Synthesis of Allylic and Homoallylic Alcohols from Unsaturated Cyclic Ethers Using a Mild and Selective C-O Reduction Approach

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Supporting Information

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General Information: Commercial reagents were purchased and used without further purification. All glassware was flame dried under vacuum and reactions were performed under a nitrogen atmosphere, unless otherwise stated. Toluene, dichloromethane, diethyl ether, and THF were dried over a column of alumina. Benzene was distilled from sodium/benzophenone ketyl. Flash chromatography was done with Grace Davisil F60 40-63μm 60Å silica, and thin layer chromatography (TLC) was performed with EMD 250 μm silica gel 60-F₂₅₄ plates. ¹H and ¹³C NMR data was acquired on a Varian Inova 600, Bruker DRX 500, or Bruker DRX 600 and referenced to residual protic solvent (CDCl₃ ¹H [7.26 ppm], CDCl₃ ¹³C [77.00 ppm], C₆F₆ ¹⁹F [-164.90 ppm]) or tetramethylsilane (0.00 ppm). Infrared spectrum were acquired on a Shimadzu Prestige FT-IR. Optical rotations were measured on a Rudolph Instruments Autopol IV polarimeter. High-resolution mass spectrometry was performed at The University of Arizona Mass Spectral Facility.

General Procedure for B(C₆F₅)₃-catalyzed reduction of cyclic ethers

To a flame-dried vial containing a stir bar was added cyclic ether (1 eq) and dichloromethane (0.1 M), and B(C₆F₅)₃ (0.05 eq). Triethylsilane (1.1 eq) was added to this solution, at room temperature, over 1 hour, and the reaction was allowed to stir at room temperature until TLC indicated completion of the reduction. TBAF (1.0 M in THF, 1.5 eq) was added in one portion, and the reaction was stirred until TLC indicated complete consumption of the triethylsilyl ether. The reaction was diluted with DI water, the organic layers were separated, and the organic layer was washed with brine, dried over MgSO₄ and concentrated. Compounds were purified via column chromatography, yielding the desired alcohol. For all alcohol products we used either 20-35% Ethyl acetate/hexanes or 7% methanol/methylene chlorides as eluents.
(Z)-but-2-en-1-ol (1)

![Structure of Z-but-2-en-1-ol](image)

1H NMR (499 MHz, Chloroform-d) δ 5.64 – 5.56 (m, 2H), 4.19 (d, J = 4.4 Hz, 2H), 2.43 (s, 1H), 1.66 (d, J = 5.2 Hz, 3H); 13C NMR (126 MHz, CDCl3) δ 129.26, 126.73, 57.95, 12.85; FTIR (thin film) 3343, 3022, 2922, 2874, 1449, 1032, 980 cm⁻¹; HRMS (EI⁺) m/z 72.0572 [calculated mass for C₄H₈O (M)⁺ 72.0575].

(Z)-undec-2-en-4-ol (2)

![Structure of Z-undec-2-en-4-ol](image)

1H NMR (499 MHz, Chloroform-d) δ 5.60 (dq, J = 11.0, 7.1 Hz, 1H), 5.43 (ddt, J = 10.8, 7.0, 1.8 Hz, 1H), 4.50 (ddt, J = 9.7, 6.8, 3.7 Hz, 1H), 1.72 (dd, J = 6.9, 1.7 Hz, 3H), 1.68 – 1.59 (m, 1H), 1.52 – 1.42 (m, 1H), 1.43 – 1.24 (m, 11H), 0.91 (t, J = 6.9 Hz, 3H); 13C NMR (126 MHz, CDCl₃) δ 133.62, 126.23, 67.44, 37.48, 31.82, 29.58, 29.29, 25.35, 22.66, 14.10, 13.32; FTIR (thin film) 3350, 2926, 2857, 1456, 1001, 725 cm⁻¹; HRMS (EI⁺) m/z 170.1668 [calculated mass for C₁₁H₂₂O (M)⁺ 170.1671].

(E)-4-phenylbut-3-en-1-ol (3)

![Structure of E-4-phenylbut-3-en-1-ol](image)

1H NMR (499 MHz, Chloroform-d) δ 7.40 – 7.18 (m, 5H), 6.50 (d, J = 15.9 Hz, 1H), 6.21 (dt, J = 15.9, 7.2 Hz, 1H), 3.76 (q, J = 6.2 Hz, 2H), 2.49 (ddt, J = 7.7, 6.4, 1.4 Hz, 2H), 1.44 (s, 1H); 13C NMR (126 MHz, CDCl₃) δ 137.20, 132.84, 128.51, 127.26, 126.29, 126.06, 62.03, 36.43; FTIR (thin film) 3347, 3080, 3057, 3024, 2926, 2876, 1493, 1040, 962, 743, 692 cm⁻¹; HRMS (EI⁺) m/z 148.0885 [calculated mass for C₁₀H₁₂O (M)⁺ 148.0888].

(Z)-2-ethylideneoctan-1-ol (4)

![Structure of Z-2-ethylideneoctan-1-ol](image)

1H NMR (499 MHz, Chloroform-d) δ 5.39 (q, J = 7.0 Hz, 1H), 4.15 (d, J = 5.0 Hz, 2H), 2.10 (ddt, J = 9.1, 6.9, 1.3 Hz, 2H), 1.67 (d, J = 7.0 Hz, 3H), 1.47 – 1.36 (m, 2H), 1.36 – 1.25 (m, 6H), 1.17 (t, J = 5.4 Hz, 1H), 0.88 (t, J = 6.8 Hz, 3H); 13C NMR (126 MHz, CDCl₃) δ 139.31, 122.46, 59.99, 35.21, 31.77, 29.14, 28.30, 22.64, 14.09, 13.10; FTIR (thin film) 3327, 2957, 2928, 2859, 1456, 1379, 1242, 1005, 833, 743, 725 cm⁻¹; HRMS (EI⁺) m/z 156.1511 [calculated mass for C₁₀H₂₀O (M)⁺ 156.1514].
(Z)-2-(p-tolyl)but-2-en-1-ol (5)

![Chemical structure of (Z)-2-(p-tolyl)but-2-en-1-ol (5)]

1H NMR (499 MHz, Chloroform-d) δ 7.32 (d, J = 8.1 Hz, 2H), 7.14 (d, J = 7.9 Hz, 2H), 5.93 (q, J = 7.0 Hz, 1H), 4.58 (d, J = 5.7 Hz, 2H), 2.34 (s, 3H), 1.88 (d, J = 7.0 Hz, 3H), 1.30 (t, J = 5.8 Hz, 1H); 13C NMR (126 MHz, CDCl3) δ 139.31, 137.99, 136.72, 129.18, 126.08, 125.78, 59.50, 21.05, 14.02; FTIR (thin film) 3350, 3022, 2920, 2862, 1512, 1437, 1024, 982, 810 cm⁻¹; HRMS (EI⁺) m/z 162.1042 [calculated mass for C11H14O (M)+ 162.1045].

4-butyloct-3-en-1-ol (6)

![Chemical structure of 4-butyloct-3-en-1-ol (6)]

1H NMR (499 MHz, Chloroform-d) δ 5.09 (t, J = 7.4 Hz, 1H), 3.62 (q, J = 6.3 Hz, 2H), 2.30 (q, J = 6.8 Hz, 2H), 2.02 (dt, J = 14.5, 7.5 Hz, 4H), 1.41 – 1.24 (m, 9H), 0.94 – 0.87 (m, 6H); 13C NMR (126 MHz, CDCl3) δ 143.78, 119.44, 62.71, 36.74, 31.32, 30.84, 30.48, 29.96, 22.90, 22.55, 14.05, 14.03; FTIR (thin film) 3331, 2957, 2930, 2872, 2860, 1456, 1049, 735 cm⁻¹; HRMS (EI⁺) m/z 184.1830 [calculated mass for C12H24O (M)+ 184.1827].

(Z)-cyclooct-2-enol (7)

![Chemical structure of (Z)-cyclooct-2-enol (7)]

1H NMR (499 MHz, Chloroform-d) δ 5.61 (dddd, J = 10.7, 8.8, 7.2, 1.6 Hz, 1H), 5.52 (ddd, J = 10.8, 6.7, 1.2 Hz, 1H), 4.70 – 4.60 (m, 1H), 2.24 – 2.02 (m, 2H), 1.95 – 1.86 (m, 1H), 1.71 – 1.32 (m, 8H); 13C NMR (126 MHz, CDCl3) δ 134.94, 128.68, 69.50, 38.67, 29.10, 26.34, 25.94, 23.73; FTIR (thin film) 3325, 3017, 2926, 2857, 1136, 1055, 986, 849, 752, 667 cm⁻¹; HRMS (EI⁺) m/z 126.1039 [calculated mass for C8H14O (M)+ 126.1045].

TES-Protected Diol (8)

![Chemical structure of TES-Protected Diol (8)]

1H NMR (499 MHz, Chloroform-d) δ 5.53 (dqd, J = 11.0, 6.9, 1.2 Hz, 1H), 5.37 – 5.28 (m, 1H), 4.49 (dd, J = 8.6, 6.8, 5.8, 1.2 Hz, 1H), 3.57 (dd, J = 10.1, 6.5 Hz, 1H), 3.42 (dd, J = 10.1, 5.8 Hz, 1H), 1.66 (dd, J = 6.9, 1.8 Hz, 3H), 0.95 (td, J = 7.9, 2.0 Hz, 18H), 0.59 (q, J = 8.1 Hz, 12H); 13C NMR (126 MHz, CDCl3) δ 132.03, 125.54, 69.38, 67.40, 13.56, 6.78, 6.77, 4.89, 4.45; FTIR
(thin film) 3019, 2955, 2913, 2878, 1460, 1414, 1238, 1121, 1092, 1005, 964, 785, 743 cm⁻¹; HRMS (EI⁺) m/z 330.2415 [calculated mass for C₁₇H₃₈O₂Si₂ (M)⁺ 330.2410].

\((E)-3\text{-phenylpent-3-en-1-ol}\) (9)

![Image of \((E)-3\text{-phenylpent-3-en-1-ol}\) (9)]

\(^1\)H NMR (400 MHz, CDCl₃) \(\delta\) 7.35 – 7.27 (m, 4H), 7.24 – 7.20 (m, 1H), 5.91 (qt, \(J = 6.9\), 0.6 Hz, 1H), 3.64 (t, \(J = 6.8\) Hz, 2H), 2.86 – 2.80 (m, 2H), 1.85 (dt, \(J = 6.9\), 0.6 Hz, 3H); \(^1\)C NMR (100 MHz, CDCl₃) \(\delta\) 142.64, 136.83, 128.35, 126.79, 126.24, 125.79, 61.22, 32.87, 14.37; IR (neat) 3338, 3028, 2956, 2933, 2877, 1492, 1442, 1045, 1020, 758, 742, 698 cm⁻¹; HRMS (EI⁺) m/z 162.1042 [(M⁺) calcd for C₁₁H₁₄O 162.1045].

\(4\text{-methyl-3-phenylpent-3-en-1-ol}\) (10)

![Image of \(4\text{-methyl-3-phenylpent-3-en-1-ol}\) (10)]

\(^1\)H NMR (600 MHz, CDCl₃) \(\delta\) 7.33 – 7.29 (m, 2H), 7.23 – 7.20 (m, 1H), 7.11 – 7.08 (m, 2H), 3.54 (td, \(J = 6.8\), 5.9 Hz, 2H), 2.67 (t, \(J = 6.8\) Hz, 2H), 1.87 (s, 3H), 1.57 (s, 3H), 1.26 (t, \(J = 5.9\) Hz, 1H); \(^1\)C NMR (100 MHz, CDCl₃) \(\delta\) 143.24, 131.16, 130.81, 128.88, 128.12, 126.14, 60.91, 37.52, 22.32, 20.39; IR (neat) 3342, 3323, 3307, 2954, 2914, 2875, 1465, 1255, 1039, 702 cm⁻¹; HRMS (EI⁺) m/z 176.1201 [(M⁺); calcd for C₁₂H₁₆O: 176.1201].

\((E)-3\text{-phenylhex-3-en-1-ol}\) (11)

![Image of \((E)-3\text{-phenylhex-3-en-1-ol}\) (11)]

\(^1\)H NMR (400 MHz, CDCl₃) \(\delta\) 7.37 – 7.28 (m, 4H), 7.25 – 7.20 (m, 1H), 5.82 (t, \(J = 7.3\) Hz, 1H), 3.62 (td, \(J = 6.9\), 5.9 Hz, 2H), 2.81 (t, \(J = 6.9\) Hz, 2H), 2.25 (p, \(J = 7.5\) Hz, 2H), 1.33 (t, \(J = 5.9\) Hz, 1H), 1.07 (t, \(J = 7.5\) Hz, 3H); \(^1\)C NMR (100 MHz, CDCl₃) \(\delta\) 142.57, 135.28, 133.64, 128.33, 126.81, 126.30, 61.34, 33.11, 22.02, 14.40; IR (neat) 3338, 3331, 3024, 2962, 2931, 2872, 1492, 1456, 1444, 1043, 1029, 759, 696 cm⁻¹; HRMS (EI⁺) m/z 176.1208 [(M⁺); calcd for C₁₂H₁₆O: 176.1201].
(Z/E)-5-methyl-3-phenylhex-3-en-1-ol (12)

1H NMR (500 MHz, CDCl₃) δ 7.36 – 7.26 (m, 4H), 7.25 – 7.12 (m, 1H), 5.63 (d, J = 9.7 Hz, 1H), 3.61 (t, J = 6.9 Hz, 2H), 2.81 (dd, J = 7.1, 6.7 Hz, 2H), 1.05 (dd, J = 6.6, 2.4 Hz, 6H); 13C NMR (100 MHz, CDCl₃) δ 142.57, 140.65, 139.55, 138.18, 133.41, 128.34, 128.28, 128.23, 126.83, 126.72, 126.41, 61.47, 60.47, 42.45, 33.29, 28.00, 27.89, 23.37, 23.31; IR (neat) 3354, 3319, 2958, 2931, 2868, 1492, 1463, 1444, 1361, 1045, 1029, 761, 698 cm⁻¹; HRMS (EI⁺) m/z 190.1364 [(M⁺) calcd for C₁₃H₁₈O 190.1358]

(E/Z)-4-methyl-3-phenylhex-3-en-1-ol (13)

1H NMR (600 MHz, CDCl₃) δ 7.33 – 7.28 (m, 4H), 7.24 – 7.19 (m, 2H), 7.08 (tt, J = 8.0, 1.7 Hz, 4H), 3.56 – 3.49 (m, 4H), 2.64 (dt, J = 13.8, 6.5 Hz, 4H), 2.27 – 2.21 (m, 2H), 1.90 – 1.85 (m, 2H), 1.84 (s, 4H), 1.54 (d, J = 0.9 Hz, 2H), 1.27 (dt, J = 8.7, 5.9 Hz, 2H), 1.08 (t, J = 7.5 Hz, 2H), 0.90 (t, J = 7.5 Hz, 4H); 13C NMR (125 MHz, CDCl₃) δ 143.20, 133.52, 128.87, 128.66, 128.12, 128.03, 126.13, 61.01, 58.11, 40.36, 37.72, 36.99, 28.65, 27.06, 19.51, 17.27, 13.28, 13.21; IR (neat) 3355 3338, 3331, 3026, 2935, 2872, 1492, 1446, 1456, 1444, 1043, 1029, 759, 696 cm⁻¹; HRMS (EI⁺) m/z 190.1356 [(M⁺) calcd for C₁₃H₁₈O 190.1358].

(Z)-5-phenylpent-3-en-1-ol/(E)-5-phenylpent-4-en-1-ol (14)

1H NMR (400 MHz, CDCl₃) δ 7.39 – 7.29 (m, 7H), 7.25 – 7.20 (m, 5H), 6.46 (dt, J = 15.8, 1.4 Hz, 1H), 6.26 (dt, J = 15.8, 6.9 Hz, 1H), 5.79 (dtt, J = 10.6, 7.5, 1.6 Hz, 1.5H), 5.56 (dtt, J = 10.7, 7.4, 1.6 Hz, 1.5H), 3.78 – 3.69 (m, 5H), 3.47 (dd, J = 7.5, 0.6 Hz, 3H), 2.52 – 2.45 (m, 3H), 2.38 – 2.31 (m, 2H), 1.79 (ddd, J = 14.7, 7.4, 6.5 Hz, 2H), 1.01 – 0.94 (m, 1.5), 0.59 – 0.52 (m, 1H); 13C NMR (100 MHz, CDCl₃) δ 140.71, 137.60, 131.41, 130.37, 130.02, 128.48, 128.47, 128.29, 126.94, 126.19, 125.96, 125.93, 62.39, 62.26, 33.58, 32.23, 30.81, 29.30, 6.77, 6.40; IR (neat) 3377, 3358, 3340, 3323, 3026, 2935, 2912, 1494, 1462, 1454, 1068, 1060, 1006, 740, 694 cm⁻¹; HRMS (EI⁺) m/z 162.1051 [(M⁺) calcd for C₁₁H₁₄O 162.1045].
(Z)-undec-3-en-1-ol (15)

![Chemical structure](image)

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 5.56 (dtt, $J = 10.4, 7.3, 1.5$ Hz, 1H), 5.35 (dtt, $J = 10.6, 7.4, 1.6$ Hz, 1H), 3.64 (dd, $J = 12.3, 6.5$ Hz, 2H), 2.33 (ddt, $J = 7.1, 6.5, 1.4, 0.6$ Hz, 2H), 2.06 (dd, $J = 13.3, 6.9$ Hz, 2H), 1.40 – 1.20 (m, 12H), 0.91 – 0.85 (m, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 133.62, 124.90, 62.35, 31.84, 30.80, 29.70, 29.26, 29.19, 27.37, 22.65, 14.09; IR (neat) 3331, 3007, 2954, 2924, 2854, 1465, 1458, 1049, 1020, 970, 723 cm$^{-1}$; HRMS (EI$^+$) m/z 170.1676 [(M$^+$) calcd for C$_{11}$H$_{22}$O 170.1671].

(Z)-dodec-3-en-1-ol (16)

![Chemical structure](image)

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 5.61 – 5.50 (m, 1H), 5.41 – 5.30 (m, 1H), 3.63 (ddd, $J = 12.2, 7.8, 6.3$ Hz, 2H), 2.33 (dtt, $J = 7.1, 6.5, 1.4, 0.6$ Hz, 2H), 2.10 – 1.98 (m, 2H), 1.39 – 1.20 (m, 13H), 0.92 – 0.83 (m, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 133.63, 124.90, 62.36, 31.88, 30.80, 29.70, 29.49, 29.31, 29.29, 27.38, 22.67, 14.10; IR (neat) 3323, 3007, 2954, 2924, 2854, 1467, 1456, 1377, 1049, 1024, 968, 721 cm$^{-1}$; HRMS (EI$^+$) m/z 166.1717 [(M-H$_2$O)$^+$ calcd for C$_{12}$H$_{22}$O 166.1722].

(Z)-3-phenethylpent-3-en-1-ol (17)

![Chemical structure](image)

$^1$H NMR (500 MHz, CDCl$_3$) $\delta$ 7.30 – 7.24 (m, 2H), 7.20 – 7.14 (m, 3H), 5.45 (q, $J = 6.8$ Hz, 1H), 3.68 (t, $J = 6.8$ Hz, 2H), 2.71 (dt, $J = 18.8, 8.3$ Hz, 2H), 2.39 (t, $J = 6.8$ Hz, 2H), 2.35 – 2.26 (m, 2H), 1.64 (d, $J = 6.8$ Hz, 3H); $^{13}$C NMR (125 MHz, CDCl$_3$) $\delta$ 142.13, 135.33, 128.31, 128.26, 125.75, 122.40, 60.88, 38.82, 34.96, 33.27, 13.48; IR (neat) 3342, 3323, 3305, 3026, 2953, 2875, 2860, 1602, 1494, 1454, 1043, 1029, 744, 698 cm$^{-1}$; HRMS (EI$^+$) m/z 190.1349 [(M$^+$) calcd for C$_{13}$H$_{18}$O 190.1358].

(Z)-3-ethylidenedecan-1-ol (18)

![Chemical structure](image)

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 5.39 (qd, $J = 6.8, 6.1$ Hz, 1H), 3.65 (td, $J = 6.8, 5.9$ Hz, 2H), 2.34 (t, $J = 6.8$ Hz, 2H), 2.03 – 1.91 (m, 2H), 1.63 (dtt, $J = 6.8, 1.2, 0.6$ Hz, 3H), 1.46 – 1.13 (m, 10H), 0.97 (t, $J = 7.9$ Hz, 1H), 0.91 – 0.85 (m, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 136.10,
121.70, 60.89, 36.94, 33.00, 31.85, 29.38, 29.21, 28.31, 22.66, 14.08, 13.42; IR (neat) 3342, 2954, 2926, 2873, 2856, 1457, 1454, 1257, 1039, 848, 740 cm⁻¹; HRMS (EI⁺) m/z 184.1821 [(M⁺) calcd for C₁₂H₂₄O 184.1827].

(Z)-3-(butan-2-ylidene) decan-1-ol (19)

\[ \text{C}_7\text{H}_{15} \]

\[
\begin{align*}
\text{HO} & \quad \text{C} \quad \text{H} \quad \text{O} \\
\end{align*}
\]

\[(Z)
\]

\[
\begin{align*}
\text{H NMR (400 MHz, CDCl}_3\text{)} \delta 3.62 (t, J = 7.0 \text{ Hz}, 2\text{H}), 2.32 (\text{td}, J = 7.0, 0.6 \text{ Hz}, 2\text{H}), 2.07 (\text{q}, J = 7.5 \text{ Hz}, 2\text{H}), 2.01 – 1.94 (\text{m}, 2\text{H}), 1.66 (s, 3\text{H}), 1.43 (s, 1\text{H}), 1.37 – 1.20 (\text{m}, 11\text{H}), 0.96 (t, J = 7.5 \text{ Hz}, 3\text{H}), 0.92 – 0.84 (\text{m}, 3\text{H}); \text{¹³C NMR (100 MHz, CDCl}_3\text{)} \delta 134.04, 127.87, 61.41, 35.02, 32.31, 31.89, 29.81, 29.27, 28.76, 27.24, 22.66, 17.54, 14.10, 13.28; \text{IR (neat) 3360, 3342, 2956, 2926, 2872, 2856, 1460, 1443, 1029, 1016, 760 cm}^{-1}; \text{HRMS (EI⁺) m/z 212.2145 [(M⁺) calcd for C}_{14}\text{H}_{28}\text{O 212.2140].}
\]

(Z)-3-propylidenedecan-1-ol (20)

\[ \text{C}_7\text{H}_{15} \]

\[
\begin{align*}
\text{HO} & \quad \text{C} \quad \text{H} \quad \text{O} \\
\end{align*}
\]

\[(Z)
\]

\[
\begin{align*}
\text{H NMR (400 MHz, CDCl}_3\text{)} \delta 5.31 (t, J = 7.2 \text{ Hz}, 1\text{H}), 3.64 (t, J = 6.8 \text{ Hz}, 2\text{H}), 2.32 (\text{p}, J = 7.5 \text{ Hz}, 2\text{H}), 2.05 (\text{p}, J = 7.5 \text{ Hz}, 2\text{H}), 2.00 – 1.94 (\text{m}, 2\text{H}), 1.56 (s, 1\text{H}), 1.43 – 1.20 (\text{m}, 12\text{H}), 0.95 (t, J = 7.5 \text{ Hz}, 3\text{H}), 0.92 – 0.84 (\text{m}, 3\text{H}); \text{¹³C NMR (125 MHz, CDCl}_3\text{)} \delta 134.39, 129.89, 60.98, 36.84, 33.30, 31.87, 29.36, 29.22, 28.35, 22.68, 21.16, 14.72, 14.11; \text{IR (neat) 3327, 2958, 2926, 2872, 2854, 1456, 1043, 759 cm}^{-1}; \text{HRMS (EI⁺) m/z 198.1978 [(M⁺) calcd for C}_{13}\text{H}_{26}\text{O 198.1984].}
\]

(E)-3-((E)-hex-1-en-1-yl)non-3-en-1-ol (21)

\[ \text{C}_7\text{H}_{15} \]

\[
\begin{align*}
\text{HO} & \quad \text{C} \quad \text{H} \quad \text{O} \\
\end{align*}
\]

\[(E)
\]

\[
\begin{align*}
\text{H NMR (600 MHz, CDCl}_3\text{)} \delta 5.98 (dd, J = 15.8, 0.7 \text{ Hz}, 1\text{H}), 5.62 (\text{dt}, J = 15.7, 6.9 \text{ Hz}, 1\text{H}), 5.51 (t, J = 7.4 \text{ Hz}, 1\text{H}), 3.66 (dd, J = 12.9, 6.9 \text{ Hz}, 2\text{H}), 2.54 (t, J = 6.9 \text{ Hz}, 2\text{H}), 2.13 (dd, J = 14.9, 7.4 \text{ Hz}, 2\text{H}), 2.08 (dt, J = 7.9, 4.0 \text{ Hz}, 2\text{H}), 1.42 – 1.24 (\text{m}, 9\text{H}), 0.91 – 0.87 (\text{m}, 6\text{H}); \text{¹³C NMR (100 MHz, CDCl}_3\text{)} \delta 133.56, 133.38, 133.28, 127.96, 61.73, 32.56, 31.77, 31.59, 30.24, 29.53, 28.23, 22.57, 22.26, 14.03, 13.95; \text{IR (neat) 3327, 3311, 3018, 2956, 2926, 2872, 2856, 1463, 1454, 1377, 1041, 1020, 964 cm}^{-1}; \text{HRMS (EI⁺) m/z 224.2144 [(M⁺) calcd for C}_{15}\text{H}_{28}\text{O 224.2140].}
\]
(E)-3-((E)-non-1-en-1-yl)dodec-3-en-1-ol (22)

![Chemical Structure](image)

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 5.97 (dd, $J = 15.8, 0.7$ Hz, 1H), 5.61 (dt, $J = 15.7, 6.9$ Hz, 1H), 5.50 (t, $J = 7.4$ Hz, 1H), 3.66 (t, $J = 6.9$ Hz, 2H), 2.54 (t, $J = 6.9$ Hz, 2H), 2.18 – 2.03 (m, 4H), 1.45 – 1.18 (m, 23H), 0.88 (t, $J = 6.9$ Hz, 6H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 133.55, 133.36, 133.25, 128.00, 61.71, 32.91, 31.87, 31.81, 30.24, 29.87, 29.62, 29.54, 29.51, 29.42, 29.35, 29.27, 29.20, 29.17, 28.27, 22.65, 14.08; IR (neat) 3315, 3016, 2954, 2924, 2852, 1465, 1377, 1041, 1020, 964, 721 cm$^{-1}$; HRMS (EI$^+$) m/z 308.3085 [(M$^+$); cacld for C$_{21}$H$_{40}$O 308.3079].

(Z)-3-(butan-2-ylidene)undecan-1-ol (23)$^1$

![Chemical Structure](image)

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 3.62 (t, $J = 7.0$ Hz, 2H), 2.32 (td, $J = 7.0, 0.7$ Hz, 2H), 2.08 – 2.00 (m, 1H), 2.00 – 1.95 (m, 2H), 1.66 (s, 3H), 1.38 – 1.20 (m, 11H), 0.95 (d, $J = 7.5$ Hz, 3H), 92 – 0.85 (m, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 134.01, 127.86, 61.41, 35.02, 32.30, 31.88, 29.81, 29.69, 29.27, 28.76, 22.66, 17.52, 14.10, 13.18; IR (neat) 3361, 3344, 2956, 2926, 2872, 2854, 1456, 1435, 1377, 1043, 1016, 740 cm$^{-1}$; HRMS (EI$^+$) m/z 213.2208 [(M$^+$) cacld for C$_{24}$H$_{27}$DO 213.2203].

3-phenylpentan-1-ol (24)$^2$

![Chemical Structure](image)

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.31 – 7.26 (m, 2H), 7.21 – 7.13 (m, 3H), 3.59 – 3.39 (m, 2H), 2.59 (tt, $J = 10.1, 5.2$ Hz, 1H), 2.00 – 1.91 (m, 1H), 1.80 (dddd, $J = 13.7, 10.0, 6.5, 5.4$ Hz, 1H), 1.74 – 1.57 (m, 2H), 1.11 (t, $J = 5.3$ Hz, 1H), 0.78 (t, $J = 7.4$ Hz, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 144.95, 128.39, 127.67, 126.14, 61.27, 44.29, 39.26, 29.79, 12.08.

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$^1$ 97% Et$_3$SiD from Aldrich was used, >95% of compound was found to be labeled according to HRMS

$^2$ Known compound, see J. Org. Chem, 1992, V57, 1237-1241
2-(2,3-dimethyl-2,3-dihydro-1H-inden-1-yl)ethanol (25)

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\begin{align*}
\text{H NMR (400 MHz, CDCl}_3\text{)} & \delta 7.22 – 7.11 (m, 4H), 3.85 (td, J = 7.2, 4.6 Hz, 2H), 2.74 (dt, J = 9.3, 5.9 Hz, 1H), 2.63 (tt, J = 13.6, 6.8 Hz, 1H), 2.14 (dtd, J = 13.9, 7.3, 5.6 Hz, 1H), 1.92 (dtd, J = 13.8, 6.7, 3.2 Hz, 1H), 1.68 – 1.56 (m, 1H), 1.35 (q, J = 5.1 Hz, 1H), 1.30 (dd, J = 6.8, 2.4 Hz, 3H), 1.22 (d, J = 6.6 Hz, 3H);\end{align*}
\]
\[
\begin{align*}
\text{C NMR (100 MHz, CDCl}_3\text{)} & \delta 147.81, 146.11, 126.44, 126.35, 123.00, 122.92, 61.42, 50.09, 47.86, 45.97, 36.34, 17.75, 17.56;\end{align*}
\]
IR (neat) 3338, 3330, 3024, 2962, 2931, 2872, 1043, 1029, 962, 759, 696 cm\(^{-1}\); HRMS (EI\(^+\)) m/z 190.1362 [(M\(^+\)) calcd for C\(_{13}\)H\(_{18}\)O 190.1358].