



SUPPLEMENTARY MATERIAL TO
Facile synthesis and antifungal activity of dithiocarbamate derivatives bearing an amide moiety

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2-Chloro-N-phenylacetamide (2a). Yield: 90.1 %; white solid; m.p.: 148.8–150 °C; Anal. Calcd. for C₈H₈ClNO: C, 56.65; H, 4.75; Cl, 20.90; N, 8.26 %. Found: C, 56.63; H, 4.72; Cl, 20.87; N, 8.29 %; ¹H-NMR (400 MHz, CDCl₃, δ / ppm): 4.20 (2H, s, ClCH₂CO), 7.18 (1H, t, J = 7.2 Hz, Ar-H), 7.35–7.39 (2H, m, Ar-H), 7.55–7.57 (2H, m, Ar-H), 8.27 (1H, bs, CONH); ESI-HRMS (m/z): Calcd. for C₈H₉ONCl [M+H]⁺: 170.0373. Found: 170.0367.

2-Chloro-N-p-tolylacetamide (2b). Yield: 87.3 %; white solid; m.p.: 168.5–169 °C; Anal. Calcd. for C₉H₁₀ClNO: C, 58.86; H, 5.49; Cl, 19.31; N, 7.63 %. Found: C, 58.88; H, 5.51; Cl, 19.29; N, 7.60 %; ¹H-NMR (400 MHz, CDCl₃, δ / ppm): 2.33 (3H, s, CH₃), 4.19 (2H, s, ClCH₂CO), 7.16 (2H, d, J = 8.4 Hz, Ar-H), 7.43 (2H, d, J = 8.4 Hz, Ar-H), 8.21 (1H, bs, CONH); ESI-HRMS (m/z): Calcd. for C₉H₁₁ONCl [M+H]⁺: 184.0529. Found: 184.0524.

2-Chloro-N-(4-nitrophenyl)acetamide (2c). Yield: 79 %; yellowish solid; m.p.: 185.2–186 °C; Anal. Calcd. for C₈H₇ClN₂O₃: C, 44.77; H, 3.29; Cl, 16.52; N, 13.05 %; Found: C, 44.74; H, 3.27; Cl, 16.49; N, 13.07 %; ¹H-NMR (400 MHz, CDCl₃, δ / ppm): 4.25 (2H, s, ClCH₂CO), 7.78 (2H, d, J = 9.2 Hz, Ar-H), 8.27 (2H, d, J = 9.2 Hz, Ar-H), 8.52 (1H, bs, CONH).

2-Chloro-N-(4-fluorophenyl)acetamide (2d). Yield: 93 %; white solid; m.p.: 146.6–147.2 °C; Anal. Calcd. for C₈H₇ClFNO: C, 51.22; H, 3.76; Cl, 18.90; F, 10.13; N, 7.47 %. Found: C, 51.20; H, 3.74; Cl, 18.91; F, 10.11; N, 7.49 %; ¹H-NMR (400 MHz, CDCl₃, δ / ppm): 4.20 (2H, s, ClCH₂CO), 7.04–7.08 (2H, m, Ar-H), 7.50–7.54 (2H, m, Ar-H), 8.26 (1H, bs, CONH); ESI-HRMS (m/z): Calcd. for C₈H₈ONClF [M+H]⁺: 188.0278. Found: 188.0273.

2-Chloro-N-(4-hydroxyphenyl)acetamide (2e). Yield: 83 %; white solid; m.p.: 148.2–149 °C (lit.¹ 142–144 °C).

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2-Chloro-N-(3-chloro-2-methylphenyl)acetamide (2f). Yield: 78 %; white solid; m.p.: 138.5–139 °C; Anal. Calcd. for C₉H₉Cl₂NO: C, 49.57; H, 4.16; Cl, 32.51; N, 6.42 %. Found: C, 49.59; H, 4.13; Cl, 32.49; N, 6.45 %; ¹H-NMR (400 MHz, CDCl₃, δ / ppm): 2.35 (3H, s, CH₃), 4.26 (2H, s, ClCH₂CO), 7.18 (1H, t, J = 8.0 Hz, Ar-H), 7.26–7.27 (1H, m, Ar-H), 7.73 (1H, d, J = 7.6 Hz, Ar-H), 8.28 (1H, bs, CONH); ESI-HRMS (m/z): Calcd. for C₉H₁₀ONCl₂ [M+H]⁺: 218.0139. Found: 218.0134.

2-Chloro-N-(5-chloro-2-methylphenyl)acetamide (2g). Yield: 75 %, white solid; m.p.: 142.1–142.5 °C; Anal. Calcd. for C₉H₉Cl₂NO: C, 49.57; H, 4.16; Cl, 32.51; N, 6.42 %. Found: C, 49.54; H, 4.18; Cl, 32.53; N, 6.39 %; ¹H-NMR (400 MHz, CDCl₃, δ / ppm): 2.28 (3H, s, CH₃), 4.25 (2H, s, ClCH₂CO), 7.09 (1H, dd, J = 8.4 Hz and 2.0 Hz, Ar-H), 7.14 (1H, d, J = 8.4 Hz, Ar-H), 8.05 (1H, s, Ar-H), 8.27 (1H, bs, CONH); ESI-HRMS (m/z): Calcd. for C₉H₁₀ONCl₂ [M+H]⁺: 218.0139. Found: 218.0133.

2-Chloro-1-(piperidin-1-yl)ethanone (2h). Yield: 81 %; yellowish oil; Anal. Calcd. for C₇H₁₂ClNO: C, 52.02; H, 7.48; Cl, 21.93; N, 8.67 %. Found: C, 51.99; H, 7.49; Cl, 21.91; N, 8.69 %; ¹H-NMR (400 MHz, CDCl₃, δ / ppm): 1.56–1.59 (2H, m, CH₂), 1.61–1.69 (4H, m, 2×CH₂), 3.46 (2H, t, J = 5.6 Hz, CH₂), 3.75 (2H, t, J = 5.6 Hz, CH₂), 4.09 (2H, s, ClCH₂CO); ESI-HRMS (m/z): Calcd. for C₇H₁₃ONCl [M+H]⁺: 162.0686. Found: 168.0680.

2-Chloro-1-morpholinoethanone (2i). Yield: 79 %; yellowish oil; Anal. Calcd. for C₆H₁₀ClNO₂: C, 44.05; H, 6.16; Cl, 21.67; N, 8.56 %. Found: C, 44.07; H, 6.14; Cl, 21.65; N, 8.59 %; ¹H-NMR (400 MHz, CDCl₃, δ / ppm): 3.54 (2H, t, J = 5.2 Hz, CH₂), 3.64 (2H, t, J = 4.8 Hz, CH₂), 3.70–3.75 (4H, m, 2×CH₂), 4.09 (2H, s, ClCH₂CO); ESI-HRMS (m/z): Calcd. for C₆H₁₁O₂NCl [M+H]⁺: 164.0478. Found: 164.0473.

2-Oxo-2-(phenylamino)ethyl piperidine-1-carbodithioate (3a). Yield: 92 %; white solid; m.p.: 146–147 °C; Anal. Calcd. for C₁₄H₁₈N₂OS₂: C, 57.11; H, 6.16; N, 9.51; S, 21.78 %. Found: C, 57.14; H, 6.14; N, 9.48; S, 21.79 %; ¹H-NMR (400 MHz, CDCl₃, δ / ppm): 1.73 (6H, bs, 3×CH₂), 3.91 (2H, bs, CH₂), 4.25 (2H, s, ClCH₂CO), 4.32 (2H, bs, CH₂), 7.08 (1H, t, J = 7.6 Hz, Ar-H), 7.29 (2H, t, J = 7.6 Hz, Ar-H), 7.53 (2H, d, J = 7.6 Hz, Ar-H), 9.23 (1H, bs, CONH); ¹³C-NMR (100 MHz, CDCl₃, δ / ppm): 24.1, 25.5, 26.1, 40.4, 52.0, 54.4, 119.8, 124.2, 128.9, 138.1, 167.3, 194.4; ESI-HRMS (m/z): Calcd. for C₁₄H₁₈ON₂S₂Na [M+Na]⁺: 317.0758. Found: 317.0749.

2-Oxo-2-(p-tolylamino)ethyl piperidine-1-carbodithioate (3b). Yield: 95 %; white solid; m.p.: 142.9–143.8 °C; Anal. Calcd. for C₁₅H₂₀N₂OS₂: C, 58.41; H, 6.54; N, 9.08; S, 20.79 %; Found: C, 58.44; H, 6.56; N, 9.07; S, 20.81 %; ¹H-NMR (400 MHz, CDCl₃, δ / ppm): 1.73 (6H, bs, 3×CH₂), 2.29 (3H, s, CH₃), 3.91 (2H, bs, CH₂), 4.23 (2H, s, ClCH₂CO), 4.32 (2H, bs, CH₂), 7.09 (2H, d, J = 8.4 Hz, Ar-H), 7.40 (2H, d, J = 8.4 Hz, Ar-H), 9.11 (1H, bs, CONH); ¹³C-NMR (100

MHz, CDCl₃, δ / ppm): 20.9, 24.1, 25.5, 26.1, 40.4, 52.0, 54.3, 119.8, 129.4, 133.7, 135.5, 167.1, 194.5; ESI-HRMS (m/z): Calcd. for C₁₅H₂₀ON₂S₂Na [M+Na]: 331.0915. Found: 331.0897.

2-((4-Nitrophenyl)amino)-2-oxoethyl piperidine-1-carbodithioate (3c). Yield: 91 %; yellowish solid; m.p.: 180.9–181.2 °C; Anal. Calcd. for C₁₄H₁₇N₃OS₂: C, 49.54; H, 5.05; N, 12.38; S, 18.89 %. Found: C, 49.52; H, 5.03; N, 12.36; S, 18.91 %; ¹H-NMR (400 MHz, CDCl₃, δ / ppm): 1.76 (6H, *bs*, 3×CH₂), 3.93 (2H, *d*, J = 5.2 Hz, CH₂), 4.27 (2H, *s*, ClCH₂CO), 4.34 (2H, *bs*, CH₂), 7.69 (2H, *dd*, J = 7.2 and 2.0 Hz, Ar-H), 8.19 (2H, *dd*, J = 7.6 and 2.0 Hz, Ar-H), 9.91 (1H, *bs*, CONH); ¹³C-NMR (100 MHz, CDCl₃, δ / ppm): 23.9, 25.6, 26.1, 40.3, 52.3, 54.6, 119.2, 125.0, 143.4, 144.0, 167.9, 194.1; ESI-HRMS (m/z): Calcd. for C₁₄H₁₇N₃O₃S₂Na [M+Na]: 362.0609. Found: 362.0618.

2-((4-Fluorophenyl)amino)-2-oxoethyl piperidine-1-carbodithioate (3d). Yield: 96 %; white solid; m.p.: 180–181 °C; Anal. Calcd. for C₁₄H₁₇FN₂OS₂: C, 53.82; H, 5.48; F, 6.08; N, 8.97; S, 20.53 %. Found: C, 53.80; H, 5.46; F, 6.09; N, 8.95; S, 20.55 %; ¹H-NMR (400 MHz, CDCl₃, δ / ppm): 1.74 (6H, *bs*, 3×CH₂), 3.92 (2H, *d*, J = 4.8 Hz, CH₂), 4.23 (2H, *s*, ClCH₂CO), 4.32 (2H, *bs*, CH₂), 6.96–7.02 (2H, *m*, Ar-H), 7.46–7.51 (2H, *m*, Ar-H), 9.26 (1H, *bs*, CONH); ¹³C-NMR (100 MHz, CDCl₃, δ / ppm): 24.1, 25.5, 26.1, 40.2, 52.1, 54.4, 115.5 (2C, *d*, ² J_{CF} = 22 Hz, Ar-C), 121.4 (2C, *d*, ³ J_{CF} = 7.0 Hz, Ar-C), 134.1 (1C, *d*, ⁴ J_{CF} = 3.0 Hz, Ar-C), 159.3 (1C, *d*, ¹ J_{CF} = 241 Hz, Ar-C), 167.2, 194.4; ESI-HRMS (m/z): Calcd. for C₁₄H₁₇FN₂OS₂Na [M+Na]: 335.0664. Found: 335.0658.

2-((4-Hydroxyphenyl)amino)-2-oxoethyl piperidine-1-carbodithioate (3e). Yield: 92 %; white solid; m.p.: 181–182.1 °C; Anal. Calcd. for C₁₄H₁₈N₂O₂S₂: C, 54.17; H, 5.84; N, 9.02; S, 20.66 %. Found: C, 54.19; H, 5.81; N, 8.99; S, 20.68 %; ¹H-NMR (400 MHz, CDCl₃, δ / ppm): 1.74 (6H, *bs*, 3×CH₂), 3.91 (2H, *bs*, CH₂), 4.23 (2H, *s*, ClCH₂CO), 4.31 (2H, *bs*, CH₂), 5.45 (1H, *bs*, OH), 6.77 (2H, *dd*, J = 6.8 and 2.0 Hz, Ar-H), 7.35 (2H, *dd*, J = 6.8 and 2.0 Hz, Ar-H), 9.07 (1H, *bs*, CONH); ¹³C-NMR (100 MHz, CDCl₃, δ / ppm): 24.1, 25.5, 26.1, 40.2, 52.0, 54.3, 115.6, 121.9, 122.1, 130.8, 152.8, 167.4, 194.4; ESI-HRMS (m/z): Calcd. for C₁₄H₁₈N₂O₂S₂Na [M+Na]: 333.0707. Found: 333.0710.

2-((3-Chloro-2-methylphenyl)amino)-2-oxoethyl piperidine-1-carbodithioate (3f). Yield: 93 %; white solid; m.p.: 157–158.1 °C; Anal. Calcd. for C₁₅H₁₉ClN₂OS₂: C, 52.54; H, 5.58; Cl, 10.34; N, 8.17; S, 18.70 %. Found: C, 52.56; H, 5.60; Cl, 10.32; N, 8.19; S, 18.68 %; ¹H-NMR (400 MHz, CDCl₃, δ / ppm): 1.74 (6H, *bs*, 3×CH₂), 2.32 (3H, *s*, CH₃), 3.94 (2H, *bs*, CH₂), 4.32 (4H, *s*, ClCH₂CO and CH₂), 7.09–7.27 (2H, *m*, Ar-H), 7.76 (1H, *d*, J = 7.6 Hz, Ar-H), 8.83 (1H, *bs*, CONH); ¹³C-NMR (100 MHz, CDCl₃, δ / ppm): 15.0, 24.1, 25.6, 26.2, 40.3, 52.1, 54.5, 121.7, 125.9, 126.8, 127.9, 134.8, 137.2, 167.7, 194.0;

ESI-HRMS (m/z): Calcd. for $C_{15}H_{19}ClN_2OS_2Na[M+Na]$: 365.0525. Found: 365.0521.

2-((5-Chloro-2-methylphenyl)amino)-2-oxoethyl piperidine-1-carbodithioate (3g). Yield: 91 %; white solid; m.p.: 172–174 °C; Anal. Calcd. for $C_{15}H_{19}ClN_2OS_2$: C, 52.54; H, 5.58; Cl, 10.34; N, 8.17; S, 18.70 %. Found: C, 52.52; H, 5.56; Cl, 10.37; N, 8.15; S, 18.72 %; 1H -NMR (400 MHz, $CDCl_3$, δ / ppm): 1.74 (6H, *bs*, $3\times CH_2$), 2.24 (3H, *s*, CH_3), 3.93 (2H, *d*, $J = 5.2$ Hz, CH_2), 4.31 (4H, *bs*, $ClCH_2CO$ and CH_2), 6.98–7.07 (2H, *m*, Ar-H), 8.06 (1H, *d*, $J = 2.4$ Hz, Ar-H), 8.81 (1H, *bs*, CONH); ^{13}C -NMR (100 MHz, $CDCl_3$, δ / ppm): 18.1, 24.1, 25.6, 26.1, 40.4, 52.0, 54.57, 121.9, 124.5, 126.6, 131.2, 131.9, 137.2, 167.5, 194.0; ESI-HRMS (m/z): Calcd. for $C_{15}H_{19}ClN_2OS_2Na [M+Na]$: 365.0525. Found: 365.0516.

2-Oxo-2-(piperidin-1-yl)ethyl piperidine-1-carbodithioate (3h). Yield: 90 %; white solid; m.p.: 145–146 °C; Anal. Calcd. for $C_{13}H_{22}N_2OS_2$: C, 54.51; H, 7.74; N, 9.78; S, 22.39 %. Found: C, 54.52; H, 7.76; N, 9.75; S, 22.37 %; 1H -NMR (400 MHz, $CDCl_3$, δ / ppm): 1.56 (2H, *t*, $J = 4.8$ Hz, CH_2), 1.65 (4H, *bs*, $2\times CH_2$), 1.66–1.71 (6H, *m*, $3\times CH_2$), 3.54–3.59 (4H, *m*, $2\times CH_2$), 3.94 (2H, *bs*, CH_2), 4.28 (2H, *bs*, CH_2), 4.32 (2H, *s*, CH_2CO); ^{13}C -NMR (100 MHz, $CDCl_3$, δ / ppm): 24.2, 24.5, 25.5, 26.5, 41.2, 43.4, 47.3, 51.5, 53.2, 165.6, 194.3; ESI-HRMS (m/z): Calcd. for $C_{13}H_{22}N_2OS_2Na [M+Na]$: 309.1071. Found: 309.1095.

2-Morpholino-2-oxoethyl piperidine-1-carbodithioate (3i). Yield: 90.5 %; white solid; m.p.: 137–138 °C; Anal. Calcd. for $C_{12}H_{20}N_2O_2S_2$: C, 49.97; H, 6.99; N, 9.71; S, 22.23 %. Found: C, 49.99; H, 7.02; N, 9.73; S, 22.20 %; 1H -NMR (400 MHz, $CDCl_3$, δ / ppm): 1.69 (6H, *t*, $J = 5.2$ Hz, $3\times CH_2$), 3.65–3.75 (8H, *m*, $4\times CH_2$), 3.93 (2H, *bs*, CH_2), 4.27 (2H, *bs*, CH_2), 4.30 (2H, *s*, CH_2CO); ^{13}C -NMR (100 MHz, $CDCl_3$, δ / ppm): 24.2, 40.1, 42.6, 46.7, 66.7, 66.8, 166.3, 193.9; ESI-HRMS (m/z): Calcd. for $C_{12}H_{20}N_2O_2S_2Na [M+Na]$: 311.0864. Found: 311.0852.

2-Oxo-2-(phenylamino)ethyl morpholine-4-carbodithioate (4a). Yield: 93 %; white solid; m.p.: 176.4–176.9 °C; Anal. Calcd. for $C_{13}H_{16}N_2O_2S_2$: C, 52.68; H, 5.44; N, 9.45; S, 21.64 %. Found: C, 52.70; H, 5.47; N, 9.43; S, 21.61 %; 1H -NMR (400 MHz, $CDCl_3$, δ / ppm): 3.80 (4H, *d*, $J = 6.0$ Hz, $2\times CH_2$), 3.98 (2H, *bs*, CH_2), 4.26 (2H, *s*, CH_2CO), 4.38 (2H, *bs*, CH_2), 7.09 (1H, *t*, $J = 7.6$ Hz, Ar-H), 7.26–7.33 (2H, *m*, Ar-H), 7.52 (2H, *d*, $J = 8.4$ Hz, Ar-H), 9.01 (1H, *bs*, CONH); ^{13}C -NMR (100 MHz, $CDCl_3$, δ / ppm): 40.2, 50.9, 52.5, 65.9, 66.5, 119.8, 124.3, 128.9, 137.9, 166.7, 196.5; ESI-HRMS (m/z): Calcd. for $C_{13}H_{16}N_2O_2S_2Na [M+Na]$: 319.0551. Found: 319.0539.

2-Oxo-2-(p-tolylamino)ethyl morpholine-4-carbodithioate (4b). Yield: 94 %; white solid; m.p.: 157.1–158.6 °C; Anal. Calcd. for $C_{14}H_{18}N_2O_2S_2$: C, 54.17; H, 5.84; N, 9.02; S, 20.66 %. Found: C, 54.19; H, 5.87; N, 8.99; S, 20.64 %; 1H -NMR (400 MHz, $CDCl_3$, δ / ppm): 2.30 (3H, *s*, CH_3), 3.79 (4H, *bs*, $2\times CH_2$),

3.98 (2H, *bs*, CH₂), 4.24 (2H, *s*, CH₂CO), 4.38 (2H, *bs*, CH₂), 7.11 (2H, *d*, *J* = 8.0 Hz, Ar-H), 7.39 (2H, *d*, *J* = 8.4 Hz, Ar-H), 8.89 (1H, *bs*, CONH); ¹³C-NMR (100 MHz, CDCl₃, δ / ppm): 20.9, 40.2, 50.9, 52.6, 65.9, 66.4, 119.8, 129.4, 133.9, 135.3, 166.6, 196.5; ESI-HRMS (*m/z*): Calcd. for C₁₄H₁₈N₂O₂S₂Na [M+Na]: 333.0707. Found: 333.0716.

2-((4-Nitrophenyl)amino)-2-oxoethyl morpholine-4-carbodithioate (4c). Yield: 93.2 %; yellowish solid; m.p.: 180.9–190.6 °C; Anal. Calcd. for C₁₃H₁₅N₃O₄S₂: C, 45.73; H, 4.43; N, 12.31; S, 18.78 %. Found: C, 45.71; H, 4.45; N, 12.29; S, 18.76 %; ¹H-NMR (400 MHz, CDCl₃, δ / ppm): 3.79 (2H, *bs*, CH₂), 3.84 (2H, *bs*, CH₂), 3.98 (2H, *bs*, CH₂), 4.28 (2H, *s*, CH₂CO), 4.39 (2H, *bs*, CH₂), 7.68 (2H, *dd*, *J* = 7.2 and 2.0 Hz, Ar-H), 8.19 (2H, *dd*, *J* = 7.2 and 2.0 Hz, Ar-H), 9.66 (1H, *bs*, CONH); ¹³C-NMR (100 MHz, CDCl₃, δ / ppm): 23.9, 25.6, 26.9, 40.2, 52.3, 54.6, 119.2, 125.0, 143.4, 144.0, 168.9, 194.1; ESI-HRMS (*m/z*): Calcd. for C₁₃H₁₅N₃O₄S₂Na [M+Na]: 364.0402. Found: 364.0426.

2-((4-Fluorophenyl)amino)-2-oxoethyl morpholine-4-carbodithioate (4d). Yield: 94.3 %; white solid; m.p.: 159.6–161.2 °C; Anal. Calcd. for C₁₃H₁₅FN₂O₂S₂: C, 49.66; H, 4.81; F, 6.04; N, 8.91; S, 20.40 %. Found: C, 49.64; H, 4.79; F, 6.07; N, 8.89; S, 20.37 %; ¹H-NMR (400 MHz, CDCl₃, δ / ppm): 3.80 (4H, *bs*, 2×CH₂), 3.98 (2H, *bs*, CH₂), 4.24 (2H, *s*, CH₂CO), 4.38 (2H, *bs*, CH₂), 6.98–7.02 (2H, *m*, Ar-H), 7.46–7.49 (2H, *m*, Ar-H), 9.03 (1H, *bs*, CONH); ¹³C-NMR (100 MHz, CDCl₃, δ / ppm): 24.1, 25.5, 26.1, 40.2, 52.1, 54.4, 115.6 (2C, *d*, ²J_{CF} = 22 Hz, Ar-C), 121.4 (2C, *d*, ³J_{CF} = 7.0 Hz, Ar-C), 134.1 (1C, *d*, ⁴J_{CF} = 3.0 Hz, Ar-C), 159.3 (1C, *d*, ¹J_{CF} = 241 Hz, Ar-C), 167.2, 194.4; ESI-HRMS (*m/z*): Calcd. for C₁₃H₁₅FN₂O₂S₂Na [M+Na]: 337.0457. Found: 337.0439.

2-((4-Hydroxyphenyl)amino)-2-oxoethyl morpholine-4-carbodithioate (4e). Yield: 90.2 %; white solid; m.p.: 213–214.2 °C; Anal. Calcd. for C₁₃H₁₆N₂O₃S₂: C, 49.98; H, 5.16; N, 8.97; S, 20.53. Found: C, 49.96; H, 5.19; N, 8.99; S, 20.51 %; ¹H-NMR (400 MHz, CDCl₃, δ / ppm): 3.76 (4H, *bs*, 2×CH₂), 3.94 (2H, *bs*, CH₂), 4.26 (2H, *s*, ClCH₂CO), 4.34 (2H, *bs*, CH₂), 5.41 (1H, *bs*, OH), 6.79 (2H, *dd*, *J* = 6.8 and 2.0 Hz, Ar-H), 7.39 (2H, *dd*, *J* = 6.8 and 2.0 Hz, Ar-H), 9.12 (1H, *bs*, CONH); ¹³C-NMR (100 MHz, CDCl₃, δ / ppm): 24.1, 25.5, 26.1, 40.2, 52.0, 54.3, 115.6, 121.9, 122.1, 130.8, 152.8, 167.4, 194.4; ESI-HRMS (*m/z*): Calcd. for C₁₃H₁₆N₂O₃S₂Na [M+Na]: 335.0500. Found: 335.0527.

2-((3-Chloro-2-methylphenyl)amino)-2-oxoethyl morpholine-4-carbodithioate (4f). Yield: 92.7 %; white solid; m.p.: 158.9–159.5 °C; Anal. Calcd. for C₁₄H₁₇ClN₂O₂S₂: C, 48.76; H, 4.97; Cl, 10.28; N, 8.12; S, 18.59 %. Found: C, 48.78; H, 4.99; Cl, 10.31; N, 8.09; S, 18.57 %; ¹H-NMR (400 MHz, CDCl₃, δ / ppm): 2.32 (3H, *s*, CH₃), 3.80 (4H, *bs*, 2×CH₂), 3.99 (2H, *bs*, CH₂), 4.32 (2H, *s*, ClCH₂CO), 4.38 (2H, *bs*, CH₂), 7.10–7.19 (2H, *m*, Ar-H), 7.75 (1H, *d*, *J* = 7.6 Hz, Ar-H), 8.67 (1H, *bs*, CONH); ¹³C-NMR (100 MHz, CDCl₃, δ / ppm): 15.0,

24.1, 25.6, 26.2, 40.3, 52.1, 54.5, 121.7, 125.9, 126.8, 127.9, 134.8, 137.2, 167.7, 194.0; ESI-HRMS (m/z): Calcd. for $C_{14}H_{17}ClN_2O_2S_2Na$ [$M+Na$]: 367.0318. Found: 367.0341.

2-((5-Chloro-2-methylphenyl)amino)-2-oxoethyl morpholine-4-carbodithioate (4g). Yield: 91.4 %; white solid; m.p.: 152.3–153.5 °C; Anal. Calcd. for $C_{14}H_{17}ClN_2O_2S_2$: C, 48.76; H, 4.97; Cl, 10.28; N, 8.12; S, 18.59 %. Found: C, 48.74; H, 4.94; Cl, 10.26; N, 8.15; S, 18.62 %; 1H -NMR (400 MHz, $CDCl_3$, δ / ppm): 2.23 (3H, *s*, CH_3), 3.79 (4H, *bs*, $2 \times CH_2$), 3.99 (2H, *bs*, CH_2), 4.31 (2H, *s*, $ClCH_2CO$), 4.37 (2H, *bs*, CH_2), 6.99–7.08 (2H, *m*, Ar-H), 8.05 (1H, *d*, $J = 2.0$ Hz, Ar-H), 8.65 (1H, *bs*, CONH); ^{13}C -NMR (100 MHz, $CDCl_3$, δ / ppm): 18.1, 24.1, 25.6, 26.1, 40.4, 52.0, 54.5, 121.9, 124.5, 126.6, 131.2, 131.9, 137.2, 167.5, 194.0; ESI-HRMS (m/z) Calcd. for $C_{14}H_{17}ClN_2O_2S_2Na$ [$M+Na$]: 367.0318. Found: 367.0339.

2-Oxo-2-(piperidin-1-yl)ethyl morpholine-4-carbodithioate (4h). Yield: 90.4 %; white solid; m.p.: 123–124.5 °C; Anal. Calcd. for $C_{12}H_{20}N_2O_2S_2$: C, 49.97; H, 6.99; N, 9.71; S, 22.23 %. Found: C, 49.96; H, 6.98; N, 9.69; S, 22.25 %; 1H -NMR (400 MHz, $CDCl_3$, δ / ppm): 1.57 (2H, *t*, $J = 5.2$ Hz, CH_2), 1.66 (4H, *t*, $J = 2.4$ Hz, $2 \times CH_2$), 3.55–3.59 (4H, *m*, $2 \times CH_2$), 3.77 (4H, *t*, $J = 4.8$ Hz, $2 \times CH_2$), 4.01 (2H, *bs*, CH_2), 4.34 (4H, *bs*, CH_2CO and CH_2); ^{13}C -NMR (100 MHz, $CDCl_3$, δ / ppm): 24.2, 40.1, 42.6, 46.7, 66.7, 66.8, 166.3, 193.9; ESI-HRMS (m/z): Calcd. for $C_{12}H_{20}N_2O_2S_2Na$ [$M+Na$]: 311.0862. Found: 311.0875.

2-Morpholino-2-oxoethyl morpholine-4-carbodithioate (4i). Yield: 92.7 %; white solid; m.p.: 125.2–126.5 °C; Anal. Calcd. for $C_{11}H_{18}N_2O_3S_2$: C, 45.49; H, 6.25; N, 9.65; S, 22.08 %. Found: C, 45.46; H, 6.23; N, 9.67; S, 22.05 %; 1H -NMR (400 MHz, $CDCl_3$, δ / ppm): 3.65–3.79 (12H, *m*, $6 \times CH_2$), 4.01 (2H, *bs*, CH_2), 4.31 (4H, *bs*, CH_2CO and CH_2); ^{13}C -NMR (100 MHz, $CDCl_3$, δ / ppm): 24.2, 40.1, 42.6, 46.7, 66.7, 66.8, 166.3, 193.9; ESI-HRMS (m/z): Calcd. for $C_{11}H_{18}N_2O_3S_2Na$ [$M+Na$]: 313.0657. Found: 313.0642.

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