Supporting information

Facile access to S-methyl dithiocarbamates with sulfonium or sulfoxonium iodides as methylation reagent

Huiying Deng, Lingling Xiang, Zhijun Yuan, Bohong Lin, Yiting He, Qi Hou, Yaoping Ruan, Jing Zhang*

Artemisinin Research Center and The First Affiliated Hospital, Guangzhou University of Chinese Medicine, 12 Jichang Road, Guangzhou 510405, China.
Email: jingzhang@gzucm.edu.cn

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Table S1: TMSO-I-mediated thiolmethylation of benzylamine (1k)*

<table>
<thead>
<tr>
<th>Entry</th>
<th>TMSO-I (equiv)</th>
<th>Temp. (°C)</th>
<th>Yield (%)*</th>
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<tr>
<td>1</td>
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<tr>
<td>2</td>
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<td>26</td>
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<tr>
<td>6</td>
<td>1.5 equiv</td>
<td>120</td>
<td>89b</td>
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*a Reaction condition: 1k (1.0 equiv), CS₂ (1.2 equiv), TMSO-I (1.1-2.0 equiv), K₂CO₃ (4.0 equiv), DMSO, 30 min; b K₂CO₃ was replaced with DIPEA.

Experimental procedure

1. General Information

All chemicals were used as received unless otherwise stated. Trimethylsulphonium iodide and trimethylsulfoxonium iodide were purchased from Bide Pharmatech Ltd. (Shanghai, China). D₆-DMSO were purchased from Shanghai Titan Scientific Co., Ltd. ¹H NMR, ¹³C NMR and ¹⁹F NMR spectra were measured on Bruker 400 NMR spectrometer. Proton chemical shifts of NMR spectra were calibrated with TMS as internal reference. HR-MS spectral data were recorded on Agilent 6550 Q-TOF or Thermo Fisher Q Exactive Orbitrap mass spectrometer. Analytical thin-layer chromatography (TLC) analysis was performed on TLC silica gel plates (0.2 ± 0.03 mm) and visualized with ultraviolet light (254 nm) to monitor the reaction progression.

2. Synthetic procedure and spectroscopic data with trimethylsulphonium iodide as methylation reagent

General procedure: A solution of trimethylsulphonium iodide (3.0 equiv) in ddH₂O (1 mL) was added to a mixture of amine (1.0 equiv), carbondisulfide (1.2 equiv), and 28% ammonium hydroxide solution (1 mL) in ethanol (6 mL) in a sealed tube, and it was stirred at 120 °C for 30 min. Then the mixture was cooled to room temperature, and extracted with DCM or ethyl ether twice. After being washed with H₂O and brine, the combined organic was dried over anhydrous Na₂SO₄, and concentrated under vacuum. The desired compound could be obtained directly for characterization or after purification by silica gel column chromatography.
Compound 2a was obtained as a yellow solid in 70% yield (195 mg, 1.11 mmol) after extraction with ethyl ether without further purification. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 4.30 (s, 2H), 3.89 (s, 2H), 2.66 (s, 3H), 1.69 (m, 6H). $^{13}$C{$^1$H} NMR (101 MHz, CDCl$_3$) $\delta$ 196.9, 53.0, 51.2, 25.7, 24.3, 20.1. Data are consistent with previous reports$^1$.

Compound 2b was obtained as a colorless liquid in 76% yield (150 mg, 0.93 mmol) after extraction with ethyl ether without further purification. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 3.95 (t, $J = 7.2$ Hz, 2H), 3.65 (t, $J = 6.4$ Hz, 2H), 2.66 (s, 3H), 2.09 (p, $J = 7.2$ Hz, 2H). $^{13}$C{$^1$H} NMR (101 MHz, CDCl$_3$) $\delta$ 193.9, 55.0, 50.5, 26.1, 24.4, 19.4. Data are consistent with previous reports$^1$.

Compound 2c was obtained as a yellow liquid in 59% yield (120 mg, 0.68 mmol) after purification with silica gel column chromatography (PE/EtOAc 12:1). $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 4.16 (brs, 4H), 3.77 (t, $J = 4.8$ Hz, 4H), 2.68 (s, 3H). $^{13}$C{$^1$H} NMR (101 MHz, CDCl$_3$) $\delta$ 198.9, 66.3, 50.6, 19.9. Data are consistent with previous reports$^2$.

Compound 2d was obtained as a yellow liquid in 60% yield (140 mg, 0.86 mmol) after extraction with ethyl ether without further purification. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 4.05 (q, $J = 7.2$ Hz, 2H), 3.75 (q, $J = 7.2$ Hz, 2H), 2.64 (s, 3H), 1.29 (m, 6H). $^{13}$C{$^1$H} NMR (101 MHz, CDCl$_3$) $\delta$ 196.8, 49.5, 46.7, 20.0, 12.4, 11.6. Data are consistent with previous reports$^1$.

Compound 2e was obtained as a colorless liquid in 72% yield (220 mg, 1.17 mmol) after extraction with ethyl ether without further purification. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 5.84 (m, 2H), 5.23 (m, 4H), 4.67 (s, 2H), 4.30 (s, 2H), 2.65 (s, 3H). $^{13}$C{$^1$H} NMR (101 MHz, CDCl$_3$) $\delta$ 199.3, 131.1 130.4, 118.5, 118.4, 56.5, 53.6, 20.4. Data are consistent with previous reports$^3$.

Compound 2f was obtained as a yellow liquid in 91% yield (150 mg, 0.71 mmol) as a mixture of isomers with a ratio of ca. 2:1 after purification through silica gel column chromatography (PE/EtOAc 8:1). $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.29 (m, 5H), 5.39 [5.00] (s, 2H), 3.29 [3.48] (s, 3H), 2.69 (s, 3H). $^{13}$C{$^1$H} NMR (101 MHz, CDCl$_3$) $\delta$ 200.1 [199.0], 135.7 [134.9], [128.9] 128.8, [128.0] 127.7, 127.1, 59.5 [57.6], [43.5] 38.8, 20.7 [20.1]. The data of minor isomer are given in square brackets. Data are consistent with previous reports$^4$.

Compound 2g was obtained as a colorless liquid in 70% yield (220 mg, 0.92 mmol) as a mixture of isomers with a ratio of 1:1 after purification through silica gel column chromatography (PE/EtOAc 20:1). $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.27 (m, 5H), [6.05] 5.00 (s, 1H), [5.32] 4.93 (s, 2H), 2.71 [2.63] (s, 3H), 1.22 (s, 6H). $^{13}$C{$^1$H} NMR (101 MHz, CDCl$_3$) $\delta$ 200.2 [199.9], 137.4 [136.5], 128.6 [128.4], 127.2 [126.8], 20.7 [20.1].
[126.5] 126.1, 55.1 [53.9], 52.3 [50.2], 20.7, [20.3] 19.8. The data of the other isomer are given in square brackets. Data are consistent with previous reports.

Compound 2h was obtained as a colorless liquid in 93% yield (273 mg, 0.95 mmol) after purification through silica gel column chromatography (PE/EtOAc 10:1). \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 7.28 (m, 10H), 5.35 (s, 2H), 4.95 (s, 2H), 2.72 (s, 3H). \(^1\)C\(^{13}\){\(^1\)H} NMR (101 MHz, CDCl\(_3\)) \(\delta\) 200.9, 139.4, 135.7, 134.8, 129.0, 128.9, 128.3, 127.9, 127.2, 127.0, 61.3, 56.4, 54.0, 42.3, 20.8. Data are consistent with previous reports.

Compound 2i was obtained as a white solid in 73% yield (307 mg, 1.45 mmol) after purification through silica gel column chromatography (PE/DCM 8:1). \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 7.26 (m, 2H), 7.13 (m, 2H), 3.76 (s, 3H), 2.53 (s, 3H), 2.41 (s, 3H). \(^1\)C\(^{13}\){\(^1\)H} NMR (101 MHz, CDCl\(_3\)) \(\delta\) 200.5, 142.3, 139.2, 130.4, 126.6, 46.2, 21.3, 20.8. Data are consistent with previous reports.

Compound 2j was obtained as a yellow liquid in 63% yield (140 mg, 0.67 mmol) after purification through silica gel column chromatography (PE/EtOAc 12:1). \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 7.25 (m, 3H), 7.12 (t, \(J\) = 7.4 Hz, 1H), 4.51 (t, \(J\) = 8.4 Hz, 2H), 3.21 (t, \(J\) = 8.4 Hz, 2H), 2.71 (s, 3H). \(^1\)C\(^{13}\){\(^1\)H} NMR (101 MHz, CDCl\(_3\)) \(\delta\) 193.5, 144.1, 134.6, 125.3, 125.2, 118.5, 54.3, 27.4, 19.6. Data are consistent with previous reports.

3. Synthetic procedure and spectroscopic data with trimethylsulfoxonium iodide as methylation reagent

**General procedure:** amine (1.0 equiv), carbondisulfide (1.2 equiv), trimethylsulfoxonium iodide (1.5 equiv), K\(_2\)CO\(_3\) (4.0 equiv) was added to DMSO (8 mL) in a sealed tube, then the mixture was stirred at 65 °C for 30 min. The reaction mixture was cooled down, diluted with H\(_2\)O, and extracted with DCM or ethyl ether twice. After being washed with H\(_2\)O and brine, the organic was dried over anhydrous Na\(_2\)SO\(_4\) and concentrated under vacuum. The desired compound could be obtained directly for characterization or after purification by silica gel column chromatography.

Compound 3a was obtained as a yellow liquid in 61% yield (138 mg, 0.61 mmol) as a mixture of isomers in the ratio of 3:1 after purification through silica gel column chromatography (PE/EtOAc 9:1). \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 7.27 (d, \(J\) = 9.2 Hz 2H), 6.90 (d, \(J\) = 8.8 Hz 2H), 4.84 [4.55] (d, \(J\) = 5.2 Hz, 2H), 3.81 (s, 3H), [2.70] 2.65 (s, 3H); \(^1\)C\(^{13}\){\(^1\)H} NMR (101 MHz, CDCl\(_3\)) \(\delta\) [201.6] 198.8, 159.5, 129.7 [129.4], 128.3 [127.2], 114.3, 55.4, 50.9 [49.9], [19.1] 18.3; HRMS-ESI (m/z): cale for C\(_{10}\)H\(_{14}\)NOS\(_2^+\) [M+H]\(^+\) 228.0511, found 228.0513.

Compound 3b was obtained as a white solid in 64% yield (142 mg, 0.64 mmol) as a mixture of isomers in the ratio of 17:1 after purification through silica gel column chromatography (PE/EtOAc 9:1). \(^1\)H NMR (400 MHz, \(d_6\)-DMSO) \(\delta\) 10.47 (s, 1H), 7.80 (m, 2H), 7.45 (d, \(J\) = 8.0 Hz 2H), 4.91 [4.67] (s, 2H), 2.55 [2.52] (s, 3H);
Compound 3c was obtained as a yellow liquid in 61% yield (197 mg, 0.92 mmol) as a mixture of isomers in the ratio of 5:1 after purification through silica gel column chromatography (PE/EtOAc 10:1). $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.31 (m, 2H), 7.05 (m, 2H), 4.90 [4.60] (d, $J$ = 5.2 Hz, 2H), [2.70] 2.86 (s, 3H); $^{13}$C($^1$H) NMR (101 MHz, CDCl$_3$) $\delta$ [202.0] 199.4, 162.5 (d, $J$ = 247.4 Hz), 132.1 [131.1] (d, $J$ = 3.0 Hz), 130.0 [129.8] (d, $J$ = 8.1 Hz), [116.1] 115.8 (d, $J$ = 21.2 Hz), 50.3 [49.6], [19.1] 18.3; $^{19}$F NMR (376 MHz, CDCl$_3$) $\delta$ [113.3] -113.8 (s, 1F); HRMS-ESI (m/z): calcd for C$_{10}$H$_{11}$NzS$_{2}$ [M+H]$^+$ 223.0358, found 223.0359.

Compound 3d was obtained as a yellow liquid in 69% yield (240 mg, 1.04 mmol) as a mixture of isomers in the ratio of 5:1 after purification through silica gel column chromatography (PE/EtOAc 10:1) $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.33 (m, J = 8.0 Hz 2H), 7.26 (d, $J$ = 8.4 Hz 2H), 4.91 [4.61] (d, $J$ = 5.6 Hz 2H), 2.67 (s, 3H); $^{13}$C($^1$H) NMR (101 MHz, CDCl$_3$) $\delta$ 199.7, 134.8, 133.9, 129.5, [129.2] 129.0, 50.3 [49.6], [19.1] 18.4; HRMS-ESI (m/z): calcd for C$_{9}$H$_{11}$ClNS$_{2}$ [M+H]$^+$ 232.0016, found 232.0017.

Compound 3e was obtained as a yellow liquid in 53% yield (147 mg, 0.53 mmol) as a mixture of isomers in the ratio of 4:1 after purification through silica gel column chromatography (PE/EtOAc 10:1) $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.47 (d, $J$ = 8.0 Hz, 2H), 7.19 (d, $J$ = 8.0 Hz, 2H), 4.87 [4.57] (d, $J$ = 5.6 Hz, 2H), 2.65 (s, 3H); $^{13}$C($^1$H) NMR (101 MHz, CDCl$_3$) $\delta$ 199.7, 135.4, 132.0, 129.8 [129.5], 122.0, 50.3 [49.6], [19.1] 18.4; HRMS-ESI (m/z): calcd for C$_{9}$H$_{11}$BrNS$_{2}$ [M+H]$^+$ 275.9511, found 275.9509.

Compound 3f was obtained as a yellow solid in 75% yield (269 mg, 0.83 mmol) as a mixture of isomers in the ratio of 4:1 after purification through silica gel column chromatography (PE/EtOAc 10:1) $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.69 (d, $J$ = 8.4 Hz, 2H), 7.07 (d, $J$ = 8.0 Hz, 2H), 4.88 [4.58] (d, $J$ = 5.2 Hz, 2H), 2.66 (s, 3H); $^{13}$C($^1$H) NMR (101 MHz, CDCl$_3$) $\delta$ 199.7, 138.0, 136.0, 130.0 [129.7], 93.6, 50.4 [49.7], [19.6] 18.4. HRMS-ESI (m/z): calcd for C$_{9}$H$_{11}$BrNS$_{2}$ [M+H]$^+$ 323.9372, found 323.9371.

Compound 3g was obtained as a white solid in 51% yield (170 mg, 0.80 mmol) as a mixture of isomers in the ratio of 3:1 after purification through silica gel column chromatography (PE/EtOAc 12:1). $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.34 (m, 2H), 7.27 (m, 1H), 7.22 (m, 2H), 6.92 (s, 1H), 4.01 [3.72] (q, $J$= 7.2, 12.8 Hz, 2H), 2.98 (m, 2H), [2.69] 2.61 (s, 3H); $^{13}$C($^1$H) NMR (101 MHz, CDCl$_3$) $\delta$ [201.9] 199.1, 138.2 [137.3], [129.0] 128.8, 128.8 [128.7], 127.1 126.8, 48.0 [47.3], [34.9] 34.3, [19.0] 18.1. The data of minor isomer are given in square brackets. Data are consistent with previous reports$^8$. 

13C($^1$H) NMR (101 MHz, $d_6$-DMSO) $\delta$ [200.7] 199.2, 143.8 [143.2], [133.0] 132.8, 128.7 [128.5], 119.5, [110.6] 110.3, 49.4 [48.9], [18.6] 18.0; HRMS-ESI (m/z): calcd for C$_{10}$H$_{11}$NzS$_{2}$[M+H]$^+$ 223.0358, found 223.0359.
Compound 3h was obtained as a yellow liquid in 66% yield (120 mg, 0.80 mmol) as a mixture of isomers with a ratio of 2:1 after purification through silica gel column chromatography (PE/EtOAc 10:1). $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ [7.63] 6.94 (s, 1H) 3.71 [3.41] (q, $J = 5.2$, 12.4 Hz, 2H), [2.68] 2.64 (s, 3H), 1.69 (m, 2H), 0.99 (m, 3H). $^{13}$C {$^1$H} NMR (101 MHz, CDCl$_3$) $\delta$ [201.8] 198.9, 49.0 [48.1], [22.1] 21.7, [18.9] 18.2, 11.4. The data of minor isomer are given in square brackets. Data are consistent with previous reports.$^9$

Compound 3i was obtained as a yellow liquid in 46% yield (50 mg, 0.31 mmol) as a mixture of isomers with a ratio of 2:1 after purification through silica gel column chromatography (PE/DCM 4:1). $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 3.74 [3.44] (m, 2H), [2.68] 2.64 (s, 3H), 1.65 (m, 2H), 1.41 (m, 2H), 0.96 (q, $J = 7.2$ Hz 3H). $^{13}$C {$^1$H} NMR (101 MHz, CDCl$_3$) $\delta$ [201.8] 198.8, 47.1 [46.1], [30.7] 30.4, 20.1 [20.0], [18.9] 18.2, 13.7 [13.6]. The data of minor isomer are given in square brackets. Data are consistent with previous reports.$^1$

Compound 2k was obtained as a yellow liquid in 88% yield (160 mg, 0.81 mmol) as a mixture of isomers with a ratio of 4:1 after purification through silica gel column chromatography (PE/EtOAc 12:1). $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.35 (m, 5H), 7.10 (s, 1H), 4.92 [4.62] (d, $J = 5.2$ Hz, 2H), [2.70] 2.66 (s, 3H). $^{13}$C {$^1$H} NMR (101 MHz, CDCl$_3$) $\delta$ [202.0] 199.2, 136.3 [135.3], [129.0] 128.9, 128.3 [128.3], 128.1 [127.9], 51.3 [50.4], [19.1] 18.4. The data of minor isomer are given in square brackets. Data are consistent with previous reports.$^{10}$

Compound 2l was obtained as a yellow liquid in 73% yield (120 mg, 0.53 mmol) as a mixture of isomers with a ratio of 2:1 after purification through silica gel column chromatography (PE/EtOAc 12:1). $^1$H NMR (400 Hz, CDCl$_3$) $\delta$ 7.30 (t, $J = 7.6$ Hz, 2H), 7.20 (m, 3H), 3.78 [3.46] (q, $J = 6.8$, 13.2 Hz, 2H), 2.70 (m, 2H), 2.60 (s, 3H), 2.02 (m, 2H). $^{13}$C {$^1$H} NMR (101 MHz, CDCl$_3$) $\delta$ [201.9] 198.9, 141.1 [140.5], 128.6, 128.4, 126.3 [126.2], 47.0 [45.9], 33.3 [33.0], [30.1] 29.8, [18.9] 18.2. The data of minor isomer are given in square brackets. Data are consistent with previous reports.$^{11}$

4. General procedure for synthesis of S-trideuteromethyl dithiocarbamates with DMSO-$d_6$ as deuterium source

**General procedure:** A mixture of trimethylsulfoxonium iodide (1.5 equiv) and DMSO-$d_6$ (80.0 equiv) in sealed tube was stirred at 120 °C for 2 h, then it was cooled down. After that, amine (1.0 equiv) and K$_2$CO$_3$ (4.0 equiv) was added in, and the mixture was further stirred at 65 °C for 30 min. After being cooled to room temperature, the reaction mixture was diluted with H$_2$O and extracted with DCM twice. The combined organic was washed with H$_2$O and brine, and dried over anhydrous Na$_2$SO$_4$. The obtained crude was concentrated under vacuum, and purified by silica gel column chromatography. The level of deuterium incorporation was determined by $^1$H NMR spectrometry of the S-CH$_3$ signal based on the following equation:
\[
Deuteration (\%) = \left(1 - \frac{Normalized \ residual \ integral}{3}\right) \times 100\%
\]

Compound 4a was obtained as a yellow solid in 96% yield and 93% deuterium incorporation (40 mg, 0.22 mmol) after purification through silica gel column chromatography (PE/EtOAc 20:1). \(^1\)H NMR (400 MHz, CDCl\textsubscript{3}) \(\delta 4.31\) (s, 2H), 3.90 (m, 2H), 2.66 (s, 0.21H), 1.71 (m, 6H).

Compound 4b was obtained as a colorless liquid in 93% yield and 96% deuterium incorporation (120 mg, 0.43 mmol) after purification through silica gel column chromatography (PE/DCM 5:1). \(^1\)H NMR (400 MHz, CDCl\textsubscript{3}) \(\delta 7.30\) (m, 10H), 5.36 (s, 2H), 4.98 (s, 2H), 2.73 (s, 0.12H).

Compound 4c was obtained as a colorless liquid in 98% yield and 95% deuterium incorporation (60 mg, 0.80 mmol) after purification through silica gel column chromatography (PE/EtOAc 15:1). \(^1\)H NMR (400 MHz, CDCl\textsubscript{3}) \(\delta 5.83\) (s, 1H), 5.40 (m, 4H), 4.65 (d, \(J = 6.0\) Hz, 2H), 4.28 (d, \(J = 5.2\) Hz, 2H), 2.65 (s, 0.14H).

Compound 4d was obtained as a yellow liquid in 85% yield and 96% deuterium incorporation (170 mg, 0.97 mmol) as a mixture of isomers in the ratio of 2:1 after extraction with ethyl ether without further purification. \(^1\)H NMR (400 MHz, CDCl\textsubscript{3}) \(\delta 7.28\) (m, 5H), 5.38 [5.00] (s, 2H), [3.48] 3.26 (s, 3H), 2.69 (s, 0.12H).

Compound 4e was obtained as a colorless liquid in 76% yield and 89% deuterium incorporation (35 mg, 0.16 mmol) as a mixture of isomers with a ratio of 2:1 after purification through silica gel column chromatography (PE/EtOAc 15:1). \(^1\)H NMR (400 MHz, CDCl\textsubscript{3}) \(\delta 3.74\) [3.44] (p, \(J = 7.2\) Hz, 2H), 2.68 [2.64] (s, 0.70H), 1.64 (m, 2H), 1.41 (m, 2H), 0.96 (t, \(J = 7.6\) Hz, 3H).

Compound 4f was obtained as a colorless liquid in 93% yield and 77% deuterium incorporation (43 mg, 0.24 mmol) as a mixture of isomers with a ratio of 2:1 after purification through silica gel column chromatography (PE/EtOAc 15:1). \(^1\)H NMR (400 MHz, CDCl\textsubscript{3}) \(\delta 3.74\) [3.44] (p, \(J = 7.2\) Hz, 2H), [2.68] 2.64 (s, 0.70H), 1.64 (m, 2H), 1.41 (m, 2H), 0.96 (t, \(J = 7.6\) Hz, 3H).
5. $^1$H and $^{13}$C NMR spectra of compounds

$^1$H NMR: CDCl$_3$, 400 MHz

$^{13}$C($^1$H) NMR: CDCl$_3$, 101 MHz
$^1$H NMR: CDCl$_3$, 400 MHz

$^{13}$C($^1$H) NMR: CDCl$_3$, 101 MHz
$^1$H NMR: CDCl$_3$, 400 MHz

$^{13}$C($^1$H) NMR: CDCl$_3$, 101 MHz
$^1$H NMR: CDCl$_3$, 400 MHz

$^{13}$C($^1$H) NMR: CDCl$_3$, 101 MHz
$^1$H NMR: CDCl$_3$, 400 MHz

$^{13}$C($^1$H) NMR: CDCl$_3$, 101 MHz
$^1$H NMR: CDCl$_3$, 400 MHz

$^1$C($^1$H) NMR: CDCl$_3$, 101 MHz
$^{1}H$ NMR: CDCl$_3$, 400 MHz

$^{13}C$ NMR: CDCl$_3$, 101 MHz
$^1$H NMR: CDCl$_3$, 400 MHz

$^{13}$C($^1$H) NMR: CDCl$_3$, 101 MHz
$^{1}H$ NMR: CDCl$_3$, 400 MHz

$^{13}C(1)H$ NMR: CDCl$_3$, 101 MHz
$^1\text{H NMR: CDCl}_3$, 400 MHz

$^{13}\text{C}(^1\text{H})$ NMR: CDCl$_3$, 101 MHz

S17
$^{1}H$ NMR: CDCl$_3$, 400 MHz

$^{13}C(\textsuperscript{1}H)$ NMR: CDCl$_3$, 101 MHz
$^1$H NMR: CDCl$_3$, 400 MHz

$^{13}$C{H} NMR: CDCl$_3$, 101 MHz
$^1$H NMR: CDCl$_3$, 400 MHz

$^{13}$C($^1$H) NMR: CDCl$_3$, 101 MHz
$^{1}H$ NMR: DMSO-d$_6$, 400 MHz

$^{13}C$ NMR: DMSO-d$_6$, 101 MHz
$^1$H NMR: CDCl$_3$, 400 MHz

$^{13}$C{[H]} NMR: CDCl$_3$, 101 MHz
$^{19}$F NMR: CDCl$_3$, 376 MHz
$^1$H NMR: CDCl$_3$, 400 MHz

$^{13}$C($^1$H) NMR: CDCl$_3$, 101 MHz
$^1$H NMR: CDCl$_3$, 400 MHz

$^{13}$C($^1$H) NMR: CDCl$_3$, 101 MHz
$^1$H NMR: CDCl$_3$, 400 MHz

$^{13}$C($^1$H) NMR: CDCl$_3$, 101 MHz
$^1$H NMR: CDCl$_3$, 400 MHz

$^{13}$C($^1$H) NMR: CDCl$_3$, 101 MHz
$^1$H NMR: CDCl$_3$, 400 MHz

$^{13}$C($^1$H) NMR: CDCl$_3$, 101 MHz
$^1$H NMR: CDCl$_3$, 400 MHz

$^{13}$C($^1$H) NMR: CDCl$_3$, 101 MHz
\textsuperscript{1}H NMR: CDCl\textsubscript{3}, 400 MHz

\[ \text{Compound 4a} \]

\[ \text{Compound 2a} \]

\[ \text{Compound 4b} \]

\[ \text{Compound 2h} \]
6. Reference


