Supporting Information

Highly Enantioselective Synthesis of (*E*)-Allylic Alcohols

Hsyueh-Liang Wu, Ping-Yu Wu and Biing-Jiun Uang*

* Prof. Uang, B.-J.; Wu, S.-L.; Wu, P.-Y.
Department of Chemistry
National Tsing Hua University, Hsinchu,
300, Taiwan
Fax: 886-3-5711082
Tel: 886-3-5721224
E-mail: bjuang@mx.nthu.edu.tw

Table of Contents

General	S2
Compound Characterization Data	S2
¹H-NMR Spectra of Addition Product	
(<i>R,E</i>)-1-Phenylnon-2-en-1-ol (2a)	S13
(<i>R,E</i>)-1-(2-Chlorophenyl)non-2-en-1-ol (2b)	S14
(<i>R,E</i>)-1-(3-Chlorophenyl)non-2-en-1-ol (2c)	S15
(<i>R,E</i>)-1-(4-Chlorophenyl)non-2-en-1-ol (2d)	S16
(<i>R,E</i>)-1-(3-Fluorophenyl)non-2-en-1-ol (2e)	S17
(<i>R,E</i>)-1- <i>o</i> -Tolylnon-2-en-1-ol (2f)	S18
(<i>R,E</i>)-1- <i>p</i> -Tolylnon-2-en-1-ol (2g)	S19
(<i>R,E</i>)-1-(3-Methoxyphenyl)non-2-en-1-ol (2h)	S20
(<i>R,E</i>)-1-(3-(Trifluoromethyl)phenyl)non-2-en-1-ol (2i)	S21
(<i>R,E</i>)-1-(4-Trifluoromethyl)phenyl)non-2-en-1-ol (2j)	S22
(<i>R,E</i>)-1-Phenylhept-2-en-1-ol (2k)	S23
(<i>R,E</i>)-1-(3-(Trifluoromethyl)phenyl)hept-2-en-1-ol (2l)	S24
(<i>R,E</i>)-2-Ethyl-1-phenylpent-2-en-1-ol (2m)	S25
(<i>R,E</i>)-4,4-Dimethyl-1-phenylpent-2-en-1-ol (2n)	S26
(<i>S,E</i>)-1-Cyclohexyl-6-phenylhex-2-en-1-ol (2o)	S27
HPLC Data of Addition Products	
(<i>R,E</i>)-1-Phenylnon-2-en-1-ol (2a)	S29
(<i>R,E</i>)-1-(2-Chlorophenyl)non-2-en-1-ol (2b)	S30
(<i>R,E</i>)-1-(3-Chlorophenyl)non-2-en-1-ol (2c)	S31
(<i>R,E</i>)-1-(4-Chlorophenyl)non-2-en-1-ol (2d)	S32
(<i>R,E</i>)-1-(3-Fluorophenyl)non-2-en-1-ol (2e)	S33
(<i>R,E</i>)-1- <i>o</i> -Tolylnon-2-en-1-ol (2f)	S34
(<i>R,E</i>)-1- <i>p</i> -Tolylnon-2-en-1-ol (2g)	S35
(<i>R,E</i>)-1-(3-Methoxyphenyl)non-2-en-1-ol (2h)	S36
(<i>R,E</i>)-1-(3-(Trifluoromethyl)phenyl)non-2-en-1-ol (2i)	S37
(<i>R,E</i>)-1-(4-Trifluoromethyl)phenyl)non-2-en-1-ol (2j)	S38
(<i>R,E</i>)-1-Phenylhept-2-en-1-ol (2k)	S39
(<i>R,E</i>)-1-(3-(Trifluoromethyl)phenyl)hept-2-en-1-ol (2l)	S40
(<i>R,E</i>)-2-Ethyl-1-phenylpent-2-en-1-ol (2m)	S41
(<i>R,E</i>)-4,4-Dimethyl-1-phenylpent-2-en-1-ol (2n)	S42
(<i>S,E</i>)-1-Cyclohexyl-6-phenylhex-2-en-1-ol (2o)	S43

General

All reaction were performed in flame-dried apparatus under an atmosphere of Ar_(g). All chemicals and solvents were used as received unless otherwise stated. THF (Na, benzophenone), toluene (Na, benzophenone), hexanes (Na, benzophenone) were distilled under argon from the drying agent indicated. Column chromatography was performed on silica gel with the eluent indicated. ¹H and ¹³C NMR spectra were recorded with 500/125 MHz instrument. Abbreviations for ¹H NMR: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, br = broaden peak. Carbon atoms were determined by DEPT experiments.

Compound Characterization Data

(*R,E*)-1-Phenylnon-2-en-1-ol (2a)

$[\alpha]_D^{24} -32.8$ (*c* 1.9, CHCl₃); ¹H NMR (500 MHz, CDCl₃): δ = 7.48-7.14 (m, 5H), 5.75 (dt, *J* = 14.7 Hz, 6.5 Hz, 1H), 5.65 (ddd, *J* = 14.7 Hz, 6.5 Hz, 1.5 Hz, 1H), 5.14 (d, *J* = 6.5 Hz, 1H), 2.04 (dt, *J* = 6.5 Hz, 6.5 Hz, 2H), 1.46-1.14 (m, 9H), 0.87 (t, *J* = 6.0 Hz, 3H); ¹³C NMR (125 MHz, CDCl₃): δ = 143.4 (C), 132.8 (CH), 132.2 (CH), 128.5 (CH), 127.4 (CH), 126.1 (CH), 75.2 (CH), 32.2 (CH₂), 31.6 (CH₂), 28.9 (CH₂), 28.8 (CH₂), 22.6 (CH₂), 14.0 (CH₃); IR (neat) 3362, 3085, 3062, 3029, 2956, 2926, 1668, 1492 cm⁻¹; HRMS calculated for C₁₅H₂₂O 218.1671, found 218.1665; HPLC analysis: Chiralcel OB, 2-propanol/hexane (1:99), 1.0 mL/min, 96% ee.

(*R,E*)-1-(2-Chlorophenyl)non-2-en-1-ol (2b)

211 mg, 85%; $[\alpha]_{\text{D}}^{21} +5.4$ (c 0.9, CHCl_3); ^1H NMR (500 MHz, CDCl_3): δ = 7.56-7.50 (m, 1H), 7.34-7.24 (m, 2H), 7.22-7.14 (m, 1H), 5.77 (dt, J = 14.0 Hz, 7.0 Hz, 1H), 5.64-5.51 (m, 2H), 2.10 (br, 1H), 2.02 (dt, J = 7.0 Hz, 7.0 Hz, 2H), 1.44-1.16 (m, 8H), 0.85 (t, J = 7.0 Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3): δ = 140.7 (C), 133.5 (CH), 132.3 (C), 130.1 (CH), 129.4 (CH), 128.5 (CH), 127.4 (CH), 127.1 (CH), 71.5 (CH), 32.2 (CH_2), 31.6 (CH_2), 28.9 (CH_2), 28.8 (CH_2), 22.6 (CH_2), 14.0 (CH_3); IR (neat) 3350, 3067, 2955, 2926, 1667, 1573, 1467 cm^{-1} ; HRMS calculated for $\text{C}_{15}\text{H}_{21}\text{ClO}$ 252.1281, found 252.1288; HPLC analysis: Chiralcel OD-H, 2-propanol/hexane (1:99), 1.0 mL/min, 95% ee.

(*R,E*)-1-(3-Chlorophenyl)non-2-en-1-ol (2c)

218 mg, 88%; $[\alpha]_{\text{D}}^{21} -46.8$ (c 1.2, CHCl_3); ^1H NMR (500 MHz, CDCl_3): δ = 7.35 (s, 1H), 7.28-7.19 (m, 3H), 5.75 (dt, J = 14.5 Hz, 7.0 Hz, 1H), 5.64-5.52 (m, 1H), 5.10 (d, J = 7.0 Hz, 1H), 2.03 (dt, J = 7.0 Hz, 7.0 Hz, 3H), 1.42-1.18 (m, 8H), 0.86 (t, J = 6.5 Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3): δ = 145.4 (C), 134.3 (C), 133.7 (CH), 131.6 (CH), 129.7 (CH), 127.5 (CH), 126.3 (CH), 126.2 (CH), 74.6 (CH), 32.1 (CH_2), 31.6 (CH_2), 28.9 (CH_2), 28.8 (CH_2), 22.6 (CH_2), 14.1 (CH_3); IR (neat) 3340, 3065, 2956, 2926, 2855, 1667, 1597, 1467 cm^{-1} ; HRMS calculated for $\text{C}_{15}\text{H}_{21}\text{ClO}$ 252.1281, found 252.1274; HPLC analysis: Chiralcel OD-H, 2-propanol/hexane (1:99), 1.0 mL/min, 97% ee.

(*R,E*)-1-(4-Chlorophenyl)non-2-en-1-ol (2d)

223 mg, 90%; $[\alpha]_D^{24} -5.8$ (c 0.9, CHCl_3); ^1H NMR (500 MHz, CDCl_3): δ = 7.39-7.23 (m, 4H), 5.73 (dt, J = 14.0 Hz, 7.0 Hz, 1H), 5.58 (dd, J = 15.5 Hz, 7.0 Hz, 1H), 5.12 (d, J = 7.0 Hz, 1H), 2.02 (dt, J = 7.0 Hz, 7.0 Hz, 2H), 1.44-1.16 (m, 9H), 0.85 (t, J = 7.0 Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3): δ = 141.8 (C), 133.4 (CH), 133.1 (C), 131.8 (CH), 128.5 (CH), 127.5 (CH), 74.6 (CH), 32.1 (CH_2), 31.6 (CH_2), 28.9 (CH_2), 28.8 (CH_2), 22.6 (CH_2), 14.0 (CH_3); IR (neat) 3414, 2956, 2926, 2855, 1665, 1618, 1588, 1490 cm^{-1} ; HRMS calculated for $\text{C}_{15}\text{H}_{21}\text{ClO}$ 252.1281, found 252.1268; HPLC analysis: Chiralcel AD-H, 2-propanol/hexane (1:99), 1.0 mL/min, 96% ee.

(*R,E*)-1-(3-Fluorophenyl)non-2-en-1-ol (2e)

204 mg, 88%; $[\alpha]_D^{21} -49.9$ (c 1.1, CHCl_3); ^1H NMR (500 MHz, CDCl_3): δ = 7.34-7.18 (m, 1H), 7.16-7.02 (m, 2H), 6.98-6.86 (m, 1H), 5.75 (dt, J = 14.0 Hz, 7.0 Hz, 1H), 5.66-5.52 (m, 1H), 5.12 (d, J = 7.0 Hz, 1H), 2.03 (dt, J = 7.0 Hz, 7.0 Hz, 3H), 1.44-1.12 (m, 8H), 0.86 (t, J = 7.0 Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3): δ = 162.9 (q, J = 243.9 Hz, C), 146.0 (d, J = 6.6 Hz, C), 133.6 (CH), 131.6 (CH), 129.8 (d, J = 8.9 Hz, CH), 121.6 (d, J = 2.3 Hz, CH), 114.2 (d, J = 22.3 Hz, CH), 113.0 (d, J = 21.1 Hz, CH), 74.6 (CH), 32.1 (CH_2), 31.6 (CH_2), 28.9 (CH_2), 28.8 (CH_2), 22.6 (CH_2), 14.0 (CH_3); IR (neat) 3356, 2957, 2927, 2855, 1614, 1591, 1486 cm^{-1} ; HRMS calculated for $\text{C}_{15}\text{H}_{21}\text{FO}$ 236.1576, found 236.1593; HPLC analysis: Chiralcel OD-H, 2-propanol/hexane (1:99), 1.0 mL/min, 96% ee.

(*R,E*)-1-*o*-Tolylnon-2-en-1-ol (2f)

189 mg, 83%; $[\alpha]_D^{24} -11.0$ (c 1.2, CHCl_3); ^1H NMR (500 MHz, CDCl_3): δ = 7.48 (d, J = 7.5 Hz, 1H), 7.25-7.19 (m, 1H), 7.16 (dt, J = 10.0 Hz, 1.5 Hz, 1H), 7.12 (d, J = 7.0 Hz, 1H), 5.70 (dt, J = 14.0 Hz, 7.0 Hz, 1H), 5.60 (dd, J = 15.3 Hz, 7.0 Hz, 1H), 5.33 (d, J = 7.0 Hz, 1H), 2.31 (s, 3H), 2.02 (dt, J = 7.0 Hz, 7.0 Hz, 2H), 1.85 (br, 1H), 1.42-1.18 (m, 8H), 0.86 (t, J = 7.0 Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3): δ = 141.2 (C), 135.0 (C), 133.0 (CH), 131.1 (CH), 130.3 (CH), 127.3 (CH), 126.2 (CH), 125.4 (CH), 71.9 (CH), 32.2 (CH_2), 31.6 (CH_2), 29.0 (CH_2), 28.8 (CH_2), 22.6 (CH_2), 19.1 (CH_3), 14.0 (CH_3); IR (neat) 3347, 3024, 2955, 2925, 2854, 1660, 1599 cm^{-1} ; HRMS calculated for $\text{C}_{16}\text{H}_{24}\text{O}$ 232.1827, found 232.1841; HPLC analysis: Chiralcel OD-H, 2-propanol/hexane (1:99), 1.0 mL/min, 96% ee.

(*R,E*)-1-*p*-Tolylnon-2-en-1-ol (2g)

189 mg, 83%; $[\alpha]_D^{24} -4.4$ (c 1.2, CHCl_3); ^1H NMR (500 MHz, CDCl_3): δ = 7.24 (d, J = 7.5 Hz, 2H), 7.14 (d, J = 7.5 Hz, 2H), 5.74 (dt, J = 14.0 Hz, 7.0 Hz, 1H), 5.63 (dd, J = 15.0 Hz, 7.0 Hz, 1H), 5.11 (d, J = 7.0 Hz, 1H), 2.33 (s, 3H), 2.02 (dt, J = 7.0 Hz, 7.0 Hz, 2H), 1.85 (br, 1H), 1.42-1.18 (m, 8H), 0.86 (t, J = 7.0 Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3): δ = 140.5 (C), 137.1 (C), 132.6 (CH), 132.2 (CH), 129.1 (CH), 126.1

(CH), 75.1 (CH), 32.2 (CH₂), 31.7 (CH₂), 29.0 (CH₂), 28.9 (CH₂), 22.6 (CH₂), 21.1 (CH₃), 14.1 (CH₃); IR (neat) 3364, 3022, 2955, 2925, 2855, 1663, 1610 cm⁻¹; HRMS calculated for C₁₆H₂₄O 232.1827, found 232.1814; HPLC analysis: Chiralcel OD-H, 2-propanol/hexane (1:99), 1.0 mL/min, 95% ee.

(*R,E*)-1-(3-Methoxyphenyl)non-2-en-1-ol (2h)

197 mg, 81%; [α]_D²¹ -38.5 (*c* 1.0, CHCl₃); ¹H NMR (500 MHz, CDCl₃): δ = 7.28-7.20 (m, 1H), 6.96-6.90 (m, 2H), 6.82-6.76 (m, 1H), 5.74 (dt, *J* = 14.0 Hz, 7.0 Hz, 1H), 5.63 (ddd, *J* = 15.3 Hz, 7.0 Hz, 1.5 Hz, 1H), 5.11 (d, *J* = 6.5 Hz, 1H), 3.79 (s, 3H), 2.03 (dt, *J* = 7.0 Hz, 7.0 Hz, 2H), 1.97 (br, 1H), 1.46-1.18 (m, 8H), 0.86 (t, *J* = 7.5 Hz, 3H); ¹³C NMR (125 MHz, CDCl₃): δ = 159.7 (C), 145.1 (C), 132.9 (CH), 132.0 (CH), 129.4 (CH), 118.4 (CH), 113.0 (CH), 111.5 (CH), 75.1 (CH), 55.2 (CH₃), 32.2 (CH₂), 31.6 (CH₂), 29.0 (CH₂), 28.8 (CH₂), 22.6 (CH₂), 14.1 (CH₃); IR (neat) 3391, 2998, 2955, 2855, 1667, 1601, 1586 cm⁻¹; HRMS calculated for C₁₆H₂₄O₂ 248.1776, found 248.1792; HPLC analysis: Chiralcel OD-H, 2-propanol/hexane (5:95), 1.0 mL/min, 95% ee.

(*R,E*)-1-(3-(Trifluoromethyl)phenyl)non-2-en-1-ol (2i)

244 mg, 87%; [α]_D²⁴ -37.3 (*c* 1.1, CHCl₃); ¹H NMR (500 MHz, CDCl₃): δ = 7.63 (s, 1H), 7.52 (dd, *J* = 13.0 Hz, 7.5 Hz, 2H), 7.43 (t, *J* = 8.0 Hz, 1H), 5.78 (dt, *J* = 14.0 Hz, 7.0 Hz, 1H), 5.60 (dd, *J* = 15.5 Hz, 7.0 Hz, 1H), 5.19 (d, *J* = 7.5 Hz, 1H), 2.04 (dt, *J* =

7.0 Hz, 7.0 Hz, 3H), 1.44-1.16 (m, 8H), 0.85 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3): $\delta = 144.2$ (C), 134.0 (CH), 131.6 (CH), 130.3 (q, $J = 32.1$ Hz, C), 129.5 (CH), 128.8 (CH), 124.17 (CH), 124.15 (q, $J = 271.6$ Hz, C), 122.9 (CH), 74.7 (CH), 32.1 (CH₂), 31.6 (CH₂), 28.9 (CH₂), 28.8 (CH₂), 22.6 (CH₂), 14.0 (CH₃); IR (neat) 3339, 2958, 2928, 2857, 1667, 1615, 1597 cm^{-1} ; HRMS calculated for $\text{C}_{16}\text{H}_{21}\text{F}_3\text{O}$ 286.1544, found 286.1544; HPLC analysis: Chiralcel OD-H, 2-propanol/hexane (1:100), 0.5 mL/min, 98% ee.

(*R,E*)-1-(4-Trifluoromethyl)phenyl)non-2-en-1-ol (2j)

253 mg; 90%; $[\alpha]_{\text{D}}^{24} -42.8$ (c 1.0, CHCl_3); ^1H NMR (500 MHz, CDCl_3): $\delta = 7.58$ (d, $J = 8.5$ Hz, 2H), 7.46 (d, $J = 8.0$ Hz, 2H), 5.77 (dt, $J = 15.0$ Hz, 7.0 Hz, 1H), 5.59 (dd, $J = 15.0$ Hz, 7.0 Hz, 1H), 5.19 (d, $J = 7.5$ Hz, 1H), 2.03 (dt, $J = 7.0$ Hz, 7.0 Hz, 3H), 1.44-1.16 (m, 8H), 0.86 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3): $\delta = 147.2$ (C), 134.0 (CH), 131.6 (CH), 129.5 (q, $J = 32.1$ Hz, C), 126.3 (CH), 125.3 (CH), 123.1 (C), 74.7 (CH), 32.1 (CH₂), 31.6 (CH₂), 28.9 (CH₂), 28.8 (CH₂), 22.6 (CH₂), 14.0 (CH₃); IR (neat) 3351, 2957, 2928, 2857, 1667, 1619, 1466 cm^{-1} ; HRMS calculated for $\text{C}_{16}\text{H}_{21}\text{F}_3\text{O}$ 286.1544, found 286.1547; HPLC analysis: Chiralcel OD-H, 2-propanol/hexane (1:200), 0.7 mL/min, >99.5% ee.

(*R,E*)-1-Phenylhept-2-en-1-ol (2k)

155 mg, 83%; $[\alpha]_{\text{D}}^{24} -39.6$ (c 1.1, CHCl_3); ^1H NMR (500 MHz, CDCl_3): δ = 7.50-7.14 (m, 5H), 5.74 (dt, J = 14.0 Hz, 7.0 Hz, 1H), 5.65 (dd, J = 15.0 Hz, 7.0 Hz, 1H), 5.14 (d, J = 6.5 Hz, 1H), 2.05 (dt, J = 7.0 Hz, 7.0 Hz, 2H), 1.98 (br, 1H), 1.44-1.20 (m, 4H), 0.87 (t, J = 7.0 Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3): δ = 143.4 (C), 132.8 (CH), 132.1 (CH), 128.4 (CH), 127.4 (CH), 126.1 (CH), 75.2 (CH), 31.8 (CH_2), 31.2 (CH_2), 22.2 (CH_2), 13.9 (CH_3); IR (neat) 3359, 2956, 2926, 2871, 1663, 1602, 1492 cm^{-1} ; HRMS calculated for $\text{C}_{13}\text{H}_{18}\text{O}$ 190.1358, found 190.1365; HPLC analysis: Chiralcel OD-H, 2-propanol/hexane (1:99), 1.0 mL/min, 97% ee.

(*R,E*)-1-(3-(Trifluoromethyl)phenyl)hept-2-en-1-ol (2l)

208 mg, 82%; $[\alpha]_{\text{D}}^{24} -50.9$ (c 1.1, CHCl_3); ^1H NMR (500 MHz, CDCl_3): δ = 7.63 (s, 1H), 7.52 (dd, J = 15.0 Hz, 7.5 Hz, 2H), 7.43 (t, J = 8 Hz, 1H), 5.78 (dt, J = 14.0 Hz, 7.0 Hz, 1H), 5.66-5.54 (m, 1H), 5.19 (d, J = 7.5 Hz, 1H), 2.05 (dt, J = 7.0 Hz, 7.0 Hz, 2H), 1.44-1.22 (m, 4H), 0.87 (t, J = 7.0 Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3): δ = 144.2 (C), 134.0 (CH), 131.6 (CH), 130.6 (q, J = 32.1 Hz, C), 129.5 (CH), 128.8 (CH), 124.2 (q, J = 271.6 Hz, C), 124.1 (CH), 122.9 (CH), 74.6 (CH), 31.8 (CH_2), 31.0 (CH_2), 22.2 (CH_2), 13.8 (CH_3); IR (neat) 3357, 2959, 2930, 2874, 1667, 1615, 1597 cm^{-1} ; HRMS calculated for $\text{C}_{14}\text{H}_{17}\text{F}_3\text{O}$ 258.1231, found 258.1238; HPLC analysis: Chiralcel OD-H, 2-propanol/hexane (1:200), 0.7 mL/min, 98% ee.

(*R,E*)-2-Ethyl-1-phenylpent-2-en-1-ol (2m)

166 mg, 89%; $[\alpha]_{\text{D}}^{24} -10.3$ (c 1.0, CHCl_3); ^1H NMR (500 MHz, CDCl_3): δ = 7.52-7.18 (m, 5H), 5.57 (t, J = 7.5 Hz, 1H), 5.15 (s, 1H), 2.16-1.80 (m, 5H), 1.01 (t, J = 7.5 Hz, 3H) 0.82 (t, J = 7.5 Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3): δ = 142.7 (C), 142.1 (C), 128.6(CH), 128.2 (CH), 127.3 (CH), 126.5 (CH), 78.0 (CH), 20.7 (CH_2), 20.5 (CH_2), 14.4 (CH_3), 14.2 (CH_3); IR (neat) 3399, 2963, 2932, 2872, 1607, 1492 cm^{-1} ; HRMS calculated for $\text{C}_{13}\text{H}_{18}\text{O}$ 190.1358, found 190.1362; HPLC analysis: Chiralcel OD-H, 2-propanol/hexane (1:99), 0.7 mL/min, 96% ee.

(*R,E*)-4,4-Dimethyl-1-phenylpent-2-en-1-ol (2n)

170 mg, 91%; $[\alpha]_{\text{D}}^{24} -46.4$ (c 1.3, CHCl_3); ^1H NMR (500 MHz, CDCl_3): δ = 7.44-7.18 (m, 5H), 5.79 (d, J = 15.5 Hz, 1H), 5.56 (dd, J = 15.5 Hz, 7.0 Hz, 1H), 5.14 (d, J = 7.0 Hz, 1H), 1.97 (br, 1H), 1.02 (s, 9H); ^{13}C NMR (125 MHz, CDCl_3): δ = 143.5 (CH), 143.4 (C), 128.4 (CH), 127.4 (CH), 127.0 (CH), 126.1 (CH), 75.3 (CH), 32.9 (C), 29.4 (CH_3); IR (neat) 3367, 3062, 2959, 2902, 2865, 1652, 1599, 1493 cm^{-1} ; HRMS calculated for $\text{C}_{13}\text{H}_{18}\text{O}$ 190.1358, found 190.1359; HPLC analysis: Chiralcel OD-H, 2-propanol/hexane (1:99), 1.0 mL/min, 96% ee.

(*S,E*)-1-Cyclohexyl-6-phenylhex-2-en-1-ol (2o)

203 mg, 80%; $[\alpha]_{\text{D}}^{25} -4.92$ (c 0.9, CHCl_3); ^1H NMR (500 MHz, CDCl_3): δ = 7.30-7.12 (m, 5H), 5.61 (dt, J = 15.0 Hz, 7.0 Hz, 1H), 5.46 (dd, J = 15.0 Hz, 7.0 Hz,

1H), 3.76 (dd, $J = 7.0$ Hz, 7.0 Hz, 1H), 2.61 (t, $J = 7.5$ Hz, 2H), 2.14 (dt, $J = 7.0$ Hz, 7.0 Hz, 2H), 1.90-1.80 (m, 1H), 1.80-1.68 (m, 6H), 1.42-1.28 (m, 1H), 1.28-1.06 (m, 4H), 1.02-0.88 (m, 2H); ^{13}C NMR (125 MHz, CDCl_3): $\delta = 142.3$ (C), 132.4 (CH), 131.9 (CH), 128.4 (CH), 128.3 (CH), 125.7 (CH), 77.6 (CH), 43.6 (CH), 35.4 (CH_2), 31.8 (CH_2), 30.9 (CH_2), 28.8 (CH_2), 28.7 (CH_2), 26.5 (CH_2), 26.1 (CH_2), 26.0 (CH_2); IR (neat) 3428, 3084, 2923, 1667, 1603, 1495 cm^{-1} ; HRMS calculated for $\text{C}_{18}\text{H}_{26}\text{O}$ 258.1984, found 258.1977; HPLC analysis: Chiralcel OD-H, 2-propanol/hexane (1:100), 0.5 mL/min, 97% ee.

^1H -NMR Spectra of Addition Products

4-ClPhenyl-octenol

expl s2pu1

SAMPLE DEC. & VT

date Apr 13 2004 dfrq 499.838

solvent CDCl3 dn H1

file exp dpwr 38

ACQUISITION exp dof 0

sfrq 499.839 dm nnn

tn H1 dmm c

at 2.182 dmf 11111

np 32768 dseq 1.0

sw 7509.6 dres n

fb 4000 homo n

bs 4

tpwr 57

pw 5.5

d1 0.001

tof 500.0

nt 100

ct 100

alock y

gain not used

FLAGS

il n

in n

dp y

hs nn

DISPLAY

sp -250.4

vp 5248.0

vs 100

sc 0

wc 250

hzmm 20.99

fs 239.43

rfl 4391.7

rfp 3618.8

th 7

ins 1.000

nm ph

PROCESSING

wtfile ft

proc fn 32768

math f

werr

wexp

wbs

wnt

wft

wft

4-CF3Ph-octenol

```

expl  s2pu1
SAMPLE
date   Apr 13 2004  dfrq  499.838
solvent CDC13      dn     H1
file   /export/home/~ dpwr  38
chem2003/vnmrsys/d~ dof   0
ata/USERUANG/4-CF3~ dm    nnn
Ph-octenol.fid      dmm    c
ACQUISITION
sfrq   499.839      dmf    11111
in     H1           dseq   1.0
at     2.182        homo   n
np     32768        wtfile  ft
sw     7509.6       proc   32768
fb     4000         fn     f
bs     4            math
tpwr   57           werr
pw     5.5          wexp
d1     0.001        wnt
tof    500.0        wft
nt     100          wft
ct     100
alock  y
gain   not used
FLAGS
il      n
in      n
dp      y
hs      nn
DISPLAY
sp      -250.4
vp      5248.0
vs      50
sc      0
wc      250
hzmm    20.99
ls      404.32
rfl     4391.7
rfp     3618.8
th      2
fns     1.000
nm      ph
  
```

7.587
7.570
7.472
7.456
7.240

2.055
2.041
2.027
2.013
1.974
1.962
1.947
1.938
1.926
1.915
1.901
1.886
1.871
1.856
1.841
1.826
1.811
1.796
1.781
1.766
1.751
1.736
1.721
1.706
1.691
1.676
1.661
1.646
1.631
1.616
1.601
1.586
1.571
1.556
1.541
1.526
1.511
1.496
1.481
1.466
1.451
1.436
1.421
1.406
1.391
1.376
1.361
1.346
1.331
1.316
1.301
1.286
1.271
1.256
1.241
1.226
1.211
1.196
1.181
1.166
1.151
1.136
1.121
1.106
1.091
1.076
1.061
1.046
1.031
1.016
1.001
0.986
0.971
0.956
0.941
0.926
0.911
0.896
0.881
0.866
0.851
0.836
0.821
0.806
0.791
0.776
0.761
0.746
0.731
0.716
0.701
0.686
0.671
0.656
0.641
0.626
0.611
0.596
0.581
0.566
0.551
0.536
0.521
0.506
0.491
0.476
0.461
0.446
0.431
0.416
0.401
0.386
0.371
0.356
0.341
0.326
0.311
0.296
0.281
0.266
0.251
0.236
0.221
0.206
0.191
0.176
0.161
0.146
0.131
0.116
0.101
0.086
0.071
0.056
0.041
0.026
0.011
0.001

3-CF₃Phenyl-hexenol
exp1 s2pu1

SAMPLE DEC. & VT
date Apr 13 2004 dfrq 499.838
solvent CDCl₃ dn H1
file exp dpwr 38
ACQUISITION dof 0
sfrq 499.839 dm nnn
tn H1 dnm c
at 2.182 dmf 11111
np 32768 dseq
sw 7509.6 dres 1.0
fb 4000 homo n
bs 4 PROCESSING
tpwr 57 wtfile
pw 5.5 proc ft
d1 0.001 fn 32768
tof 500.0 math f
nt 100
ct 100 werr
alock y wexp
gain not used wft
FLAGS n wft
il n
in n
dp y
hs nn
DISPLAY
sp -250.4
wp 5248.0
vs 68
sc 0
wc 250
hzmm 20.99
is 269.08
rfl 772.9
rfp 0
th 2
ins 1.000
nm ph

7.625
7.536
7.521
7.512
7.496
7.450
7.434
7.419
7.240

5.984
5.790
5.775
5.761
5.747
5.624
5.621
5.619
5.609
5.607
5.604
5.590
5.579
5.576
5.574
5.197
5.182

2.071
2.057
2.043
2.029
1.990
1.987
1.976
1.970
1.964
1.944
1.936
1.930
1.931
1.918
1.904
1.889
1.874
1.861
0.912
0.898
0.888
0.873
0.859
0.829
0.822

2l

2,3-diehtyl-1-phenylpropenol

```

expl  szpul
SAMPLE
date   Apr 20 2004   dfrq  499.836
solvent CDC13      dn    H1
file    exp  dpwr    38
ACQUISITION  dof    0
sfrq    499.839   dm   nnn
tn       2.182   dmm   c
at       32768   dmf   11111
np       7509.6   dseq  1.0
sw       4000    homo  n
bs       4
tpwr     57   wfile
pw       5.5   proc   ft
dl       0.001  fn     32768
tof      500.0  math   f
nt       100
ct       92   werr
alock    y     wexp
gain     not used  wbs   wft
          FLAGS   wnt   wft
il        n
in        n
dp        y
hs        nn
DISPLAY
sp      -250.4
vp      5248.0
ve       37
sc       0
wc       250
hzmm     20.99
is      404.32
rfl      772.0
rtp      0
th       5
ins      1.000
nm      ph

```

3-tButyl-1-phenylprpenol

expl s2pu1

SAMPLE DEC. & VT
 date Apr 20 2004 dfrq 499.838
 solvent CDC13 dn H1
 file exp dpwr 38
 ACQUISITION dof 0
 sfrq 499.839 dm nnn
 tn H1 dmm c
 at 2.182 dmf 11111
 np 32768 dseq
 sw 7509.6 dres 1.0
 fb 4000 homo n
 bs 4
 tpwr 57
 pw 5.5
 dl 0.001 fn 32768
 tof 500.0 math f
 nt 100
 ct 32
 alock y werr
 gain not used wbs wft
 FLAGS wnt wft
 il n
 in n
 dp y
 hs nn
 DISPLAY
 sp -250.4
 wp 5248.0
 vs 200
 sc 0
 wc 250
 hzmm 20.99
 is 404.32
 rfl 772.0
 rfp 0
 th 5
 ins 1.000
 nm ph

7.367
 7.354
 7.341
 7.264
 7.243

5.805
 5.774
 5.580
 5.566
 5.150
 5.136

2n

HPLC DATA of Addition Products

CH. 1 C.S 1.25 ATT 7 OFFS 0 00/07/00 16:05

D-2500

00/07/00 16:05

METHOD: TAG: 16 CH: 1

FILE: 0 CALC-METHOD: AREA% TABLE: 0 CONC: AREA

NO.	RT	AREA	CONC	BC
1	13.10	294191	49.507	BB
2	19.75	300052	50.493	BB
TOTAL		594243	100.000	
PEAK REJ :		0

Racemic 2a

CH. 1 C.S 1.25 ATT 5 OFFS 0 00/07/00 15:03

D-2500

00/07/00 15:03

METHOD: TAG: 14 CH: 1

FILE: 0 CALC-METHOD: AREA% TABLE: 0 CONC: AREA

NO.	RT	AREA	CONC	BC
1	13.24	5994	2.027	BB
2	19.70	289714	97.973	BB
TOTAL		295708	100.000	
PEAK REJ :		0

Reaction Product 2a

Detector : UV 254 nm
Column : Chiralcel OB
Eluent : *i*-PrOH / Hex = 1/99
Rate : 1 mL/min

CH. 1 C.5 1.25 ATT 4 OFFS 0 00/32/00 16:55

D-2500

00/32/00 16:55

METHOD: TAG: 35 CH: 1

FILE: 0 CALC-METHOD: AREA% TABLE: 0 CONC: AREA

NO.	RT	AREA	CONC	BC
1	12.95	89915	49.392	BB
2	16.00	92128	50.608	BB
TOTAL		182043	100.000	
PEAK REJ :		0

Racemic **2b**

CH. 1 C.5 1.25 ATT 6 OFFS 0 00/32/00 17:18

D-2500

00/32/00 17:18

METHOD: TAG: 36 CH: 1

FILE: 0 CALC-METHOD: AREA% TABLE: 0 CONC: AREA

NO.	RT	AREA	CONC	BC
1	12.86	375658	97.578	BB
3	15.90	9326	2.422	BB
TOTAL		384984	100.000	
PEAK REJ :		3000

Reaction Product **2b**

Detector : UV 254 nm
Column : Chiralcel OD-H
Eluent : *i*-PrOH / Hex = 1/99
Rate : 1 mL/min

CH. 1 C.S 1.25 ATT 5 OFFS 0 00/34/00 11:31

D-2500

00/34/00 11:31

METHOD: TAG: 39 CH: 1

FILE: 0 CALC-METHOD: AREA% TABLE: 0 CONC: AREA

NO.	RT	AREA	CONC	BC
1	16.59	78151	49.109	BU
2	17.87	80988	50.891	UB

TOTAL 159139 100.000

PEAK REJ : 3000

CH. 1 C.S 1.25 ATT 5 OFFS 0 00/34/00 11:55

D-2500

00/34/00 11:55

METHOD: TAG: 40 CH: 1

FILE: 0 CALC-METHOD: AREA% TABLE: 0 CONC: AREA

NO.	RT	AREA	CONC	BC
1	16.48	473663	98.326	BU
2	17.83	8064	1.674	TBB

TOTAL 481727 100.000

PEAK REJ : 3000

Detector : UV 254 nm
Column : Chiralcel OD-H
Eluent : *i*-PrOH / Hex = 1/99
Rate : 1 mL/min

CH. 1 C.S. 1.25 ATT 6 OFFS 0 00/04/00 04:14

D-2500

00/04/00 04:14

METHOD: TAG: 15 CH: 1

FILE: 0 CALC-METHOD: AREA% TABLE: 0 CONC: AREA

NO.	RT	AREA	CONC	BC
1	22.24	469902	50.460	BB
3	26.22	461331	49.540	BB

TOTAL

931233 100.000

PEAK REJ :

3000

Racemic 2d

CH. 1 C.S. 1.25 ATT 5 OFFS 0 00/04/00 05:28

D-2500

00/04/00 05:28

METHOD: TAG: 17 CH: 1

FILE: 0 CALC-METHOD: AREA% TABLE: 0 CONC: AREA

NO.	RT	AREA	CONC	BC
1	22.59	6067	1.981	BB
2	26.44	300187	98.019	BB

TOTAL

306254 100.000

PEAK REJ :

3000

Reaction Product 2d

Detector : UV 254 nm
Column : Chiralcel AD-H
Eluent : *i*-PrOH / Hex = 1/99
Rate : 1 mL/min

Detector : UV 254 nm
 Column : Chiralcel OD-H
 Eluent : *i*-PrOH / Hex = 1/99
 Rate : 1 mL/min

CH. 1 C.S 1.25 ATT 6 OFFS 0 00/36/00 16:46

D-2500

00/36/00 16:46

METHOD: TAG: 46 CH: 1

FILE: 0 CALC-METHOD: AREA% TABLE: 0 CONC: AREA

NO.	RT	AREA	CONC	BC
1	15.22	107804	49.439	88
2	19.04	110250	50.561	88
TOTAL				

PEAK REJ : 218054 100.000
0

Racemic 2f

CH. 1 C.S 1.25 ATT 5 OFFS 0 00/36/00 17:32

D-2500

00/36/00 17:32

METHOD: TAG: 48 CH: 1

FILE: 0 CALC-METHOD: AREA% TABLE: 0 CONC: AREA

NO.	RT	AREA	CONC	BC
1	15.20	545028	97.982	88
2	19.14	11226	2.018	88
TOTAL				

PEAK REJ : 556254 100.000
10000

Reaction Product 2f

Detector : UV 254 nm
Column : Chiralcel OD-H
Eluent : *i*-PrOH / Hex = 1/99
Rate : 1 mL/min

CH. 1 C.S 1.25 ATT 5 OFFS 0 00/50/00 12:23

D-2500

00/50/00 12:23

METHOD: TAG: 51 CH: 1

FILE: 0 CALC-METHOD: AREA% TABLE: 0 CONC: AREA

NO.	RT	AREA	CONC	BC
1	14.63	161430	49.215	BB
2	17.19	153426	46.775	BB
3	19.56	13154	4.010	BB

TOTAL

328010 100.000

PEAK REJ :

0

Racemic **2g**

CH. 1 C.S 1.25 ATT 5 OFFS 0 00/50/00 17:08

D-2500

00/50/00 17:08

METHOD: TAG: 55 CH: 1

FILE: 0 CALC-METHOD: AREA% TABLE: 0 CONC: AREA

NO.	RT	AREA	CONC	BC
1	14.76	279396	97.480	BB
2	17.42	7224	2.520	BB

TOTAL

286620 100.000

PEAK REJ :

0

Reaction Product **2g**

Detector : UV 254 nm
 Column : Chiralcel OD-H
 Eluent : *i*-PrOH / Hex = 1/99
 Rate : 1 mL/min

Detector : UV 254 nm
 Column : Chiralcel OD-H
 Eluent : *i*-PrOH / Hex = 5/95
 Rate : 0.5 mL/min

Detector : UV 254 nm
 Column : Chiralcel OD-H
 Eluent : *i*-PrOH / Hex = 1/100
 Rate : 0.5 mL/min

Detector : UV 254 nm
 Column : Chiralcel OD-H
 Eluent : *i*-PrOH / Hex = 1/200
 Rate : 0.7 mL/min

Detector : UV 254 nm
 Column : Chiralcel OD-H
 Eluent : *i*-PrOH / Hex = 1/99
 Rate : 1 mL/min

Detector : UV 254 nm
 Column : Chiralcel OD-H
 Eluent : *i*-PrOH / Hex = 1/200
 Rate : 0.7 mL/min

CH. 1 C.S 1.25 ATT 6 OFFS 0 00/02/00 06:00

D-2500

00/02/00 06:00

METHOD: TAG: 6 CH: 1

FILE: 0 CALC-METHOD: AREA% TABLE: 0 CONC: AREA

NO.	RT	AREA	CONC	BC
1	22.19	213371	49.855	BU
2	23.63	214616	50.145	UB

TOTAL 427987 100.000

PEAK REJ : 10000

Racemic **2m**

CH. 1 C.S 1.25 ATT 6 OFFS 0 00/02/00 07:01

D-2500

00/02/00 07:01

METHOD: TAG: 8 CH: 1

FILE: 0 CALC-METHOD: AREA% TABLE: 0 CONC: AREA

NO.	RT	AREA	CONC	BC
1	22.08	504313	97.837	BU
2	23.60	11147	2.163	TBB

TOTAL 515460 100.000

PEAK REJ : 10000

Reaction Product **2m**

Detector : UV 254 nm
Column : Chiralcel OD-H
Eluent : *i*-PrOH / Hex = 1/99
Rate : 0.7 mL/min

CH. 1 C.S 1.25 ATT 6 OFFS 0 00/11/00 04:13

D-2500

00/11/00 04:13

METHOD: TAG: 32 CH: 1

FILE: 0 CALC-METHOD: AREA% TABLE: 0 CONC: AREA

NO.	RT	AREA	CONC	BC
1	14.26	142262	51.696	BB
2	21.58	132229	48.304	BB
TOTAL		275190	100.000	
PEAK REJ :		0

Racemic **2n**

CH. 1 C.S 1.25 ATT 5 OFFS 0 00/11/00 05:13

D-2500

00/11/00 05:13

METHOD: TAG: 34 CH: 1

FILE: 0 CALC-METHOD: AREA% TABLE: 0 CONC: AREA

NO.	RT	AREA	CONC	BC
1	14.26	410427	98.222	BB
2	21.70	7428	1.778	BB
TOTAL		417855	100.000	
PEAK REJ :		0

Reaction Product **2n**

Detector : UV 254 nm
 Column : Chiralcel OD-H
 Eluent : *i*-PrOH / Hex = 1/99
 Rate : 1 mL/min

Detector : UV 254 nm
 Column : Chiralcel OD-H
 Eluent : *i*-PrOH / Hex = 1/100
 Rate : 0.5 mL/min