 mmol) was dissolved in 15 mL of CH_2Cl_2 and Et_3N (120 μL, 0.86 mmol) was added. The phosphonate solution was added slowly to the aziridine solution and the reaction mixture was stirred at –20 °C for 1.5 h followed by 1 h at 0 °C. Concentration and

purification by flash chromatography (Et_2O) afforded 227.6 mg (78%) of phosphonate **3b** as a colorless oil. **3b**: ^{1}H NMR (250 MHz) δ 7.40-7.21 (m, 10H), 4.21-4.09 (m, 4H), 3.89 (s, 2H), 2.78 (dd, *J* = 18.0, 14.0 Hz, 1H), 2.69 (dd, *J* = 18.0, 14.0 Hz, 1H), 1.39-1.22 (m, 6H); ^{13}C NMR (50.3 MHz) δ 172.2, 134.8, 128.6, 128.2, 126.1, 62.7 (d, J_{PC} = 6 Hz), 62.2 (d, J_{PC} = 6 Hz), 48.5, 37.4 (d, J_{PC} = 132 Hz), 16.2 (d, J_{PC} = 5 Hz), 16.1 (d, J_{PC} = 5 Hz); IR 3470, 2985, 1690, 1604, 1498, 1464, 1422, 1360, 1332, 1257, 1163, 1027, 970, 755, 699 cm^{-1}; m/z 373 ([M+], 30%), 195 (50%), 194 (100%), 130 (37%); $[\alpha]_D$ = –66.3 (c 1.16, CH_2Cl_2). Anal. Calcd for $C_{20}H_{24}NO_4P$: C, 64.34; H, 6.48; N, 3.75. Found: C, 64.41; H, 6.27; N, 3.61.

Phosphonate 3a. Prepared in 72% yield by an analogous procedure, using (*R*,*R*)-2,3-diphenylaziridine instead. **3a:** Spectral data identical with those obtained for **3b**. $[\alpha]_D$ = +66.3 (c 1.08, CH_2Cl_2). Anal. Calcd for $C_{20}H_{24}NO_4P$: C, 64.34; H, 6.48; N, 3.75. Found: C, 64.49; H, 6.71; N, 3.73.

General Procedure for the Asymmetric Horner-Wadsworth-Emmons Reactions. To a solution of the phosphonate(s) (0.50-0.55 equiv of each) and 18-crown-6 (when KHMDS was used as base; 2.5 equiv in the standard kinetic resolutions, 5.0 equiv in the PKR experiments) in THF (0.02 M with respect to the combined amount of phosphonate) at –78 °C under argon was added KHMDS or NaHMDS (0.5 M in toluene or 0.6 M in hexane, respectively; 0.50 equiv in the standard kinetic resolutions, 1.0 equiv in the PKR experiments). After 30 min, the resulting solution was added via cannula to a precooled (–78 °C) solution of the aldehyde (1.0-1.1 equiv) in THF. The reaction mixture was stirred for 2-6 h at –78 °C and then quenched with a 1 M solution of acetic acid in methanol followed by phosphate buffer (pH 7). After 5 min, the reaction mixture was warmed to room temperature. Extractive workup (EtOAc or Et_2O), drying ($MgSO_4$) and concentration gave the crude condensation products. Further purification was generally performed by chromatography, as detailed below.



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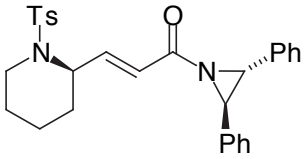
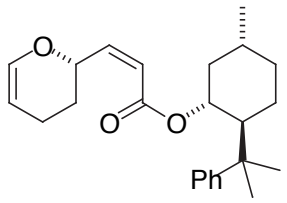


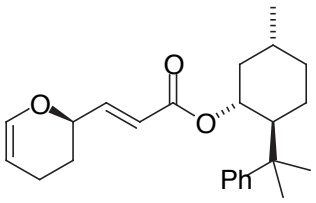
5a

Alkenes 4 and 5a. PKR of aldehyde **1**[4] by reaction with phosphonates **2**[5] and **3a** (Table 1, entry 3) gave alkenes **4** and **5a** in 38% and 36% yield, respectively, after separation by flash chromatography (50% Et_2O in pentane). **4:** Geometric ratio (*Z*):(*E*) > 99:1, diastereomeric ratio[6] (*S*,*Z*):(*R*,*Z*) > 99:1. ^{1}H NMR (250 MHz) δ 7.59 (d, *J* = 8.2 Hz, 2H), 7.32-7.08 (m, 7H), 5.66 (d quartet, *J* = 8.2, 1.5 Hz, 1H), 5.48-5.38 (m, 1H,), 4.98 (ddd [app td], J = 10.7, 4.5 Hz, 1H), 3.66 (ddd [app br dt], *J* = 12, 3.5 Hz, 1H), 2.99 (br ddd, *J* = 12, 11, 3.5 Hz, 1H), 2.40 (s, 3H), 2.11-0.82 (m, 24H); ^{13}C NMR (50.3 MHz, some signals in the aromatic/alkene region overlap) δ 165.7, 151.2, 142.8, 139.5, 136.2, 129.1, 127.8, 127.4, 125.4, 125.1, 77.1, 74.3, 52.2, 50.2, 41.9, 41.7, 39.9, 34.4, 31.3, 26.9, 26.8, 26.4, 25.1, 21.7, 21.4, 20.0, 19.7; IR 2925, 2868, 1704, 1599, 1496, 1455, 1340, 1238, 1210, 1165, 1093, 984, 922, 816, 764, 735, 702, 665 cm^{-1}; $[\alpha]_D$ = +51.9 (c 3.82, $CHCl_3$). Anal. Calcd for $C_{32}H_{43}NO_4S$: C, 71.47; H, 8.06; N, 2.60. Found: C, 71.68; H, 8.32; N, 2.47. **5a:** Geometric ratio (*E*):(*Z*) > 99:1, diastereomeric ratio[6] (*R*,*E*):(*S*,*E*) > 99:1. ^{1}H

NMR (250 MHz) δ 7.62 (d, *J* = 8.2 Hz, 2H), 7.40-7.20 (m, 12H), 6.60 (dd, *J* = 16.0, 5.5 Hz, 1H), 5.82 (dd, *J* = 16.0, 1.8 Hz, 1H), 4.60-4.50 (m, 1H), 3.80 (s, 2H), 3.63-3.52 (br d, *J* = 13 Hz, 1H), 2.66 (br ddd, *J* = 13, 11, 3.5 Hz, 1H), 2.40 (s, 3H), 1.62-0.88 (m, 6H); ^{13}C NMR (50.3 MHz) δ 173.7, 143.7, 143.2, 137.2, 135.5, 129.5, 128.6, 128.1, 127.1, 126.5, 126.3, 53.5, 48.2, 41.6, 29.4, 24.5, 21.4, 18.8; IR 2942, 1676, 1492, 1338, 1157, 1093, 933, 816, 702, 660 cm^{-1}; $[\alpha]_D$ = +97.4 (c 0.98, $CHCl_3$); mp 136-139 °C. Anal. Calcd for $C_{29}H_{30}N_2O_3S$: C, 71.58; H, 6.21; N, 5.76. Found: C, 71.79; H, 6.41; N, 5.57.

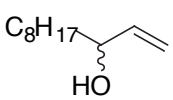


(S,Z)-**8**

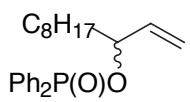


(R,E)-**8**

Alkenes (*S*,*Z*)-8 and (*R*,*E*)-8. PKR of aldehyde **6** by reaction with phosphonates **7a**[7] and **7d**[7] (Table 2, entry 6) afforded alkenes (*S*,*Z*)-**8** and (*R*,*E*)-**8** in 42% and 50% yield, respectively, after separation by flash chromatography (4% EtOAc in hexane). (*S*,*Z*)-**8:** Diastereomeric ratio[6] (*S*,*Z*):(*R*,*Z*) = 96:4. ^{1}H NMR (250 MHz, C_6D_6) δ 7.25-7.02 (m, 5H), 6.40 (dd, *J* = 6.3, 1.8 Hz, 1H), 6.16 (dd, *J* = 11.8, 7.3 Hz, 1H), 5.67 (tm, *J* = 8 Hz, 1H), 5.30 (dd, *J* = 11.8, 1.8 Hz, 1H, minor diastereomer), 5.28 (dd, *J* = 11.8, 1.8 Hz, 1H, major diastereomer), 4.98 (ddd [app td], *J* = 10.8, 4.5 Hz, 1H), 4.67-4.59 (m, 1H), 2.18-0.50 (m, 20H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.8, 151.5, 148.5, 142.9, 128.0, 125.4, 125.1, 120.1, 100.9, 74.3, 72.5, 50.6, 41.8, 39.7, 34.6, 31.3, 27.8, 27.1, 26.6, 25.1, 21.8, 19.3; IR 2955, 2924, 1711, 1651, 1413, 1240, 1198, 1074, 1056, 1039, 986, 764, 700 cm^{-1}; $[\alpha]_D$ = –35.2 (c 2.76, $CHCl_3$). Anal. Calcd for $C_{24}H_{32}O_3$: C, 78.22, H, 8.75. Found: C, 77.93, H, 8.54. (*R*,*E*)-**8:** Diastereomeric ratio[6] (*R*,*E*):(*S*:*E*) = 93:7. ^{1}H NMR (250 MHz, C_6D_6) δ 7.28-7.00 (m, 5H), 6.80 (dd, *J* = 15.8, 4.4 Hz, 1H, major diastereomer), 6.62 (dd, *J* = 15.8, 4.4 Hz, 1H, minor diastereomer), 6.33 (ddd [app dt], *J* = 6.3, 1.8 Hz, 1H), 5.89 (dd, *J* = 15.7, 1.8 Hz, 1H), 5.14 (ddd [app td], *J* = 10.8, 4.5 Hz, 1H), 4.54 (m, 1H), 4.15 (m, 1H), 2.07-0.55 (m, 20H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.6, 151.5, 145.7, 143.1, 128.0, 125.5, 125.1, 121.5, 100.7, 74.6, 73.3, 50.6, 41.7, 39.8, 34.6, 31.3, 27.3, 27.1, 26.7, 25.8, 21.8, 19.1; IR 2923, 1713, 1654, 1242, 1173, 1063, 701 cm^{-1}; $[\alpha]_D$ = –33.9 (c 2.82, $CHCl_3$). Anal. Calcd for $C_{24}H_{32}O_3$: C, 78.22, H, 8.75. Found: C, 77.99, H, 8.65.



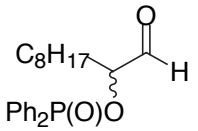
11



12

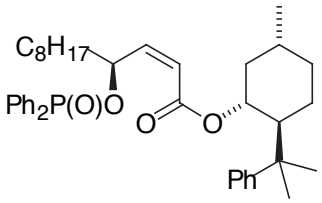
Diphenylphosphinyl ester 12. To a solution of imidazole (1.073 g, 15.76 mmol) in dry CH_2Cl_2/Et_2O (1:1, 26 mL) was added dropwise diphenylphosphinyl chloride (1.97 mL, 10.51 mmol), followed by dropwise addition of a solution of alcohol **11**[8] (1.491 g, 8.76 mmol) in 2 mL of dry CH_2Cl_2. The mixture was stirred at room temperature for 16 h, and then diluted with 80

mL of Et_2O and filtered through celite. The filtrate was washed with 5% H_2SO_4 (2x30 mL), 2.5% NaOH (2x30 mL), H_2O (2x30 mL) and brine (30 mL). Drying ($MgSO_4$), filtration, concentration and purification by flash chromatography (elution gradient 20-40% EtOAc in hexane) afforded 2.813 g (87%) of **12** as a colorless oil. **12:** ^{1}H NMR (250 MHz) δ 7.96-7.72 (m, 4H), 7.62-7.35 (m, 6H), 5.83 (ddd, J = 17.3, 10.4, 7.0 Hz), 5.12 (br dd, J = 17.3, 1.2 Hz, 1H), 5.08 (br dd, J = 10.4, 1.2 Hz, 1H), 4.81 (dddd [app br quintet], J = 7 Hz, 1H), 1.88-1.58 (m, 2H), 1.37-1.05 (m, 12H), 0.87 (t, J = 6 Hz, 3H); ^{13}C NMR (62.9 MHz; some splitting in the aromatic region is due to P-C coupling) δ 137.3, 137.2, 131.9, 131.9, 131.8, 131.5, 131.3, 128.4, 128.3, 128.2, 128.1, 116.9, 77.5 (d, J_{PC} = 6 Hz), 36.2 (d, J_{PC} = 4 Hz), 31.7, 29.3, 29.2, 29.1, 24.5, 22.6, 14.0; IR 2926, 2855, 1439, 1232, 1129, 982, 753, 729, 697, 559 cm^{-1}. Anal. Calcd for $C_{23}H_{31}O_2P$: C, 74.57, H, 8.43. Found: C, 74.31, H, 8.53.

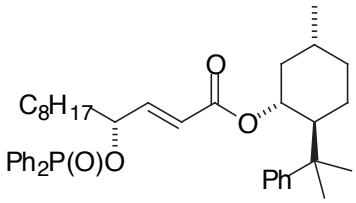


9

Aldehyde 9. Into a solution of alkene **12** (1.007 g, 2.718 mmol) in CH_2Cl_2/MeOH (9:1, 50 mL) at –78 °C was bubbled ozone until a blue color was persistent. The solution was purged with nitrogen until the blue color disappeared, and Me_2S (6 mL) was added. After stirring for 40 min at –78 °C and for 30 min at room temperature a negative peroxide test was obtained, and the solution was concentrated. Addition of water (10 mL), extraction with Et_2O (4x20 mL), drying ($MgSO_4$), filtration, concentration and purification by flash chromatography (50% EtOAc in hexane) gave 940.4 mg (93%) of **9** as a colorless oil. **9:** ^{1}H NMR (500 MHz) δ 9.70 (d, J = 1 Hz, 1H), 7.86-7.81 (m, 4H), 7.59-7.43 (m, 6H), 4.68 (dddd [app dtd], J = 9.3, 6.3, 1 Hz, 1H), 1.84-1.79 (m, 2H), 1.41-1.15 (m, 12H), 0.87 (t, J = 6 Hz); ^{13}C NMR (62.9 MHz; some splitting in the aromatic region is due to P-C coupling) δ 200.0, 132.5, 132.4, 131.8, 131.6, 131.5, 128.7, 128.6, 128.5, 128.4, 78.9 (d, J_{PC} = 6 Hz), 31.7, 30.9 (d, J_{PC} = 4 Hz), 29.13, 29.07, 29.0, 24.2, 22.5, 14.0; IR 3323, 2926, 2854, 1740, 1439, 1215, 1131, 1016, 753, 730, 696, 541 cm^{-1}. Due to the limited stability of this compound, a satisfactory elemental analysis could not be obtained.



(S,Z)-**10**

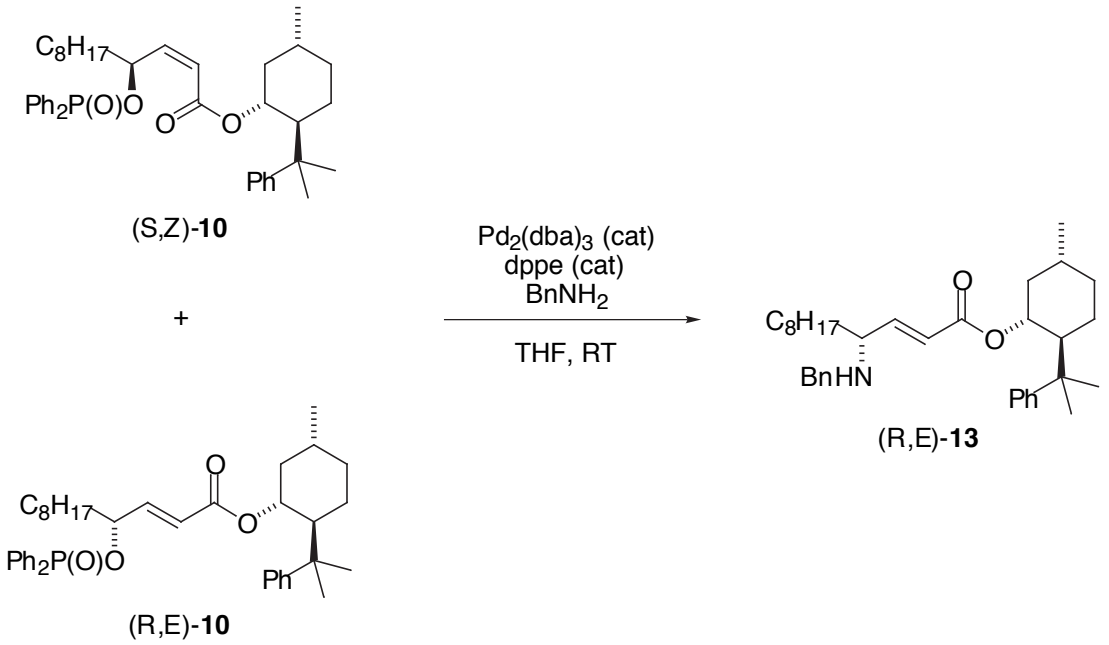


(R,E)-**10**

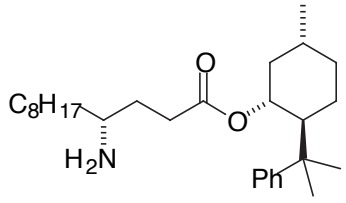
Alkenes (*S*,*Z*)-10 and (*R*,*E*)-10. PKR of aldehyde **9** by reaction with phosphonates **7a**[7] and **7c**[7] (Table 2, entry 11) afforded a mixture of alkenes (*Z*)-**10** and (*E*)-**10** in 63% combined yield [(*Z*):(*E*) = 52:48; (*S*,*Z*):(*R*,*Z*) = 90:10, (*R*,*E*):(*S*,*Z*) = 94:6] after flash chromatography (25% EtOAc in hexane). The (*E*)- and (*Z*)-isomers could be partially separated after two flash columns (elution gradient 20% - 25% EtOAc in hexane) to give geometrically pure samples of (*Z*)-**10** and

(*E*)-**10**, both as colorless oils. The diastereomers (*S*,*Z*)-**10** and (*R*,*Z*)-**10** were partially separable: in the geometrically pure sample obtained after chromatography, the ratio had been improved to 97:3. (*S*,*Z*)-**10:** ^{1}H NMR (500 MHz) δ 7.80-7.75 (m, 4H), 7.52-7.38 (m, 5H), 7.23-7.20 (m, 5H), 7.14-7.10 (m, 1H), 6.15 (dd, *J* = 11.7, 8.1 Hz, 1H), 5.84 (dddd [app br quintet], *J* = 6.9 Hz, 1H), 5.11 (dd, *J* = 11.7, 1.5 Hz, 1H, minor diastereomer), 4.98 (dd, *J* = 11.7, 1.4 Hz, 1H, major diastereomer), 4.68 (ddd [app td], *J* = 10.5, 4.5 Hz, 1H), 2.00-0.80 (m, 34H); ^{13}C NMR (50.3 MHz; some peaks in the aromatic region overlap) δ 164.2, 151.4, 147.9, 132.0, 131.8, 131.6, 128.5, 128.4, 128.3, 128.2, 127.9, 125.4, 125.0, 119.8, 74.1, 73.5 (d, J_{PC} = 6 Hz), 50.5, 41.6, 39.7, 36.0 (d, J_{PC} = 5 Hz), 34.5, 31.9, 31.3, 29.5, 29.4, 29.2, 27.5, 26.6, 25.4, 24.9, 22.7, 21.8, 14.1; IR 2924, 2855, 1712, 1439, 1412, 1232, 1198, 1130, 981, 819, 729, 697, 562 cm^{-1}; $[\alpha]_D$ = +20.6 (c 0.64, $CHCl_3$). Anal. Calcd for $C_{40}H_{53}O_4P$: C, 76.40, H, 8.50. Found: C, 76.51, H, 8.76. (*R*,*E*)-**10:** Diastereomeric ratio (*R*,*E*):(*S*,*E*) = 94:6. ^{1}H NMR (500 MHz) δ 7.83-7.73 (m, 4H), 7.56-7.39 (m, 5H), 7.25-7.18 (m, 5H), 7.05-6.98 (m, 1H), 6.57 (dd, *J* = 15.8, 6.1 Hz, 1H, major diastereomer), 6.28 (dd, *J* = 15.8, 5.5 Hz, 1H, minor diastereomer), 5.41 (dd, *J* = 15.6, 1.6 Hz, 1H, minor diastereomer), 5.40 (dd, *J* = 15.6, 1.4 Hz, 1H, major diastereomer), 4.96-4.89 (m, 1H), 4.82 (ddd [app td], *J* = 10.6, 4.5 Hz, 1H), 2.03-0.80 (m, 34H); ^{13}C NMR (50.3 MHz; some peaks in the aromatic region overlap) δ 165.1, 151.3, 145.1, 132.2, 131.9, 131.7, 131.5, 131.3, 128.6, 128.3, 127.9, 125.4, 125.1, 122.5, 74.7 (2C), 50.5, 41.7, 39.8, 35.7, 34.5, 31.8, 31.3, 29.3 (2C), 29.2, 27.0, 26.7, 26.0, 24.3, 22.6, 21.8, 14.1; IR 2925, 2856, 1713, 1654, 1439, 1233, 1130, 972, 729, 699, 560 cm^{-1}; $[\alpha]_D$ = +1.2 (c 0.77, $CHCl_3$, (*R*,*E*):(*S*,*E*) = 85:15). Anal Calcd for $C_{40}H_{53}O_4P$: C, 76.40, H, 8.50. Found: C, 76.19, H, 8.67.

In order to determine the absolute configurations at the allylic stereocenter of alkenes (*S*,*Z*)-**10** and (*R*,*E*)-**10**, both compounds were converted to lactam **13** as described below. In the first step, (*S*,*Z*)-**10** undergoes substitution with *inversion* of both the allylic stereocenter and the alkene geometry, while (*R*,*E*)-**10** reacts with *retention* of both the allylic stereocenter and the alkene geometry.[9]

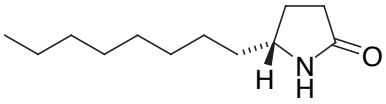


Unsaturated aminoester 13. To a solution of a mixture of (*Z*)-**10** and (*E*)-**10** [(*E*):(*Z*) = 51:49, (*S*,*Z*):(*R*,*Z*) = 90:10, (*R*,*E*):(*S*,*E*) = 86:14; 422.0 mg, 0.671 mmol], $Pd_2(dba)_3$•$CHCl_3$ (69.5 mg, 0.0671 mmol) and dppe (66.8 mg, 0.1678 mmol) in 10 mL of dry THF was added benzylamine (293 μL, 2.685 mmol). The reaction was stirred at room temperature for 42 h. Water (3 mL) was added and the mixture was extracted with Et_2O (3x4 mL). Drying ($MgSO_4$), filtration, concentration and purification by flash chromatography (10% EtOAc in hexane) gave 323.5 mg (93%) of **13** as a light greenish oil; (*E*):(*Z*) > 99:1, (*R*,*E*):(*S*,*E*) = 80:20. In a separate reaction, using starting material of higher diastereomeric purity, product with improved diastereomer ratio [(*R*,*E*)-**13**:(*S*,*E*)-**13** = 93:7] was obtained in similar yield. **13:** ^{1}H NMR (250 MHz) δ 7.41-7.19 (m, 9H), 7.11-7.02 (m, 1H), 6.49 (dd, *J* = 15.7, 8.2 Hz, 1H, major diastereomer), 6.46 (dd, *J* = 15.7, 8.2 Hz, 1H, minor diastereomer), 5.38 (dd, *J* = 15.7, 1.0 Hz, 1H, minor diastereomer), 5.35 (dd, *J* = 15.7, 1.0 Hz, 1H, major diastereomer), 4.87 (ddd [app td], *J* = 10.7, 4.2 Hz, 1H, 3.78 (d, *J* = 13.0 Hz, 1H, minor diastereomer), 3.74 (d, *J* = 13.0 Hz, 1H, major diastereomer), 3.60 (d, *J* = 13.0 Hz, 1H, minor diastereomer), 3.55 (d, *J* = 13.0 Hz, 1H, major diastereomer), 3.08 (dddd [app br quartet], *J* = 7 Hz, 1H), 2.12-1.90 (m, 2H), 1.73-0.79 (m, 33H); ^{13}C NMR (62.9 MHz, recorded on a 76:24 mixture of (*R*,*E*)-**13** and (*S*,*E*)-**13**; signals from both diastereomers appear in the aromatic and aliphatic regions) δ 165.5, 151.5, 149.7, 128.8, 128.4, 128.2, 127.8, 127.5, 127.0, 125.3, 124.9, 122.6, 74.4, 58.9, 51.1, 50.4, 41.6, 39.7, 34.9, 34.5, 31.8, 31.2, 29.50, 29.46, 29.4, 29.2, 27.3, 26.6, 25.7, 25.59, 25.56, 22.6, 21.7, 14.0; IR 2954, 2923, 2855, 1713, 1496, 1456, 1267, 1176, 984, 765, 699 cm^{-1}; $[\alpha]_D$ = +13.8 (c 2.47, CH_2Cl_2, (*R*,*E*):(*S*,*E*) = 93:7). Anal. Calcd for $C_{35}H_{51}NO_2$: C, 81.19, H, 9.93, N, 2.71. Found: C, 81.04, H, 9.68, N, 2.44.

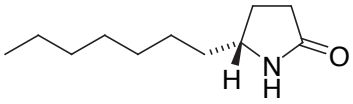


14

Saturated aminoester 14. To a mixture of **13** (323.5 mg, 0.625 mmol, (*R*,*E*):(*S*,*E*) = 80:20) and 10% Pd/C (301.0 mg, 0.283 mmol) in EtOAc (11 mL) was added 2.2 mL of glacial acetic acid. A balloon with hydrogen was attached to the flask and the mixture was stirred at room temperature for 72 h. The catalyst was filtered off through a glass frit, and the solution was concentrated to give **14** (268 mg, quantitative yield) as a colorless oil. No signal separation was observed for the product diastereomers in the NMR, but the isomer ratio is assumed to be virtually unchanged during the reaction. **14:** R_f = 0.15 (12% MeOH in EtOAc); ^{1}H NMR (500 MHz) δ 7.30-7.10 (m, 5H), 4.80 (ddd [app td], *J* = 9.8, 4.3 Hz, 1H), 3.10-3-03 (m, 1H), 2.89 (dd [app t], *J* = 8 Hz, 1H), 2.71 (dd [app t], *J* = 8 Hz, 1H), 2.20-0.83 (m, 38H); IR 3374, 2925, 1724, 1458, 1370, 1196, 765, 701 cm^{-1}; $[\alpha]_D$ = +4.3 (c 0.70, CH_2Cl_2).



15



(R)-**16**

Lactam 15. A solution of amine **14** [(*R*):(*S*) = 80:20;[10] 297.2 mg, 0.692 mg] and Et_3N (175 μL, 1.259 mmol) in toluene (11 mL) was warmed to reflux for 5 h. Concentrated on the reaction mixture and purification by flash chromatography (EtOAc) gave lactam **15** (65 mg, 48%) as white crystals, and also 8-phenylmenthol (91%). **15:** ^{1}H NMR (500 MHz) δ 6.56 (br s, 1H), 3.61 (app br quintet, *J* = 6.8 Hz, 1H), 2.37-2.19 (m, 4H), 1.72-1.64 (m, 1H), 1.56-1.40 (m, 1H), 1.32-1.21 (m, 11H), 0.87 (t, *J* = 6.7 Hz, 1H); ^{13}C NMR (125.7 MHz) δ 178.0, 54.5, 36.7, 31.8, 30.1, 29.5, 29.4, 29.2, 27.4, 25.9, 22.6, 14.1; IR 3203, 2926, 2855, 1698, 1459, 1266 cm^{-1}; $[\alpha]_D$ = +4.7 (c 2.0, CH_2Cl_2). Anal. Calcd for $C_{12}H_{23}NO$: C, 73.04, H, 11.75, N, 7.10. Found: C, 72.86, H, 11.46, N, 6.90.

Lactam (*R*)-**16** has been reported to have $[\alpha]_D$ = +9.0 (c 2.0, CH_2Cl_2) (>99% *ee*).[11] Thus, the rotation measured by us for lactam **15** indicates by analogy that it has (*R*)-configuration. Furthermore, the absolute configurations assigned for (*S*,*Z*)-**10** and (*R*,*E*)-**10** are consistent with the absolute configurations determined for products obtained from asymmetric HWE reactions of aldehydes structurally similar to **9**.

References and footnotes

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