Supporting Information

Synthesis of novel 1,2,4-triazole derivatives containing the quinazolinylpiperidinyl moiety and N-(substituted phenyl)acetamide group as efficient bactericides against the phytopathogenic bacterium Xanthomonas oryzae pv. oryzae

Lan Yang and Xiao-Ping Bao*
State Key Laboratory Breeding Base of Green Pesticide and Agricultural Bioengineering, Key Laboratory of Green Pesticide and Agricultural Bioengineering, Ministry of Education, Centre for Research and Development of Fine Chemicals, Guizhou University, Guiyang 550025, China
E-mail: baoxp_1980@aliyun.com

Table of Contents

Characterization data of target compounds 7a–7p.....................................................S2
Spectra of 1H, 13C NMR and HRMS of intermediates 2–5 and target compounds 7a–7p..........................................................S8
**N-(4-acetylphenyl)-2-((4-phenyl-5-(1-(quinazolin-4-yl)piperidin-4-yl)-4H-1,2,4-triazol-3-yl)thio)acetamide (7a)** 59.1 mg, yield: 81%, as a brown solid; mp 119–120 °C; \(^1\)H NMR (500 MHz, DMSO-\(d_6\)): 10.65 (s, 1H), 8.56 (s, 1H), 7.91 (d, \(J = 10.0\) Hz, 3H), 7.78–7.74 (m, 2H), 7.66 (d, \(J = 5.0\) Hz, 2H), 7.60 (d, \(J = 5.0\) Hz, 3H), 7.51–7.47 (m, 3H), 4.20 (d, \(J = 15.0\) Hz, 2H), 4.14 (s, 2H), 3.12 (t, \(J = 10.0\) Hz, 2H), 2.92–2.86 (m, 1H), 2.49 (s, 3H), 1.94–1.83 (m, 4H); \(^{13}\)C NMR (125 MHz, DMSO-\(d_6\)): 197.1, 166.8, 164.2, 158.6, 154.1, 151.8, 150.4, 143.6, 133.4, 133.2, 132.5, 130.8, 130.7, 130.1, 128.5, 128.0, 126.1, 125.8, 118.9, 116.4, 49.2, 37.4, 32.5, 30.3, 27.0; IR (KBr, \(\nu/cm^{-1}\)): 1676 (C=O); ESI-HRMS \(m/z\): [M + H]\(^+\) calcd for C\(_{31}\)H\(_{30}\)N\(_7\)O\(_2\)S: 564.2176; found: 564.2179.

**N-(4-fluorophenyl)-2-((4-phenyl-5-(1-(quinazolin-4-yl)piperidin-4-yl)-4H-1,2,4-triazol-3-yl)thio)acetamide (7b)** 52.8 mg, yield: 75%, as a white solid; mp 111–113 °C; \(^1\)H NMR (500 MHz, DMSO-\(d_6\)): 10.39 (s, 1H), 8.56 (s, 1H), 7.91 (d, \(J = 5.0\) Hz, 1H), 7.75 (t, \(J = 5.0\) Hz, 2H), 7.61 (d, \(J = 5.0\) Hz, 3H), 7.56–7.47 (m, 5H), 7.13 (t, \(J = 5.0\) Hz, 2H), 4.20 (d, \(J = 15.0\) Hz, 2H), 4.09 (s, 2H), 3.12 (t, \(J = 10.0\) Hz, 2H), 2.91–2.86 (m, 1H), 1.94–1.83 (m, 4H); \(^{13}\)C NMR (125 MHz, DMSO-\(d_6\)): 166.1, 164.2, 158.6, 154.1, 151.6, 150.5, 135.6, 133.3, 130.9, 130.7, 128.3, 128.0, 126.2, 125.8, 121.6, 121.5, 116.3, 116.0, 115.8, 49.2, 37.2, 32.5, 30.2; IR (KBr, \(\nu/cm^{-1}\)): 1669 (C=O); ESI-HRMS \(m/z\): [M + H]\(^+\) calcd for C\(_{29}\)H\(_{27}\)FN\(_7\)O\(_2\): 540.1976; found: 540.1982.

**N-(4-bromophenyl)-2-((4-phenyl-5-(1-(quinazolin-4-yl)piperidin-4-yl)-4H-1,2,4-triazol-3-yl)thio)acetamide (7c)** 68.0 mg, yield: 88%, as a white solid; mp 113–115 °C; \(^1\)H NMR (500 MHz, DMSO-\(d_6\)): 10.46 (s, 1H), 8.56 (s, 1H), 7.91 (d, \(J = 5.0\) Hz, 1H), 7.78–7.74 (m, 2H), 7.61–7.60 (m, 3H), 7.51–7.46 (m, 7H), 4.20 (d, \(J = 15.0\) Hz, 2H), 4.09 (s, 2H), 3.12 (t, \(J = 10.0\) Hz, 2H), 2.91–2.85 (m, 1H), 1.94–1.83 (m, 4H); \(^{13}\)C NMR (125 MHz, DMSO-\(d_6\)): 166.3, 164.2, 158.6, 154.1, 151.8, 150.4, 138.7, 133.4, 133.2, 132.2, 130.8, 130.7, 128.5, 128.0, 126.1, 125.8, 121.6, 116.4, 49.2, 37.4, 32.5, 30.3; IR (KBr, \(\nu/cm^{-1}\)): 1683 (C=O); ESI-HRMS \(m/z\): [M + H]\(^+\) calcd
for C_{29}H_{27}BrN_{8}O_{3}S: 600.1175; found: 600.1177.

**N-(4-nitrophenyl)-2-((4-phenyl-5-(1-(quinazolin-4-yl)piperidin-4-yl)-4H-1,2,4-triazol-3-yl)thio)acetamide (7d)** 64.9 mg, yield: 88%, as a pale yellow solid; mp 120–123 °C; \(^1\)H NMR (500 MHz, DMSO-\(d_6\)): 10.94 (s, 1H), 8.56 (s, 1H), 8.21 (d, \(J = 10.0\) Hz, 2H), 7.91 (d, \(J = 5.0\) Hz, 1H), 7.79–7.75 (m, 4H), 7.60–7.58 (m, 3H), 7.51–7.50 (m, 3H), 4.20 (d, \(J = 15.0\) Hz, 2H), 4.16 (s, 2H), 3.12 (t, \(J = 10.0\) Hz, 2H), 2.92–2.86 (m, 1H), 1.93–1.86 (m, 4H); \(^13\)C NMR (125 MHz, DMSO-\(d_6\)): 167.2, 164.2, 158.7, 154.1, 151.7, 150.3, 145.4, 143.0, 135.6, 133.3, 130.9, 130.7, 128.4, 128.0, 126.2, 125.8, 125.6, 119.4, 116.3, 49.2, 37.4, 32.5, 30.2; IR (KBr, \(\nu/cm^{-1}\)): 1700 (C=O); ESI-HRMS \(m/z\): [M + H]+ calcd for C_{29}H_{27}N_{8}O_{3}S: 567.1921; found: 567.1926.

**N-(2,4-difluorophenyl)-2-((4-phenyl-5-(1-(quinazolin-4-yl)piperidin-4-yl)-4H-1,2,4-triazol-3-yl)thio)acetamide (7e)** 43.1 mg, yield: 60%, as a white solid; mp 205–206 °C; \(^1\)H NMR (500 MHz, DMSO-\(d_6\)): 10.17 (s, 1H), 8.56 (s, 1H), 7.91 (d, \(J = 10.0\) Hz, 1H), 7.84–7.78 (m, 1H), 7.76–7.74 (m, 2H), 7.62–7.59 (m, 3H), 7.51–7.47 (m, 3H), 7.31 (t, \(J = 10.0\) Hz, 1H), 7.04 (t, \(J = 10.0\) Hz, 1H), 4.20 (d, \(J = 15.0\) Hz, 2H), 4.13 (s, 2H), 3.12 (t, \(J = 10.0\) Hz, 2H), 2.92–2.86 (m, 1H), 1.95–1.84 (m, 4H); \(^13\)C NMR (125 MHz, DMSO-\(d_6\)): 166.8, 164.2, 158.6, 154.1, 151.8, 150.4, 133.4, 133.2, 130.8, 130.7, 128.5, 128.0, 126.1, 125.8, 125.7, 125.6, 116.4, 111.9, 111.8, 111.6, 104.9, 104.7, 104.5, 49.2, 36.9, 32.6, 30.3; IR (KBr, \(\nu/cm^{-1}\)): 1679 (C=O); ESI-HRMS \(m/z\): [M + H]+ calcd for C_{29}H_{26}F_{2}N_{8}O_{3}S: 558.1882; found: 558.1884.

**N-(4-(trifluoromethyl)-phenyl)-2-((4-phenyl-5-(1-(quinazolin-4-yl)piperidin-4-yl)-4H-1,2,4-triazol-3-yl)thio)acetamide (7f)** 58.4 mg, yield: 77%, as a white solid; mp 115–116 °C; \(^1\)H NMR (500 MHz, DMSO-\(d_6\)): 10.66 (s, 1H), 8.56 (s, 1H), 7.91 (d, \(J = 10.0\) Hz, 1H), 7.78–7.73 (m, 4H), 7.66 (d, \(J = 5.0\) Hz, 2H), 7.60 (d, \(J = 5.0\) Hz, 3H), 7.51–7.47 (m, 3H), 4.20 (d, \(J = 15.0\) Hz, 2H), 4.13 (s, 2H), 3.13 (t, \(J = 10.0\) Hz, 2H), 2.92–2.86 (m, 1H), 1.95–1.83 (m, 4H); \(^13\)C NMR (125 MHz, DMSO-\(d_6\)): 166.8, 164.2, 158.6, 154.1, 151.8, 150.4, 142.9, 133.4, 133.2, 130.8, 130.7, 128.5, 128.0, 126.8, 158.6, 154.1, 151.8, 142.9, 133.4, 133.2, 130.8, 130.7, 128.5, 128.0, 126.8.
N-(3-fluorophenyl)-2-((4-phenyl-5-(1-(quinazolin-4-yl)piperidin-4-yl)-4H-1,2,4-triazol-3-yl)thio)acetamide (7g) 48.7 mg, yield: 70%, as a white solid; mp 120–122 °C; 1H NMR (500 MHz, DMSO-d6): 10.53 (s, 1H), 8.56 (s, 1H), 7.91 (d, J = 10.0 Hz, 1H), 7.78–7.74 (m, 2H), 7.61–7.60 (m, 3H), 7.53–7.48 (m, 4H), 7.35–7.30 (m, 1H), 7.24 (d, J = 5.0 Hz, 1H), 6.86 (t, J = 10.0 Hz, 1H), 4.20 (d, J = 15.0 Hz, 2H), 4.10 (s, 2H), 3.12 (t, J = 10.0 Hz, 2H), 2.91–2.87 (m, 1H), 1.94–1.83 (m, 4H); 13C NMR (125 MHz, DMSO-d6): 166.5, 164.2, 163.6, 161.7, 158.6, 154.2, 1518, 150.4, 141.1, 133.4, 133.2, 130.8, 130.7, 128.5, 128.0, 126.1, 125.8, 116.4, 115.4, 110.6, 106.5, 49.2, 37.3, 32.5, 30.3; IR (KBr, ν/cm−1): 1683 (C=O); ESI-HRMS m/z: [M + H]+ calcd for C30H27F3N7OS: 590.1944; found: 590.1945.

N-(2,6-difluorophenyl)-2-((4-phenyl-5-(1-(quinazolin-4-yl)piperidin-4-yl)-4H-1,2,4-triazol-3-yl)thio)acetamide (7h) 66.1 mg, yield: 92%, as a white solid; mp 258–260 °C; 1H NMR (500 MHz, DMSO-d6): 10.09 (s, 1H), 8.57 (s, 1H), 7.92 (d, J = 15.0 Hz, 1H), 7.77–7.75 (m, 2H), 7.63–7.58 (m, 3H), 7.51–7.48 (m, 3H), 7.35–7.29 (m, 1H), 7.13 (t, J = 5.0 Hz, 2H), 4.21 (d, J = 15.0 Hz, 2H), 4.17 (s, 2H), 3.13 (t, J = 10.0 Hz, 2H), 2.92–2.87 (m, 1H), 1.96–1.85 (m, 4H); 13C NMR (125 MHz, DMSO-d6): 166.5, 164.3, 159.0, 158.5, 157.1, 154.2, 151.8, 150.2, 143.4, 133.2, 130.8, 130.7, 128.5, 128.0, 126.1, 125.8, 116.4, 112.5, 112.4, 49.2, 36.2, 32.5, 30.3; IR (KBr, ν/cm−1): 1672 (C=O); ESI-HRMS m/z: [M + H]+ calcd for C29H26F2N7OS: 558.1882; found: 558.1886.

N-(2-nitrophenyl)-2-((4-phenyl-5-(1-(quinazolin-4-yl)piperidin-4-yl)-4H-1,2,4-triazol-3-yl)thio)acetamide (7i) 43.2 mg, yield: 59%, as a brown solid; mp 99–100 °C; 1H NMR (500 MHz, DMSO-d6): 10.68 (s, 1H), 8.56 (s, 1H), 7.97 (d, J = 5.0 Hz, 1H), 7.91 (d, J = 10.0 Hz, 1H), 7.79–7.75 (m, 3H), 7.70 (t, J = 10.0 Hz, 1H), 7.63–
N-(2,6-dimethylphenyl)-2-((4-phenyl-5-(1-(quinazolin-4-yl)piperidin-4-yl)-4H-1,2,4-triazol-3-yl)thio)acetamide (7j)  41.2 mg, yield: 58%, as a white solid; mp 238–240 °C; 1H NMR (500 MHz, DMSO-d6): 9.59 (s, 1H), 8.57 (s, 1H), 7.92 (d, J = 10.0 Hz, 1H), 7.79–7.75 (m, 2H), 7.64–7.60 (m, 3H), 7.52–7.48 (m, 3H), 7.05–6.99 (m, 3H), 4.22 (d, J = 15.0 Hz, 2H), 4.10 (s, 2H), 3.13 (t, J = 10.0 Hz, 2H), 2.93–2.88 (m, 1H), 1.94–1.84 (m, 4H); 13C NMR (125 MHz, DMSO-d6): 165.9, 164.3, 158.5, 154.2, 151.8, 150.4, 135.7, 135.2, 133.3, 133.2, 130.8, 130.7, 128.5, 128.1, 127.1, 126.1, 125.8, 116.4, 49.3, 36.4, 32.5, 30.4, 18.5; IR (KBr, ν/cm⁻¹): 1680 (C=O); ESI-HRMS m/z: [M + H]^+ calcd for C_{30}H_{27}N_{8}O_{3}S: 550.2383; found: 550.2386.

N-(2-(trifluoromethyl)phenyl)-2-((4-phenyl-5-(1-(quinazolin-4-yl)piperidin-4-yl)-4H-1,2,4-triazol-3-yl)thio)acetamide (7k)  54.9 mg, yield: 72%, as a pink solid; mp 169–172 °C; 1H NMR (500 MHz, DMSO-d6): 9.95 (s, 1H), 8.56 (s, 1H), 7.92 (d, J = 10.0 Hz, 1H), 7.77–7.76 (m, 2H), 7.70 (d, J = 10.0 Hz, 1H), 7.67–7.60 (m, 4H), 7.52–7.47 (m, 4H), 7.42 (t, J = 10.0 Hz, 1H), 4.22 (d, J = 15.0 Hz, 2H), 4.12 (s, 2H), 3.13 (t, J = 10.0 Hz, 2H), 2.93–2.88 (m, 1H), 1.97–1.85 (m, 4H); 13C NMR (125 MHz, DMSO-d6): 167.4, 164.3, 158.6, 154.1, 151.8, 150.4, 135.5, 133.6, 133.4, 133.2, 130.8, 130.7, 129.9, 128.5, 128.0, 127.3, 126.9, 126.8, 126.1, 125.8, 122.9, 116.1, 49.2, 36.6, 32.5, 30.3; IR (KBr, ν/cm⁻¹): 1695 (C=O); ESI-HRMS m/z: [M + H]^+ calcd for C_{30}H_{27}F_{3}N_{8}O_{3}S: 590.1944; found: 590.1944.

N-(3-acetylphenyl)-2-((4-phenyl-5-(1-(quinazolin-4-yl)piperidin-4-yl)-4H-1,2,4-triazol-3-yl)thio)acetamide (7l)  54.9 mg, yield: 72%, as a pink solid; mp 169–172 °C; 1H NMR (500 MHz, DMSO-d6): 9.95 (s, 1H), 8.56 (s, 1H), 7.92 (d, J = 10.0 Hz, 1H), 7.77–7.76 (m, 2H), 7.70 (d, J = 10.0 Hz, 1H), 7.67–7.60 (m, 4H), 7.52–7.47 (m, 4H), 7.42 (t, J = 10.0 Hz, 1H), 4.22 (d, J = 15.0 Hz, 2H), 4.12 (s, 2H), 3.13 (t, J = 10.0 Hz, 2H), 2.93–2.88 (m, 1H), 1.97–1.85 (m, 4H); 13C NMR (125 MHz, DMSO-d6): 167.4, 164.3, 158.6, 154.1, 151.8, 150.4, 135.5, 133.6, 133.4, 133.2, 130.8, 130.7, 129.9, 128.5, 128.0, 127.3, 126.9, 126.8, 126.1, 125.8, 122.9, 116.1, 49.2, 36.6, 32.5, 30.3; IR (KBr, ν/cm⁻¹): 1695 (C=O); ESI-HRMS m/z: [M + H]^+ calcd for C_{30}H_{27}F_{3}N_{8}O_{3}S: 590.1944; found: 590.1944.
**triazol-3-ylthio)acetamide (7l)** 66.1 mg, yield: 91%, as a white solid; mp 165–166 °C; 1H NMR (500 MHz, DMSO-d$_6$): 10.52 (s, 1H), 8.56 (s, 1H), 8.12 (s, 1H), 7.91 (d, J = 10.0 Hz, 1H), 7.78–7.74 (m, 3H), 7.65 (d, J = 10.0 Hz, 1H), 7.62–7.58 (m, 3H), 7.51–7.43 (m, 4H), 4.20 (d, J = 15.0 Hz, 2H), 4.11 (s, 2H), 3.12 (t, J = 10.0 Hz, 2H), 2.92–2.86 (m, 1H), 2.52 (s, 3H), 1.94–1.83 (m, 4H); 13C NMR (125 MHz, DMSO-d$_6$): 198.1, 166.5, 164.2, 158.6, 154.2, 151.8, 150.4, 139.7, 137.9, 133.4, 133.2, 130.8, 130.7, 129.8, 128.5, 128.1, 126.1, 125.8, 124.2, 124.1, 118.7, 116.4, 49.2, 37.3, 32.5, 30.3, 27.3; IR (KBr, $\nu$/cm$^{-1}$): 1669 (C=O); ESI-HRMS m/z: [M + H]$^+$ calcd for C$_{31}$H$_{30}$N$_7$O$_2$S: 564.2176; found: 564.2180.

**N-(4-methoxyphenyl)-2-((4-phenyl-5-(1-(quinazolin-4-yl)piperidin-4-yl)-4H-1,2,4-triazol-3-yl)thio)acetamide (7m)** 64.8 mg, yield: 91%, as a white solid; mp 160–163 °C; 1H NMR (500 MHz, DMSO-d$_6$): 10.15 (s, 1H), 8.56 (s, 1H), 7.91 (d, J = 10.0 Hz, 1H), 7.76 (d, J = 5.0 Hz, 2H), 7.60 (d, J = 5.0 Hz, 3H), 7.51–7.47 (m, 3H), 7.43 (d, J = 10.0 Hz, 2H), 6.85 (d, J = 10.0 Hz, 2H), 4.21 (d, J = 15.0 Hz, 2H), 4.05 (s, 2H), 3.68 (s, 3H), 3.13 (t, J = 10.0 Hz, 2H), 2.92–2.86 (m, 1H), 1.93–1.84 (m, 4H); 13C NMR (125 MHz, DMSO-d$_6$): 165.5, 164.3, 158.5, 155.9, 154.1, 151.8, 150.5, 133.5, 133.2, 132.5, 130.8, 130.7, 128.5, 128.1, 126.1, 125.8, 121.2, 116.4, 114.5, 55.7, 49.2, 37.4, 32.5, 30.3; IR (KBr, $\nu$/cm$^{-1}$): 1669 (C=O); ESI-HRMS m/z: [M + H]$^+$ calcd for C$_{30}$H$_{30}$N$_7$O$_2$S: 552.2176; found: 552.2182.

**N-(3-nitrophenyl)-2-((4-phenyl-5-(1-(quinazolin-4-yl)piperidin-4-yl)-4H-1,2,4-triazol-3-yl)thio)acetamide (7n)** 55.4 mg, yield: 75%, as a white solid; mp 209–211 °C; 1H NMR (500 MHz, DMSO-d$_6$): 10.81 (s, 1H), 8.57 (t, J = 2.1 Hz, 1H), 8.55 (s, 1H), 7.90 (d, J = 10.0 Hz, 2H), 7.84 (d, J = 10.0 Hz, 1H), 7.78–7.73 (m, 2H), 7.61–7.58 (m, 4H), 7.52–7.46 (m, 3H), 4.20 (d, J = 15.0 Hz, 2H), 4.13 (s, 2H), 3.12 (t, J = 10.0 Hz, 2H), 2.93–2.87 (m, 1H), 1.94–1.84 (m, 4H); 13C NMR (125 MHz, DMSO-d$_6$): 167.0, 164.2, 158.6, 154.1, 151.8, 150.3, 148.5, 140.4, 133.4, 133.2, 130.9, 130.8, 130.7, 128.5, 128.0, 126.1, 125.8, 125.6, 118.6, 116.4, 113.7, 49.2, 37.2, 32.5, 30.3; IR (KBr, $\nu$/cm$^{-1}$): 1680 (C=O); ESI-HRMS m/z: [M + H]$^+$ calcd for C$_{29}$H$_{27}$N$_7$O$_3$S:
N-(4-chlorophenyl)-2-((4-phenyl-5-(1-(quinazolin-4-yl)piperidin-4-yl)-4H-1,2,4-triazol-3-yl)thio)acetamide (7o) 65.9 mg, yield: 92%, as a white solid; mp 115–117 °C; ¹H NMR (500 MHz, DMSO-d₆): 7.71 (s, 1H), 7.15 (d, J = 10.0 Hz, 1H), 6.97–6.96 (m, 2H), 6.81–6.78 (m, 4H), 6.73–6.69 (m, 3H), 6.67–6.65 (m, 2H), 6.47 (d, J = 10.0 Hz, 2H), 3.59 (d, J = 15.0 Hz, 2H), 3.17 (s, 2H), 2.33 (d, J = 10.0 Hz, 2H), 2.20–2.14 (m, 1H), 1.27–1.14 (m, 4H); ¹³C NMR (125 MHz, DMSO-d₆): 166.0, 163.8, 158.2, 152.5, 150.5, 150.0, 136.3, 132.1, 132.0, 129.7, 129.2, 128.1, 127.7, 126.7, 126.1, 124.9, 124.5, 120.2, 115.4, 48.3, 35.7, 32.2, 29.1. IR (KBr, ν/cm⁻¹): 1688 (C=O). ESI-HRMS m/z: [M + H]⁺ calcd for C₂₉H₂₇ClN₇O₅S: 556.1680; found: 556.1687.

N-(2,4-dichlorophenyl)-2-((4-phenyl-5-(1-(quinazolin-4-yl)piperidin-4-yl)-4H-1,2,4-triazol-3-yl)thio)acetamide (7p) 44.0 mg, yield: 58%, as a brown solid; mp 90–92 °C; ¹H NMR (500 MHz, DMSO-d₆): 10.01 (s, 1H), 8.53 (s, 1H), 7.88 (d, J = 10.0 Hz, 1H), 7.77–7.73 (m, 3H), 7.61–7.57 (m, 4H), 7.48–7.45 (m, 3H), 7.37–7.35 (m, 1H), 4.18 (d, J = 15.0 Hz, 2H), 4.12 (s, 2H), 3.09 (t, J = 10.0 Hz, 2H), 2.89–2.84 (m, 1H), 1.92–1.81 (m, 4H); ¹³C NMR (125 MHz, DMSO-d₆): 167.0, 164.2, 158.6, 154.2, 151.8, 150.4, 134.4, 133.4, 133.2, 130.9, 130.7, 129.8, 129.5, 128.5, 128.2, 128.0, 127.0, 126.6, 126.1, 125.8, 116.4, 49.2, 36.8, 32.5, 30.3; IR (KBr, ν/cm⁻¹): 1688 (C=O); ESI-HRMS m/z: [M + H]⁺ calcd for C₂₉H₂₆Cl₂N₇O₅S: 590.1291; found: 590.1293.
Figure S1. $^1$H NMR spectrum of intermediate 2 (DMSO-$d_6$)

Figure S2. $^{13}$C NMR spectrum of intermediate 2 (DMSO-$d_6$)
Figure S3. HRMS-ESI spectrum of intermediate 2

Figure S4. $^1$H NMR spectrum of intermediate 3 (DMSO-$d_6$)
Figure S5. $^{13}$C NMR spectrum of intermediate 3 (DMSO-$d_6$)

Figure S6. HRMS-ESI spectrum of intermediate 3
Figure S7. $^1$H NMR spectrum of intermediate 4 (DMSO-$d_6$)

Figure S8. $^{13}$C NMR spectrum of intermediate 4 (DMSO-$d_6$)
Figure S9. HRMS-ESI spectrum of intermediate 4

Figure S10. $^1$H NMR spectrum of intermediate 5 (DMSO-$d_6$)
Figure S11. $^{13}\text{C}$ NMR spectrum of intermediate 5 (DMSO-$d_6$)

Figure S12. HRMS-ESI spectrum of intermediate 5
Figure S13. $^1$H NMR spectrum of compound 7a (DMSO-$d_6$)

Figure S14. $^{13}$C NMR spectrum of compound 7a (DMSO-$d_6$)
Figure S15. HRMS-ESI spectrum of compound 7a

Figure S16. $^1$H NMR spectrum of compound 7b (DMSO-$d_6$)
Figure S17. $^{13}$C NMR spectrum of compound 7b (DMSO-$d_6$)

Figure S18. HRMS-ESI spectrum of compound 7b
Figure S19. $^1$H NMR spectrum of compound 7c (DMSO-$d_6$)

Figure S20. $^{13}$C NMR spectrum of compound 7c (DMSO-$d_6$)
Figure S21. HRMS-ESI spectrum of compound 7c

Figure S22. 1H NMR spectrum of compound 7d (DMSO-\textit{d}_6)
Figure S23. $^{13}$C NMR spectrum of compound 7d (DMSO-$d_6$)

Figure S24. HRMS-ESI spectrum of compound 7d
Figure S25. $^1$H NMR spectrum of compound 7e (DMSO-$d_6$)

Figure S26. $^{13}$C NMR spectrum of compound 7e (DMSO-$d_6$)
Figure S27. HRMS-ESI spectrum of compound 7e

Figure S28. $^1$H NMR spectrum of compound 7f (DMSO-$d_6$)
Figure S29. $^{13}$C NMR spectrum of compound 7f (DMSO-$d_6$)

Figure S30. HRMS-ESI spectrum of compound 7f
Figure S31. $^1$H NMR spectrum of compound 7g (DMSO-$d_6$)

Figure S32. $^{13}$C NMR spectrum of compound 7g (DMSO-$d_6$)
Figure S33. HRMS-ESI spectrum of compound 7g

Figure S34. $^1$H NMR spectrum of compound 7h (DMSO-$d_6$)
Figure S35. $^{13}$C NMR spectrum of compound 7h (DMSO-$d_6$)

Figure S36. HRMS-ESI spectrum of compound 7h
Figure S37. $^1$H NMR spectrum of compound 7i (DMSO-$d_6$)

Figure S38. $^{13}$C NMR spectrum of compound 7i (DMSO-$d_6$)
Figure S39. HRMS-ESI spectrum of compound 7i

Figure S40. $^1$H NMR spectrum of compound 7j (DMSO-$d_6$)
Figure S41. $^{13}$C NMR spectrum of compound 7j (DMSO-$d_6$)

Figure S42. HRMS-ESI spectrum of compound 7j
Figure S43. $^1$H NMR spectrum of compound 7k (DMSO-$d_6$)

Figure S44. $^{13}$C NMR spectrum of compound 7k (DMSO-$d_6$)
Figure S45. HRMS-ESI spectrum of compound 7k

Figure S46. $^1$H NMR spectrum of compound 7l (DMSO-$d_6$)
Figure S47. $^{13}$C NMR spectrum of compound 7l (DMSO-$d_6$)

Figure S48. HRMS-ESI spectrum of compound 7l
Figure S49. $^1$H NMR spectrum of compound 7m (DMSO-$d_6$)

Figure S50. $^{13}$C NMR spectrum of compound 7m (DMSO-$d_6$)
Figure S51. HRMS-ESI spectrum of compound 7m

Figure S52. ¹H NMR spectrum of compound 7n (DMSO-ｄ6)
Figure S53. $^{13}$C NMR spectrum of compound 7n (DMSO-$d_6$)

Figure S54. HRMS-ESI spectrum of compound 7n
Figure S55. $^1$H NMR spectrum of compound 7o (DMSO-$d_6$)

Figure S56. $^{13}$C NMR spectrum of compound 7o (DMSO-$d_6$)
**Figure S57.** HRMS-ESI spectrum of compound 7o

**Figure S58.** $^1$H NMR spectrum of compound 7p (DMSO-$d_6$)
**Figure S59.** $^{13}$C NMR spectrum of compound 7p (DMSO-$d_6$)

**Figure S60.** HRMS-ESI spectrum of compound 7p