

# Cumyl Ester as the C-terminal Protecting Group in the Enantioselective Alkylation of Glycine Benzophenone Imine.

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## Supporting Information

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## **Part A. General Considerations**

All reagents were purchased from commercial suppliers and used as received. NMR spectra were recorded on a Varian FT-NMR Mercury-300, 400 or 500 MHz Spectrometer. Low-resolution mass spectra were recorded on a Waters ZQ2000 single quadrupole mass spectrometer using an electrospray ionization source, while high-resolution mass spectra were recorded on a Waters-Micromass LCT Premier XE time of flight mass spectrometer. IR spectra were recorded on a Nicolet FT-IR spectrophotometer. Optical rotations were obtained by using Autopol III Automatic Polarimeter. HPLC was performed on an Agilent 1200 Preparative Purification System equipped with a multi-wavelength detector. Column purifications were performed using silica gel flash chromatography unless mentioned otherwise. Compounds **1a**<sup>1</sup>, **1b**<sup>1</sup>, **3**<sup>2</sup>, **8**<sup>3</sup>, <sup>4</sup>and benzophenone imine<sup>5</sup> used in this report were synthesized according to previously reported literature procedures. All reactions were performed under ambient atmosphere unless otherwise noted.

### **Compound abbreviations are as follows:**

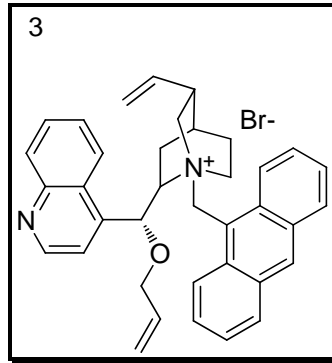
NBS: *N*-Bromosuccinimide

TBAH: Tetrabutylammonium hydrogensulfate

TFA: Trifluoroacetic acid

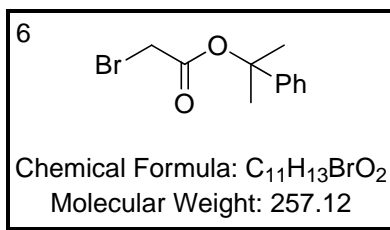
DIPEA: *N,N*-Diisopropylethylamine

## Structures of CPTC



**Part B.** Experimental procedures and tabulated characterization data for new compounds

**2-phenylpropan-2-yl 2-bromoacetate (6).**

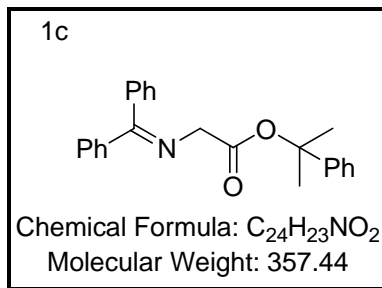


Sodium hydride (60% in oil, 180 mg 4.50 mmol) was suspended in anhydrous ether (4.50 mL) and a solution of 2-phenyl-2-propanol in ether (6.50 mL) was added dropwise with stirring, under an Ar atmosphere. After 20 min the solids dissolved and the solution was cooled to 0°C. Trichloroacetonitrile (6.82 g, 47.2 mmol) was added dropwise over 15 min and the reaction mixture was allowed to warm up to rt over 60 min. The reaction mixture was concentrated to a syrup and pentane (4.50 mL) was added. The resulting solution was filtered and the filter cake was washed with pentane (2 × 5 mL). The filtrate was evaporated to give the crude imidate that was used as is without further purification. The imidate was stored at -20°C as solutions in cyclohexanes (1.00 mmol/1.00 mL) for periods up to 2 months.<sup>6</sup>

The imidates in cyclohexanes (3.00 mL, 3.00 mmol) were added to bromoacetic acid (417 mg, 3.00 mmol) in dry CH<sub>2</sub>Cl<sub>2</sub> under Ar at rt and the resulting solution stirred for 12 h. Trichloroacetamide was removed by filtration and the filter cake was washed with CH<sub>2</sub>Cl<sub>2</sub>. The solvent was evaporated to give a solidifying crude mixture that was purified by flash chromatography on silica (5 to 10% EtOAc in hexanes) to afford the product **6** as an oil (696 mg, 2.71 mmol, 90%). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.44-7.32 (m, 4H), 7.32-7.25 (m, 1H), 3.80 (s, 2H), 1.82 (s, 6H), <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 165.8, 145.1, 128.6, 127.6, 124.5, 84.1, 28.6, 27.5; IR (thin film) 3089, 3061, 3028, 2982, 2935,

2875, 1737, 1603, 1584, 1496, 1468, 1449, 1420, 1384, 1367, 1285, 1202, 1178, 1139, 1100, 1077, 1030, 960, 938, 909, 827, 764, 699 HRMS (ESMS) calcd for C<sub>11</sub>H<sub>13</sub>BrO<sub>2</sub>Na 278.9997 (M+Na)<sup>+</sup>, found : 279.0003.

**2-phenylpropan-2-yl 2-((diphenylmethylene)amino)acetate (1c).**



To a solution of 2-phenylpropan-2-yl 2-bromoacetate (5.80 g, 22.6 mmol) in anhydrous CH<sub>3</sub>CN (23 mL), DIPEA (3.93 mL, 22.56 mmol) and benzophenone imine<sup>5</sup> (4.09 g, 22.6 mmol) were added under an Ar atmosphere. The resulting solution was stirred for 24 h at rt. After the completion of the reaction as determined by TLC analysis, the crude mixture was filtered through a cotton plug, dissolved with 75 mL of CH<sub>2</sub>Cl<sub>2</sub> and 50 mL of 5% NaHCO<sub>3</sub> in H<sub>2</sub>O. The organic layer was separated and the aqueous layer extracted with CH<sub>2</sub>Cl<sub>2</sub> (2 × 50 mL). The organic layers were combined, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated. The crude mixture was purified by flash chromatography on silica basified with 1% TEA (1% TEA in 4 to 9% EtOAc/hexanes) to give product **1c** as an oil (6.87g, 19.2 mmol, 85%).

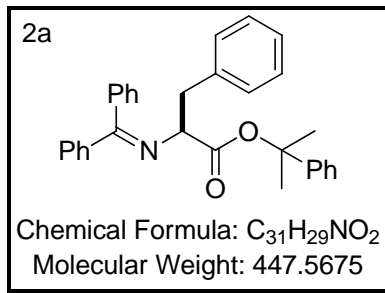
<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.71-7.66 (m, 2H), 7.50-7.45 (m, 3H), 7.43-7.31 (m, 7H), 7.29-7.33 (m, 1H), 7.20-7.15 (m, 2H), 4.26 (s, 2H), 1.82 (s, 6H), <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 172.0, 169.3, 145.9, 139.6, 136.3, 130.7, 130.3, 129.1, 129.0, 128.9, 128.5, 128.3, 128.0, 127.3, 124.6, 82.5, 56.6, 28.9; IR (thin film) 3058, 3026, 2980, 2929, 1744,

1659, 1625, 1598, 1577, 1495, 1446, 1383, 1343, 1315, 1274, 1193, 1137, 1102, 1076, 1029, 1000, 940, 907, 838, 764, 696 HRMS (ESMS) calcd for  $C_{24}H_{24}NO_2$  358.1807 (M+H)<sup>+</sup>, found : 358.1807.

**General procedure for the asymmetric alkylation of glycine benzophenone imine :**

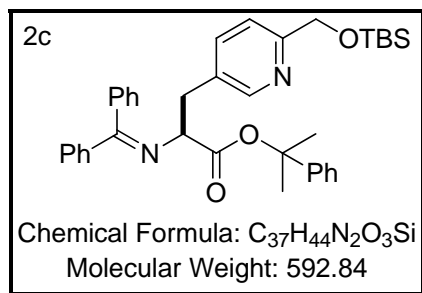
A solution of 2-phenylpropan-2-yl 2-((diphenylmethylene)amino)acetate (150 mg, 0.42 mmol) in Toluene/ $CHCl_3$  (7/3, 1.05 mL) in a Schlenk flask was treated with the catalyst **3** (18.2 mg, 0.03 mmol) and the resulting solution was cooled to -55°C. The electrophile (0.30 mmol) was then added at -55°C and the resulting solution stirred for 3 min.  $CsOH \cdot H_2O$  was then added in one portion (504 mg, 3.00 mmol) at -55°C and the resulting solution turned rapidly yellow and was stirred at -55°C for 12-24 h. The completion of the reaction was followed by TLC. The crude was then dissolved in 10 mL of  $H_2O$  and 20 mL of anhydrous ether. The organic layer was washed with  $H_2O$  (2 × 10 mL). The combined aqueous layers were then extracted with anhydrous ether (3 × 15 mL). All organic layers were combined, dried over  $Na_2SO_4$  and evaporated. The crude mixture was purified by flash chromatography on silica basified with 1% TEA (1% TEA in 4 to 9% EtOAc/hexanes) to give the alkylation products **2a-g** as oils.

**(S)-2-phenylpropan-2-yl 2-((diphenylmethylene)amino)-3-phenylpropanoate (2a) :**



**2a** was obtained as a yellow oil (115 mg, 0.257 mmol, 86 %). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.70-7.64 (m, 2H), 7.47-7.17 (m, 14H), 7.16-7.09 (m, 2H), 6.71-6.55 (d, *J* = 5.7, Hz, 2H), 4.29-4.22 (dd, *J* = 8.9, 4.1 Hz, 1H), 3.38-3.20 (m, 2H), 1.85 (s, 3H), 1.80 (s, 3H), <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 170.5, 170.3, 145.9, 139.7, 138.6, 136.5, 130.5, 130.2, 129.0, 128.5, 128.5, 128.4, 128.4, 128.3, 127.9, 127.3, 126.5, 124.6, 82.7, 68.2, 39.6, 29.2, 28.6; IR (thin film) 3083, 3060, 3027, 2979, 2927, 2853, 1741, 1623, 1597, 1576, 1495, 1446, 1382, 1365, 1315, 1272, 1247, 1200, 1180, 1137, 1101, 1076, 1029, 1000, 975, 909, 841, 779, 762, 696, 637; [*α*] = -48.9° (c=0.922, CHCl<sub>3</sub>) ; HRMS (ESMS) calcd for C<sub>31</sub>H<sub>30</sub>NO<sub>2</sub> 448.2277 (M+H)<sup>+</sup>, found : 448.2266.

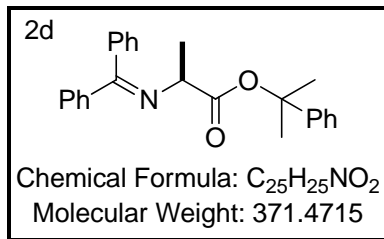
**(S)-2-phenylpropan-2-yl 3-(6-(((tert-butyldimethylsilyl)oxy)methyl)pyridin-3-yl)-2-((diphenylmethylene)amino)propanoate (2c) :**



**2c** was obtained as a yellow oil (140 mg, 0.237 mmol, 79 %). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 8.23 (d, *J* = 1.6 Hz, 1H), 7.64-7.58 (m, 2H), 7.44-7.20 (m, 13H), 6.74-6.60 (d, *J* = 7.3 Hz, 2H), 4.21-4.17 (dd, *J* = 8.9, 4.1 Hz, 1H), 3.28-3.12 (m, 2H), 1.79 (s, 3H), 1.75 (s, 3H), 0.94 (s, 9H), 0.10 (s, 6H), <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 171.2, 169.9, 159.5, 150.0, 145.7, 139.3, 138.3, 136.3, 132.0, 130.6, 129.0, 128.8, 128.6, 128.5, 128.3, 127.7, 127.3, 124.5, 119.7, 82.9, 67.5, 66.2, 36.4, 29.2, 28.5, 26.2, 18.6, -5.1; IR (thin film) 3445 (broad), 3062, 2954, 2928, 2855, 1741, 1622, 1600, 1574, 1488, 1471, 1463, 1447, 1396, 1383, 1366, 1314, 1253, 1199, 1136, 1102, 1077, 1030, 1006, 838, 778, 763, 697, 667; [α]<sub>D</sub><sup>20</sup> = -30.0° (c=0.3, CHCl<sub>3</sub>) ; HRMS (ESMS) calcd for C<sub>37</sub>H<sub>45</sub>N<sub>2</sub>O<sub>3</sub>Si 593.3199 (M+H)<sup>+</sup>, found : 593.3201.

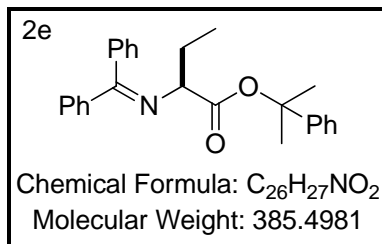


**(S)-2-phenylpropan-2-yl 2-((diphenylmethylene)amino)propanoate (2d):**



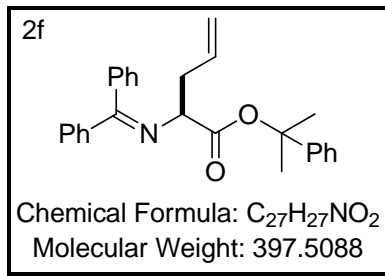
**2d** was obtained as a yellow oil (62 mg, 0.17 mmol, 56 %)  $^1H$  NMR (400 MHz,  $CDCl_3$ )  $\delta$  7.70-7.64 (m, 2H), 7.49-7.44 (m, 3H), 7.44-7.21 (m, 8H), 7.21-7.15 (m, 2H), 4.14-4.12 (q,  $J$  = 6.5 Hz, 1H), 1.79 (s, 3H), 1.75 (s, 3H), 1.44 (d,  $J$  = 6.5 Hz, 3H)  $^{13}C$  NMR (100 MHz,  $CDCl_3$ )  $\delta$  171.4, 169.7, 146.0, 139.8, 136.7, 130.5, 129.0, 128.8, 128.4, 128.3, 128.0, 127.2, 124.5, 82.3, 61.5, 29.1, 28.6; 19.2; IR (thin film) 3059, 3026, 2980, 2932, 2870, 1743, 1661, 1623, 1598, 1577, 1495, 1446, 1382, 1366, 1315, 1273, 1198, 1140, 1121, 1102, 1076, 1030, 1001, 951, 909, 841, 780, 764, 697;  $[\alpha] = -35.8^\circ$  ( $c=1.025$ ,  $CH_2Cl_2$ ) ; HRMS (ESMS) calcd for  $C_{25}H_{26}NO_2$  372.1964 ( $M+H$ ) $^+$ , found : 372.1957

**(S)-2-phenylpropan-2-yl 2-((diphenylmethylene)amino)butanoate (2e):**



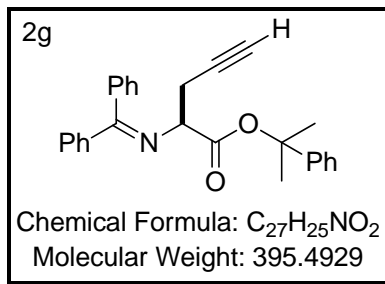
**2e** was obtained as a yellow oil (89 mg, 0.23 mmol, 77 %) <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.72-7.65 (m, 2H), 7.49-7.42 (m, 3H), 7.42-7.20 (m, 8H), 7.20-7.12 (m, 2H), 3.99-3.92 (dd, *J* = 8.1, 4.9 Hz, 1H), 2.06-1.87 (m, 2H), 1.80 (s, 3H), 1.76 (s, 3H), 0.89 (t, *J* = 7.3 Hz, 3H) <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 170.9, 170.3, 146.0, 139.9, 136.9, 130.4, 130.3, 129.0, 128.7, 128.6, 128.4, 128.3, 128.1, 127.1, 124.6, 82.3, 67.6, 29.1, 28.6; 26.9; 10.9; IR (thin film) 3060, 3027, 2976, 2932, 2874, 1739, 1660, 1623, 1598, 1577, 1496, 1447, 1383, 1366, 1316, 1276, 1198, 1139, 1102, 1076, 1030, 1000, 941, 919, 838, 780, 763, 698, 638 ; [α] = -56.2° (c=1.6, CHCl<sub>3</sub>) ; HRMS (ESMS) calcd for C<sub>26</sub>H<sub>28</sub>NO<sub>2</sub> 386.2120 (M+H)<sup>+</sup>, found : 386.2121.

**(S)-2-phenylpropan-2-yl 2-((diphenylmethylene)amino)pent-4-enoate (2f) :**



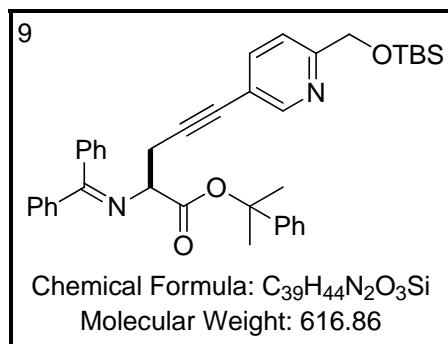
**2f** was obtained as a yellow oil (101 mg, 0.254 mmol, 85 %). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.70-7.64 (m, 2H), 7.47-7.43 (m, 3H), 7.43-7.21 (m, 8H), 7.20-7.13 (m, 2H), 5.80-5.67 (m, 1H), 5.13-5.01 (m, 2H), 4.14-4.09 (dd, *J* = 7.3, 2.4 Hz, 1H), 2.78-2.62 (m, 2H), 1.80 (s, 3H), 1.75 (s, 3H), <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 170.5, 170.3, 145.9, 139.8, 136.8, 134.9, 130.5, 129.0, 128.8, 128.7, 128.4, 128.3, 128.2, 127.2, 124.6, 117.7, 82.5, 66.1, 38.1, 29.2, 28.5; IR (thin film) 3061, 3025, 2980, 2928, 1741, 1623, 1598, 1576, 1495, 1446, 1414, 1383, 1365, 1314, 1271, 1245, 1194, 1137, 1102, 1076, 1030, 1000, 915, 839, 780, 763, 697, 651; [*α*] = -7.6° (c=1.84, CHCl<sub>3</sub>) ; HRMS (ESMS) calcd for C<sub>27</sub>H<sub>28</sub>NO<sub>2</sub> 398.2120 (M+H)<sup>+</sup>, found : 398.2116.

**(S)-2-phenylpropan-2-yl 2-((diphenylmethylene)amino)pent-4-ynoate (2g) :**



**2g** was obtained as a yellow oil (108 mg, 0.274 mmol, 91 %).  $^1H$  NMR (400 MHz,  $CDCl_3$ )  $\delta$  7.73-7.68 (m, 2H), 7.50-7.44 (m, 3H), 7.44-7.21 (m, 10H), 4.31-4.25 (dd,  $J$  = 8.1, 4.9 Hz, 1H), 2.91-2.75 (m, 2H), 1.98 (t,  $J$  = 2.4 Hz, 1H), 1.80 (s, 3H), 1.76 (s, 3H),  $^{13}C$  NMR (100 MHz,  $CDCl_3$ )  $\delta$  171.8, 169.0, 145.6, 139.7, 136.4, 130.7, 129.2, 128.9, 128.7, 128.5, 128.3, 127.3, 124.6, 83.1, 81.5, 65.0, 29.1, 28.5; 23.4 ; IR (thin film) 3293, 3059, 3026, 2980, 2924, 2854, 1740, 1659, 1623, 1598, 1577, 1496, 1447, 1383, 1366, 1316, 1276, 1196, 1138, 1102, 1076, 1030, 1000, 942, 919, 838, 781, 764, 698, 638 ;  $[\alpha]_D^{25}$  = -75.4° (c=1.0,  $CH_2Cl_2$ ) ; HRMS (ESMS) calcd for  $C_{27}H_{26}NO_2$  396.1964 (M+H)<sup>+</sup>, found : 396.1971.

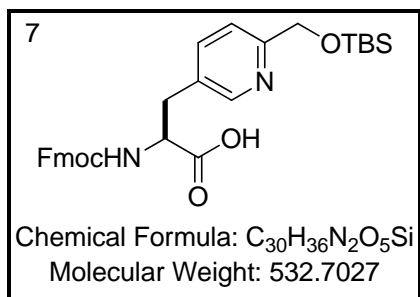
**(S)-2-phenylpropan-2-yl 5-(6-(((tert-butyldimethylsilyl)oxy)methyl)pyridin-3-yl)-2-((diphenylmethylene)amino)pent-4-ynoate (**9**) :**



To a solution of, (S)-2-phenylpropan-2-yl 2-((diphenylmethylene)amino)pent-4-ynoate (99.0 mg, 0.25 mmol) **2g** in anhydrous THF (3 mL) in a pressure flask under Ar were added 5-bromo-2-((tert-butyldimethylsilyloxy)methyl)pyridine **8** (83.0 mg, 0.28 mmol), Pd(PPh<sub>3</sub>)<sub>4</sub> (29.0 mg, 0.03 mmol), CuI (7.00 mg, 0.04 mmol) and Et<sub>3</sub>N (350  $\mu$ L, 2.50 mmol). The solution turned quickly brown-black and was heated to 60°C for 36 h. The completion of the reaction was monitored by TLC. After completion of the reaction, the crude was extracted with CH<sub>2</sub>Cl<sub>2</sub> (3 $\times$ 10 mL, addition of 15 mL of 5% NaHCO<sub>3</sub> in H<sub>2</sub>O). The organic layers were collected, dried over Na<sub>2</sub>SO<sub>4</sub> and evaporated. The crude was purified by flash chromatography on silica basified with 1% TEA (1% TEA in 4% EtOAc/hexanes) to give the alkylation product **9** as a yellow oil (117 mg, 0.19 mmol, 76%). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)  $\delta$  8.47 (d, *J* = 2.4 Hz, 1H), 7.74-7.67 (m, 2H), 7.63 (dd, *J* = 8.1, 2.4 Hz, 1H) 7.47-7.39 (m, 5H), 7.39-7.31 (m, 4H), 7.31-7.20 (m, 5H), 4.81 (s, 2H), 4.39-4.34 (dd, *J* = 8.1, 4.9 Hz, 1H), 3.14-2.98 (m, 2H), 1.82 (s, 3H), 1.78 (s, 3H), 0.96 (s, 9H), 0.12 (s, 6H), <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>)  $\delta$  171.9, 169.1, 160.4, 151.4, 145.6, 139.7, 139.4, 136.4, 130.7, 129.2, 129.0, 128.7, 128.5, 128.4, 128.3, 127.3, 124.5, 119.5, 118.9, 90.1, 83.1, 79.4, 66.2, 65.2, 29.1, 28.6, 26.2, 18.6, -5.1; IR (thin film) 3449

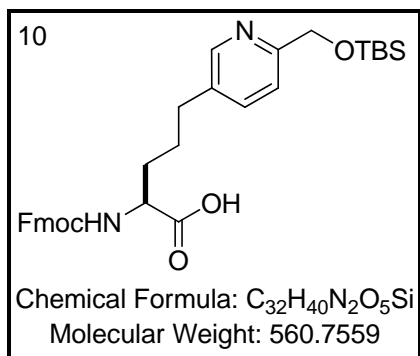
(broad), 3060, 3026, 2953, 2929, 2885, 2856, 1742, 1624, 1595, 1576, 1556, 1485, 1471, 1463, 1447, 1418, 1376, 1366, 1314, 1258, 1215, 1188, 1136, 1102, 1077, 1029, 1006, 987, 967, 908, 839, 779, 763, 697, 640;  $[\alpha] = -23.5^\circ$  (c=1.18, CHCl<sub>3</sub>) ; HRMS (ESMS) calcd for C<sub>39</sub>H<sub>45</sub>N<sub>2</sub>O<sub>3</sub>Si 617.3199 (M+H)<sup>+</sup>, found : 617.3180.

**(S)-2-((((9H-fluoren-9-yl)methoxy)carbonylamino)-3-(6-(((tert-butyl)dimethylsilyl)oxy)methyl)pyridin-3-yl)propanoic acid (7).**



**From compound 2c:** A mixture of (S)-2-phenylpropan-2-yl 3-(6-(((tert-butyl)dimethylsilyl)oxy)methyl)pyridin-3-yl)-2-((diphenylmethylene)amino)propanoate (**2c**) (88.0 mg, 0.15 mmol), Pd(OH)<sub>2</sub>/C (13.0 mg, 15% w/w) and MeOH (2.60 mL) was stirred at rt under H<sub>2</sub> (75 psi) for 12 h. The reaction mixture was filtered through celite to remove Pd/C and the filtrate was concentrated to give the deprotected amino acid (60 mg) as a colorless solid. The reaction mixture was analyzed by <sup>1</sup>H NMR spectroscopy to ensure completion of the hydrogenolysis step. The solid was dissolved in a 1:1 mixture of H<sub>2</sub>O and acetone (2.00 mL), NaHCO<sub>3</sub> (25.0 mg, 0.295 mmol) and Fmoc-OSu (54.8 mg, 0.16 mmol) in dioxane (1.00 mL) were added and the resulting solution was stirred at rt for 16 h. After completion of the reaction as determined by TLC analysis, the pH of the reaction was brought to pH~4-5 with 10% citric acid in H<sub>2</sub>O and extracted with EtOAc (5 × 10 mL). The organic layers were collected, dried over Na<sub>2</sub>SO<sub>4</sub> and evaporated. The crude was purified by flash chromatography on silica (1 to 10% CH<sub>3</sub>OH in CH<sub>2</sub>Cl<sub>2</sub>) to give **2c** as an amorphous solid. NMR data and optical rotations for **10** agreed well with literature data.<sup>7</sup>

**((S)-2-phenylpropan-2-yl 5-(6-(((tert-butyldimethylsilyl)oxy)methyl)pyridin-3-yl)-2-((diphenylmethylene)amino)pentanoate (10).**

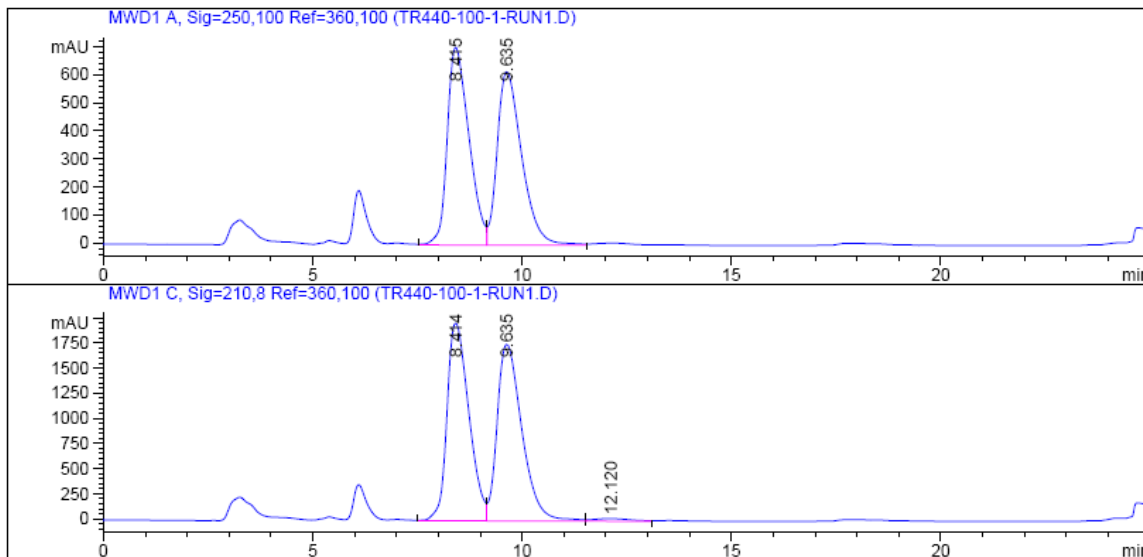
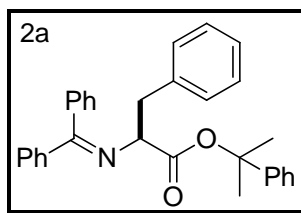


**From compound 9:** A mixture of ((S)-2-phenylpropan-2-yl 5-(6-(((tert-butyldimethylsilyl)oxy)methyl)pyridin-3-yl)-2-((diphenylmethylene)amino)pent-4-ynoate (**9**) (100 mg, 0.16 mmol), Pd/C black (15 mg, 15% w/w) and MeOH (2.85 mL) was stirred at rt under  $H_2$  (75 psi) for 36 h. The reaction mixture was filtered through celite to remove Pd/C and the filtrate was concentrated to give the deprotected amino acid (69 mg) as a colorless solid. The reaction mixture was analyzed by  $^1H$  NMR spectroscopy to ensure completion of the hydrogenolysis step. The solid was dissolved in a 1:1 mixture of  $H_2O$  and acetone (2.20 mL),  $NaHCO_3$  (27.0 mg, 0.32 mmol) and Fmoc-OSu (60.3 mg, 0.18 mmol) in dioxane (1.10 mL) were added. The resulting solution was stirred at rt for 16 h. After completion of the reaction as determined by TLC analysis, the pH of the reaction was brought to pH~4-5 with 10% citric acid in  $H_2O$  and the aqueous layer was extracted with EtOAc (5×10 mL). The organic layers were collected, dried over  $Na_2SO_4$  and concentrated. The crude was purified by flash chromatography on silica (1 to 10%  $CH_3OH$  in  $CH_2Cl_2$ ) to give **10** as an amorphous solid. NMR data and optical rotation for **10** agreed well with the literature data.<sup>7</sup>



**Part C.** Determination of enantiomeric excess (ee):

**(S)-2-phenylpropan-2-yl 2-((diphenylmethylene)amino)-3-phenylpropanoate (2a) :**

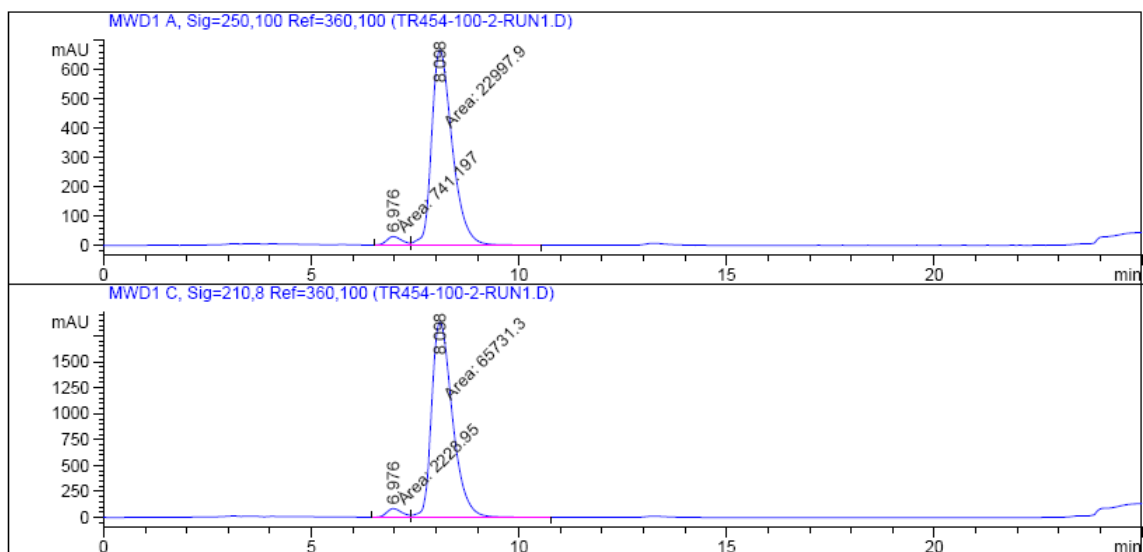


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Use Multiplier & Dilution Factor with ISTDs

Signal 1: MWD1 A, Sig=250,100 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.415	VV	0.5644	2.53885e4	704.59943	50.1218
2	9.635	VV	0.6130	2.52651e4	617.93176	49.8782



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                        Area Percent Report
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Signal 1: MWD1 A, Sig=250,100 Ref=360,100

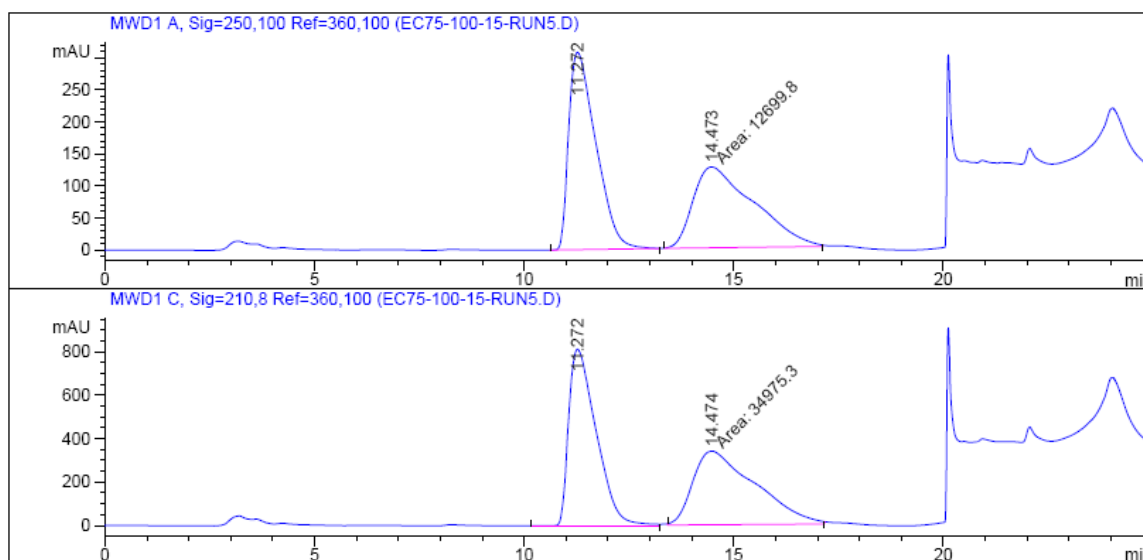
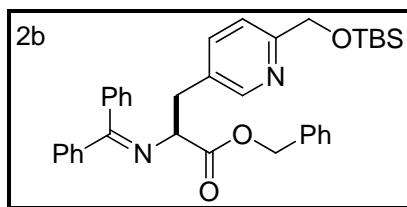
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.976	MF	0.4229	741.19720	29.20864	3.1223
2	8.098	FM	0.5752	2.29979e4	666.39508	96.8777

The enantiomeric excess was determined using HPLC on an Chiralcel OD-H chiral column (250 × 4.6 mm ID) for the racemic and enantioenriched substrates under isocratic conditions (100:2 Hexanes-Isopropanol) with a flowrate of 1.0 ml/min

Retention times: 6.98 min and 8.10 min

Enantiomeric excess: 94%

**(S)-benzyl 3-(6-(((tert-butyldimethylsilyl)oxy)methyl)pyridin-3-yl)-2-((diphenylmethylene)amino)propanoate (2b) :**

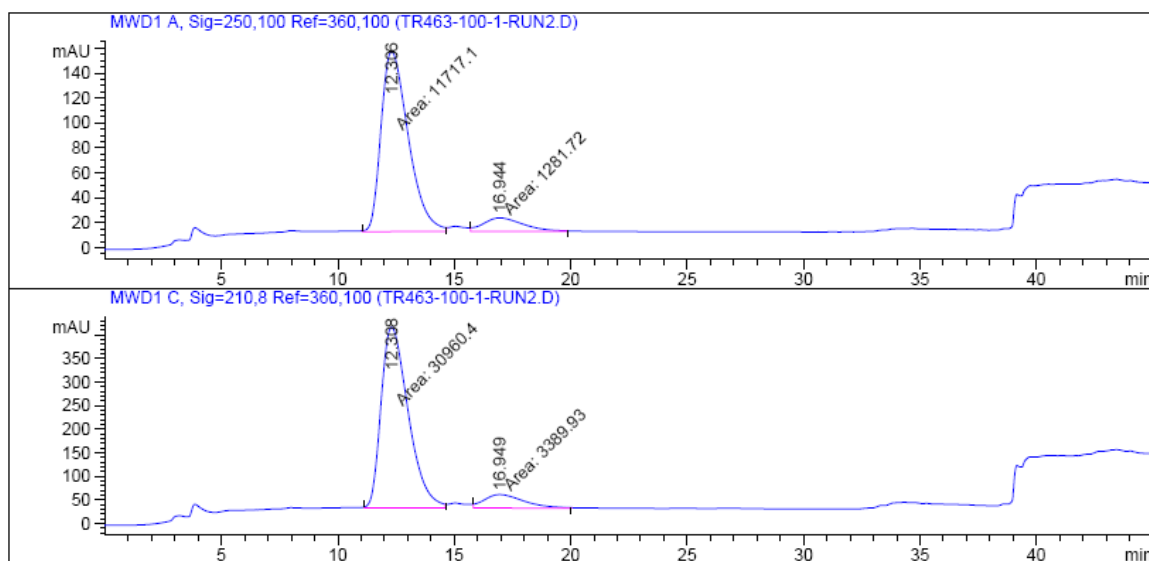


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Use Multiplier & Dilution Factor with ISTDs

Signal 1: MWD1 A, Sig=250,100 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	11.272	BB	0.6800	1.38770e4	307.77429	52.2148
2	14.473	MM	1.6780	1.26998e4	126.14252	47.7852



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 Area Percent Report  
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Sorted By : Signal  
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 Dilution : 1.0000  
 Sample Amount : 50.00000 [ng/ul] (not used in calc.)  
 Use Multiplier & Dilution Factor with ISTDs

Signal 1: MWD1 A, Sig=250,100 Ref=360,100

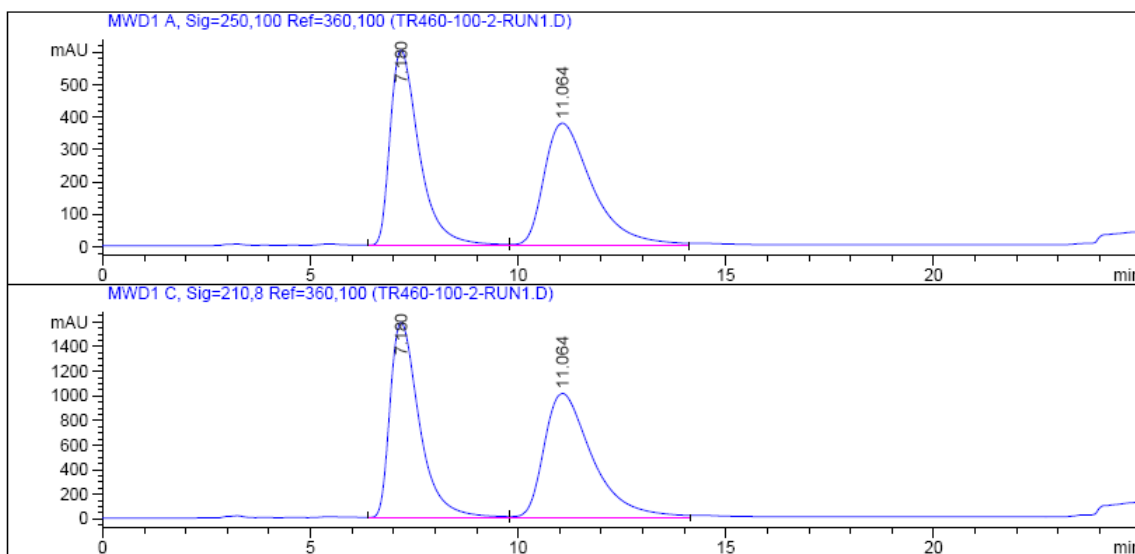
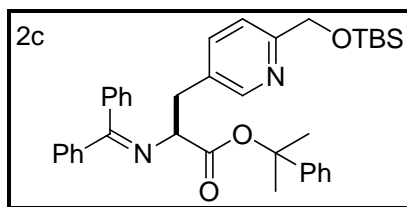
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	12.306	MF	1.3516	1.17171e4	144.48506	90.1398
2	16.944	FM	1.9785	1281.71692	10.79684	9.8602

The enantiomeric excess was determined using HPLC on an Chiralcel OD-H chiral column (250 × 4.6 mm ID) for the racemic and enantioenriched substrates under isocratic conditions (100:1 Hexanes-Isopropanol) with a flowrate of 1.0 ml/min

Retention times: 12.31 min and 16.94 min

Enantiomeric excess: 80%

**(S)-2-phenylpropan-2-yl 3-(6-(((tert-butyldimethylsilyl)oxy)methyl)pyridin-3-yl)-2-((diphenylmethylene)amino)propanoate (2c) :**

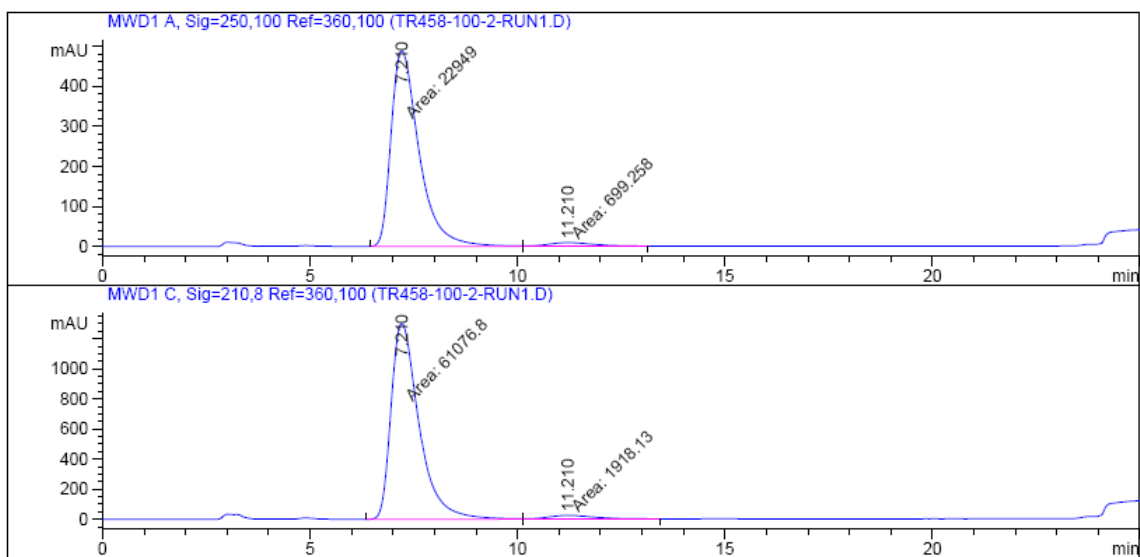


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Use Multiplier & Dilution Factor with ISTDs

Signal 1: MWD1 A, Sig=250,100 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.180	VV	0.7465	2.94167e4	601.60315	48.9894
2	11.064	VV	1.2278	3.06303e4	377.02859	51.0106



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                        Area Percent Report
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Use Multiplier & Dilution Factor with ISTDs
  
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Signal 1: MWD1 A, Sig=250,100 Ref=360,100

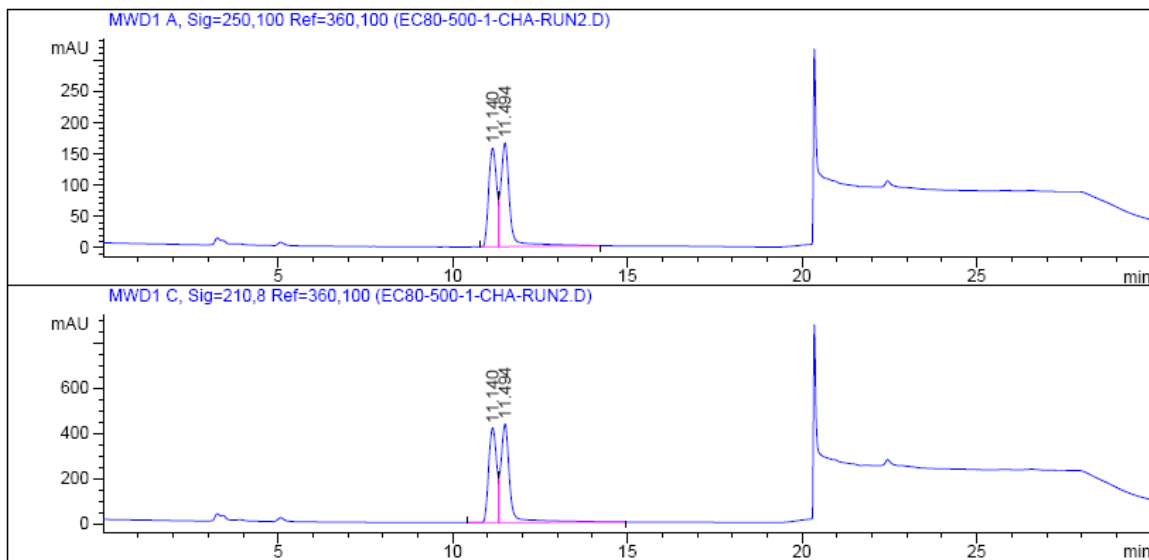
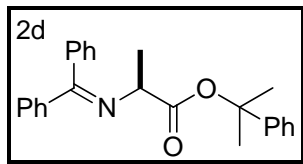
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.210	MF	0.7826	2.29490e4	488.74872	97.0431
2	11.210	FM	1.2771	699.25775	9.12578	2.9569

The enantiomeric excess was determined using HPLC on an Chiralcel OD-H chiral column (250 × 4.6 mm ID) for the racemic and enantioenriched substrates under isocratic conditions (100:2 Hexanes-Isopropanol) with a flowrate of 1.0 ml/min

Retention times: 7.21 min and 11.21 min

Enantiomeric excess: 94%

**(S)-2-phenylpropan-2-yl 2-((diphenylmethylene)amino)propanoate (2d):**

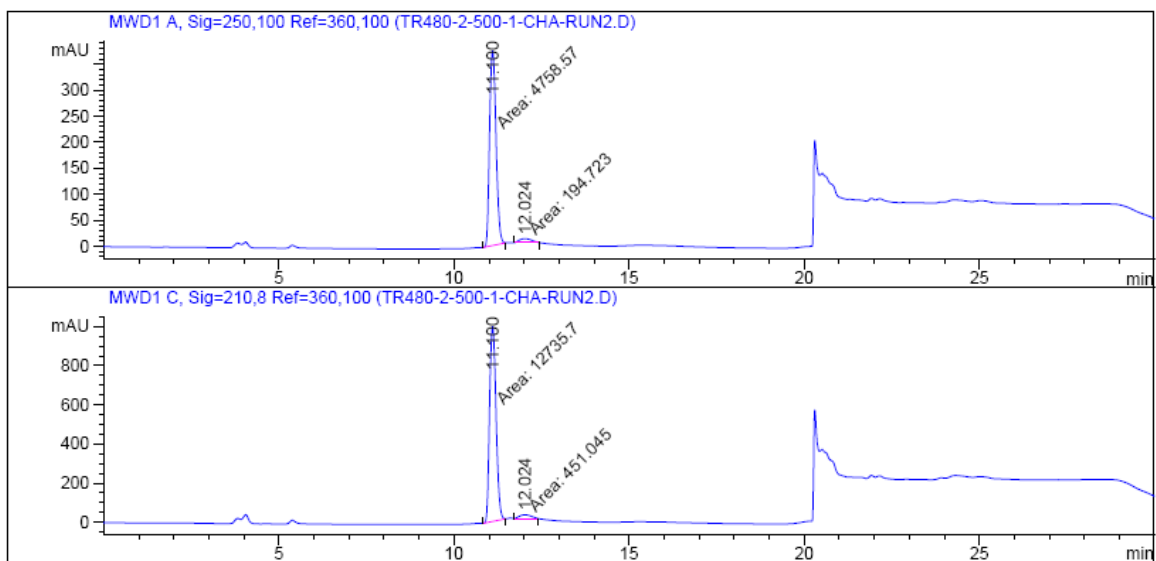


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Dilution : 1.0000  
Sample Amount : 50.00000 [ng/ul] (not used in calc.)  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: MWD1 A, Sig=250,100 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	11.140	BV	0.2512	2450.17700	157.71756	44.7847
2	11.494	VB	0.2644	3020.84131	165.94911	55.2153



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 Area Percent Report  
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Sorted By : Signal  
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 Sample Amount : 50.00000 [ng/ul] (not used in calc.)  
 Use Multiplier & Dilution Factor with ISTDs

Signal 1: MWD1 A, Sig=250,100 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	11.100	MM	0.2122	4758.56787	373.75891	96.0688
2	12.024	MM	0.4131	194.72266	7.85543	3.9312

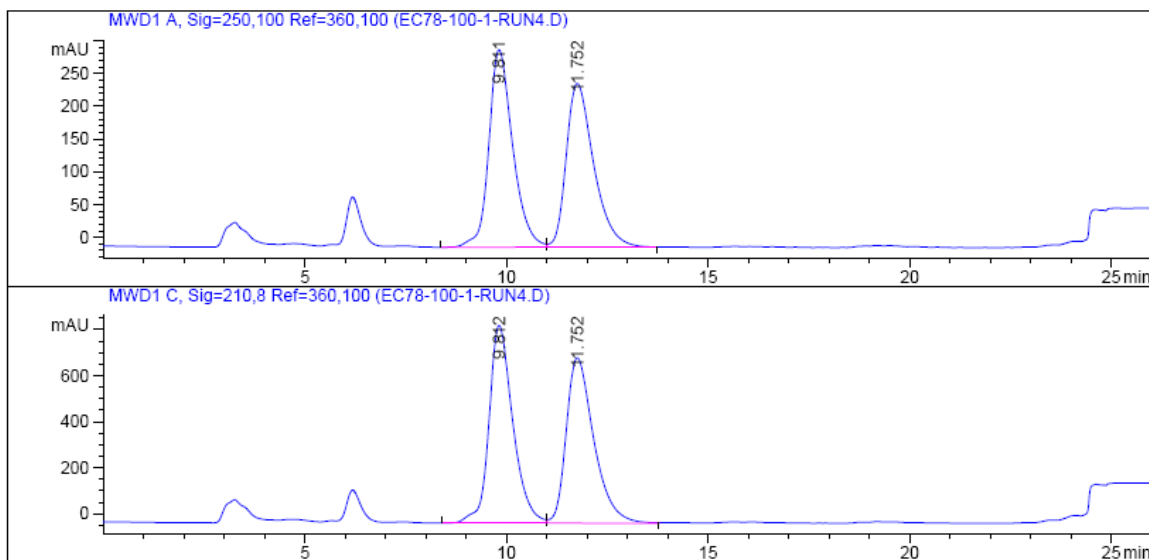
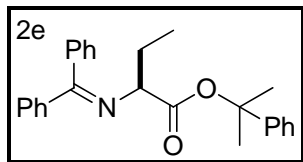
The enantiomeric excess was determined using HPLC on an Chiralcel OD-H chiral column (250 × 4.6 mm ID) for the racemic and enantioenriched substrates under isocratic conditions (500:1 Hexanes-Isopropanol) with a flowrate of 1.0 ml/min

Retention times: 11.10 min and 12.02 min

Enantiomeric excess: 92%



**(S)-2-phenylpropan-2-yl 2-((diphenylmethylene)amino)butanoate (2e):**

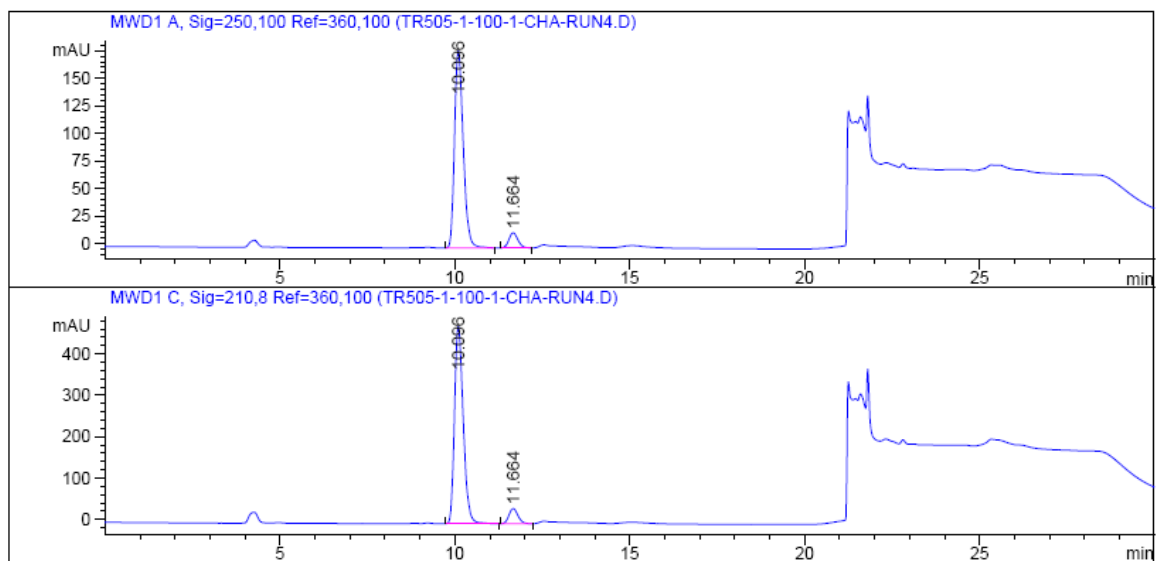


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Use Multiplier & Dilution Factor with ISTDs

Signal 1: MWD1 A, Sig=250,100 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.811	VV	0.6124	1.23977e4	301.06070	51.2681
2	11.752	VB	0.7067	1.17844e4	249.67369	48.7319



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 Area Percent Report  
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Sorted By : Signal  
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 Sample Amount : 50.00000 [ng/ul] (not used in calc.)  
 Use Multiplier & Dilution Factor with ISTDs

Signal 1: MWD1 A, Sig=250,100 Ref=360,100

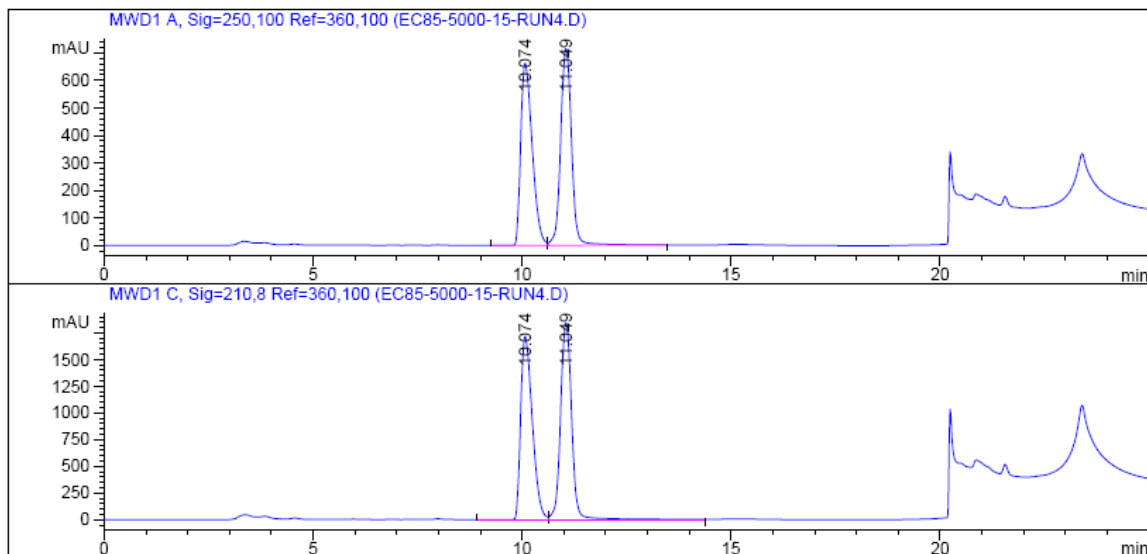
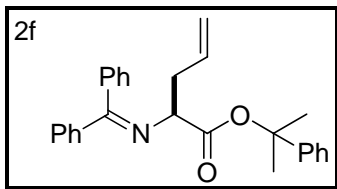
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.096	BB	0.2684	3104.37109	178.95375	92.7437
2	11.664	BB	0.2772	242.88545	13.67393	7.2563

The enantiomeric excess was determined using HPLC on an Chiralcel OD-H chiral column (250 × 4.6 mm ID) for the racemic and enantioenriched substrates under isocratic conditions (100:1 Hexanes-Isopropanol) with a flowrate of 1.0 ml/min

Retention times: 10.10 min and 11.66 min

Enantiomeric excess: 85%

**(S)-2-phenylpropan-2-yl 2-((diphenylmethylene)amino)pent-4-enoate (2f) :**

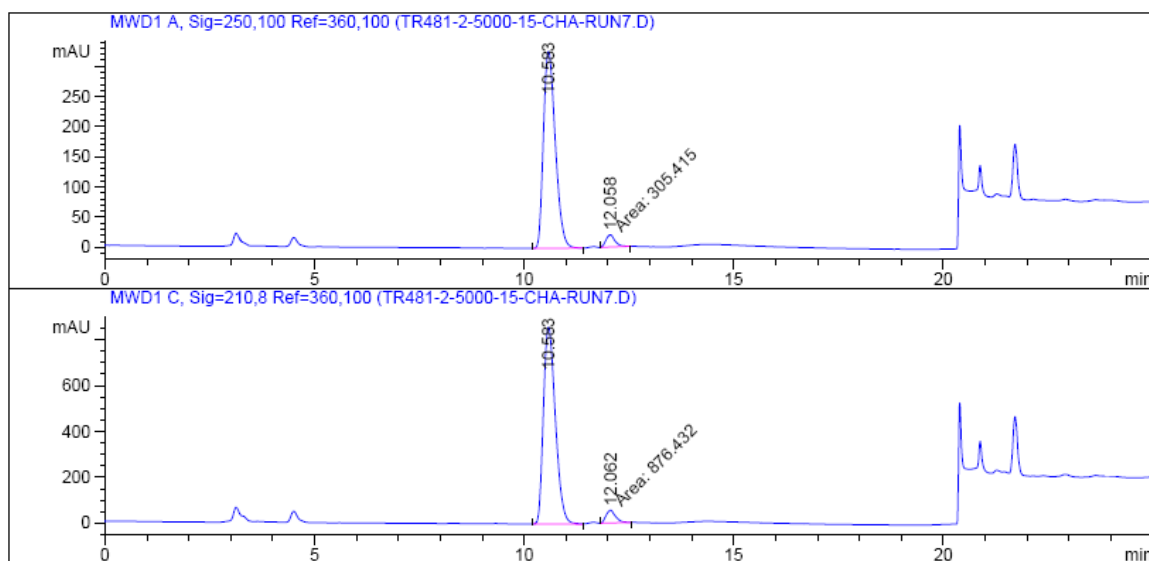


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Use Multiplier & Dilution Factor with ISTDs

Signal 1: MWD1 A, Sig=250,100 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.074	BV	0.2960	1.25991e4	662.02496	49.1652
2	11.049	VB	0.2847	1.30269e4	714.62256	50.8348



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 Area Percent Report  
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 Sample Amount : 50.00000 [ng/ul] (not used in calc.)  
 Use Multiplier & Dilution Factor with ISTDs

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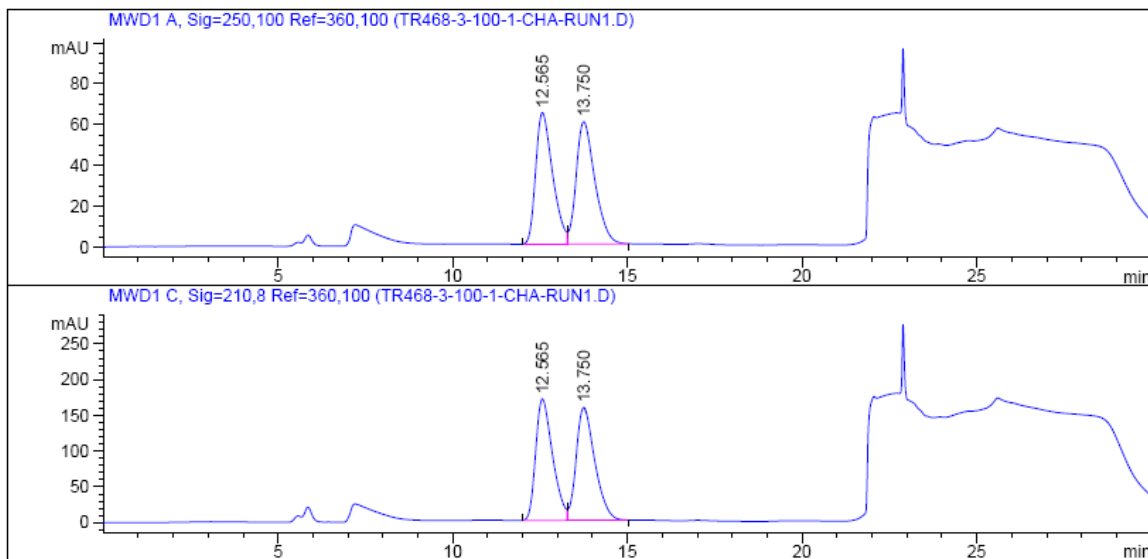
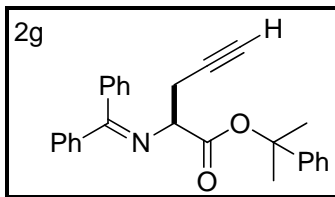
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.583	BV	0.3070	6401.47363	326.13348	95.4463
2	12.058	MM	0.2488	305.41464	20.46243	4.5537

The enantiomeric excess was determined using HPLC on an Chiralcel OD-H chiral column (250 × 4.6 mm ID) for the racemic and enantioenriched substrates under isocratic conditions (500:1.5 Hexanes-Isopropanol) with a flowrate of 1.0 ml/min

Retention times: 10.58 min and 12.06 min

Enantiomeric excess: 91%

**(S)-2-phenylpropan-2-yl 2-((diphenylmethylene)amino)pent-4-ynoate (2g) :**

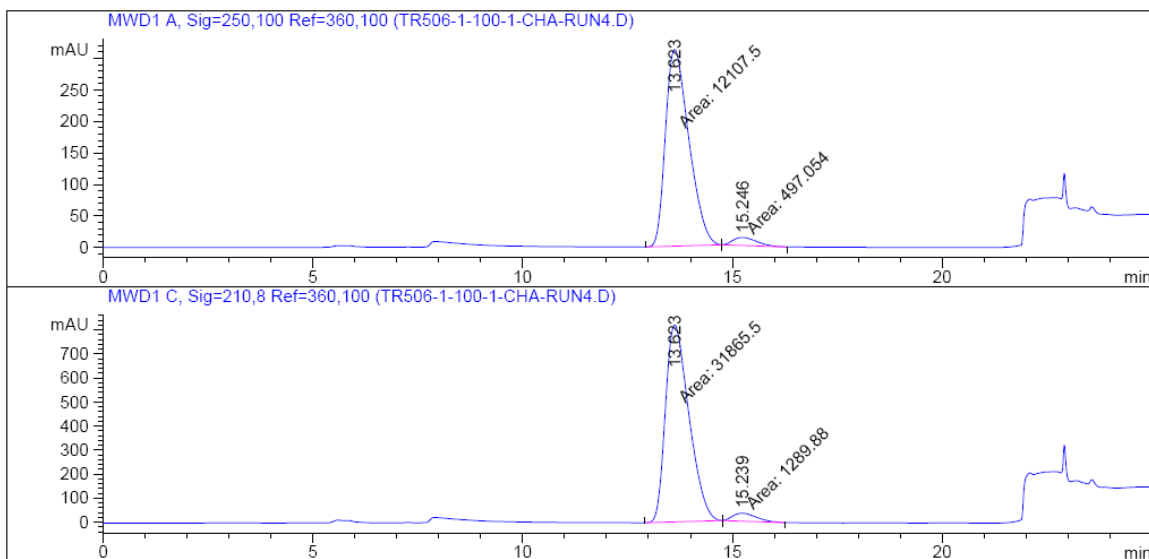


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Sample Amount : 50.00000 [ng/ul] (not used in calc.)  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: MWD1 A, Sig=250,100 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	12.565	BV	0.5123	2164.85962	64.38284	49.2588
2	13.750	VB	0.5663	2230.01294	59.91125	50.7412



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Area Percent Report  
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Sorted By : Signal  
Multiplier : 1.0000  
Dilution : 1.0000  
Sample Amount : 50.00000 [ng/ul] (not used in calc.)  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: MWD1 A, Sig=250,100 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	13.623	MM	0.6467	1.21075e4	312.01645	96.0565
2	15.246	MM	0.6549	497.05380	12.64924	3.9435

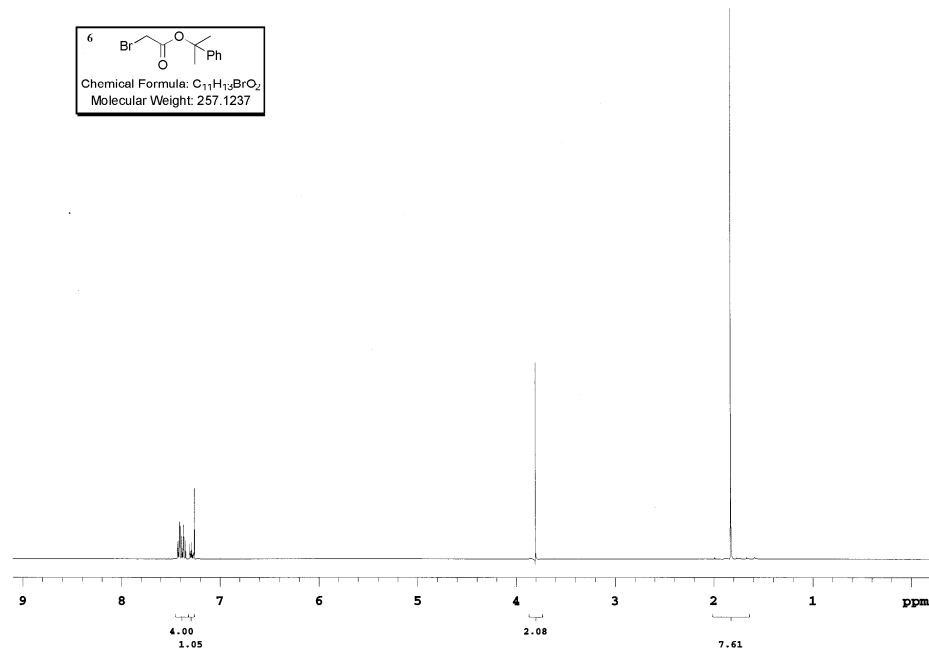
The enantiomeric excess was determined using HPLC on an Chiralcel OD-H chiral column (250 × 4.6 mm ID) for the racemic and enantioenriched substrates under isocratic conditions (100:1 Hexanes-Isopropanol) with a flowrate of 0.6 ml/min

Retention times: 13.62 min and 15.25 min

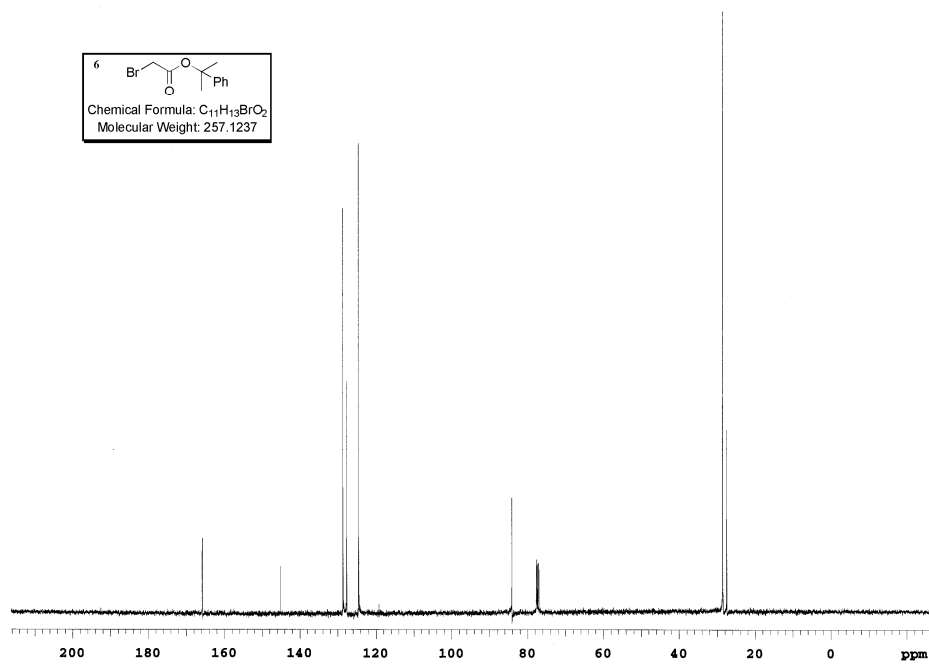
Enantiomeric excess: 92%

**Part D.**  $^1\text{H}$  and  $^{13}\text{C}$  NMR spectra for compounds

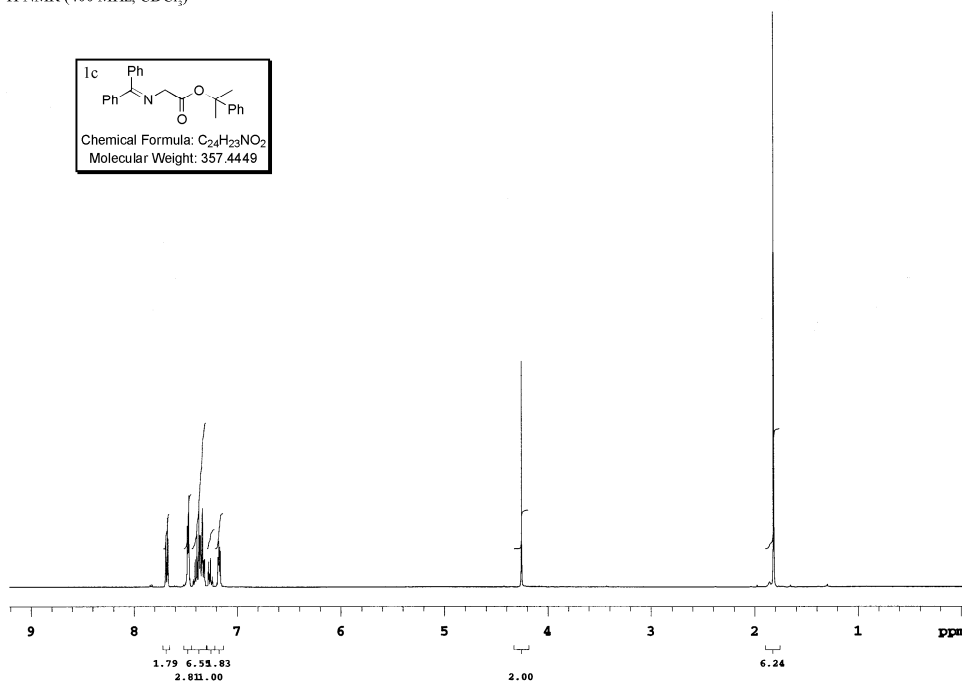
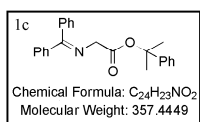
$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )



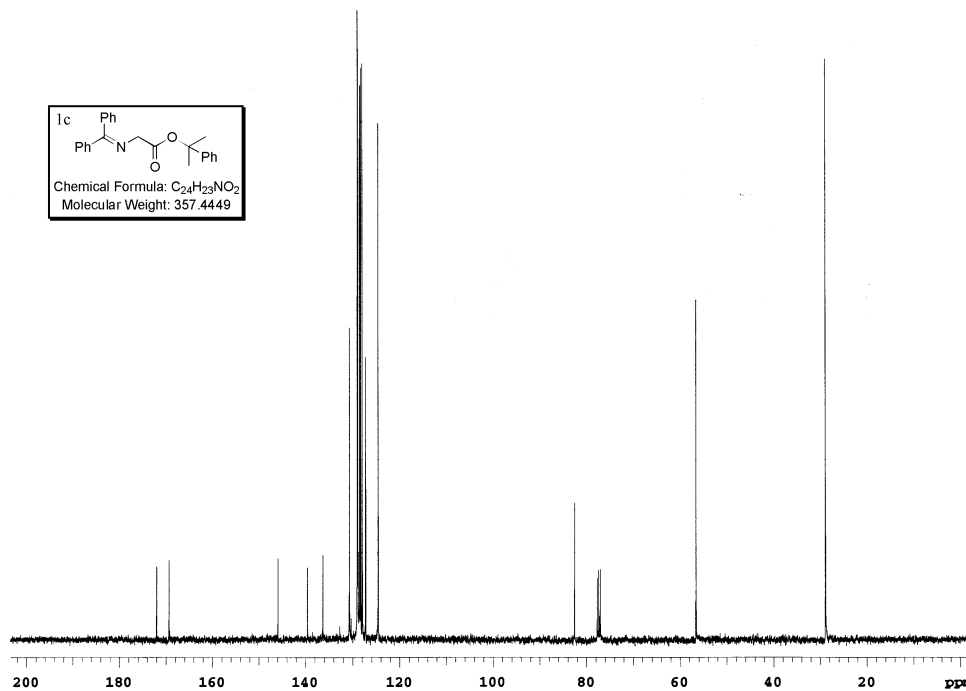
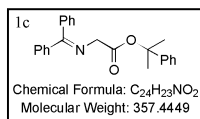
$^{13}\text{C}$  NMR (100 MHz,  $\text{CDCl}_3$ )



<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)

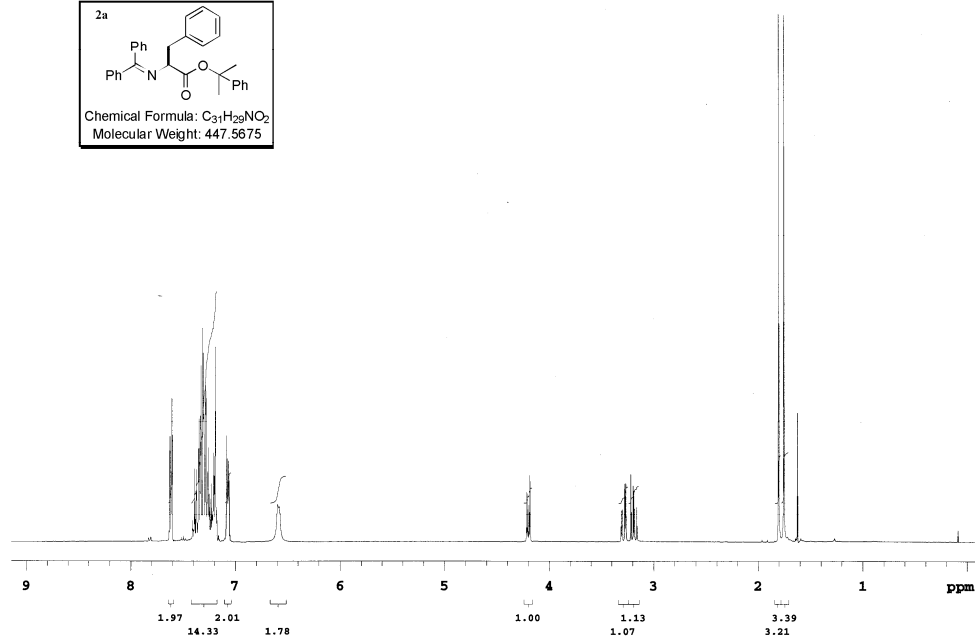
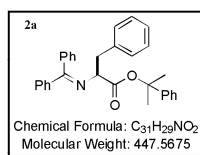


<sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>)

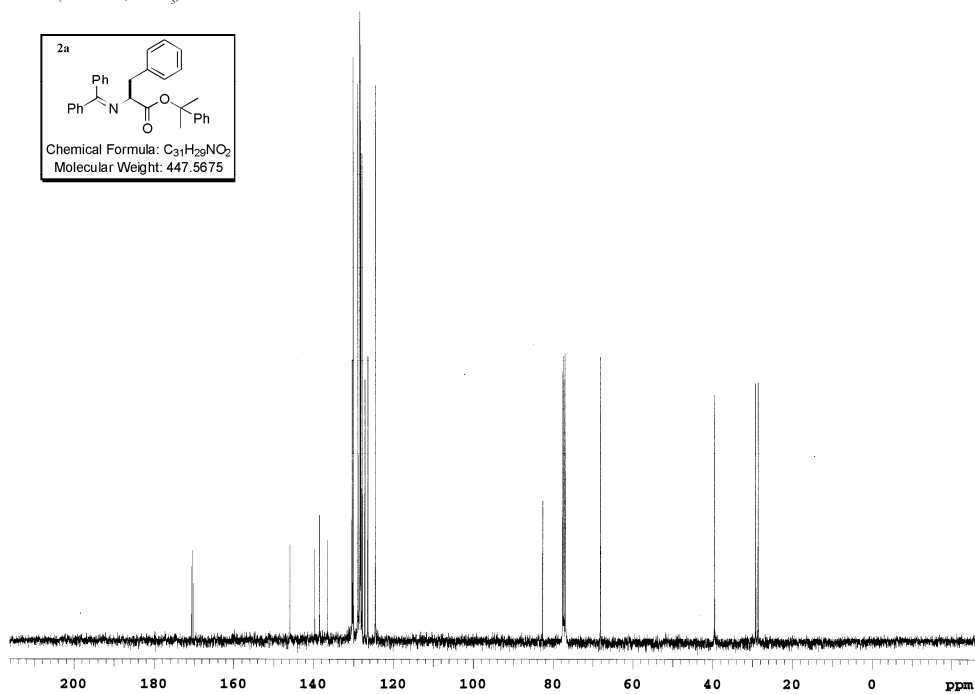
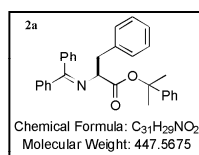




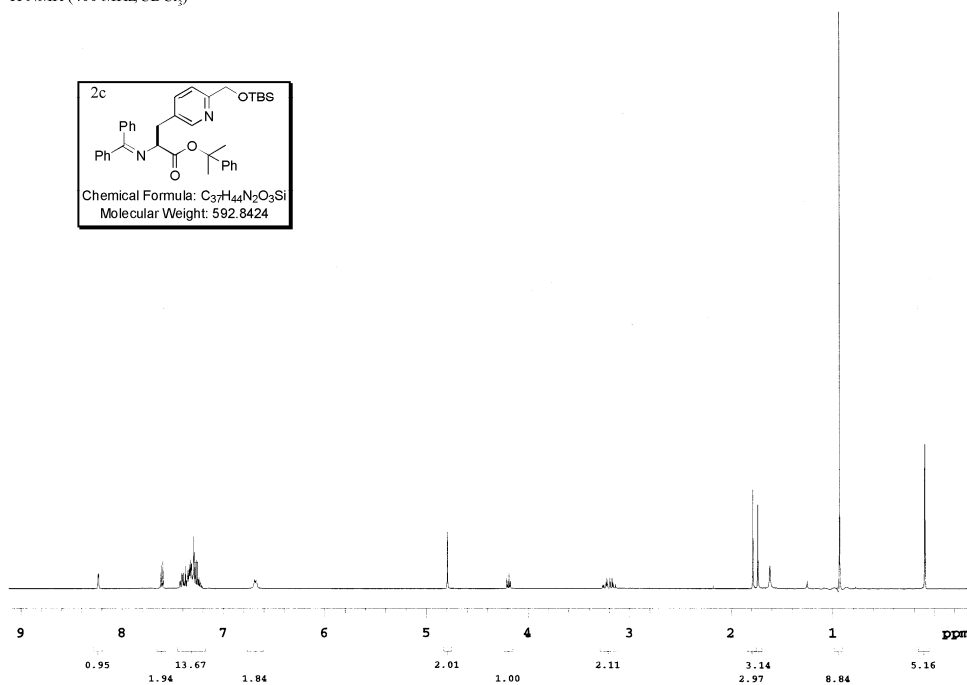
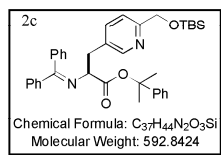
$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )



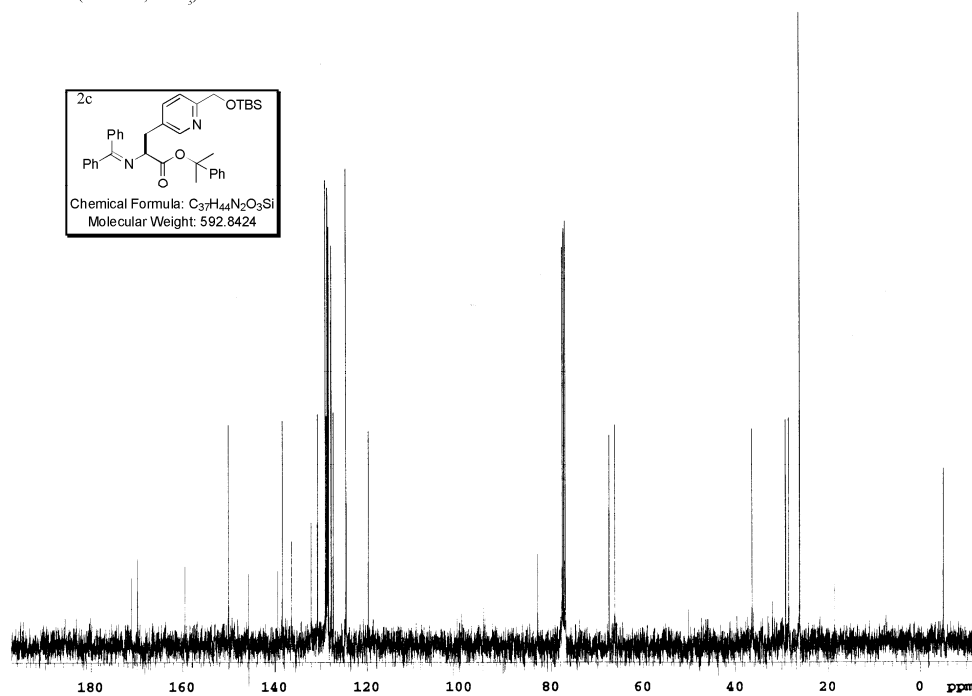
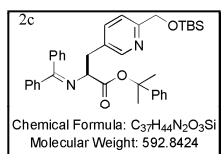
$^{13}\text{C}$  NMR (100 MHz,  $\text{CDCl}_3$ )



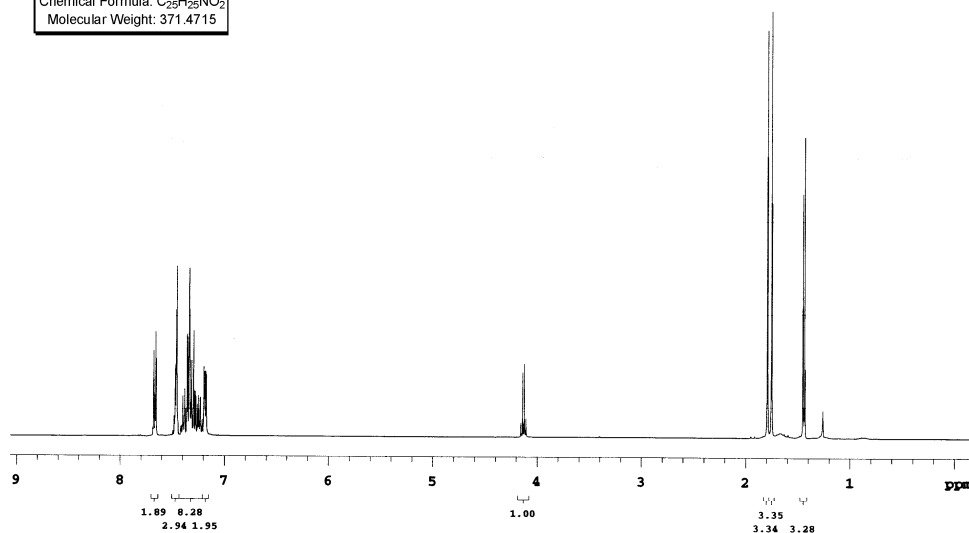
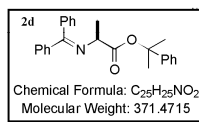
$^1\text{H}$  NMR (400 MHz  $\text{CDCl}_3$ )



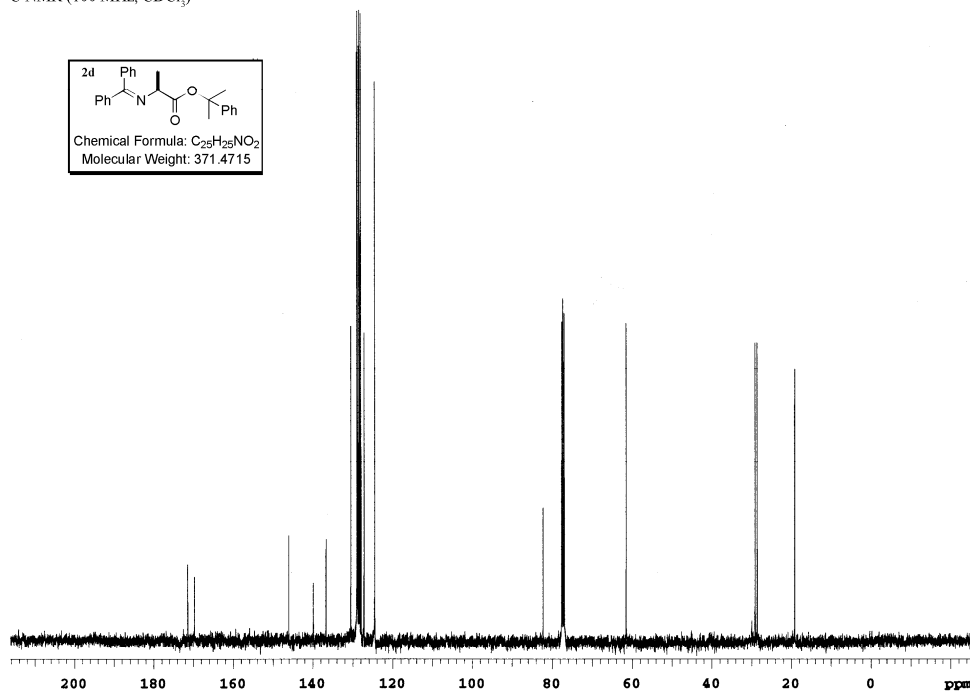
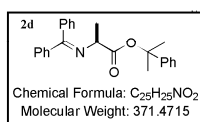
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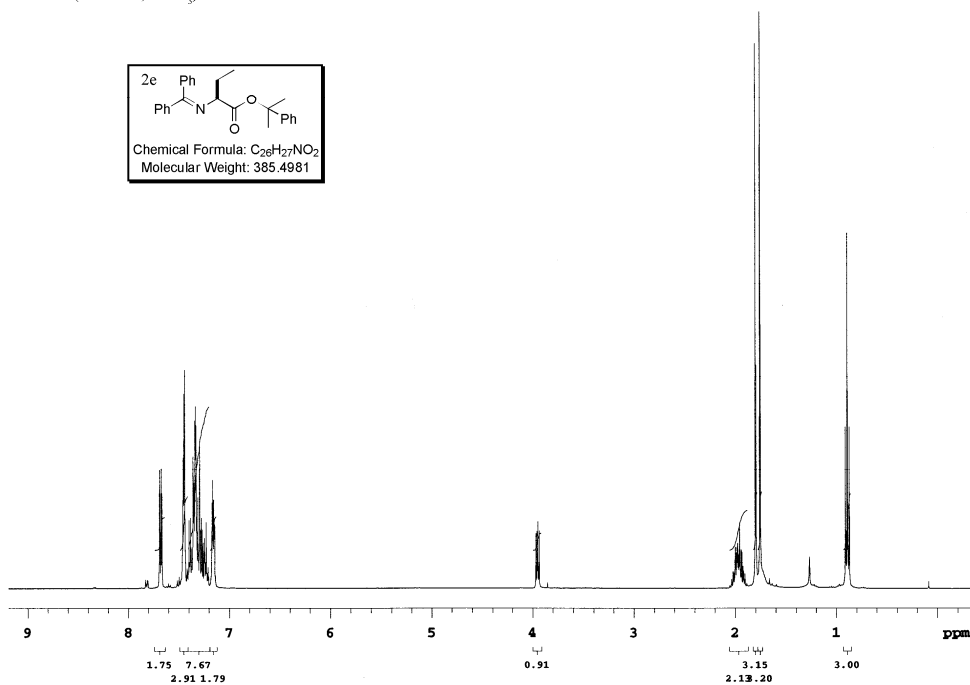
<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)



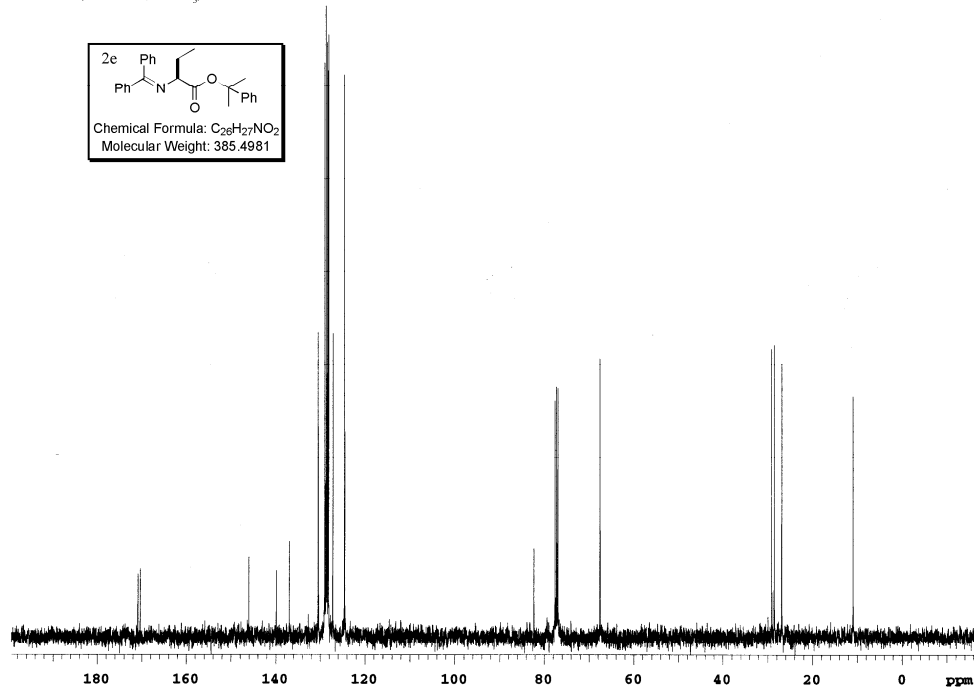
<sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>)



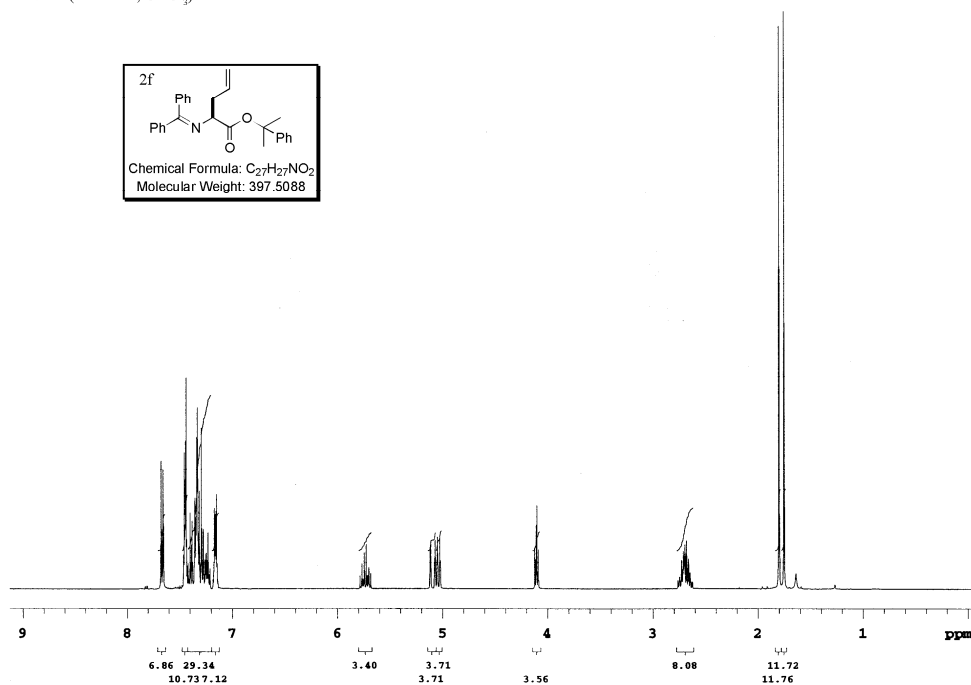
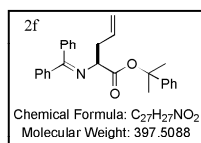
<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)



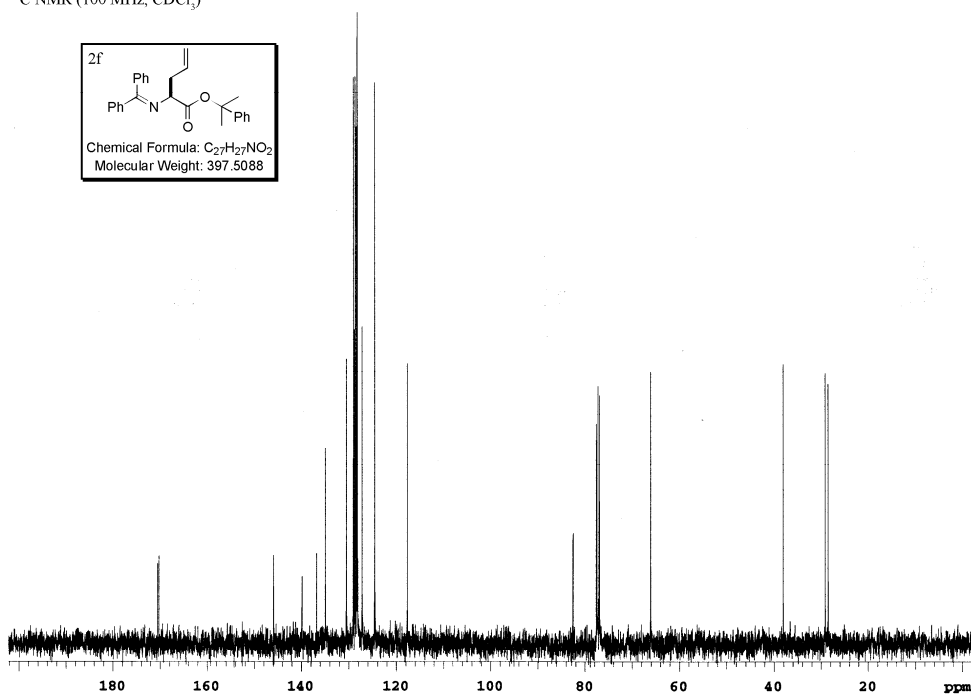
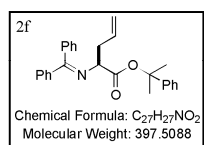
<sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>)



$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )



$^{13}\text{C}$  NMR (100 MHz,  $\text{CDCl}_3$ )

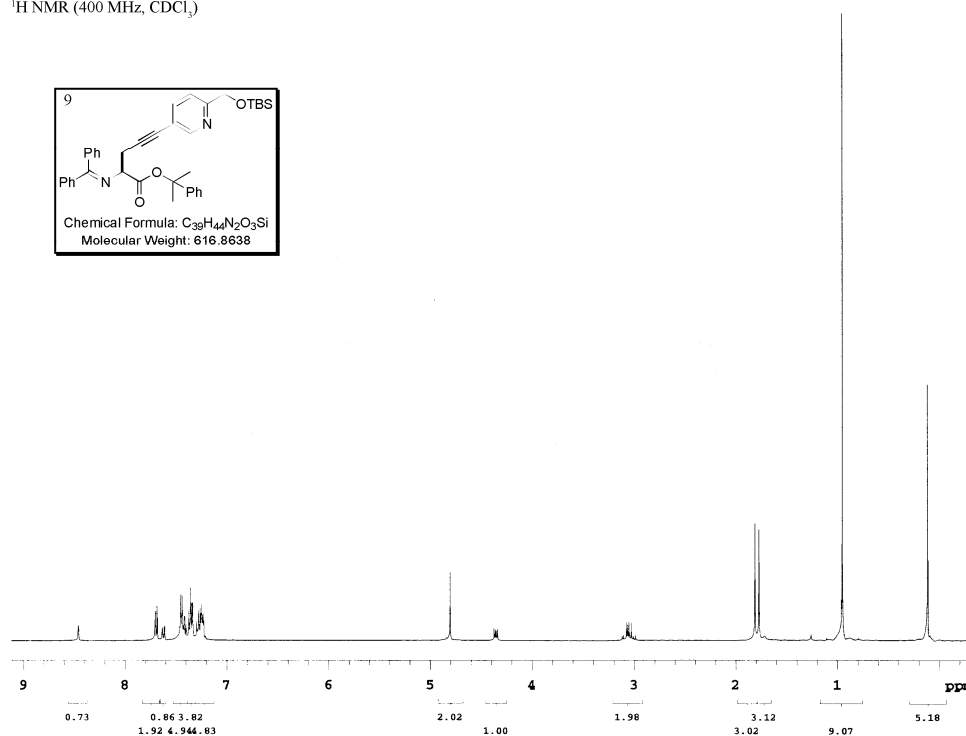
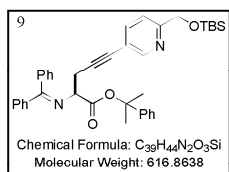


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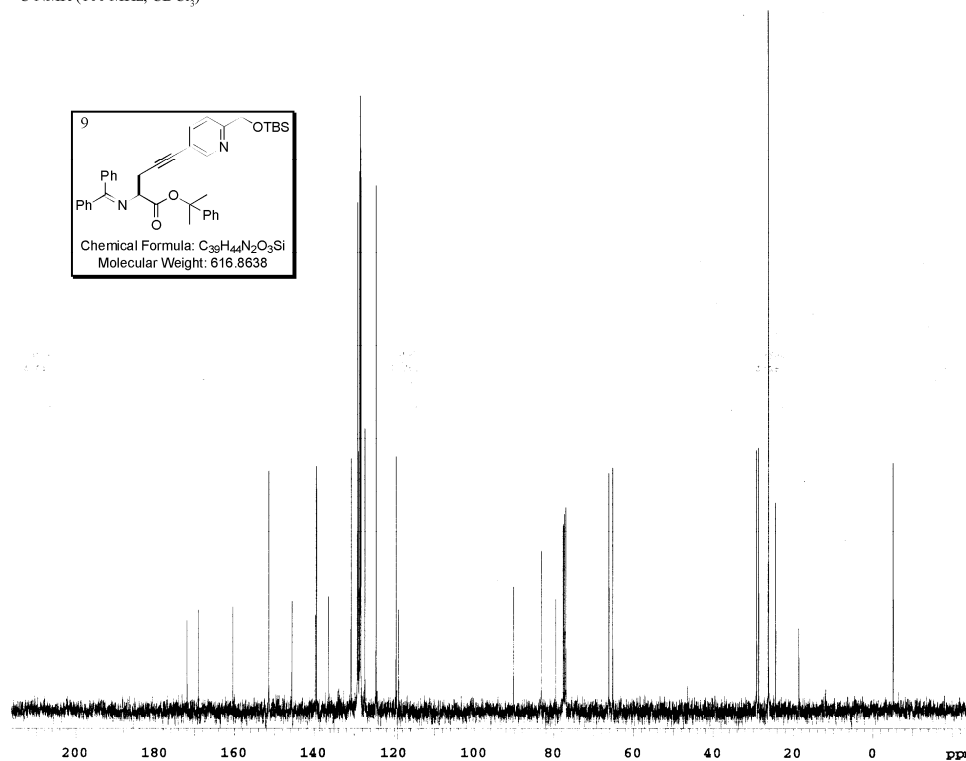
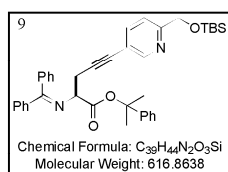
2g

Chemical Formula:  $C_{27}H_{25}NO_2$   
Molecular Weight: 395.4929

$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )



$^{13}\text{C}$  NMR (100 MHz,  $\text{CDCl}_3$ )



## Part E: References

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