

Supporting Information (6 pages)

**Reactivity of *N*-alkanoyloxy-2,2,6,6-tetramethylpiperidines (*O*-acylTEMPO) towards hydride-transferring or metallic alkylating reagents; unprecedented stability and application to chemoselective transformations**

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## Experimental Procedure

IR spectra were obtained with a Horiba, Model FT-210, or a JASCO, Model FT/IR-230, fourier transform infrared spectrometer instrument, and only major absorptions are cited.  $^1\text{H}$  and  $^{13}\text{C}$  NMR spectra were recorded on JEOL JNM-AL400 and Varian Mercury-300 instruments with  $\text{CDCl}_3$  as a solvent unless otherwise indicated.

**1. Preparation of *O*-acylTEMPOs 1c.** In a 50 mL one-necked flask were placed  $\text{C}_{10}\text{H}_8$  (160 mg, 1.2 mmol), TEMPO• (3.12 g, 20 mmol), and THF (15  $\text{cm}^3$ ). To this solution was added Na metal (632 mg, 27 mmol) and the mixture was stirred at room temperature until Na dissolved and blue-black color of  $\text{Na}^+[\text{C}_{10}\text{H}_8]^\bullet$  persisted. To a cooled (0~4 °C) solution of cyclohexanecarbonyl chloride ( $\text{R} = c\text{-C}_6\text{H}_{11}$ , 3.0  $\text{cm}^3$ , 22 mmol) in THF (10  $\text{cm}^3$ ) was added dropwise a chilled solution of the above TEMPO anion. The mixture was stirred at 0~4°C for 3 h and at room temperature for 12 h. The reaction was quenched with cold aqueous  $\text{NaHCO}_3$  and products were extracted with AcOEt, worked up in a usual manner, and purified by distillation to give 4.5 g (84% based on TEMPO•) of **1c**: bp 109-110 °C (0.07 Torr); IR (Neat) 1762, 1450, 1376, 1363, 1247, 1149, 1132, 1105, 993, 937, 819  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR (300 MHz)  $\delta$  1.03, 1.15 (s, 12H), 1.20-1.82 (m, 14H), 1.92-2.01 (m, 2H), 2.32-2.43 (m, 1H);  $^{13}\text{C}$  NMR (75.5 MHz)  $\delta$  14.6, 18.2 (2C), 23.2 (2C), 23.4, 27.0 (2C), 29.5 (2C), 36.6 (2C), 40.5, 57.4 (2C), 172.6.

**Preparation of alkanedioic acid alkyl/TEMP-1-yl ester 4~6 and 10 a, a typical procedure.** To a solution of glutaric anhydride (1.37 g, 12 mmol) in THF (10  $\text{cm}^3$ ) was added dropwise at 0~4°C a solution of the TEMPO anion, prepared from TEMPO• (1.56 g, 10 mmol), Na (320 mg, 14 mmol), and  $\text{C}_{10}\text{H}_8$  (80 mg, 0.62 mmol) in THF (10  $\text{cm}^3$ ). The solids precipitated during the addition. After stirring at room temperature for 2 h, the mixture was cooled to 0~4 °C, and to this mixture was added MeI (3.0  $\text{cm}^3$ , 48 mmol) and DMF (6  $\text{cm}^3$ ). The mixture was allowed to warm to room temperature and then heated at 55 °C for 48 h. The mixture was poured into cold aqueous  $\text{NaHCO}_3$ , and extracted with AcOEt. Usual workup followed by purification by column chromatography ( $\text{SiO}_2$ , hexane-AcOEt, 10:1, 7:1, 5:1, then 3:1) gave 1.33 g (46 %) of **5** ( $R_f$  = 0.35, hexane-AcOEt 5:1).

EtO<sub>2</sub>C(CH<sub>2</sub>)<sub>4</sub>CO<sub>2</sub>TEMP (**4**): IR (Neat) 2976, 2935, 1766, 1736, 1464, 1377, 1365, 1248, 1182, 1120, 1045, 930, 872 cm<sup>-1</sup>; <sup>1</sup>H NMR (400 MHz) δ 1.01, 1.11 (s, 12H), 1.22 (t, *J* = 7.2 Hz, 3H), 1.34-1.84 (m, 10H), 2.25-2.36 (m, 4H), 4.09 (q, *J* = 14.8, 7.2 Hz, 2H); <sup>13</sup>C NMR (100 MHz) δ 14.4, 17.1, 20.6 (2C), 24.77, 24.79, 32.1 (2C), 32.7, 34.0, 39.1 (2C), 59.9 (2C), 60.3, 172.6, 173.0. HRMS (EI) calcd for C<sub>17</sub>H<sub>31</sub>NO<sub>4</sub> 313.2253, found 313.2263.

MeO<sub>2</sub>C(CH<sub>2</sub>)<sub>3</sub>CO<sub>2</sub>TEMP (**5**): IR (Neat) 2937, 1765, 1739, 1439, 1379, 1363, 1248, 1173, 1122, 1045, 939, 874 cm<sup>-1</sup>; <sup>1</sup>H NMR (400 MHz) δ 1.00, 1.10 (s, 12H), 1.33-1.84 (m, 8H), 1.93-2.01 (m, 2H), 2.37 (t, *J* = 7.6 Hz, 2H), 3.64 (s, 3H); <sup>13</sup>C NMR (100 MHz) δ 17.1, 20.5, 20.6 (2C), 31.9, 32.0 (2C), 33.3, 39.0 (2C), 51.6, 59.9 (2C), 172.2, 173.0. HRMS (EI) calcd for C<sub>15</sub>H<sub>27</sub>NO<sub>4</sub> 285.1940, found 285.1907.

MeO<sub>2</sub>C(CH<sub>2</sub>)<sub>2</sub>CO<sub>2</sub>TEMP (**6**): IR (Neat) 2935, 1765, 1741, 1439, 1363, 1265, 1209, 1174, 1130, 1047, 995, 949, 887, 845, 793 cm<sup>-1</sup>; <sup>1</sup>H NMR (400 MHz) δ 1.03, 1.13 (s, 12H), 1.21-1.72 (m, 6H), 2.66 (s, 4H), 3.67 (s, 3H); <sup>13</sup>C NMR (100 MHz) δ 16.9, 20.4 (2C), 27.7, 29.0, 31.8 (2C), 39.0 (2C), 51.7, 59.9 (2C), 171.4, 172.2. HRMS (EI) calcd for C<sub>14</sub>H<sub>25</sub>NO<sub>4</sub> 271.1824, found 271.1824.

The compound **10** (*cis/trans*=14/1): IR (Neat) 3028, 2933, 2848, 1768, 1730, 1655, 1435, 1379, 1365, 1296, 1134, 1034, 955, 953, 908, 872, 812, 789, 733 cm<sup>-1</sup>; <sup>1</sup>H NMR (400 MHz) δ 1.00, 1.01, 1.10, 1.11 (s, 12H), 1.32-1.73 (m, 6H), 2.32-2.49 (m, 2H), 2.56-2.73 (m, 2H), 2.92-2.99 (m, 1H), 3.15-3.23 (m, 1H), 3.63 and 3.66 (s, 3H), 5.67 (brs, 2H); <sup>13</sup>C NMR (100 MHz) δ 17.1, 20.8 (2C), 25.8, 26.8, 31.8, 31.9, 39.2, 39.3 (2C), 39.5, 51.8, 60.1 60.2, 124.9, 125.4, 172.2, 173.4.

**LiAlH<sub>4</sub> reduction of 1a, a typical procedure.** To a solution of **1a** (100 mg, 0.34 mmol) in THF (2 cm<sup>3</sup>) was added LiAlH<sub>4</sub> (80%, 39 mg, 0.82 mmol) at room temperature under N<sub>2</sub> and the mixture was stirred at the same time for 1h, quenched with cold sat. NH<sub>4</sub>Cl, and worked up in the usual manner to give 45 mg (95%) of **3a** after column chromatography (SiO<sub>2</sub>, hexane-AcOEt 10:1 and 5:1).

**Grignard reaction of 4, a typical procedure.** To a solution of **4** (100 mg, 0.32 mmol)

in THF (2 cm<sup>3</sup>) was added dropwise PhMgBr (1.0 M in THF, 0.96 cm<sup>3</sup>, 0.96 mmol) at 0 °C under N<sub>2</sub> and the mixture was stirred at room temperature for 2 h, quenched with cold sat. NH<sub>4</sub>Cl. Usual workup and purification by column chromatography (SiO<sub>2</sub>, hexane-AcOEt 10:1 and 5:1) gave 112 mg (83%) of **7b** (R = Ph). Spectral data and HRMS data of the products are as follows:

4-MeOC<sub>6</sub>H<sub>4</sub>CH<sub>2</sub>OH (**3a**): IR (Neat) 3367, 3003, 2935, 2837, 1612, 1585, 1514, 1464, 1302, 1248, 1174, 1111, 1034, 818, 754, 708 cm<sup>-1</sup>; <sup>1</sup>H NMR (400 MHz) δ 2.27, (brs, 1H), 3.78 (s, 3H), 4.56 (s, 2H), 6.87 (d, *J* = 8.8 Hz, 2H), 7.25 (d, *J* = 8.8 Hz, 2H); <sup>13</sup>C NMR (100 MHz) δ 55.2, 64.8, 113.7 (2C), 128.4 (2C), 132.9, 158.8.

*c*-C<sub>6</sub>H<sub>11</sub>CH<sub>2</sub>OH (**3c**): IR (Neat) 3377, 2924, 2852, 1448, 1379, 1360, 1342, 1259, 1173, 1130, 1090, 1034, 910, 791, 735 cm<sup>-1</sup>; <sup>1</sup>H NMR (400 MHz) δ 0.80-1.73 (m, 12H), 3.40 (d, *J* = 6.0 Hz, 2H); <sup>13</sup>C NMR (100 MHz) δ 26.2 (2C), 26.9, 30.0 (2C), 40.9, 69.0.

HOCH<sub>2</sub>(CH<sub>2</sub>)<sub>4</sub>COOTEMP (**7a**): IR (Neat) 3448, 2935, 2870, 1759, 1462, 1379, 1365, 1265, 1248, 1209, 1182, 1132, 1076, 939, 874 cm<sup>-1</sup>; <sup>1</sup>H NMR (400 MHz) δ 0.96, 1.07 (s, 12H), 1.30-1.68 (m, 12H), 2.26, (brs, 1H), 2.28 (t, *J* = 7.6 Hz, 2H), 3.56 (t, *J* = 6.4 Hz, 2H); <sup>13</sup>C NMR (100 MHz) δ 17.0, 20.5 (2C), 24.9, 25.5, 31.9 (2C), 32.2, 32.8, 38.9 (2C), 59.9 (2C), 62.3, 173.0. HRMS (EI) calcd for C<sub>15</sub>H<sub>29</sub>NO<sub>3</sub> 271.2147, found 271.2195.

Ph<sub>2</sub>(OH)C(CH<sub>2</sub>)<sub>4</sub>COOTEMP (**7b**): IR (KBr) 3462, 3057, 2939, 2870, 1753, 1599, 1493, 1448, 1363, 1263, 1132, 1063, 972, 937, 872, 752, 700 cm<sup>-1</sup>; <sup>1</sup>H NMR (400 MHz) δ 0.94, 1.06 (s, 12H), 1.20-1.70 (m, 10H), 2.10, (brs, 1H), 2.22-2.28 (m, 4H), 7.13-7.17 (m, 2H), 7.22-7.25 (m, 4H), 7.31-7.36 (m, 4H); <sup>13</sup>C NMR (100 MHz) δ 17.1, 20.6 (2C), 23.8, 25.7, 32.0 (2C), 33.1, 39.0 (2C), 41.7, 59.9 (2C), 78.1, 125.8 (4C), 126.6 (2C), 128.0 (4C), 146.7 (2C), 172.8. HRMS (EI) calcd for C<sub>27</sub>H<sub>37</sub>NO<sub>3</sub> 423.2773, found 423.2766.

Me<sub>2</sub>(OH)C(CH<sub>2</sub>)<sub>4</sub>COOTEMP (**7c**): IR (Neat) 3483, 2972, 2937, 1757, 1468, 1379, 1365, 1248, 1209, 1132, 1111, 1045, 910, 733 cm<sup>-1</sup>; <sup>1</sup>H NMR (400 MHz) δ 1.00, 1.10 (s, 12H), 1.16 (s, 6H), 1.33-1.70 (m, 13H), 2.32 (t, *J* = 7.6 Hz, 2H); <sup>13</sup>C NMR (100 MHz) δ 17.1, 20.6 (2C), 24.2, 25.8, 29.3 (2C), 32.0 (2C), 33.0, 39.0 (2C), 43.5, 59.9 (2C), 70.8, 172.9. HRMS (EI) calcd for C<sub>17</sub>H<sub>33</sub>NO<sub>3</sub> 299.2460, found 299.2454.

allyl<sub>2</sub>(OH)C(CH<sub>2</sub>)<sub>4</sub>COOTEMP (**7d**): IR (Neat) 3473, 3074, 2976, 2937, 1755, 1639, 1446, 1379, 1363, 1248, 1182, 1132, 1045, 997, 912, 733 cm<sup>-1</sup>; <sup>1</sup>H NMR (400 MHz) δ 1.01, 1.11 (s, 12H), 1.25-1.72 (m, 13H), 2.13-2.24 (m, 4H), 2.32 (t, *J* = 7.6 Hz, 2H), 5.02-5.16 (m, 4H), 5.74-5.88 (m, 2H); <sup>13</sup>C NMR (100 MHz) δ 17.0, 20.5 (2C), 23.2, 25.7, 31.9 (2C), 32.9, 38.7, 38.9 (2C), 43.7 (2C), 59.8 (2C), 73.1, 118.5 (2C), 133.3 (2C), 172.8. HRMS (EI) calcd for C<sub>21</sub>H<sub>37</sub>NO<sub>3</sub> 351.2773, found 351.2796.

allyl<sub>2</sub>(OH)C(CH<sub>2</sub>)<sub>4</sub>C(allyl)2OH (by-product): IR (Neat) 3429, 3074, 3006, 2978, 2939, 2864, 1639, 1441, 1263, 1132, 997, 914, 796, 735 cm<sup>-1</sup>; <sup>1</sup>H NMR (400 MHz) δ 1.27-1.40 (m, 4H), 1.40-1.50 (m, 4H), 1.60 (brs, 2H), 2.14-2.25 (m, 8H), 5.05-5.16 (m, 8H), 5.76-5.89 (m, 4H, CH=C); <sup>13</sup>C NMR (100 MHz) δ 24.0 (2C), 39.2 (2C), 43.8 (4C), 73.4 (2C), 118.37, 118.47, 118.51, 118.65, 133.6 (4C).

(PhCC)<sub>2</sub>(OH)C(CH<sub>2</sub>)<sub>4</sub>COOTEMP (**7e**): IR (Neat) 3402, 3055, 2943, 2870, 2227, 1753, 1599, 1489, 1442, 1365, 1265, 1182, 1132, 1088, 995, 916, 872, 758 cm<sup>-1</sup>; <sup>1</sup>H NMR (400 MHz) δ 0.96, 1.05 (s, 12H), 1.37-1.67 (m, 6H), 1.70-1.80 (m, 4H), 2.02-2.09 (m, 2H), 2.31-2.38 (m, 2H), 2.88 (brs, 1H), 7.18-7.27 (m, 6H), 7.37-7.43 (m, 4H); <sup>13</sup>C NMR (100 MHz) δ 17.0, 20.6 (2C), 24.7, 25.1, 32.0 (2C), 33.0, 39.0 (2C), 43.7, 59.9 (2C), 64.2, 83.6 (2C), 89.2 (2C), 121.9 (2C), 128.0 (4C), 128.5 (2C), 131.6 (4C), 172.8.

HOCH<sub>2</sub>(CH<sub>2</sub>)<sub>3</sub>COOTEMP (**8a**): IR (Neat) 3448, 2939, 2871, 1755, 1456, 1379, 1365, 1246, 1209, 1182, 1132, 1045, 995, 912, 795, 735 cm<sup>-1</sup>; <sup>1</sup>H NMR (400 MHz) δ 0.97, 1.08 (s, 12H), 1.30-1.75 (m, 10H), 2.30 (brs, 1H), 2.32 (t, *J* = 7.2 Hz, 2H), 3.59 (t, *J* = 6.4 Hz, 2H); <sup>13</sup>C NMR (100 MHz) δ 17.0, 20.6 (2C), 21.4, 31.9 (2C), 32.2, 32.5, 38.9 (2C), 59.9 (2C), 61.9, 173.1. HRMS (EI) calcd for C<sub>14</sub>H<sub>27</sub>NO<sub>3</sub> 257.1991, found 257.1969.

Ph<sub>2</sub>(OH)C(CH<sub>2</sub>)<sub>3</sub>COOTEMP (**8b**): IR (KBr) 3411, 3059, 3005, 2939, 2870, 1745, 1599, 1493, 1446, 1425, 1354, 1296, 1244, 1136, 1059, 1032, 1009, 976, 926, 870, 816, 775, 754, 700 cm<sup>-1</sup>; <sup>1</sup>H NMR (400 MHz) δ 0.97, 1.06 (s, 12H), 1.31-1.69 (m, 8H), 2.37, (brs, 1H), 2.25-2.35 (m, 4H), 7.12-7.18 (m, 2H), 7.20-7.28 (m, 4H), 7.33-7.39 (m, 4H); <sup>13</sup>C NMR (100 MHz) δ 17.1, 19.6, 20.6 (2C), 32.1 (2C), 32.6, 39.0 (2C), 41.3, 59.9 (2C),

78.0, 126.1 (4C), 126.6 (2C), 127.9 (4C), 146.6 (2C), 173.0. HRMS (EI) calcd for  $C_{26}H_{35}NO_3$  409.2617, found 409.2614.

$Me_2(OH)C(CH_2)_2COOTEMP$  (**9a**): mp 72-73 °C; IR (KBr) 3371, 1741, 1671, 1440, 1365, 1274, 1245, 1182, 1130, 1108, 1049, 945, 923  $cm^{-1}$ ;  $^1H$  NMR (300 MHz)  $\delta$  1.05, 1.15 (s, 12H), 1.25 (s, 6H), 1.35-1.80 (m, 6H), 1.81-1.87 (m, 2H), 2.17 (brs), 2.49 (t,  $J$  = 8.3 Hz, 2H);  $^{13}C$  NMR (100 MHz)  $\delta$  16.9, 20.4 (2C), 27.8, 29.2 (2C), 31.9 (2C), 38.1, 38.9 (2C), 59.9 (2C), 70.0, 174.0. HRMS (EI) calcd for  $C_{15}H_{29}NO_3$  271.2147, found 271.2179.

The compound **11** (*cis/trans*=14/1): IR (Neat) 3437, 2935, 1749, 1651, 1439, 1379, 1365, 1265, 1132, 1045, 976, 955, 910, 872, 733  $cm^{-1}$ ;  $^1H$  NMR (400 MHz)  $\delta$  1.00, 1.03, 1.11, 1.13 (s, 12H), 1.30-1.71 (m, 6H), 1.84-2.80 (m, 6H), 2.88-2.96 (m, 1H), 3.58-3.65 (m, 1H), 3.72-3.79 (m, 1H), 5.60-5.75 (m, 2H);  $^{13}C$  NMR (100 MHz)  $\delta$  16.8, 20.6 (2C), 25.8, 26.9, 31.8 (2C), 36.8, 38.9 (2C), 39.8, 59.9 (2C), 63.4, 124.5, 125.4, 174.3.

$Ph_2(OH)C(CH_2)_4CO_2H$ : IR (KBr) 3556, 3508, 2951, 1712, 1676, 1493, 1466, 1448, 1425, 1402, 1315, 1261, 1196, 1171, 1059, 1030, 976, 914, 876, 779, 758, 702  $cm^{-1}$ ;  $^1H$  NMR (400 MHz)  $\delta$  1.23-1.34 (m, 3H,  $CH_2$ , OH), 1.55-1.66 (m, 2H,  $CH_2$ ), 2.19-2.30 (m, 4H,  $CH_2$ ), 7.13-7.38 (m, 10H, Ph);  $^{13}C$  NMR (100 MHz)  $\delta$  16.9, 20.4 (2C), 27.8, 29.2 (2C), 31.9 (2C), 38.1, 38.9 (2C), 59.9 (2C), 70.0, 174.0. HRMS (EI) calcd for  $C_{18}H_{20}O_3$  284.1412, found 284.1412.